INSTITUTE OF AERONAUTICAL ENGINEERING
(Autonomous)
Dundigal, Hyderabad - 500 043

COURSE DESCRIPTION

Department	**CIVIL ENGINEERING**				
Course Title	**ENGLISH FOR COMMUNICATION**				
Course Code	AHS001				
Program	B. Tech				
Semester	I				
Course Type	Foundation				
Regulation	R-16				
Course Structure	Theory			Practical	
	Lecture	Tutorials	Credits	Laboratory	Credits
	3	-	3	-	-
Course Coordinator	Dr. Jetty Wilson, Professor				

I COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites
-	-	-	-

II COURSE OVERVIEW:

The principle aim of the course is that the students will have 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.

III MARKS DISTRIBUTION:

Subject	SEE Examination	CIE Examination	Total Marks
English	70 Marks	30 Marks	100

IV CONTENT DELIVERY / INSTRUCTIONAL METHODOLOGIES:

✓	LCD / PPT	x	Chalk & Talk	x	Assignments	x	MOOC
✓	Open Ended Experiments	✓	Seminars	x	Mini Project	✓	Videos
x	Others						

V EVALUATION METHODOLOGY:

The course will be evaluated for a total of 100 marks, with 30 marks for Continuous Internal Assessment (CIA) and 70 marks for Semester End Examination (SEE). Out of 30 marks allotted for CIA during the semester, marks are awarded by taking average of two CIE examinations or the marks scored in the make-up examination.

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 14 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
30 %	Understand
60 %	Apply
0 %	Analyze

Continuous Internal Assessment (CIA):
CIA is conducted for a total of 30 marks, with 25 marks for Continuous Internal Examination (CIE) and 05 marks for Quiz \Alternative Assessment Tool (AAT).

Component	Theory		Total Marks
Type of Assessment	CIE Exam	Quiz \AAT	
CIA Marks	25	05	30

Continuous Internal Examination (CIE):
Two CIE exams shall be conducted at the end of the 8^{th} and 17^{th} week of the semester respectively. The CIE exam is conducted for 25 marks of 2 hours duration consisting of two parts. Part–A shall have five compulsory questions of one mark each. In part–B, four out of five questions have to be answered where, each question carries 5 marks. Marks are awarded by taking average of marks scored in two CIE exams.

Quiz - Online Examination
Two Quiz exams shall be online examination consisting of 25 multiple choice questions and are to be answered by choosing the correct answer from a given set of choices (commonly four). Such a question paper shall be useful in testing of knowledge, skills, application, analysis, evaluation and understanding of the students. Marks shall be awarded considering the average of two quiz examinations for every course.

Alternative Assessment Tool (AAT)
This AAT enables faculty to design own assessment patterns during the CIA. The AAT converts the classroom into an effective learning center. The AAT may include tutorial hours/classes, seminars, assignments, term paper, open ended experiments, METE (Modeling and Experimental Tools in Engineering), five minutes video, MOOCs etc. The AAT chosen for this course is given in table

Concept Video	Tech-talk	Complex Problem Solving
40%	40%	20%

VI COURSE OBJECTIVES:

The students will try to learn:

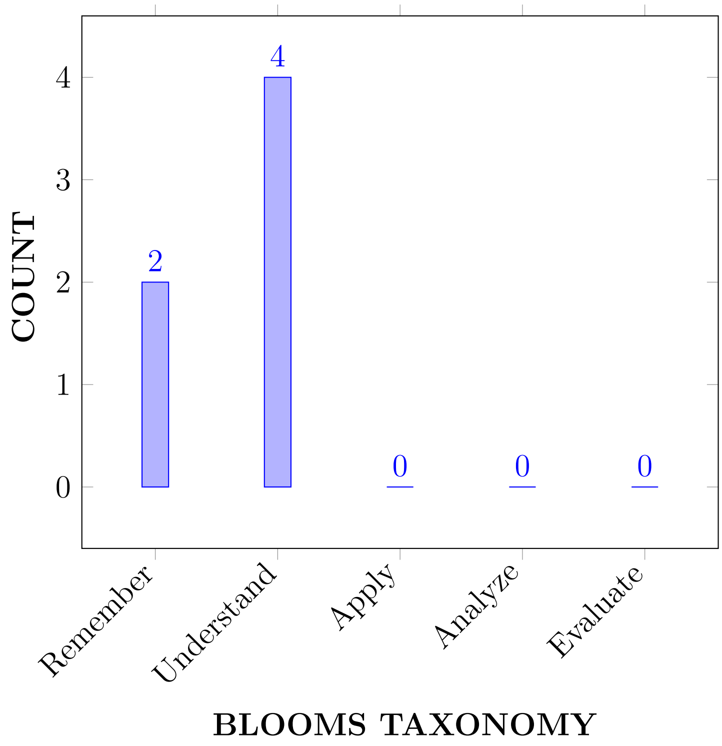
I	Communicate in an intelligible English pronunciation to meet the global standards.
II	Effectively use of four language skills (listening skill, speaking skill, reading skill and writing skill) in day-to-day affairs.
III	A critical aspect of speaking and reading for interpreting in-depth meaning between the sentences.
IV	Develop the art of writing in English keeping the standards of reader's understanding levels.

VII COURSE OUTCOMES:

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

CO 1	**Describe** that Listening skills are essential to leadership which is useful in the real-world situations.	Remember
CO 2	**Illustrate** appropriate speaking strategies such as keeping the discussion going, turn-taking, asking for clarification or confirmation, paraphrasing, keeping the discussion on topic, and trying to reach a consensus.	Understand
CO 3	**Define** the value of English as a Lingua-Franca and recall the knowledge in soft skills for the perfect language usage.	Understand
CO 4	**Explain** the effective usage of functional English grammar and lexical items at academic and non-academic platforms.	Remember
CO 5	**Understand** the importance of critical reading to catch on the in-depth meaning of a written text at various levels of professional career.	Understand
CO 6	**Demonstrate** the role of written communication as a key aspect to meet the academic and professional challenges.	Understand

COURSE KNOWLEDGE COMPETENCY LEVEL



VIII PROGRAM 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.

Program Outcomes	
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

IX 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 (Communication). "Students should demonstrate the ability to communicate effectively in writing / Orally." 1. Clarity (Writing); 2. Grammar/Punctuation (Writing); 3. References (Writing); 4. Speaking Style (Oral); 5. Subject Matter (Oral).	5	Seminar/ Conferences/ Research Papers IE/AAT / Discussion

3 = High; 2 = Medium; 1 = Low

X HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

PROGRAM SPECIFIC OUTCOMES		Strength	Proficiency Assessed by
PSO 1	Understand, analyze, design and supervise sub-structures and superstructures for residential and public buildings, industrial structures, irrigation structures, powerhouses, highways, railways, airways, docks and harbors.	-	-
PSO 2	Focus on broad knowledge of aeronautical engineering in innovative, dynamic challenging environment for design and development of new products.	-	-

PROGRAM SPECIFIC OUTCOMES		Strength	Proficiency Assessed by
PSO 3	Make use of advanced software for creating modern avenues to succeed as an entrepreneur or to pursue higher studies.	-	-

3 = High; 2 = Medium; 1 = Low

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

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	-	-	-	-	-	-	-	-	-	✓	-	-	-	-	-
CO 2	-	-	-	-	-	-	-	-	-	✓ -	-	-	-	-	-
CO 3	-	-	-	-	-	-	-	-	-	✓	-	-	-	-	-
CO 4	-	-	-	-	-	-	-	-	-	✓	-	-	-	-	-
CO 5	-	-	-	-	-	-	-	-	-	✓	-	-	-	-	-
CO 6	-	-	-	-	-	-	-	-	-	✓	-	-	-	-	

XII 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 matched.
CO 1	PO 1	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	Illustrate essential aspects of grammar as well as punctuation marks for speaking or writing towards a discussion on a topic to give the clarity.	5
CO3	PO 10	Choose suitable grammatical structures and punctuation marks at speaking and writing areas maintaining clarity at professional platform.	5
CO4	PO 10	Interpret the grammatical knowledge and punctuation marks systematically towards providing the clarity in speaking and writing.	5
CO5	PO 10	Demonstrate the role of grammar and punctuation marks understanding the meaning between the sentences as well as paragraphs in speaking or writing for a clarity.	5
CO6	PO 10	Describe the clarity of grammatical usage and the obligation of punctuation marks in speaking and writing.	5

XIII 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	-		-	-	- -

XIV 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	-		-	-	- -

XV COURSE ARTICULATION MATRIX (PO / PSO MAPPING):

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

0 - $0 \leq C \leq 5\%$ – No correlation
1 -$5 < C \leq 40\%$ – Low/ Slight
2 - $40\ \% < C < 60\%$ –Moderate
3 - $60\% \leq C < 100\%$ – Substantial /High

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

XVI ASSESSMENT METHODOLOGY-DIRECT:

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

XVII ASSESSMENT METHODOLOGY-INDIRECT:

	Assessment of mini projects by experts	✓	End Semester OBE Feedback

XVIII SYLLABUS:

MODULE I	**GENERAL INTRODUCTION AND LISTENING SKILL**
	Introduction to communication skills; Communication process; Elements of communication; Soft skills vs. hard skills; Importance of soft skills for engineers; Listening skills; Significance; Stages of listening; Barriers and effectiveness of listening; Listening comprehension.
MODULE II	**SPEAKING SKILL**
	Significance; Essentials; Barriers and effectiveness of speaking; Verbal and non-verbal communication. Generating talks based on visual prompts; Public speaking; Exposure to structured talks; Addressing a small group or a large formal gathering; Oral presentation; Power point presentation.
MODULE III	**VOCABULARY AND GRAMMAR**
	The concept of Word Formation; Root words from foreign languages and their use in English; Acquaintance with prefixes and suffixes from foreign languages in English to form derivatives; Synonyms; Antonyms; Standard abbreviations; Idioms and phrases; One-word substitutes Sentence structure; Uses of phrases and clauses; Punctuation; Subject verb agreement; Modifiers; Articles; Prepositions.
MODULE IV	**READING SKILL**
	Significance, Techniques of reading, Skimming-Reading for the gist of a text, Scanning - Reading for specific information, Intensive, Extensive reading, Reading comprehension, Reading for information transfer, Text to diagram, Diagram to text.
MODULE V	**WRITING SKILL**
	Significance; Effectiveness of writing; Organizing principles of Paragraphs in documents; Writing Introduction and conclusion; Techniques for writing precisely, Letter writing; Formal and Informal letter writing, E-mail writing, Report Writing.

TEXTBOOKS

1. Handbook of English (Prepared by the faculty of English, IARE).

REFERENCE BOOKS:

1. 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.

5. Dr. N V Sudershan, President Kalam's Call to the Nation, Bala Bharathi Publications, Secunderabad, 1st Edition,2003

XIX COURSE PLAN:

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

S.No	Topics to be covered	CO's	Reference T1: 4.1
OBE DISCUSSION			
1	Discussion on mapping COs with POs. (OBE)		
CONTENT DELIVERY (THEORY)			
2	Introduction to communication skills.	CO 1	T1:06.06
3	Communication process.	CO 1	T1:06.09
4	Soft skills vs hard skills.	CO 3	T1:09.10
5	Significance of LSRW skills.	CO 1	T1:10.11
6	Significance of listening skill.	CO 1	TI:12.16
7	Different stages of listening.	CO 1	T1:16.18
8	Barriers of listening skill.	CO 1	TI:18.21
9	Different types of listeners.	CO 1	TI:21.22
10	Effectiveness of listening skill.	CO 1	T1:22.24
11	Phonetics: Listening to the sounds of English language.	CO 1	T1:24.29
12	Introduction to speaking skills.	CO 2	T1:30.32
13	Effectiveness of speaking skills.	CO 2	T1:33.34
14	Verbal and non-verbal communication.	CO 2	T1:34.35
15	Generating talks based on visual or written prompts.	CO 2	T1:36.37
16	Developing public speaking skills.	CO 2	T1:38.39
17	Oral presentation with power-point.	CO 3	TI:39.42
18	The concept of word formation.	CO 4	T1:43.100
19	Antonyms and synonyms.	CO 4	TI:49.56
20	Idioms and phrases.	CO 4	TI:57.60
21	One-word substitutes.	CO 4	TI:60.62
22	Root words from foreign languages and their usage in English.	CO 4	TI:60.62
23	Sentence structure.	CO 4	T1:58.62
24	Punctuation tools and their role in a language.	CO 4	TI:63.66
25	Subject-verb agreement.	CO 4	TI:66.69
26	Usage of Adjectives.	CO 4	TI:70.73
27	Significance of articles and their usage	CO 4	TI:74.75
28	The usage of prepositions.	CO 4	T1:76.77

29	Significance of reading skill.	CO 5	T1:78.79
30	Different techniques of reading skill.	CO 6	T1:80.82
31	How to Read Your Textbook More Efficiently.	CO 6	TI:83.85
32	Different types of reading comprehension.	CO 6	TI:85.86
33	Reading for information transfer.	CO 6	TI:85.96
34	Significance and effectiveness of writing skill.	CO 6	TI:96.98
35	Organizing principles of a paragraph in documents and types of paragraphs.	CO 5	T1:101.103
36	Writing introduction and conclusion.	CO 5	T1:103.103
37	Techniques for writing precis.	CO 5	T1:103.103
38	Introduction to informal letters.	CO 6	TI:105.108
39	Introduction to formal letters.	CO 6	TI:109.110
40	Introduction of email writing and formal and informal emails.	CO 6	TI:111.112
41	Significance of Report Writing.	CO 5	TI: 113. 114
PROBLEM SOLVING/ CASE STUDIES			
42	The aspects to improve listening comprehension Discuss in detail.	CO 1	TI:10,11
43	Different types of listeners with examples	CO 1	TI: 19,21
44	The sounds of English language	CO 1	TI:23,27
45	verbal communication or written communication.	CO 2	TI: 27,30
46	Various difficulties in public speaking.	CO 2	TI: 32,33
47	Different ways of greeting people in formal and informal situation and discuss how do they matter in communication?	CO 2	TI: 35,37
48	‘Oral presentation requires a good planning’.	CO 2	TI:36,38
49	Power point presentation and the ways to make Power point presentation.	CO 2	TI: 37,38
50	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
51	The usage of idioms and phrases in spoken English.	CO 4	TI: 47,50
52	‘Structure proposition-evaluation’ -Reading technique.	CO 5	TI:56,58
53	Active reading, detailed reading, and speed-reading techniques used in different situations.	CO 5	TI: 79,81
54	The elements of paragraph writing in detail.	CO 5	TI:100,102
55	Logical bridges and Verbal bridges in writing.	CO 5	TI:102,104
56	Soft skills and Interpersonal Communication.	CO 5	TI:102,104
DISCUSSION OF DEFINITION AND TERMINOLOGY			
57	Soft skills and Interpersonal Communication.	CO 1	TI 8,9
58	Language acquisition is a process.	CO 1	TI: 11,12
59	Communication.	CO 1	TI: 14,16
60	Time management.	CO 3	TI:9,10
61	Stress management.	CO 3	TI:9,10
DISCUSSION OF QUESTION BANK			

62	Soft Skills for difficult situations in terms of reassurance and reliability.	CO 3	TI:9,10
63	Verbal and non-verbal communication.	CO 2	TI: 34,35
64	Honesty, Respect, Self-Control and Accountability their role in building long lasting interpersonal skills?	CO 3	TI: 9,10
65	Etiquette and manners. Its importance in social, personal and professional communication.	CO 2,3	TI: 9,10
66	Problem solving and decision making.	CO 3	TI: 9,10

Signature of Course Coordinator **HOD**

INSTITUTE OF AERONAUTICAL ENGINEERING
(Autonomous)
Dundigal, Hyderabad - 500 043
COURSE DESCRIPTION

Department	**CIVIL ENGINEERING**					
Course Name	**Linear algebra and Ordinary differential equations**					
Course Code	AHS002					
Program	B.Tech					
Semester	I					
Course Type	Foundation					
Regulation	IARE -R16					
Course Structure	Theory			Practical		
	Lecture	Tutorials	Credits	Laboratory	Credits	
	3	1	4	-	-	
Course Coordinator	Ms. L Indira, Associate Professor					

I COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites
-	-	-	

II COURSE OVERVIEW:

The Linear algebra is a sub-field of mathematics concerned with vectors, matrices, and linear transforms. Calculus is the branch of mathematics which majorly deals with derivatives and integrals. Linear algebra is a key foundation to the field of machine learning. The course includes types of Matrices, Rank, methods of finding rank, Eigen values and Eigen vectors, maxima and minima of functions of several variables, solutions of higher order ordinary differential equations and Fourier series. Matrices are used in computer animations, color image processing. Eigen values are used by engineers to discover new and better designs for the future. The laws of physics are generally written down as differential equations. So, differential equations have wide applications in various engineering and science disciplines. This course enables the students to gain basic knowledge on the mathematics which is used in modeling the real time engineering problems very often.

III MARKS DISTRIBUTION:

Subject	SEE Examination	CIE Examination	Total Marks
Linear Algebra and Ordinary Differential Equations	70 Marks	30 Marks	100

IV CONTENT DELIVERY / INSTRUCTIONAL METHODOLOGIES:

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

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Concept Video	Tech-talk	Complex Problem Solving
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VI COURSE OBJECTIVES:

The students will try to learn:

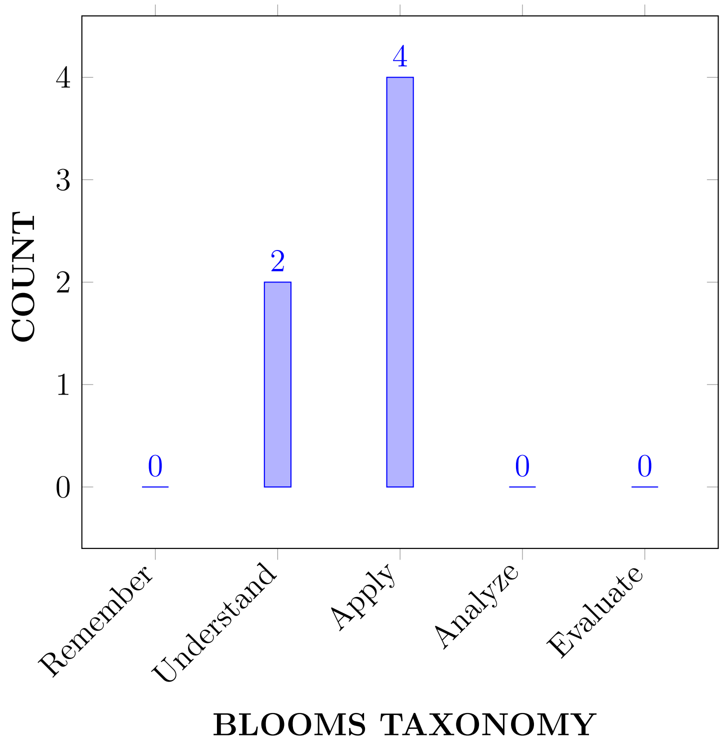
I	The principles of Eigen value analysis and linear transformations, Matrix rank finding methods.
II	The analytical methods for solving higher order differential equations with constant coefficients.
III	The calculus of functions of several variables and the concept of maxima-minima for a three-dimensional surface

VII COURSE OUTCOMES:

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

CO 1	**Calculate** the rank and inverse of real and complex matrices with elementary transformation methods.	Apply
CO 2	**Compute** the diagonally equivalent matrix and Cayley Hamiltonion equation of the given matrix by using Eigen values and Eigen vectors.	Apply
CO 3	**Interpret** the properties of differential equation of first order and first degree and orthogonal trajectories byusing integration factor method	Understand
CO 4	**Solve** the Second and higher order linear homogeneous and non homogeneous differential equations with constant coefficients by using substitution method.	Apply
CO 5	**Interpret** the extreme values for functions of several variables by using parial derivatives .	Understand
CO 6	**Apply** mean–value theorems in establishing some mathematical inequalities	Apply

COURSE KNOWLEDGE COMPETENCY LEVEL



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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.
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Program Outcomes	
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

IX 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

3 = High; 2 = Medium; 1 = Low

X HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

PROGRAM SPECIFIC OUTCOMES		Strength	Proficiency Assessed by
PSO 1	Design and Supervise Sub-Structures and Super Structures for Residential and Public Buildings, Industrial Structures, Irrigation Structures, Power Houses, Highways, Railways, Airways, Docs and Harbours.	-	-
PSO 2	Focus on Improving Performance of Structures with reference to Safety, Serviceability and Sustainable Green Building Technology. .	-	-
PSO 3	Make use of Advanced Structural Analysis and Project Management Software for creating Modern Avenues to succeed as an Entrepreneur, Pursue Higher Studies and Career Paths.	-	-

3 = High; 2 = Medium; 1 = Low

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

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	✓	-	-	-	-	-	-	-	-	-	-		-		-
CO 2	✓	✓	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 3	✓	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 4	✓	✓	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 5	✓	-	-	-	-	-	-	-	-	-	-	-	-	-	- -
CO 6	✓	-	-	-	-	-	-	-	-	-	-	-	-	-	-

XII 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 matched.
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** and **scientific methodology**).	2
CO 2	PO 1	Determine the diagonally equivalent matrix of given matrix involved in the complex engineering problems modeled by matrices with help of Eigen values and Eigen vectors (**principles of mathematics** and **scientific methodology)**).	2
	PO 2	Understand the **statement** and **formulation** of a complex engineering problem **modeled** by matrices with help of Eigen values and Eigen vectors and diagonalization to **develop** the solution and reaching substantiated conclusions by the **interpretation of results**	5
CO 3	PO 1	Identify whether the given differential equation of first order and first degree is exact or not by using integration factor method (**principles of mathematics** and **scientific methodology**)	2
CO 4	PO 1	Solve the complex engineering problems modeled by Second and higher order linear homogeneous differential equations (principles of mathematics) with constant coefficients by using substitution method (**principles of mathematics** and **scientific methodology**)	2
	PO 2	Understand the **statement** and **formulation** of a complex engineering problem **Modeled** by linear differential equations and solve them using substitution method along with basic principles of mathematics to **develop** the solution and reaching substantiated conclusions by the **interpretation of results** .	5

Course Outcomes	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key competencies matched.
CO 5	PO 1	Explain the mean–value theorems for the single variable functions and apply them in the complex engineering problems modeled by functions of single variables with their geometrical interpretation (**principles of mathematics** and **scientific methodology**).	2
CO 6	PO 1	Interpret the extreme values for functions of several variables and apply them in the complex engineering problems modeled by functions of several variableswith the help of partial derivatives (**principles of mathematics** and **scientific methodology**).	2

XIII 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	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 2	2	5	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 3	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 4	2	5	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 5	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 6	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-

XIV 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	67	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 2	67	50	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 3	67	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 4	67	50	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 5	67	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 6	67	-	-	-	-	-	-	-	-	-	-	-	-	-	-

XV COURSE ARTICULATION MATRIX (PO / PSO MAPPING):

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

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

1 -5 <C$\leq$ 40% – Low/ Slight

2 - 40 % <C < 60% –Moderate

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

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

XVI ASSESSMENT METHODOLOGY-DIRECT:

CIE Exams	✓	SEE Exams	✓	Seminars	-
Laboratory Practices	-	Student Viva	-	Certification	-
Term Paper	-	5Tech-talk	✓	Open Ended Experiments	-
Assignments		concept video		mini project	

XVII ASSESSMENT METHODOLOGY-INDIRECT:

	Assessment of mini projects by experts	✓	End Semester OBE Feedback

XVIII SYLLABUS:

MODULE I	**THEORY OF MATRICES**
	Real matrices: Symmetric, skew-symmetric and orthogonal matrices; Complex matrices: Hermitian, Skew- Hermitian and unitary matrices; Elementary row and column transformations, elementary matrix, finding rank of a matrix by reducing to Echelon form and normal form; Finding the inverse of a matrix using elementary row/column transformations: Gauss-Jordan method; Solving of linear system of equations by LU decomposition method.
MODULE II	**LINEAR TRANSFORMATIONS**
	Cayley-Hamilton theorem: Statement, verification, finding inverse and powers of a matrix; Linear dependence and independence of vectors; Linear transformation; Eigen values and Eigen vectors of a matrix; Properties of Eigen values and Eigen vectors of real and complex matrices; Diagonalization of matrix.
MODULE III	**DIFFERENTIAL EQUATIONS OF FIRST ORDER AND THEIR APPLICATIONS**
	Solution of first order linear differential equations by exact, non exact, linear equations; Bernoulli equation. Applications of first order differential equations: Orthogonal trajectories; Newton's law of cooling; Law of natural growth and decay.

MODULE IV	**HIGHER ORDER LINEAR DIFFERENTIAL EQUATIONS AND THEIR APPLICATIONS**
	Linear differential equations of second and higher order with constant coefficients, non-homogeneous term of the f(x)=e^{ax},sinax,cosaxand f (x) = x^n , $e^{ax}v(x)$, $x^n v(x)$; Method of variation of parameter; Application to electrical circuits and Simple Harmonic Motion
MODULE V	**FUNCTIONS OF SINGLE AND SEVERAL VARIABLES**
	Mean value theorems: Rolle's theorem, Lagrange's theorem, Cauchy's theorem-without proof; Functions of several variables: Partial differentiation, chain rule, total derivative, Euler's theorem, functional dependence, Jacobian, maxima and minima of functions of two variables without constraints and with constraints; Method of Lagrange multipliers

TEXTBOOKS

1. Kreyszig, "Advanced Engineering Mathematics", John Wiley & Sons Publishers, 9th Edition,2014. .

2. B. S. Grewal, "Higher Engineering Mathematics", Khanna Publishers, 42nd Edition,2012.

REFERENCE BOOKS:

1. RK Jain & SRK Iyengar, "Advanced Engineering Mathematics", Narosa Publishers, 5th Edition,2016

2. Ravish R Singh, Mukul Bhatt, "Engineering Mathematics-1", Tata McGraw Hill Education, 1st Edition, 2009..

3. Srimanthapa & SubothC.Bhunia,"EngineeringMathematics", Oxford Publishers, 3rd Edition ,2015

WEB REFERENCES:

1. https://nptel.ac.in/courses/111/108/111108157

COURSE WEB PAGE:

1. lms.iare.ac.in

XIX 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	Introduction to outcome based education		
CONTENT DELIVERY (THEORY)			
2	Theory of matrices: types of real matrices	CO1	T2:32.1R1:4.1 1
3	Real matrices:symmetric, skew-symmetric matrices	CO1	T2:32.1 R1:4.2
4	Real Matrices: orthogonal matrices	CO1	T2:32.1 R1:4.3
5	Complex matrices:Hermitian, Skew- Hermitian	CO1	T2:32.1 R1:4.3
6	Complex matrices: unitary matrices	CO1	T2:32.5 R1:4.6
7	Elementary row and column transformations	CO1	T2:32.5 R1:4.6
8	Rank of a matrix by echelon form	CO1	T2:32.4 R1:4.5
9	Rank of a matrix by normal form	CO1	T2:32.7 R1:4.8

10	Inverse of a matrix by Gauss-Jordan method	CO1	T2-7.1 R1:7.4
11	Eigen values of a matrix	CO2	T2-7.1 R1:7.4
12	Eigen vectors of a matrix	CO2	T2-7.1 R1:7.4
13	Diagonalizationof matrix by linear transformation.	CO 2	T2:7.1 R1:7.4
14	Cayley-Hamilton theorem- statement, verifications	CO 2	T2:7.1 R1:7.4
15	Applications of Cayley – Hamilton theorem	CO 2	T3-2.9 R1:2.1
16	Linear dependence and independence of vectors	CO 2	T3-2.5 R1:2.8
17	First order linear differential equations	CO3	T3-2.5 R1:2.8
18	Bernoulli's differential equations	CO3	T3-2.5 R1:2.8
19	Exact differential equations	CO3	T3-2.5 R1:2.8
20	Non exact differential equations	CO3	T3-2.5 R1:2.8
21	Equations reducible to exact form	CO3	T3-2.61 R1:2.10
22	Orthogonal trajectories	CO3	T1-7.1 R2:7.5
23	Newton's law of cooling	CO3	T3-2.61 R1:2.10
24	Law of natural growth and decay	CO3	T1-7.1 R2:7.6
25	Application method of Lagrange multipliers	CO3	T1-7.1 R2:7.7
26	Method of Lagrange multipliers	CO3	T3-2.5 R1:2.8
27	higher order Linear differential equations	CO4	T3-2.5 R1:2.8
28	Linear differential equations of second and higher order with polynomial coefficients	CO4	T3-2.5 R1:2.8
29	Non-homogeneous term of the type f (x) =e^{ax}	CO4	T3-2.5 R1:2.8
30	Q(x) is of the type f(x) = sinax or cosax	CO4	T2-7.1 R1:7.4
31	Non-homogeneous term of the type f (x) = X^n	CO4	T2:7.1 R1:7.4
32	Non-homogeneous term of the type f (x) = $e^{ax}V(x)$	CO4	T2:7.1 R1:7.4
33	Method of variation of parameters	CO4	T3-2.9 R1:2.1
34	Mean value theorems:1. Rolle's theorem	CO5,CO 6	T3-2.5 R1:2.8
35	Mean value theorems:2. Lagrange's theorem	CO5,CO 6	T3-2.5 R1:2.8
36	Mean value theorems:3. Cauchy's theorem	CO5,CO 6	T2:7.1 R1:7.4
37	Functions of several variables: Partial differentiation	CO5,CO 6	T3-2.9 R1:2.1
38	Jacobian transformations	CO5,CO 6	T3-2.5 R1:2.8
39	Functional dependence	CO5,CO 6	T2:7.1R1:7.4
40	Maxima and minima of functions with two variables	CO5,CO 6	T3-2.9 R1:2.1
41	Maxima and minima of functions with three variables	CO5,CO 6	T3-2.5R1:2.8
PROBLEM SOLVING/ CASE STUDIES			
42	Rank of the matrix by Echelon and normal form	CO1	T2:32.1 R1:4.2
43	Solving system of linear non homogeneous equations	CO1	T2:32.1 R1:4.3
44	Eigen values and eigen vectors of the matrix	CO2	T2:32.1 R1:4.3
45	Finding spectral matrix by linear transformation.	CO2	T2-7.1 R1:7.4
46	Verification of Caley- Hamilton theorem	CO2	T2-7.1 R1:7.4
47	Finding powers of the matrix by Caley -Hamilton theorem	CO2	T2:7.1 R1:7.4
48	Solving first order differential equations	CO3	T2:7.1 R1:7.4
49	Solving Non-Homogeneous Differential Equations.	CO3	T3-2.5 R1:2.8

50	Solving linear and exact differential equations	CO3	T3-2.5 R1:2.8
51	Finding C.F and P.I. of higher order differential equations	CO6	T3-2.5 R1:2.8
52	Solving Second Order Non-homogeneous differential equations by method of variation of parameters	CO4	T3-2.5 R1:2.8
53	Solving higher differential equations of different types	CO4	T3-2.61 R1:2.10
54	Jacobian transformation in Cartesian and Polar Forms	CO 5,CO 6	T2:7.1 R1:7.4
55	Finding functional relationship.	CO 5,CO 6	T3-2.9 R1:2.1
56	Finding max.and min. of functions of two variables	CO 5,CO 6	T3-2.5 R1:2.8
DISCUSSION OF DEFINITION AND TERMINOLOGY			
57	Real, complex matrices and rank of a matrix	CO1	T3-2.5 R1:2.8
58	Eigen values and eigen vectors, diagonalization	CO2	T3-2.5 R1:2.8
59	First order linear, exact and non-exact D.Es.	CO3	T3-2.5 R1:2.8
60	Higher order differential equations	CO4	T3-2.5 R1:2.8
61	Mean value theorems, Jacobian transformations, functionally dependent and independent	CO5	T3-2.61 R1:2.10
DISCUSSION OF QUESTION BANK			
62	Theory of matrices	CO1	T2:7.1R1:7.4
63	Linear transformations	CO2	T3-2.9R1:2.1
64	First order and degree differential equations	CO3	T3-2.5R1:2.8
65	Higher order differential equations	CO4	T2:32.1R1:4.3
66	Functions of several variables	CO5, CO 6	T2-7.1R1:7.4

Signature of Course Coordinator **HOD,CE**

INSTITUTE OF AERONAUTICAL ENGINEERING
(Autonomous)
Dundigal, Hyderabad - 500 043

COURSE DESCRIPTION

Department	**CIVIL ENGINEERING**				
Course Title	**ENGINEERING CHEMISTRY**				
Course Code	AHS005				
Program	B.Tech				
Semester	I				
Course Type	FOUNDATION				
Regulation	R-16				
Course Structure	Theory			Practical	
	Lecture	Tutorials	Credits	Laboratory	Credits
	3	-	3	-	-
Course Coordinator	Dr. V Anitha Rani, Associate Professor				

I COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites
-	-	-	-

II COURSE OVERVIEW:

The concepts developed in this course will aid in quantification of several concepts in chemistry that have been introduced at the Intermediate level. Technology is being increasingly based on the electronic, atomic and molecular level modifications. Quantum theory is more than 100 years old and to understand phenomena at nanometer levels; one has to base the description of all chemical processes at molecular levels.

III MARKS DISTRIBUTION:

Subject	SEE Examination	CIE Examination	Total Marks
Engineering Chemistry	70 Marks	30 Marks	100

IV CONTENT DELIVERY / INSTRUCTIONAL METHODOLOGIES:

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

V EVALUATION METHODOLOGY:

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 14 marks. There could be a maximum of two sub divisions in a question.

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 14 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
0%	Remember
50%	Understand
50%	Apply
0 %	Analyze
0%	Evaluate
0 %	Create

Continuous Internal Assessment (CIA):
CIA is conducted for a total of 30 marks, with 20 marks for Continuous Internal Examination (CIE), 05 marks for Quiz and 05 marks for Alternative Assessment Tool (AAT).

Component	Theory			Total Marks
Type of Assessment	CIE Exam	Quiz	AAT	
CIA Marks	20	05	05	30

Continuous Internal Examination (CIE):
Two CIE exams shall be conducted at the end of the 8^{th} and 16^{th} week of the semester respectively. The CIE exam is conducted for 20 marks of 2 hours duration consisting of five descriptive type questions out of which four questions have to be answered where, each question carries 5 marks. Marks are awarded by taking average of marks scored in two CIE exams.

Quiz - Online Examination
Two Quiz exams shall be online examination consisting of 50 multiple choice questions and are to be answered by choosing the correct answer from a given set of choices (commonly four). Such a question paper shall be useful in testing of knowledge, skills, application, analysis, evaluation and understanding of the students. Marks shall be awarded considering the average of two quiz examinations for every course.

Alternative Assessment Tool (AAT)
This AAT enables faculty to design own assessment patterns during the CIA. The AAT converts the classroom into an effective learning center. The AAT may include tutorial hours/classes, seminars, assignments, term paper, open ended experiments, METE (Modeling and Experimental Tools in Engineering), five minutes video, MOOCs etc. The AAT chosen for this course is given in table

Concept Video	Tech-talk	Complex Problem Solving
40%	40%	20%

VI COURSE OBJECTIVES:

The students will try to learn:

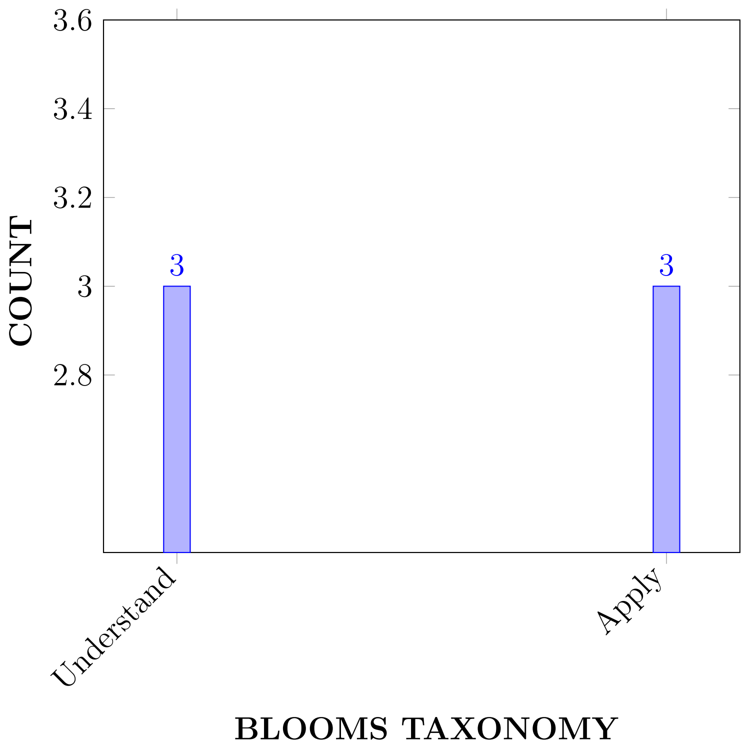
I	The concepts of electrochemical principles and causes of corrosion in the new development and breakthroughs efficiently in engineering and technology.
II	The different parameters to remove causes of hardness of water and their reactions towards the complexometric method.
III	The microscopic chemistry in terms of atomic, molecular orbitals and Intermolecular forces.
IV	The different molecular organic chemical reactions that are used in the synthesis of molecules.
V	The properties, separation techniques of natural gas and crude oil along with potential applications in major chemical reactions.

VII COURSE OUTCOMES:

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

CO 1	**Explain** the operation of electrochemical systems for the production of electric energy, i.e. batteries.	Understand
CO 2	**Utilize** electrochemical cell parameters, electrochemical active surface area, current and over potential under given condition for calculating the electromotive force and electrode potential.	Apply
CO 3	**Illustrate** the electrochemical theory of corrosion process in metals for protection of different metals from corrosion.	Understand
CO 4	**Make use of** the basic electrochemical knowledge of corrosion processes and apply the concept for protection of different metals from corrosion.	Apply
CO 5	**Explain** the importance of different types of materials for understanding their composition and applications.	Understand
CO 6	**Choose** different types of solid, liquid and gaseous fuels in terms of calorific value for utilizing in industries and automobiles.	Apply

COURSE KNOWLEDGE COMPETENCY LEVEL



VIII PROGRAM 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.

Program Outcomes	
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

IX 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.	2.5	SEE/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.	1	SEE/CIE/Quiz/ AAT
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.	2	SEE/CIE/Quiz/ AAT

3 = High; 2 = Medium; 1 = Low

X HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

PROGRAM SPECIFIC OUTCOMES		Strength	Proficiency Assessed by
PSO 1	Design and Supervise Sub-Structures and Super Structures for Residential and Public Buildings, Industrial Structures, Irrigation Structures, Power Houses, Highways, Railways, Airways, Docs and Harbours.	-	-
PSO 2	Focus on Improving Performance of Structures with reference to Safety, Serviceability and Sustainable Green Building Technology. .	-	-

PROGRAM SPECIFIC OUTCOMES		Strength	Proficiency Assessed by
PSO 3	Make use of Advanced Structural Analysis and Project Management Software for creating Modern Avenues to succeed as an Entrepreneur, Pursue Higher Studies and Career Paths..	-	-

3 = High; 2 = Medium; 1 = Low

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

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	✓	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 2	✓	✓	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 3	✓	✓	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 4	✓	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 5	✓	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 6	✓	✓	-	-	-	-	✓	-	-	-	-	-	-	-	

XII 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 matched.
CO 1	PO 1	Explain the electrochemical properties for producing electrical energy (understand) by using principles of science for solving engineering problems.	2
CO 2	PO 1	Choose different electrodes for finding pH of unknown solutions by applying mathematical expressions of cell potential by using principles of science and mathematics for solving engineering problems	3
	PO 2	Identify the problem formulation and abstraction for calculating electrode potential under non standard conditions by applying Nernst equation from the provided information.	2
CO3	PO1	Explain the concept of corrosion processes in metals by exposing to acidic environment for solving engineering problems by applying the principles of science	3
	PO2	Identify the problem and formulate for finding the hardness of water in terms of CaCO3 equivalents with given information and data by applying principles of science.	2
CO4	PO1	Explain the formation of molecular orbitals by linear combination of atomic orbitals, splitting of d orbitals for formation of octahedral, tetrahedral and square planar complexes for solving engineering problems by applying the principles of science.	2

Course Outcomes	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key competencies matched.
CO5	PO1	Illustrate the structural and stereo isomers of optically active compounds, different types of molecular organic reactions for synthesizing drugs by using principles of science for solving engineering problems.	2
CO6	PO1	Classify different types of solid, liquid and gaseous fuels with their characteristics and calorific value by using principles of science and mathematics for solving engineering problems.	3
	PO2	Identify the given problem and formulate for finding the calorific value of fuel with the given information and data by applying principles of science.	2
	PO7	Make use of gaseous fuels like LPG, CNG to reduce the pollutants in atmosphere and know the impact in socio economic and environmental contexts for sustainable development.	2

XIII 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	2	-	-	-	-	-	-	-	-	-	-		-	-	-
CO 2	3	2	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 3	3	2	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 4	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 5	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 6	3	2	-	-	-	-	2	-	-	-	-	-	-	-	-

XIV 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	100	20.0	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 3	100	20.0	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 4	66.6	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 5	66.6	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 6	100	20.0	-	-	-	-	66.6	-	-	-	-	-	-	-	-

XV COURSE ARTICULATION MATRIX (PO / PSO MAPPING):

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

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

1 -5 $< C \leq 40\%$ – Low/ Slight

2 - 40 % $< C < 60\%$ –Moderate

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

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	2	-	-	-	-	-	-	-	-	-	-	-	-	-	
CO 2	3	1	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 3	3	1	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 4	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 5	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 6	3	1	-	-	-	-	2	-	-	-	-	-	-	-	-
TOTAL	15	3	-	-	-	-	2	-	-	-	-	-	-	-	-
AVERAGE	2.5	1	-	-	-	-	2	-	-	-	-	-	-	-	-

XVI ASSESSMENT METHODOLOGY-DIRECT:

CIE Exams	po1,po2,po7	SEE Exams	po1,po2,po7	5 minutes video	po1,po2,po7
Laboratory Practices	-	Student Viva	-	Certification	-
Term Paper	po1,po2,po7	-	-	-	-

XVII ASSESSMENT METHODOLOGY-INDIRECT:

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

XVIII SYLLABUS:

UNIT I	ELECTROCHEMISTRY AND BATTERIES
	Electro chemical cells: Electrode potential, standard electrode potential, types of electrodes; Calomel, Quinhydrone and glass electrode; Nernst equation; Electrochemical series and its applications; Numerical problems; Batteries: Primary (Dry cell) and secondary batteries (Lead-acid storage battery and Lithium ion battery). Causes and effects of corrosion: Theories of chemical and electrochemical corrosion, mechanism of electrochemical corrosion; Types of corrosion: Galvanic, water-line and pitting corrosion; Factors affecting rate of corrosion; Corrosion control methods: Cathodic protection, sacrificial anode and impressed current; Surface coatings: Metallic coatings- Methods of coating- Hot dipping, cementation, electroplating and Electroless plating of copper.

UNIT II	**CORROSION AND ITS CONTROL**
	Corrosion: Introduction, causes and effects of corrosion; Theories of corrosion: Chemical and electrochemical corrosion with mechanism; Factors affecting the rate of corrosion: Nature of the metal and nature of the environment; Types of corrosion: Waterline and crevice corrosion; Corrosion control methods: Cathodic protection- sacrificial anodic protection and impressed current cathodic protection; Surface coatings: Metallic coatings, methods of application of metallic coatings-hot dipping(galvanizing, tinning), electroplating(copper plating); Organic coatings: Paints, its constituents and their functions
UNIT III	**WATER TECHNOLOGY**
	Water: Sources and impurities of water, hardness of water, expression of hardness-units; Types of hardness: Temporary hardness, permanent hardness and numerical problems; Estimation of temporary and permanent hardness of water by EDTA method; Determination of dissolved oxygen by Winkler's method; Boiler troubles: Priming, foaming, scales, sludges and caustic embrittlement. Treatment of water: Internal treatment of boiler feed water- carbonate, calgon and phosphate conditioning, softening of water by Zeolite process and Ion exchange process; Potable water-its specifications, steps involved in the treatment of potable water, sterilization of potable water by chlorination and ozonization, purification of water by reverse osmosis process.
UNIT IV	**MATERIALS CHEMISTRY**
	Materials chemistry: Polymers-classification with examples, polymerization-addition, condensation and co-polymerization; Plastics: Thermoplastics and thermosetting plastics; Compounding of plastics; Preparation, properties and applications of polyvinyl chloride, Teflon, Bakelite and Nylon-6, 6; Rubbers: Natural rubber its process and vulcanization; Elastomers: Buna-s and Thiokol rubber; Fibers: Characteristics of fibers, preparation properties and applications of Dacron; Characteristics of fiber reinforced plastics; Cement: Composition of Portland cement, setting and hardening of Portland cement; Lubricants: Classification with examples; Properties: Viscosity, flash, fire, cloud and pour point; Refractories: Characteristics and classification with examples..
UNIT V	**FUELS AND COMBUSTION**
	Fuel: Definition, classification of fuels and characteristics of a good fuels; Solid fuels: Coal; Analysis of coal: Proximate and ultimate analysis; Liquid fuels: Petroleum and its refining; Cracking: Fixed bed catalytic cracking; Knocking: Octane and cetane numbers; Gaseous fuels: Composition, characteristics and applications of natural gas, LPG and CNG; Combustion: Calorific value: Gross Calorific Value(GCV) and Net Calorific Value(NCV), calculation of air quantity required for complete combustion of fuel, numerical problems.

TEXTBOOKS

1. P. C. Jain and Monica Jain, "Engineering Chemistry", Dhanpat Rai Publishing Company, 16th Edition, 2017.

2. Shashi Chawla, "Engineering Chemistry", Dhanat Rai and Company, 2011, 1st Edition.

3. R.T. Morrison, RN Boyd and SK Bhattacharya, "Organic Chemistry", Pearson, 7th Edition, 2011

4. K.F. Purcell and J.C. Kotz, "Inorganic Chemistry", Cengage learning, 2017.

REFERENCE BOOKS:

1. K. P. C. Volhardt and N. E. Schore, “Organic Chemistry Structure and Functions”, Oxford Publications, 7th Edition 2010.
2. B. H. Mahan, “University Chemistry”, Narosa Publishers, 4th Edition, 2009.

WEB REFERENCES:

1. https://nptel.ac.in/courses/112105171/1

COURSE WEB PAGE:

XIX COURSE PLAN:

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

S.No	Topics to be covered	CO’s	Reference T1: 4.1
OBE DISCUSSION			
1	Discussion on Outcome Based Education		
CONTENT DELIVERY (THEORY)			
2	Concept of Electro chemical cells	CO1	T1,T2
3	Numerical problems on EMF: Galvanic Cells	CO 2	T1,T2
4	Types of Electrodes: Calomel, Quinhydrone and Glass electrode	CO 2	T1,T2
5	Nernst equation and its applications	CO 2	T1,T2
6	Batteries: Primary cells (dry cells)	CO 1	T1,T2
7	Secondary cells (lead-Acid cell). Applications of batteries	CO 1	T1,T2
8	Corrosion-Definition ,Causes and effects of corrosion, Theories of corrosion – Chemical corrosion theory	CO 1	T1,T2
9	Types of corrosion (water line and pitting), Factors affecting rate of corrosion	CO 1	T1,T2
10	Corrosion control methods – Cathodic protection and metallic coating.	CO 1	T1,T2
11	Hardness of water, expression of hardness-units; Types of hardness: Temporary hardness, permanent hardness and numerical problems.	CO 3	T1,T2
12	Estimation of temporary and permanent hardness of water by EDTA	CO 3	T1,T2
13	Potable water and its specifications, steps involved in its treatment of water.	CO 3	T1,T2
14	Boiler troubles – Priming and foaming, caustic embrittlement	CO 3	T1,T2
15	Treatment of boiler feed water – Internal treatment (Phosphate, carbonate and calgon conditioning)	CO 3	T1,T2
16	Ion exchange process, steps involved in the treatment of this process	CO 3	T1,T2
17	Sterilization of potable water by chlorination and ozonization	CO 3	T1,T2
18	purification of water by reverse osmosis process. Numerical problems	CO 3	T1,T2

19	Shapes of Atomic Orbitals	CO 4	T1,T2
20	Linear combination of Atomic orbitals (LACO)	CO 4	T1,T2
21	Molecular orbitals of diatomic molecules N2 O2 and F2.	CO 4	T1,T2
22	Molecular orbitals diatomic CO and NO molecule	CO 4	T1,T2
23	Crystal Field Theory (CFT), Salient Features of CFT-Crystal Fields	CO 4	T1,T2
24	Splitting of transition metal ion d- orbitals in Tetrahedral	CO 4	T1,T2
25	Splitting of transition metal ion Octahedral and square planar geometries	CO 4	T1,T2
26	Band structure of solids and effect of doping on conductance	CO 4	T1,T2
27	Introduction to representation of 3-dimensional structures	CO 5	T1,T2
28	Structural and stereoisomers of organic compounds	CO 5	T3
29	Configurations, symmetry and chirality.	CO 5	T3
30	Enantiomers, diastereomers, optical activity and Absolute configuration	CO 5	T3
31	Conformation alanalysis of n- butane	CO 5	T3
32	Nucleophilic substitution reactions, Mechanism of SN1, SN2 reactions	CO 5	T3
33	Electrophilic and nucleophilic addition reactions; Addition of HBr to Propene; Markownikoff and anti Markownikoff's additions	CO 5	T3
34	Grignard additions on carbonyl compounds, EliminationreactionsDehydro halogenations of alkylhalides	CO 5	T3
35	Oxidation reactions: Oxidation of alcohols using KMnO4 and chromicacid.	CO 5	T3
36	Reduction reactions: Reduction of carbonyl compounds using LiAlH4& NaBH4	CO 5	T3
37	Hydroboration of olefins	CO 5	T3
38	Structure, synthesis and pharmaceutical applications of Paracetamol and Aspirin.		T3
39	Definition, classification of fuels and characteristics of a good fuels	CO 5	T1,T2
40	Solid fuel Coal, analysis of coal- proximate analysis	CO 6	T1,T2
41	Analysis of coal -ultimate analysis.	CO 6	T1,T2
42	Liquid fuels: Petroleum and its refining Cracking: Fixed bed catalytic cracking;	CO 6	T1,T2
43	Knocking: Octane and cetane numbers	CO 6	T1,T2
44	Gaseous fuels: Composition, characteristics and applications of Natural gas, LPG and CNG	CO 6	T1,T2
45	Combustion: Calorific value-Gross calorific value(GCV) and net calorific value(NCV)	CO 6	T1,T2
46	Calculation of air quantity required for complete combustion of fuel, numerical problems.	CO 6	T1,T2
PROBLEM SOLVING			
1	Probelms on EMF	CO 1	T1:3.3.1; R3:3.2

2	Probelms on Nernst equation	CO 1	T2:16.5; R3:8.10
3	Determination of Electrode potential	CO 2	T2:16.5; R3:8.10
4	Determination of Hardness	CO 3	T1:3.3.1; R3:3.2
5	Determination of Hardness by EDTA	CO 3	T2:16.5; R3:8.10
6	Crystal field stabalization energy	CO 4	T2:16.5; R3:8.10
7	Proximate Analysis of coal	CO 6	T1:3.3.1; R3:3.2
8	ultimate Analysis of coal	CO 6	T2:16.5; R3:8.10
9	Dulungs Equation for coal analysis	CO 6	T2:16.5; R3:8.10
10	Probelms on Combustion	CO 6	T1:3.3.1; R3:3.2
DISCUSSION OF DEFINITION AND TERMINOLOGY			
1	Electro Chemistry and Batteries	CO 1	T2:16.5; R3:8.10
2	Water and Its Treatment	CO 2	T1:3.3.1; R3:3.2
3	Molecular Structure and Theories of Bonding	CO 3	T2:16.5; R3:8.10
4	Streo chemistry,Reaction Mechanisim	CO 4	T2:16.5; R3:8.10
5	Fuels and Combustion	CO 6	T2:16.5; R3:8.10
DISCUSSION OF QUESTION BANK			
1	Electro Chemistry and Batteries	CO 1	T2:16.5; R3:8.10
2	Water and Its Treatment	CO 2	T1:3.3.1; R3:3.2
3	Molecular Structure and Theories of Bonding	CO 3	T2:16.5; R3:8.10
4	Streo chemistry,Reaction Mechanisim	CO 4	T2:16.5; R3:8.10
5	Fuels and Combustion	CO 6	T2:16.5; R3:8.10

Signature of Course Coordinator **HOD,CE**

INSTITUTE OF AERONAUTICAL ENGINEERING
(Autonomous)
Dundigal, Hyderabad - 500 043

COURSE DESCRIPTION

Department	**CIVIL ENGINEERING**				
Course Title	**APPLIED PHYSICS**				
Course Code	AHS007				
Program	B.Tech				
Semester	I				
Course Type	Foundation				
Regulation	R-16				
Course Structure	Theory			Practical	
	Lecture	Tutorials	Credits	Laboratory	Credits
	3	1	4	-	-
Course Coordinator	Dr. Rizwana, Professor				

I COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites
-	-	-	-

II COURSE OVERVIEW:

This course develops abstract and critical reasoning by studying mathematical and logical proofs and assumptions as applied in basic physics and to make connections between physics and other branches of sciences and technology. The topics covered include dielectric and magnetic properties, acoustics of buildings, ultrasonics, equilibrium of system of forces, friction and dynamics of rigid bodies. The course helps students to gain knowledge of basic principles and appreciate the diverse applications in technological fields in respective branches and also in their lives.

III MARKS DISTRIBUTION:

Subject	SEE Examination	CIE Examination	Total Marks
Applied Physics	70 Marks	30 Marks	100

IV CONTENT DELIVERY / INSTRUCTIONAL METHODOLOGIES:

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

V EVALUATION METHODOLOGY:

The course will be evaluated for a total of 100 marks, with 30 marks for Continuous Internal Assessment (CIA) and 70 marks for Semester End Examination (SEE). Out of 30 marks allotted for CIA during the semester, marks are awarded by taking average of two CIA examinations or the marks scored in the make-up examination.

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 units and each unit 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 unit. Each question carries 14 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
0%	Remember
50 %	Understand
50 %	Apply
0 %	Analyze

Continuous Internal Assessment (CIA):
CIA is conducted for a total of 30 marks, with 25 marks for Continuous Internal Examination (CIE), 05 marks for Quiz/Alternative Assessment Tool.

Component	Theory		Total Marks
Type of Assessment	CIE Exam	Quiz/AAT	
CIA Marks	25	05	30

Continuous Internal Examination (CIE):
Two CIE exams shall be conducted at the end of the 8^{th} and 17^{th} week of the semester respectively. The CIE exam is conducted for 25 marks of 2 hours duration consisting of two parts. Part–A shall have five compulsory questions of one mark each. In part–B, four out of five questions have to be answered where, each question carries 5 marks. Marks are awarded by taking average of marks scored in two CIE exams.

Quiz – Online Examination:
Two Quiz exams shall be online examination consisting of 25 multiple choice questions and are to be answered by choosing the correct answer from a given set of choices (commonly four). Such a question paper shall be useful in testing of knowledge, skills, application, analysis, evaluation and understanding of the students. Marks shall be awarded considering the average of two quiz examinations for every course.

Alternative Assessment Tool (AAT):
This AAT enables faculty to design own assessment patterns during the CIA. The AAT converts the classroom into an effective learning center. The AAT may include tutorial hours/classes, seminars, assignments, presentations, open ended experiments, METE (Modeling and Experimental Tools in Engineering), five minutes video, MOOCs etc. The AAT chosen for this course is given in table 3.

Assignment	Seminar	Presentations
40 %	40 %	20 %

VI COURSE OBJECTIVES:

The students will try to learn:

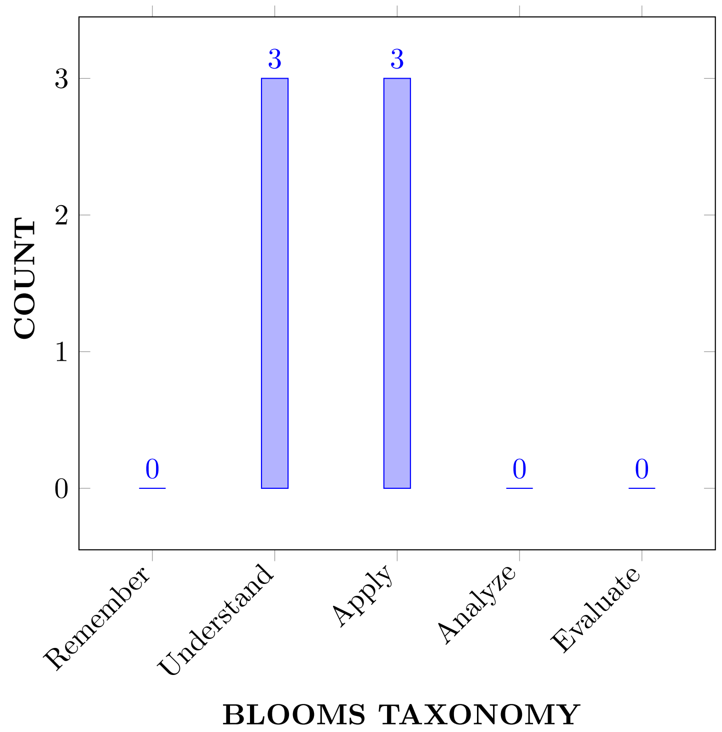
I	Develop the strong fundamentals of system of forces and friction.
II	Strengthen the knowledge of theoretical and technological aspects of dynamics of rigid bodies.
III	Correlate principles with applications of the dielectric and magnetic materials.
IV	Enrich knowledge in acoustics and ultrasonics.

VII COURSE OUTCOMES:

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

CO 1	**Illustrate** the properties of dielectric and magnetic materials which are suitable for engineering applications.	Understand
CO 2	**Outline** the basic principles of acoustics of buildings and modern architectural acoustic techniques using Sabine's formula.	Understand
CO 3	**Demonstrate** the generation and applications of ultrasonic waves in different fields of science and industries.	Understand
CO 4	**Identify** the condition of equilibrium from basic concepts and the laws of forces.	Apply
CO 5	**Make use of** laws of friction to obtain equilibrium of a body lying on an inclined plane.	Apply
CO 6	**Apply** knowledge of parallel and perpendicular theorems to obtain Moment of inertia of different types of objects.	Apply

COURSE KNOWLEDGE COMPETENCY LEVEL



VIII PROGRAM 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.

Program Outcomes	
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

IX 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	
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	

PROGRAM OUTCOMES		Strength	Proficiency Assessed by
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.	1	

3 = High; 2 = Medium; 1 = Low

X HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

PROGRAM SPECIFIC OUTCOMES		Strength	Proficiency Assessed by
PSO3	Make use of Advanced Structural Analysis and Project Management Software for creating Modern Avenues to succeed as an Entrepreneur, Pursue Higher Studies and Career Paths.	1	Laboratory experiments

3 = High; 2 = Medium; 1 = Low

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

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	✓	✓	-	-	-	-	-	-	-	-	-		-	-	-
CO 2	✓	-	-	✓	-	-	-	-	-	-	-	-	✓	-	-
CO 3	✓	✓	-	-	-	-	-	-	-	-	-		-	-	-
CO 4	✓	✓	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 5	✓	-	-	✓	-	-	-	-	-	-	-	-	-	-	
CO 6	✓	✓	-	-	-	-	-	-	-	-	-	-	-	-	-

XII 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 matched.
CO 1	PO 1	**Summarize** different types of polarizations and internal field due to the dipoles in the dielectric materials.	3
	PO 2	**Identify** the use of magnetic materials and their magnetization values for the **research based knowledge** and **technological development.**	4
CO 2	PO 1	**Describe** the different types of acoustic defects and principles of acoustics of buildings.	3
	PO 4	**Identify** good acoustic materials based on their response to sound waves for **construction of buildings**.	2
	PSO1	**Ability** to determine remnant magnetization and coercive values from B-H curve by make use of modern computer tools and for gaining knowledge helpful for higher studies.	1
CO 3	PO 1	**Demonstrate** the generation of ultrasonic waves using different methods and **describe** their properties.	3

Course Outcomes	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key competencies matched.
	PO 2	**Relate** the given problem statement and **formulate** the relation between time and distance to **find out** the depth of sea using echo sounder.	4
CO 4	PO 1	**Illustrate** detailed **knowledge** of various kinds of forces and laws that govern these forces.	3
	PO 2	**Apply** the knowledge of different kind of forces to move the heavy bodies with minimum manpower and machine tools.	4
CO 5	PO 1	**Utilize** frictional properties to **derive** condition for equilibrium of a body lying on an inclined plane.	3
	PO 4	**Make use of** laws of frictional forces for the r**esearch based knowledge** and **technological development**.	2
CO 6	PO 1	**Outline** the consequences of moment of inertia by applying theorems to different types of objects.	3
	PO 2	**Identify the given problem** and **formulate** expressions for moment of inertia **information and data.**	4

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

XIV 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	-	-	-	-	-	-	-	-	-		-	-	-
CO 2	100	-	-	20	-	-	-	-	-	-	-	-	33	-	-
CO 3	100	40	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 4	100	40	-	-	-	-	-	-	-	-	-		-	-	-
CO 5	100	-	-	20	-	-	-	-	-	-	-	-	-	-	-
CO 6	100	40	-	-	-	-	-	-	-	-	-	-	-	-	-

XV COURSE ARTICULATION MATRIX (PO / PSO MAPPING):

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

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

1 -5 <C$\leq$ 40% – Low/ Slight

2 - 40 % <C < 60% –Moderate
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	-	-	-	-	-	-	-	-	-		-	-	-
CO 2	3	-	-	1	-	-	-	-	-	-	-	-	1	-	-
CO 3	3	2	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 4	3	2	-	-	-	-	-	-	-	-	-		-	-	-
CO 5	3	-	-	1	-	-	-	-	-	-	-	-	-	-	-
CO 6	3	2	-	-	-	-	-	-	-	-	-	-	-	-	-
TOTAL	18	8	-	2	-		-	-	-	-	-	-	-	-	1
AVERAGE	3	2	-	1	-		-	-	-	-	-	-	-	-	1

XVI ASSESSMENT METHODOLOGY-DIRECT:

CIE Exams	✓	SEE Exams	✓	Seminars	✓
Laboratory Practices	-	Student Viva	-	Certification	-
Presentation	✓	5 Minutes Video	-	Open Ended Experiments	-
Assignments	✓				

XVII ASSESSMENT METHODOLOGY-INDIRECT:

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

XVIII SYLLABUS:

UNIT I	**DIELECTRIC AND MAGNETIC PROPERTIES**
	Dielectric Properties: Basic definitions, electronic, ionic and orientation polarizations-qualitative; Internal field in solids. Magnetic Properties: Basic definitions, origin of magnetic moment, Bohr magneton, classification of dia, para and ferro magnetic materials on the basis of magnetic moment, domain theory of ferro magnetism on the basis of hysteresis curve.
UNIT II	**ACOUSTICS AND ULTRASONICS**
	Acoustics: Reverberation, reverberation time, Sabine's formula (qualitative), absorption coefficient, measurement of absorption coefficient, factors affecting acoustics of an auditorium and their remedies; Ultrasonics: Introduction; Generation of ultrasonic waves; Magnetostriction method, piezoelectric method, properties, applications.
UNIT III	**EQUILIBRIUM OF SYSTEM OF FORCES**
	Introduction, basic concepts, system of forces, coplanar concurrent forces, force systems in plane, parallel forces in plane; Force systems in space, couples, resultant, Lami's theorem, triangle law of forces, polygon law of forces, condition of equilibrium.
UNIT IV	**FRICTION**
	Friction: Types of friction, limiting friction, laws of friction, angle of repose, equilibrium of body laying on rough inclined plane, Application of friction: ladder friction, wedge friction, screw friction.

UNIT V	**DYNAMICS OF RIGID BODIES - MOMENT OF INERTIA**
	Rotational motion, torque, angular momentum, relation between torque and angular momentum, angular momentum of system of particles, moment of inertia, expression for moment of inertia, radius of gyration, theorems on moment of inertia, moment of inertia of thin rod, rectangular lamina, circular disc.

TEXTBOOKS

1. Dr. K Vijay Kumar and Dr. S Chandralingam - "Modern Engineering Physics" Volume-1 & 2, S Chand. Co, 2018.
2. R. C Hibbler, "Engineering mechanics", Prentice Hall, 12th Edition, 2009.

REFERENCE BOOKS:

1. R. K. Gaur, S. L. Gupta, "Engineering Physics", Dhanpat Rai Publications, 8th Edition, 2001.
2. Timoshenko, D. H. Young, "Engineering mechanics", Tata Mc Graw Hill, 5th Edition, 2013.
3. Hitendra K Malik, A. K. Singh, "Engineering Physics", Mc Graw Hill Education, 1st Edition, 2009.
4. S. S. Bhavikatti, "A text book of Engineering mechanics", New age international, 1st Edition, 2012.

XIX 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	Introduction to OBE and its importance.		
	CONTENT DELIVERY (THEORY)		
2	Basic definitions of dielectric materials	CO1	T1, T2, R1, R2
3	electronic, ionic and orientation polarizations	CO1	T1, T2, R1, R2
4-5	Internal field in solids	CO1	T1, T2, R1, R2
6	Basic definitions of magnetic materials	CO2	T1, T2, R1, R2
7	origin of magnetic moment, Bohr magneton	CO2	T1, T2, R1, R2
8-9	Classification ofdia, para and ferro magneticmaterials on the basis of magnetic moment	CO2	T1, T2, R1, R2
10	Domain theory of ferromagnetism on the basis of hysteresis curve	CO2	T1, T2, R1, R2
11	Acoustics: Reverberation, reverberation time, Sabine's formula	CO3	T1, T2, R1, R2
12	Absorption coefficient, measurement of absorption coefficient	CO3	T1, T2, R1, R2

13	Factors affecting acoustics of an auditorium and their remedies	CO3	T1, T2, R1, R2
14	Ultrasonics: Introduction	CO4	T1, T2, R1, R2
15	Generation: Magnetostriction method	CO4	T1, T2, R1, R2
16	Generation: Piezoelectric method	CO4	T1, T2, R1, R2
17	Properties and applications of ultrasonic waves	CO4	T1, T2, R1, R2
18	Introduction, basic concepts	CO5	T1, T2, R1, R4
19	System of forces, coplanar concurrent forces	CO5	T1, T2, R1, R4
20	Force systems in space	CO5	T1, T2, R1, R4
21	Parallel forces in plane	CO5	T1, T2, R1, R4
22	Couples, resultant	CO6	T1, T2, R1, R4
23	Lami's theorem	CO6	T1, T2, R1, R4
24	Triangle law of forces	CO6	T1, T2, R1, R4
25	Polygon law of forces	CO6	T1, T2, R1, R4
26	Condition of equilibrium	CO6	T1, T2, R1, R4
27	Friction: Introduction, types of friction	CO6	T1, T2, R1, R2
28	Limiting friction	CO6	T1, T2, R1, R2
29	Laws of friction & Angle of repose	CO5, CO6	T1, T2, R1, R2
30	Equilibrium of body laying on rough inclined plane	CO6	T1, T2, R1, R2
31	Ladder and Wedge friction	CO5, CO6	T1, T2, R1, R2
32	Wedge friction & Screw friction	CO5, CO6	T1, T2, R1, R2
33	Screw friction	CO5, CO6	T1, T2, R1, R2
34	Rotational motion, torque, angular momentum	CO5	T1, T2, R1, R2
35	Relation between torque and angular momentum	CO6	T1, T2, R1, R2
36	Angular momentum of system of particles, moment of inertia	CO6	T1, T2, R1, R2

37	Expression for moment of inertia	CO6	T1, T2, R1, R2
38	Radius of gyration	CO6	T1, T2, R1, R2
39	Theorems on moment of inertia	CO6	T1, T2, R1, R2
40	Moment of inertia of thin rod, rectangular lamina, circular disc.	CO6	T1, T2, R1, R2
PROBLEM SOLVING/ CASE STUDIES			
1	Electron polarizability of materials	CO 1	T1, T2, R1, R2
2	Internal filed of solids	CO 1	T1, T2, R1, R2
3	Susceptibility of magnetic materials	CO 2	T1, T2, R1, R2
4	Reverberation time of a room	CO 3	T1, T2, R1, R2
5	Intensity of sound	CO 3	T1, T2, R1, R4
6	Frequency of ultrasonic waves	CO 4	T1, T2, R1, R2
7	Young's modulus of quartz given fundamental frequency	CO 4	T1, T2, R1, R2
8	Resultant force acting on an object	CO 5	T1, T2, R1, R4
9	Concurrent forces in equilibrium	CO 5	T1, T2, R1, R4
10	Tension in a string attached to a weight	CO 6	T1, T2, R1, R4
11	Coefficient of static friction	CO 5	T1, T2, R1, R2
12	Frictional force acting on a body	CO 5	T1, T2, R1, R2
13	Motion of an object on an inclined plane	CO 5	T1, T2, R1, R2
14	Radius of gyration of a rod	CO 6	T1, T2, R1, R2
15	Moment of inertia of a rectangular block	CO 6	T1, T2, R1, R2
DISCUSSION OF DEFINITION AND TERMINOLOGY			
1	Dielectric and magnetic properties	CO 1	T1, T2, R1, R2
2	Acoustics and ultrasonics	CO 2, 3	T1, T2, R1, R2
3	Equilibrium of system of forces	CO 4	T1, T2, R1, R4
4	Friction	CO 5	T1, T2, R1, R2

5	Dynamics of rigid bodies - moment of inertia	CO 6	T1, T2, R1, R2
DISCUSSION OF QUESTION BANK			
1	Dielectric and magnetic properties	CO 1,2	T1, T2, R1, R2
2	Acoustics and ultrasonics	CO 3, 4	T1, T2, R1, R2
3	Equilibrium of system of forces	CO 5, 6	T1, T2, R1, R4
4	Friction	CO 5, 6	T1, T2, R1, R2
5	Dynamics of rigid bodies - moment of inertia	CO 5,6	T1, T2, R1, R2

Signature of Course Coordinator **HOD, FE**

INSTITUTE OF AERONAUTICAL ENGINEERING
(Autonomous)
Dundigal, Hyderabad - 500 043

COURSE DESCRIPTION

Department	**CIVIL ENGINEERING**				
Course Title	**ENGINEERING DRAWING**				
Course Code	AME001				
Program	B.Tech				
Semester	I				
Course Type	Core				
Regulation	R-16				
Course Structure	Theory			Practical	
	Lecture	Tutorials	Credits	Laboratory	Credits
	2	-	4	-	-
Course Coordinator	R.Srinivas, Assistant Professor				

I COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites
-	-	-	-

II COURSE OVERVIEW:

One of the best ways to communicate one's ideas is through some form of picture or drawing. This is especially true for the engineer. An engineering drawing course focuses on usage of drawing instruments, lettering, construction of geometric shapes, etc. Students study use of dimensioning, shapes and angles or views of such drawings. Dimensions feature prominently, with focus on interpretation, importance and accurate reflection of dimensions in an engineering drawing. Other areas of study in this course may include projected views, pictorial projections and development of surfaces. This course also gives basic concepts for studying machine drawing, building drawing, circuit drawings etc.

III MARKS DISTRIBUTION:

Subject	SEE Examination	CIE Examination	Total Marks
Engineering drawing	70 Marks	30 Marks	100

IV CONTENT DELIVERY / INSTRUCTIONAL METHODOLOGIES:

✓	Chalk & Talk	✓	Quiz	✓	Assignments	x	MOOC
✓	LCD / PPT	✓	Seminars	x	Mini Project	✓	Videos
x	Open Ended Experiments						

V EVALUATION METHODOLOGY:

Each laboratory will be evaluated for a total of 100 marks consisting of 30 marks for internal assessment and 70 marks for semester end lab examination. Out of 30 marks of internal assessment, continuous lab assessment will be done for 20 marks for the day to day performance and 10 marks for the final internal lab assessment.

Semester End Examination (SEE): The semester end lab examination for 70 marks shall be conducted by two examiners, one of them being Internal Examiner and the other being External Examiner, both nominated by the Principal from the panel of experts recommended by Chairman, BOS.

The emphasis on the experiments is broadly based on the following criteria:

	Experiment Based	**Programming based**
20%	Objective	Purpose
20%	Analysis	Algorithm
20%	Design	Programme
20%	Conclusion	Conclusion
20%	Viva	Viva

Continuous Internal Assessment (CIA):

CIA is conducted for a total of 30 marks, with 25 marks for Continuous Internal Examination (CIE) and 05 marks for Quiz \Alternative Assessment Tool (AAT).

Component	Theory		Total Marks
Type of Assessment	CIE Exam	Quiz \AAT	
CIA Marks	25	05	30

Continuous Internal Examination (CIE):

Two CIE exams shall be conducted at the end of the 8^{th} and 17^{th} week of the semester respectively. The CIE exam is conducted for 25 marks of 2 hours duration consisting of two parts. Part–A shall have five compulsory questions of one mark each. In part–B, four out of five questions have to be answered where, each question carries 5 marks. Marks are awarded by taking average of marks scored in two CIE exams.

Quiz - Online Examination

Two Quiz exams shall be online examination consisting of 25 multiple choice questions and are to be answered by choosing the correct answer from a given set of choices (commonly four). Such a question paper shall be useful in testing of knowledge, skills, application, analysis, evaluation and understanding of the students. Marks shall be awarded considering the average of two quiz examinations for every course.

Alternative Assessment Tool (AAT)

This AAT enables faculty to design own assessment patterns during the CIA. The AAT converts the classroom into an effective learning center. The AAT may include tutorial hours/classes, seminars, assignments, term paper, open ended experiments, METE (Modeling and Experimental Tools in Engineering), five minutes video, MOOCs etc. The AAT chosen for this course is given in table

Concept Video	Tech-talk	Complex Problem Solving
40%	40%	20%

VI COURSE OBJECTIVES:

The students will try to learn:

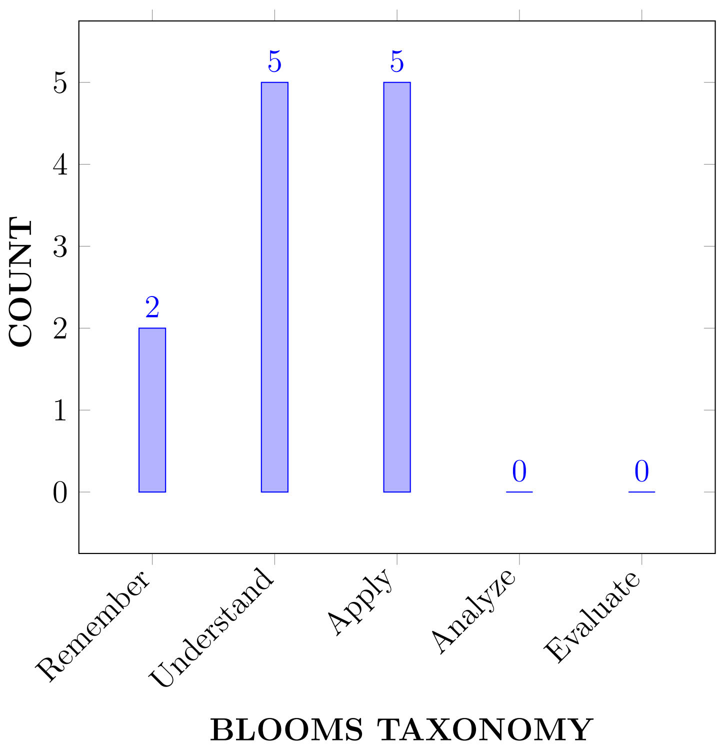
I	Understand the basic principles of engineering drawing and construction of curves used in engineering field
II	Apply the knowledge of interpretation of projection in different quadrants
III	Understand the projections of solids, when it is inclined to both planes simultaneously
IV	Convert the pictorial views into orthographic view and vice versa
IV	Create intricate details of components through sections and develop its surfaces

VII COURSE OUTCOMES:

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

CO 1	**Demonstrate** the instruments used in engineering drawing, conventional representations and placing dimensions for **producing flawless drawings in engineering applications**	Understand
CO 2	**Make use of** principles of orthographic projections for the representation **of three dimensional objects on a plane used in engineering field**	Apply
CO 3	**Draw** the isometric projection of three dimensional objects **for visualization of shape and size of the objects.**	Understand
CO 4	**Draw** the development of surfaces of regular solids and their cut sections **used in sheet metal work for making industrial needs.**	Understand
CO 5	**Visualize** the components by isometric projection by representing three dimensional objects in two dimensions **in technical and engineering drawings.**	Understand
CO 6	**Convert** the orthographic views into pictorial views and vice-versa **for designing and manufacturing of components in industries.**	Apply

COURSE KNOWLEDGE COMPETENCY LEVEL



VIII PROGRAM 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

IX 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	Assignments
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	Assignments
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.	1	Assignments

3 = High; 2 = Medium; 1 = Low

X HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

PROGRAM SPECIFIC OUTCOMES		Strength	Proficiency Assessed by
PSO 1	Design and Supervise Sub-Structures and Super Structures for Residential and Public Buildings, Industrial Structures, Irrigation Structures, Power Houses, Highways, Railways, Airways, Docs and Harbours	1	Assignments
PSO 2	Focus on Improving Performance of Structures with reference to Safety, Serviceability and Sustainable Green Building Technology.	-	Assignments
PSO 3	Make use of Advanced Structural Analysis and Project Management Software for creating Modern Avenues to succeed as an Entrepreneur, Pursue Higher Studies and Career Paths.	-	-

3 = High; 2 = Medium; 1 = Low

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

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	✓	-	-	-	-	-	-	-	-	-	-		✓	-	-
CO 2	✓	-	-	-	-	-	-	-	-	✓	-	-	✓	-	-
CO 3	✓	-	✓	-	-	-	-	-	-	✓	-	-	✓	-	-
CO 4	✓	-	✓	-		-	-	-	-	✓	-	✓	✓	-	-

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

XII 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 matched.
CO 1	PO 1	Recall the basic commands of AutoCAD for various curves and scales using **scientific principles** and **engineering fundamentals**	2
	PO 5	Understand Scales and Curves with different methods conceptually and apply them in modeling a **complex engineering** activity	1
	PSO 3	Make use of design **computational** and modeling **experimental tools** for building career paths towards innovative startups to be an entrepreneur.	2
CO 2	PO 1	Recall the basic commands of AutoCAD for various curves and scales using **scientific principles** and **engineering fundamentals**	2
	PO 3	Understand the given **problem statement** related to question formatted for engineering drawings and based upon type use different AutoCAD commands .	1
	PO 10	**Demonstrate** the autocad commands to develop sketches in multi sectional views of a solid object and **Illustrate** to other views	2
CO 3	PO 1	Develop expression for eccentricity and Identify the appropriate type of curve for **problem solving** using **engineering sciences.**	1
	PO 3	Use research based knowledge for different methods of drawing engineering curves and draw with **modern tools**	1
	PO 10	Develop the 3D images of the machine objects and check the **Interference** of the post manufactured objects	1
CO 4	PO 1	Apply the **engineering knowledge** to classify Cycloidal and involutes profiles in user Coordinate System to draw engineering problems.	1
	PO 3	Build practical experience in building the real time products, using **industry standard** and **collaboration technique** in the field of curves.	2
	PO 9	**Classify** the scales for all types of drawings and **Simplify** the image understanding	2
CO 5	PO 5	Recall various types of scales and **use principles of BIS**, and **engineering** fundamentals for engineering applications like maps, buildings, bridges.	2

Course Outcomes	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key competencies matched.
CO 6	PO 1	Make a use of an appropriate plane to draw different position of points and lines to solve **engineering problems** for **solution enhancement**	2
	PO 5	Recall various positions in coordinate system for points and lines **use principles of views**, and **engineering fundamentals** for completing the drawing	2
	PO 12	**Develop** the views of the plane projects and extend it to Solve unknown images and provide solutions apart from four planes of projections	2

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

XIV 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	-	-	-	-	-	-	-	-	40	-	-	-	-	-
CO 3	100	-	40	-	-	-	-	-	-	60	-	-	-	-	-
CO 4	100	-	60	-		-	-	-	-	60	-	60	60	-	-
CO 5	100	-	60	-	-	-	-	-	-	60	-	60	60	-	-
CO 6	100	-	60	-		-	-	-	-	60	-	-	60	-	-

XV COURSE ARTICULATION MATRIX (PO / PSO MAPPING):

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

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

1 -5 $<C \leq 40\%$ – Low/ Slight

2 - 40 % $<C < 60\%$ –Moderate

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

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	3	-	-	-	-	-	-	-	-	-	-	-	-	-	
CO 2	3	-	-	-	-	-	-	-	-	1	-	-	-	-	-
CO 3	3	-	1	-	-	-	-	-	-	2	-	-	-	-	-
CO 4	3	-	2	-	-	-	-	-	-	2	-	2	2	-	-
CO 5	3	-	2	-	-	-	-	-	-	2	-	2	2	-	-
CO 6	3	-	2	-	-	-	-	-	-	2	-	-	1	-	-
TOTAL	18	-	7	2	-	-	-	-	-	9	-	4	5	-	-
AVERAGE	3	-	1.75	-	-	-	-	-	-	1.8	-	2	1.67	-	-

XVI ASSESSMENT METHODOLOGY-DIRECT:

CIE Exams	PO 1	SEE Exams	PO 1	Assignments	PO 2
Laboratory Practices	PO 2	Student Viva	-	Certification	-
Term Paper	-	5 Minutes Video	PO 4	Open Ended Experiments	-
Seminars	PO 2				

XVII ASSESSMENT METHODOLOGY-INDIRECT:

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

XVIII SYLLABUS:

MODULE I	**FUNDAMENTALS OF ENGINEERING DRAWING, SCALES AND CURVES**
	Introduction to engineering drawing: Drawing instruments and accessories, types of line, lettering practice and rules of dimensioning, geometrical constructions, basic geometrical shapes; Scales: Types of scales, units of length and their conversion, construction of scales, plain scale, diagonal scale, vernier scale; Curves used in engineering practice and their constructions; Conic sections, construction of ellipse parabola and hyperbola, special curves, construction of cycloid, epicycloids, hypocycloid and involutes
MODULE II	**ORTHOGRAPHIC PROJECTION, PROJECTION OF PLANES**
	Orthographic projection: Principles of orthographic projections, conventions, first and third angle projections, projection of points, projection of lines, lines inclined to single plane, lines inclined to both the planes, true lengths and traces; Projection of planes: Projection of regular planes, planes inclined to one plane, planes inclined to both planes, projection of planes by auxiliary plane projection method.
MODULE III	**PROJECTION OF SOLIDS**
	Projection of solids: Projections of regular solid, prisms, cylinders, pyramids, cones. Solids inclined to one plane, solids inclined to both planes, projection of solid by auxiliary Page — 5 plane projection method.

MODULE IV	**DEVELOPMENT OF SURFACES, ISOMETRIC PROJECTIONS**
	Development of surfaces: Development of lateral surface of right regular solids, prisms, cylinders, pyramids and cones; Isometric projections: Principle of isometric projection, isometric scale, isometric projections and isometric views, isometric projections of planes, prisms, cylinders, pyramids, and cones
MODULE V	**TRANSFORMATION OF PROJECTIONS**
	Transformation of projections: Conversion of isometric views to orthographic views and conversion of orthographic views to isometric views..

TEXTBOOKS

1. N. D. Bhatt, "Engineering Drawing", Charotar Publications, 49thEdition, 2012.
2. C. M. Agrawal, Basant Agrawal, "Engineering Drawing", Tata McGraw Hill, 2ndEdition, 2013.

REFERENCE BOOKS:

1. K.Venugopal, "Engineering Drawing and Graphics", New Age Publications, 2ndEdition, 2010
2. K. C. John, "Engineering Drawing", PHI Learning Private Limited", 2nd Edition, 2009.
3. Dhananjay. A. Johle, "Engineering Drawing", Tata McGraw Hill, 1st Edition, 2008

WEB REFERENCES:

1. https://nptel.ac.in/courses/112105171/1

XIX COURSE PLAN:

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

S.No	Topics to be covered	CO's	Reference T1: 4.1
OBE DISCUSSION			
1	Discuss on Outcome based education		
CONTENT DELIVERY (THEORY)			
1	Principles of engineering drawing – various drawing instruments and their uses. (general exercises).	CO 1	T1:1.1
2	History of Manual Drafting	CO 1	T1: 2.3
3	Structure of drawing boards, lettering practice, dimensioning	CO 2	T1: 3.1
4	Basic geometrical shapes, scales and its uses, plain, diagonal scale	CO 1	T1:3.3
5	Curves used in engineering practice and their constructions	CO 1	T1: 4.3
6	Construction of ellipse parabola and hyperbola	CO 1	T1: 4.3.2
7	cycloid, epicycloids curves	CO 1	T1:3.3
8	Construction of hypocycloid and involutes	CO 2	T1:3.4, R1: 4.1
9	Principles of orthographic projections	CO 1	T1: 4.3
10	Conventions in Drawing – Lettering – BIS	CO 2	T1:1.1
11	auxiliary plane projection method	CO 2	T1: 2.1

12	True lengths and traces	CO 2	T1:2.2 R1: 2.2.3
13	Planes inclined to one plane	CO 1	T1: 2.3
14	Planes inclined to both planes	CO 2	T1: 3.1
15	Projection of planes by auxiliary plane	CO 1	T1:3.3
16	Plane projection method.	CO 2	T1:3.4, R1: 4.1
17	Principles of orthographic projections,	CO 2	T1: 4.1
18	Projection of solids inclined to single plane.	CO 1	T1: 4.3
19	Projection of solids inclined to a both planes.	CO 1	T1: 4.3.2
20	Projection of solids Auxiliary plane method	CO 1	T1:4.3
21	auxiliary plane projection method	CO 2	T1:2.2 R1: 2.2.3
22	True lengths and traces	CO 1	T1:2.2
23	Planes inclined to one plane	CO 2	R1: 2.2.3
24	Planes inclined to both planes	CO 1	T1: 2.3
25	Projection of planes by auxiliary plane	CO 1	T1: 3.1
26	Plane projection method.	CO 2	T1: 4.3
27	Principles of orthographic projections,	CO 1	T1: 4.3.2
28	Projection of solids inclined to single plane.	CO 2	T1: 3.1
29	Projection of solids inclined to a both planes.	CO 2	T1:3.3
30	Projection of solids Auxiliary plane method	CO 2	T1: 4.4
31	Draw the development of surfaces	CO 1	T1: 5.2
32	Draw the isometric projections	CO 2	T1: 5.2.3
33	Convert the pictorial views to orthographic views	CO 2	T1: 6.1
34	lateral surface Development	CO 2	T1: 8.1
35	Right regular solids, prisms, cylinders	CO 1	T1:8.1.2
36	Isometric projections	CO 1	T1: 3.1
37	Isometric scale	CO 1	T1:3.3
38	Transformation of projections:	CO 1	T1: 4.3
39	Conversion of isometric views to orthographic views	CO 2	T1: 4.3.2
40	Conversion of orthographic to isometric	CO 1	T1:3.3
PROBLEM SOLVING/ CASE STUDIES			
1	Calculating scales and proportions for all types of drawings	CO 1	R2:1.5
2	Estimating the lengths of curves in eclipse, hyperbola and parabola	CO 2	R2:5.5
3	Calculating points and planes of projections on V.P. and H.P.	CO 6	R2:6.5
4	Calculating surface area of section of prisms and pyramids	CO 4	R2:3.5
5	Conversion of orthographic to isometric	CO 2	R2:2.5
DISCUSSION OF DEFINITION AND TERMINOLOGY			
1	Calculating curve points for ellipse, parabola and hyperbola	CO 3	R4:1.5
2	Tracking the point of projection of point on planes	CO 5	R3:2.5

3	Tracing the surfaces of two dimensional planes and its projections	CO 6	R4:5.5
4	Conversion of orthographic to oblique projections	CO 5	R1:3.5
5	Developing the surfaces of regular solids	CO 5	R3:2.5
6	Solids Inclined to one planes	CO 6	R2:5.5
DISCUSSION OF QUESTION BANK			
1	Path curve calculations of parabola and hyperbola	CO 1, 3	R4: 1.1
2	Points projection on planes in I quadrant	CO 2, 6	T1: 3.5
3	Planes and surfaces projection on vertical planes	CO 3, 4	T1: 3.5
4	Section of Solids surfaces projection on planes	CO 1, 2	T3: 2.5
5	Projection of Section of solids on both planes	CO 5, 6	T6: 3.5

Signature of Course Coordinator **HOD,CE**

INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

Dundigal, Hyderabad - 500 043

COURSE DESCRIPTION

Course Title	ENGLISH LANGUAGE AND COMMUNICATION SKILLS LABORATORY				
Course Code	AHS101				
Program	B.Tech				
Semester	I	CE			
Course Type	Foundation				
Regulation	R16				
Course Structure	Theory			Practical	
	Lecture	Tutorials	Credits	Laboratory	Credits
	-	-	-	2	1
Course Coordinator	Dr. Jetty Wilson, Professor				

I COURSE OVERVIEW:

This lab course is designed to introduce the students to create wide exposure on language learning techniques regarding the basic elements of Listening, Speaking, Reading and Writing. In this lab the students are trained in communicative English language skills, phonetics, word accent, word stress, rhythm and intonation, oral presentations, extempore and Prepared-seminars, group-discussions, presenting techniques of writing, participating role plays, telephonic etiquettes, asking and giving directions, information transfer , debates, description of persons, places, objects etc; . The lab encourages the 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.

II COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites
-	-	-	-

III MARKS DISTRIBUTION:

Subject	SEE Examination	CIE Examination	Total Marks
English Language and Communication Skills Laboratory	70 Marks	30 Marks	100

IV DELIVERY / INSTRUCTIONAL METHODOLOGIES:

✓	Demo Video	✓	Lab Worksheets	✓	Viva Questions	✓	Probing further Questions

V EVALUATION METHODOLOGY:

Each laboratory will be evaluated for a total of 100 marks consisting of 30 marks forinternal assessment and 70 marks for semester end lab examination. Out of 30 marks ofinternal assessment, continuous lab assessment will be done for 20 marks for the day today performance and 10 marks for the final internal lab assessment.

Semester End Examination (SEE): The semester end labexamination for 70 marks shall be conducted by two examiners, one of them beingInternal Examiner and the other being External Examiner, both nominated by thePrincipal from the panel of experts recommended by Chairman, BOS. The emphasis on the experiments is broadly based on the following criteria given in Table: 1

	Sofware based
20 %	To test the perfection of primary tonic stress accent, pre-tonic secondary stress accent and post-tonic secondary stress accent.
20 %	To test the performance to achieve neutralization of accent.
20 %	To test the awareness while pronouncing gemination, elision and assimilation.
20 %	To test the presentation skills in the ICS laboratory.
20 %	To test the subject knowledge through viva.

Continuous Internal Assessment (CIA):

CIA is conducted for a total of 30 marks (Table 1), with 20 marks for continuous lab assessment during day to day performance, 10 marks for final internal lab assessment.

Component			Total Marks
Type of Assessment	**Day to day performance**	**Final internal lab assessment**	
CIA Marks	20	10	30

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.

1. **Sofware based**

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

2. **Programming Based**

Objective	Analysis	Design	Conclusion	Viva	Total
-	-	-	-	-	-

VI COURSE OBJECTIVES:

The students will try to learn:

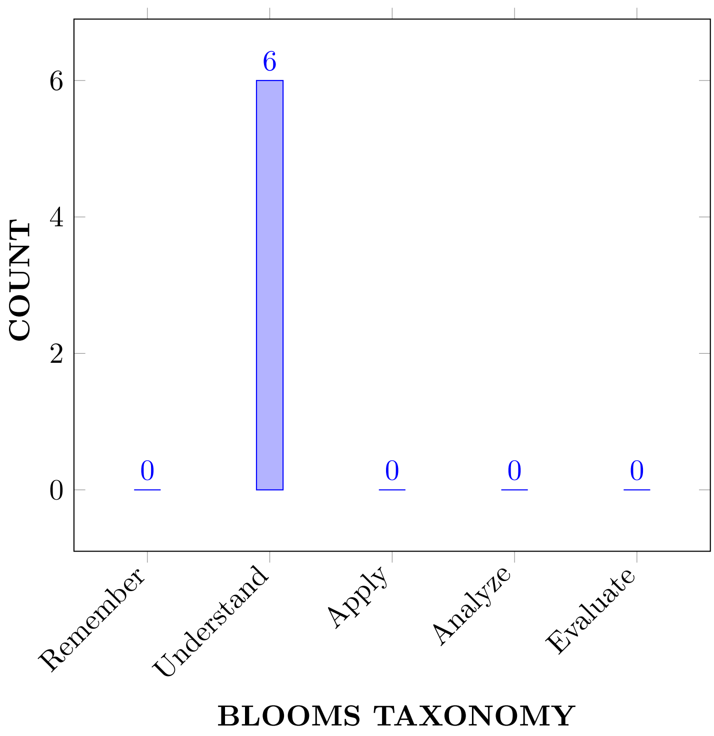
I	Facilitate computer-assisted multi-media instructions to make possible individualized and independent language learning.
II	The critical aspect of speaking and reading for interpreting in-depth meaning of the sentences.
III	Use language appropriately for social interactions such as public speaking, group discussions and interviews.
IV	Habituate using English speech sounds, word accent, intonation and rhythm.

VII COURSE OUTCOMES:

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

CO 1	**Discuss** the prime necessities of listening skill for improving pronunciation in academic and non-academic purposes.	Understand
CO 2	**Summarize** the knowledge of English phonetics for speaking accepted language and describe the procedure of phonemic transcriptions and intonation patterns.	Understand
CO 3	**Express** about necessity of stressed and unstressed syllables in a word with appropriate length and clarity.	Understand
CO 4	**Explain** how writing skill fulfill the academic and non-academic requirements of various written communicative functions.	Understand
CO 5	**Generalize** appropriate concepts and methods from a variety of disciplines to solve problems effectively and creatively.	Understand
CO 6	**Classify** the roles of collaboration, risk-taking, multi-disciplinary awareness, and the imagination in achieving creative responses to problems.	Understand

COURSE KNOWLEDGE COMPETENCY LEVEL



VIII HOW PROGRAM OUTCOMES ARE ASSESSED:

Program		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	Day-to-day evaluation / CIE/SEE
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 (Communication).	5	Day-to-day evaluation / CIE/SEE

3 = High; 2 = Medium; 1 = Low

IX HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

Program		Strength	Proficiency Assessed by
PSO 1	Design and Supervise Sub-Structures and Super Structures for Residential and Public Buildings, Industrial Structures, Irrigation Structures, Power Houses, Highways, Railways, Airways, Docs and Harbours	-	-

PSO 2	Focus on Improving Performance of Structures with reference to Safety, Serviceability and Sustainable Green Building Technology	-	-
PSO 3	Make use of multi physics, computational fluid dynamics and flight simulation tools for building career paths towards innovative startups, employability and higher studies.	-	-

3 = High; 2 = Medium; 1 = Low

X 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 9	Define the meaning of **individual work** and **team work** and also participate effectively to develop **leadership** qualities among the **diverse teams** in **multidisciplinary** settings.	5
CO 3	PO 10	Describe the **clarity** of **grammatical** usage and the obligation of **punctuation** marks in **speaking** and **writing**.	5
CO 4	PO 10	Choose suitable **grammatical** structures and **punctuation** marks at **speaking** and **writing** areas maintaining **clarity** at professional platform.	5
CO 5	PO 10	Interpret the **grammatical** knowledge and **punctuation** marks systematically towards providing the **clarity** in **speaking** and **writing**.	5
CO 6	PO 10	Demonstrate the role of **grammar** and **punctuation** marks understanding the meaning between the sentences as well as paragraphs in **speaking** or **writing** for a **clarity**.	5

XI MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

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

XII ASSESSMENT METHODOLOGY DIRECT:

Laboratory Practices	PO 9, PO 10	Student Viva	PO 9, PO 10	Certification	-
Assignments	-	-	-	-	

XIII ASSESSMENT METHODOLOGY INDIRECT:

✓	Early Semester Feedback	✓	End Semester OBE Feedback
X	Assessment of Mini Projects by Experts		

XIV SYLLABUS:

WEEK I	**INTRODUCTION ABOUT ELCS LAB..**
	Introducing Self and Introducing Others – feedback.
WEEK II	**INTRODUCTION TO PHONETICS AND PRACTICING CONSONANTS**
	Describing a person or place or a thing using relevant adjectives – feedback.
WEEK III	**PRACTICING VOWEL SOUNDS.**
	JAM Sessions using public address system.
WEEK IV	**STRUCTURE OF SYLLABLES.**
	Giving directions with help of using appropriate phrases – activities.
WEEK V	**WORD ACCENT AND STRESS SHIFTS. – PRACTICE EXERCISES.**
	Starting a conversation, developing and closing appropriately using fixed expressions..
WEEK VI	**PAST TENSE AND PLURAL MARKERS.**
	Role Play activities.
WEEK VII	**WEAK FORMS AND STRONG FORMS.**
	Oral Presentation..
WEEK VIII	**INTRODUCTION TO INTONATION- USES OF INTONATION - TYPES OF INTONATION- PRACTICE EXERCISES.**
	Expresions In Various Situations.
WEEK IX	**NEUTRALIZATION OF MOTHER TONGUE INFLUENCE (MTI).**
	Sharing Summaries Or Reviews On The Topics Of Students' Choice.
WEEK X	**COMMON ERRORS IN PRONUNCIATION AND PRONUNCIATION PRACTICE THROUGH TONGUE TWISTERS.**
	Interpretation Of Proverbs And Idioms.
WEEK XI	**LISENING COMPREHENSION.**
	Etiquettes.

WEEK XII	**TECHNIQUES AND METHODS TO WRITE SUMMARIES AND REVIEWS OF VIDEOS.**
	Writing Messages, Leaflets And Notices Etc.
WEEK XIII	**COMMON ERRORS.**
	Resume Writing.
WEEK XIV	**INTRODUCTION TO WORD DICTIONARY.**
	Group Discussions – Video Recording – Feedback.
WEEK XV	**INTRODUCTION TO CONVERSATION SKILLS.**
	Mock Interviews.

TEXTBOOKS

1. ENGLISH LANGUAGE AND COMMUNICATION SKILLS: LAB 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.

XV 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	Introduction About Elcs Lab, Introducing Self And Introducing Others – Feedback.	CO 2	R1: 1.2
2	Introduction To Phonetics And Practicing Consonants, Describing A Person Or Place Or A Thing Using Relevant Adjectives – Feedback.	CO 2	R2: 25-30
3	Practicing Vowel Sounds,Jam Sessions Using Public Address System.	CO 2	R1: 28-29,49-54
4	Structure Of Syllables, Giving Directions With Help Of Using Appropriate Phrases – Activities.	CO 3	R1: 23-38
5	Word Accent And Stress Shifts. – Practice Exercises, Starting A Conversation, Developing And Closing Appropriately Using Fixed Expressions.	CO 3	R1: 2.4
6	Past Tense And Plural Markers,	CO 2	R3: 4.5
7	Weak Forms And Strong Forms,Oral Presentation.	CO 2	R3: 4.6
8	Introduction To Intonation- Uses Of Intonation - Types Of Intonation- Practice Exercises, Expresions In Various Situations.	CO 2	R2: 39-42
9	Neutralization Of Mother Tongue Influence (Mti), Sharing Summaries Or Reviews On The Topics Of Students' Choice.	CO 2	R2: 5.2
10	Common Errors In Pronunciation And Pronunciation Practice Through Tongue Twisters, Interpretation Of Proverbs And Idioms.	CO 2	R1:42-43
11	Lisening Comprehension, Etiquettes	CO 5	R1:44-48

12	Techniques And Methods To Write Summaries And Reviews Of Videos,Writing Messages, Leaflets And Notices Etc.	CO 4	R1:107-110
13	Common Errors, Resume Writing.	CO 4	R1:7.3
14	Introduction To Word Dictionary,Group Discussions – Video Recording – Feedback.	CO 5	R1:7.3
15	Introduction To Conversation Skills,Mock Interviews.	CO 6	R1: 54-58

XVI EXPERIMENTS FOR ENHANCED LEARNING (EEL):

S.No	Design Oriented Experiments.
1	**Effective listening skills can be used in professional and personal platforms in future.**
2	**By learning LSRW skills, students can enhance desired language skills to fulfill their needs.**
3	**Practicing presentation skills will boost confidence at work place.**
4	**The overall experiments of the laboratory will lead to be an effective communicator.**
5	**The Students will develop critical comprehensive skills to solve the career related problems in future.**

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

INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

Dundigal, Hyderabad - 500 043

CIVIL ENGINEERING

COURSE DESCRIPTION

Course Title	**ENGINEERING CHEMISTRY LABORATORY**				
Course Code	AHS103				
Program	B.Tech				
Semester	I	CE			
Course Type	FOUNDATION				
Regulation	IARE – R16				
Course Structure	Theory			Practical	
	Lecture	Tutorials	Credits	Laboratory	Credits
	-	-	-	2	1
Course Coordinator	Mr G Mahesh Kumar, Assiatant Professor				

I COURSE OVERVIEW:

The aim of this Engineering Chemistry laboratory is to develop the analytical ability of the students by better understanding the concepts experimental chemistry. The experiments carried out like preparation of aspirin, thiokol rubber, conductometry, potentiometry, physical properties like viscosity and surface tension of liquids. The volumetric analytical experiments like determination of hardness of water, dissolved oxygen and copper in brass can be carried out in the laboratory.

II COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites	Credits
-	-	-	-	-

III MARKS DISTRIBUTION:

Subject	SEE Examination	CIE Examination	Total Marks
Engineering Chemistry Laboratory	70 Marks	30 Marks	100

IV DELIVERY / INSTRUCTIONAL METHODOLOGIES:

✓	Demo Video	✓	Lab Worksheets	✓	Viva Questions	✓	Probing Further Experiments

V EVALUATION METHODOLOGY:

Each laboratory will be evaluated for a total of 100 marks consisting of 30 marks for internal assessment and 70 marks for semester end lab examination. Out of 30 marks of internal assessment, continuous lab assessment will be done for 20 marks for the day-to-day performance and 10 marks for the final internal lab assessment.

Semester End Examination (SEE): The semester end lab examination for 70 marks shall be conducted by two examiners, one of them being Internal Examiner and the other being External Examiner, both nominated by the principal from the panel of experts recommended by Chairman, BOS.
The emphasis on the experiments is broadly based on the following criteria given in Table: 1

	Experiment Based	Programming based
20 %	Objective	Purpose
20 %	Analysis	Algorithm
20 %	Design	Programme
20 %	Conclusion	Conclusion
20 %	Viva	Viva

Continuous Internal Assessment (CIA):

CIA is conducted for a total of 30 marks (Table 1), with 20 marks for continuous lab assessment during day to day performance, 10 marks for final internal lab assessment.

Component	**Laboratory**		Total Marks
Type of Assessment	**Day to day performance**	**Final internal lab assessment**	
CIA Marks	20	10	30

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.

A. Experiment Based

Objective	**Analysis**	**Design**	**Conclusion**	**Viva**	**Total**
2	2	2	2	2	10

B. Programming Based

Purpose	**Algorithm**	**Program**	**Conclusion**	**Viva**	**Total**
2	2	2	2	2	10

VI COURSE OBJECTIVES:

The students will try to learn:

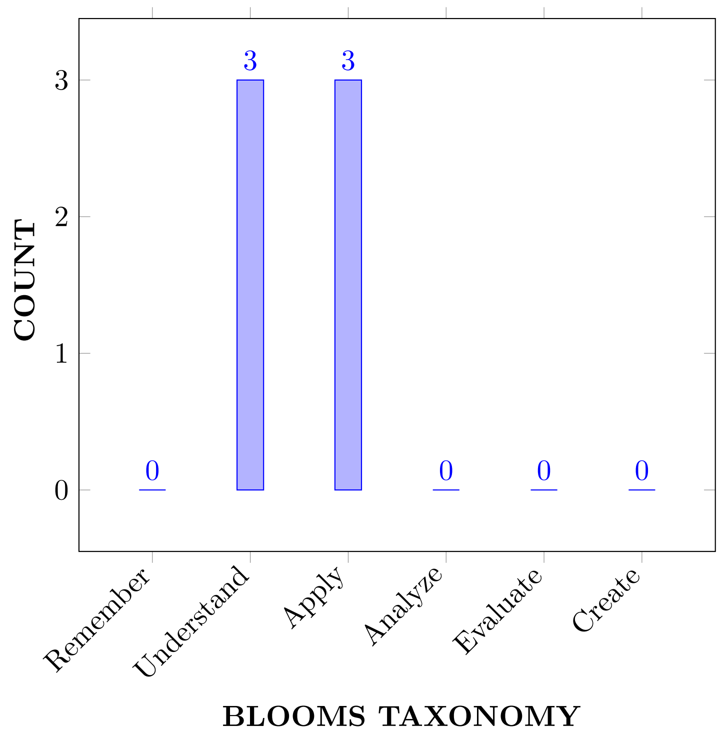
I	The basic principles involved in chemical analysis and mechanism of synthetic organic reactions. processes.
II	The need and importance of quality of water for industrial and domestic use..
III	The measurement of physical properties like surface tension and viscosity.
IV	The knowledge on existing future upcoming devices, materials and methodology.

VII COURSE OUTCOMES:

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

CO 1	**Identify** Explain the mechanism of chemical reactions for synthesizing drug molecules. for making a desired product with given work piece.	Understand
CO 2	**Determine** Identify the total hardness, dissolved oxygen in water by volumetric analysis for finding the hardness causing salts in water. to demonstrating proficiency with hand tools common in fitting.	Apply
CO 3	**Create** Make use of conductometric and potentiometric titrations for finding the concentration of unknown solutions.to convert given shape into useable elements using basic blacksmith techniques.	Apply
CO 4	**Organize** the moulding techniques along with suitable tools Choose different types of liquids for finding the surface tension and viscosity of lubricants.	Apply
CO 5	**Develop** Explain the preparation of synthetic rubbers for utilizing in industries and domestic purpose. for manufacturing the tin boxes, cans, funnels, ducts etc., from a flat sheet of metal.	Understand
CO 6	**Compare** various electrical circuits by using conduit system of wiring Relate the importance of different types of materials for understanding their composition and applications.	Understand

COURSE KNOWLEDGE COMPETENCY LEVEL



VIII HOW PROGRAM OUTCOMES ARE ASSESSED:

Program		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.	-	SEE/CIE
PO 2	**Design/development of solutions:** 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	-	SEE/CIE
PO 7	**Modern tool usage:** 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.	-	SEE/CIE

3 = High; 2 = Medium; 1 = Low

IX HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

Program		Strength	Proficiency Assessed by
PSO 1	Formulate and evaluate engineering concepts of design, thermal and production to provide solutions for technology aspects in digital manufacturing.	-	-
PSO 2	Focus on ideation and research towards product development using additive manufacturing, CNC simulation and high speed machining. .	-	-
PSO 3	Make use of computational and experimental tools for creating innovative career paths, to be an entrepreneur and desire for higher studies.	-	-

3 = High; 2 = Medium; 1 = Low

X 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 mechanism of chemical reactions for synthesizing drug molecules by applying mathematical expressions for finding the percentage of Aspirin by using principles of science for solving engineering problems.	3

CO 2	PO 1	Demonstrate the total hardness, dissolved oxygen in water by volumetric analysis for finding the hardness causing salts in water by applying mathematical expressions by using principles of science for solving engineering problems..	3
	PO 2	Identify the problem and formulate for finding the hardness of water in terms of CaCO3 equivalents with given information and data by applying principles of science..	2
	PO 7	Identify the dissolved oxygen content in raw water and reduce the pollutants in atmosphere to protect aquatic organisms and know the impact in socio economic and environmental contexts for sustainable development..	2
CO 3	PO 1	Choose different electrodes for finding pH of unknown solutions by applying mathematical expressions of cell potential by using principles of science for solving engineering problems.	3
	PO 2	Identify the problem formulation and abstraction for calculating the concentration of unknown solutions by applying normality of standard solution from the provided information.	2
CO 4	PO 1	Choose different types of liquids for finding the surface tension and viscosity of lubricants by applying mathematical expressions by using principles of science for solving engineering problems..	3
	PO 2	Identify the problem formulation and abstraction for calculating viscosity and surface tension of test liquids by applying viscosity and surface tension of standard liquids, density of liquids from the provided information.	2
CO 5	PO 1	Explain the preparation of synthetic rubbers for utilizing in industries and domestic purpose by using principles of science for solving engineering problems.	2
CO 6	PO 1	Demonstrate the percentage of copper in brass, manganese dioxide in pyrolusite by volumetric analysis using mathematical expressions by using principles of science for solving engineering problems. .	3

XI MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

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

3 = High; 2 = Medium; 1 = Low

XII ASSESSMENT METHODOLOGY DIRECT:

CIE Exams	PO 1, PO 2,	SEE Exams	PO 1,PO 2, PO 7,	Seminars	-
Laboratory Practices	PO 1,PO 2, PO 7,	Student Viva	PO 1, PO 5	Certification	-
Assignments	-				

XIII ASSESSMENT METHODOLOGY INDIRECT:

✓	Early Semester Feedback	✓	End Semester OBE Feedback
X	Assessment of Mini Projects by Experts		

XIV SYLLABUS:

WEEK 1	**PREPARATIONS OF ORGANIC COMPOUNDS**
	Preparation of Aspirin
WEEK 2	**VOLUMETRIC ANALYSIS**
	Estimation of hardness of water by EDTA method
WEEK 3	**CONDUCTOMETRIC TITRATIONS**
	Conductometric titration of strong acid Vs strong base
WEEK 4	**POTENTIOMETRIC TITRATIONS**
	Potentiometric titration of strong acid Vs strong base
WEEK 5	**CONDUCTOMETRIC TITRATIONS**
	Conductometric titration of mixture of acid Vs strong base
WEEK 6	**POTENTIOMETRIC TITRATIONS**
	Potentiometric titration of weak acid Vs strong base.
WEEK 7	**PHYSICAL PROPERTIES**
	Determination of surface tension of a given liquid using stalagmometer
WEEK 8	**PHYSICAL PROPERTIES**
	Determination of viscosity of a given liquid by using Ostwald's viscometer
WEEK 9	**VOLUMETRIC ANALYSIS**
	Estimation of dissolved oxygen in water
WEEK 10	**PREPARATIONS OF RUBBER**
	Preparation of Thiokol rubber.
WEEK 11	**VOLUMETRIC ANALYSIS**
	Determination of percentage of copper in brass.
WEEK 12	**VOLUMETRIC ANALYSIS**
	Estimation of MnO 2 in pyrolusite

TEXTBOOKS

1. Vogel's, "Quantitative Chemical Analaysis", Prentice Hall, 6th Edition, 2000.

2. Gary D.Christian, "Analytical Chemistry",Wiley India, 6th Edition, 2007.

REFERENCE BOOKS:

1. A text book on experiments and calculation Engg. S.S. Dara.

2. Instrumental methods of chemical analysis, Chatwal, Anand, Himalaya Publications

XV 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	Preparation of Aspirin.	CO 1, CO 2	R1, R2
2	Estimation of hardness of water by EDTA method.	CO 2	R1, R2
3	Conductometric titration of strong acid Vs strong base	CO 3,	R1, R2
4	Potentiometric titration of strong acid Vs strong base.	CO 3	R1, R2
5	Conductometric titration of mixture of acid Vs strong base	CO 3	R1, R2
6	Potentiometric titration of weak acid Vs strong base	CO 3	R1, R2
7	Determination of surface tension of a given liquid using stalagmometer	CO4	R1, R2
8	Determination of viscosity of a given liquid by using Ostwald's viscometer	CO4	R1, R2
9	Estimation of dissolved oxygen in water	CO 2	R1, R2
10	Preparation of Thiokol rubber	CO 5	R1, R2
11	Determination of percentage of copper in brass.	CO 6	R1, R2
12	Estimation of MnO 2 in pyrolusite	CO6	R1, R2

Signature of Course Coordinator **HOD,CE**
Mr. G Mahesh Kumar, Assistant Professor

INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

Dundigal, Hyderabad -500 043

Civil Engineering

COURSE DESCRIPTION

Course Title	**IT WORKSHOP**				
Course Code	**ACS113**				
Programme	**B.Tech**				
Semester	**III**				
Course Type	**Foundation**				
Regulation	**IARE R-16**				
Course Structure	**Theory**			**Practical**	
	Lectures	**Tutorials**	**Credits**	**Laboratory**	**Credits**
	-	-	-	3	1.5
Chief Coordinator	**Ms B. Pravallika, Assistant Professor**				

I. COURSE OVERVIEW:

This course covers the basics of computer knowledge and demonstrates fundamental LaTex programming techniques, spreadsheet files and terms including the most common latex functions and the usage of the mathematical equations. This course helps to undertake future courses organization and management of local area networks (LANs) wide area networks (WANs). The applications of this course are to design, implement and maintain a basic web page.

II. COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites	Credits
-	-	-	-	-

III. MARKSDISTRIBUTION:

Subject	SEE Examination	CIA Examination	Total Marks
IT Workshop	70 marks	30 marks	100

IV. DELIVERY / INSTRUCTIONAL METHODOLOGIES:

	Open Ended Experiments	✔	Demo Video	✔	Lab Worksheets	✔	Viva Questions

V. EVALUATION METHODOLOGY:

Each laboratory will be evaluated for a total of 100 marks consisting of 30 marks for internal assessment and 70 marks for semester end lab examination. Out of 30 marks of internal assessment, continuous lab assessment will be done for 20 marks for the day today performance and 10 marks for the final internal lab assessment.

Semester End Examination (SEE): The semester end lab examination for 70 marks shall be conducted by two examiners, one of them being Internal Examiner and the other being External Examiner, both nominated by the Principal from the panel of experts recommended by Chairman, BOS.

The emphasis on the experiments is broadly based on the following criteria:

	Experiment Based	**Programming based**
20 %	Objective	Purpose
20 %	Analysis	Algorithm
20 %	Design	Programme
20 %	Conclusion	Conclusion
20 %	Viva	Viva

Continuous Internal Assessment (CIA):

CIA is conducted for a total of 30 marks (Table 1), with 20 marks for continuous lab assessment during day to day performance, 10 marks for final internal lab assessment.

Table 1: Assessment pattern for CIA

Component	**Laboratory**		**Total Marks**
Type of Assessment	**Day to day performance**	**Final internal lab assessment**	
CIA Marks	20	10	30

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.

A. Experiment Based

Objective	**Analysis**	**Design**	**Conclusion**	**Viva**	**Total**
2	2	2	2	2	10

B. Programming Based

Purpose	**Algorithm**	**Program**	**Conclusion**	**Viva**	**Total**
2	2	2	2	2	10

VI. 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	Case study
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	Lab Exercise
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 Exercise, Case study
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	Lab Exercise

3 = High; 2 = Medium; 1 = Low

VII. HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

	Program Specific Outcomes	Strength	Proficiency assessed by
PSO 3	Make use of Computational and Experimental tools for Building Career Paths towards Innovation Startups, Employability and Higher Studies.	2	Lab Exercise

3 = High; 2 = Medium; 1 = Low

VIII. COURSE OBJECTIVES:

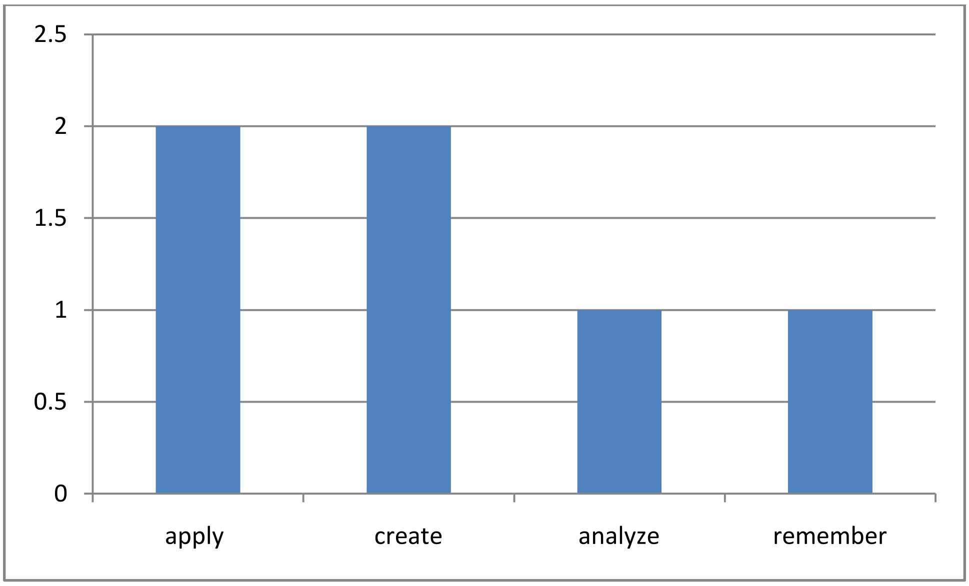
The students will try to learn	
I	Preambles of Latex file to define document class and layout options.
II	The various templates Mathematical documents, presentations, and reports from latex
III	The fundamental concepts of computer networking.
IV	How to Create a link within a web page.

IX. COURSE OUTCOMES:

After successful completion of the course, students will be able to:		
CO No	**Course Outcomes**	**Knowledge Level (Bloom's Taxonomy)**
CO 1	**Make use of** the LaTeX file to define document class and layout options for writing simple latex programs	Apply
CO 2	**Apply** the paragraphs, design pages, create lists, tables, references, and figures for preparing word documents and inserting figures using latex	Create
CO 3	**Make use of** the concepts beginning with basic formulas (inline) and centered and numbered equations (display math) and aligning multi-line	Apply

	equations to prepare mathematical documents	
C0 4	**Develop** large documents create complex projects building upon sub-files for writing technical papers	Create
CO 5	**Analyze** various methods to either create or import graphics into a LaTeX document	Analyze
CO 6	**List** the fundamental concepts of computer networking.	Remember

COURSE KNOWLEDGE COMPETENCY LEVELS



X. JUSTIFICATIONS FOR CO – (PO, PSO) MAPPING

Course Outcomes	POs / PSOs	Justification for mapping (Students will be able to)	No. of key competencies
CO 1	**PO 1**	**Describe** latex, texworks, document class, and the installation of latex **using principles of mathematics, science, and engineering fundamentals.**	3
	PO 2	**Describe** latex, texworks, document class, and the installation of latex **with Problem statement and system definition , Problem formulation and abstraction**	2
CO 2	**PO 1**	**Demonstrate** the use of latex for writing technical paper and maintenance **basic fundamentals of mathematics and engineering fundamentals.**	2
	PO 2	**Demonstrate** the use of latex for writing technical paper and maintenance for **the Problem statement and system definition, Problem formulation and abstraction, Information and data collection, Model translation**	3
	PO 3	**Demonstrate** the use of latex for writing technical paper and maintenance for **of Investigate and define a problem and identify constraints Manage the design process and evaluate outcomes,**	4
	PO 5	**Demonstrate** the use of latex for writing technical paper and maintenance **by Understanding of contexts in which engineering knowledge can be applied, Understanding use of technical literature , Understanding of appropriate codes of**	3

		practice and industry standards.	
	PSO 3	**Demonstrate** the use of latex for writing technical paper	1
CO 3	**PO 2**	**Make use of** basic formulas (inline) and centered and numbered equations (display math) and aligning multi-line equations to prepare mathematical documents for **the Problem statement and system definition, Problem formulation and abstraction , Information and data collection, Model translation**	4
	PO 3	**Make Use of** basic formulas (inline) and centered and numbered equations (display math) and aligning multi-line equations to prepare mathematical documents for the help of **Investigate and define a problem and identify constraints, Manage the design process and evaluate outcomes**	3
	PO 5	**Make Use of** basic formulas (inline) and centered and numbered equations (display math) and aligning multi-line equations to prepare mathematical documents **by Understanding of contexts in which engineering knowledge can be applied, Understanding use of technical literature , Understanding of appropriate codes of practice and industry standards.**	3
	PSO 3	**Make Use of** basic formulas (inline) and centered and numbered equations (display math) and aligning multi-line equations to prepare mathematical documents **by using a set of steps.**	1
CO 4	**PO 1**	**Define** large documents, create complex projects ,building upon sub-files for writing technical papers **for the knowledge of mathematics, science, and engineering fundamentals.**	3
	PO 2	**Define** Develop large documents create complex projects building upon sub-files for writing technical papers for **the Problem statement and system definition, Problem formulation and abstraction , Information and data collection, Model translation**	4
CO 5	**PO 2**	**Apply** various methods to either create or import graphics into a LaTeX document **Problem statement and system definition, Problem formulation and abstraction, Information and data collection, Model translation**	4
	PO 3	**Apply** various methods to either create or import graphics into a LaTeX document **Investigate and define a problem and identify constraints ,Understand customer and user needs**	4
	PO 5	**Apply** various methods to either create or import graphics into a LaTeX document **by Understanding of contexts in which engineering knowledge can be applied, Understanding use of technical literature , Understanding of appropriate codes of practice and industry standards.**	3
	PSO 3	**Apply** various methods to either create or import graphics into a LaTeX document **by using sequence of steps**	1
CO 6	**PO 1**	**Design** Understand the fundamental concepts of computer networking **with basic fundamentals of mathematics and engineering fundamentals.**	2
	PO 2	**Design** Understand the fundamental concepts of computer networking **by the Problem statement and system definition, Problem formulation and abstraction , Information and data collection, Model translation**	4
	PO 3	**Design** Understand the fundamental concepts of computer networking by **Investigate and define a problem and identify**	4

		constraints ,Understand customer and user needs, Manage the design process and evaluate outcomes	
	PO 5	**Design** Understand the fundamental concepts of computer networking **Understanding of contexts in which engineering knowledge can be applied, Understanding use of technical literature, Understanding of appropriate codes of practice and industry standards.**	3
	PSO 3	**Design** Understand the fundamental concepts of computer networking **by using sequence of steps**	1

3 = High; 2 = Medium; 1 = Low

XI. MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

Course Outcomes	**Program Outcomes**				**Program Specific Outcomes**
	PO1	**PO2**	**PO3**	**PO5**	**PSO2**
CO 1	3	2			
CO 2	2	3	3	2	3
CO 3		2	3	3	3
CO 4	3	3			
CO 5		2	2	3	2
CO 6	2	2	3	2	1

3 = High; 2 = Medium; 1 = Low

XII. ASSESSMENT METHODOLOGIES–DIRECT

CIE Exams	✔	SEE Exams	✔	Assignments	-	Seminars	-
Laboratory Practices	✔	Student Viva	✔	Mini Project	-	Certification	-

XIII. ASSESSMENT METHODOLOGIES–INDIRECT

✔	Early Semester Feedback	✔	End Semester OBE Feedback
✘	Assessment of Mini Projects by Experts		

XIV. SYLLABUS

LISTOFEXPERIMENTS	
WEEK-1	**LaTeX FORMATTING**
Introduction of LaTex and LateX document formatting: Create a LaTeX document with following formatting: All margins with 1.5, headings with bold, text with normal, chapter name with blue color, line space with 1.5.	
WEEK-2	**TECHNICAL PAPER PREPARATION IN LaTeX**

Essential steps in writing the technical report: Create a technical report according to IEEE format includes title of the paper, authors name and affiliations, abstract and keywords, introduction section, background section, and other sections, references.	
WEEK-3	**FORMATTING MATHEMATICAL EQUATIONS IN LaTeX**
Create a LaTeX document with following mathematical equations along with equation numbers in Italic format: summation (represent in sigma symbol), integration, integral of summation, average of summation, trigonometric equations, polynomial and non-polynomial equations	
WEEK–4	**GRAPHICS AND TABLES IN LaTeX**
Create a LaTeX documents with images and image caption at centre alignment, table with thick border and table caption with centre alignment, row height, content with cell centre alignment.	
WEEK-5	**VARIOUS FORMATTING STYLES IN LaTeX**
Using LaTeX to create project certificate. Features to be covered:- Formatting Fonts in word, Drop Cap in word, Applying Text effects, Using Character Spacing, Borders and Colors, Inserting Header and Footer, Using Date and Time option in both LaTeX.	
WEEK-6	**EXCEL SPREADSHEETS**
Spreadsheet Orientation: Accessing, overview of toolbars, saving spreadsheet files, Using help and resources. Creating a Scheduler:- Gridlines, Format Cells, Summation, auto fill, Formatting Text Calculating GPA - Features to be covered:- Cell Referencing, Formulae in spreadsheet – average, std. deviation, Charts, Renaming and Inserting worksheets, Hyper linking, Count function, Sorting, Conditional formatting.	
WEEK-7	**PREPARATION OF POWERPOINT PRESENTATION IN LaTeX**
Student should work on basic power point utilities and tools in Latex which help them create basic power point presentation. PPT Orientation, Slide Layouts, Inserting Text, Formatting Text, Bullets and Numbering, Auto Shapes, Lines and Arrows	
WEEK-8	**WEBPAGES CREATION AND DESIGNING**
HTML, creating simple web pages, images and links, design of web pages. Develop home page: Student should learn to develop his/her home page using HTML consisting of his/her photo, name, address and education details as a table and his/her skill set as a list.	
WEEK-9	**WEB DESIGN FOR SAMPLE PROJECT**
Create a webpage with HTML describing your department. Use paragraph and list tags. Apply various colors to suitably distinguish key words. Also apply font styling like italics, underline and two other fonts to words you find appropriate. Also use header tags. Create links on the words e.g. “Wi-Fi” and “LAN” to link them to Wikipedia pages. Insert an image and create a link such that clicking on image takes user to other page. Change the background color of the page. At the bottom create a link to take user to the top of the page.	
WEEK-10	**NETWORK CONNECTIVITY**
Students should get connected to their Local Area Network and access the Internet. In the process they configure the TCP/IP setting. Finally students should demonstrate how to access the websites and email.	
WEEK-11	**SURFING THE WEB**
Web Browsers, Surfing the Web: Students customize their web browsers with the LAN proxy settings, bookmarks, search toolbars and pop up blockers.	
WEEK-12	**ROUTER CONFIGURATION**
Cabling a network using CCNA, basic and challenge router configuration, subnetting, practical test router connections and settings, troubleshooting challenges	
TextBooks:	
1 A beginner guide to latex,learn latex in easy tutorials by chetan Shirore,2012 2 Peterson, Davie, Elsevier,―ComputerNetworks‖,5 th Edition,2011	
ReferenceBooks:	
1.Introduction to Information Technology, ITL Education Solutions limited, Pearson Education India, 2005 2.LaTeX Companion – Leslie Lamport, PHI/Pearson. 3.David Anfinson and Ken Quamme, IT Essentials: PC Hardware and Software Companion Guide, Third	

Edition, Cisco Press, 2008
WebReferences:
1. https://www.latex-tutorial.com/tutorials/https://tutorial.techaltum.com/webdesigning.html

XV. COURSE PLAN:

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

Week No.	Topics to be covered	Course Outcomes	Reference
1	LaTex Formatting	CO 1	T1:4.1
2	Technical Paper Preparation In Latex	CO 1	T1:4.9,4.11
3	Formatting Mathematical Equations In Latex	CO 2	T1:3
4	Graphics And Tables In Latex	CO 3	T1:18
5	Various Formatting Styles In Latex	CO 3	T1:18
6	Excel Spreadsheets	CO 4	T1:10
7	Preparation Of Powerpoint Presentation In Latex	CO 5	T1:28
8	Webpages Creation And Designing	CO 5	T1:29
9	Web Design For Sample Project	CO 5	T1:35
10	Network Connectivity	CO 6	T2:24
11	Surfing The Web	CO 6	T2:26
12	Router Configuration	CO 6	T2:28

XVI. EXPERIMENTS FOR ENHANCED LEARNING (EEL):

S. No.	Design Oriented Experiments
1	Assist student to design system calls in LaTex Systems.
2	Stimulate students to develop graphics programming
3	Encourage students to solve real time applications and prepare towards competitive examinations.

Prepared by:
Ms. B pravallika
Assistant Professor **HOD, CE**

INSTITUTE OF AERONAUTICAL ENGINEERING
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CIVIL ENGINEERING

COURSE DESCRIPTION

Course Title	**BASIC WORKSHOP**				
Course Code	AME101				
Program	B.Tech				
Semester	I	CE			
Course Type	FOUNDATION				
Regulation	IARE - R16				
Course Structure	Theory			Practical	
	Lecture	Tutorials	Credits	Laboratory	Credits
	-	-	-	3	2
Course Coordinator	Mr. GOOTY ROHAN, Assistant Professor				

I COURSE OVERVIEW:

Engineering workshop Practice is intended to enhance the learning experience of the student about engineering tools for cutting and measuring used in a workshop. Students are expected to gain experience in hands on training as well as knowledge to carry out a particular process for making a product using the basic manufacturing devices used in Workshop.

II COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites	Credits
-	-	-	-	-

III MARKS DISTRIBUTION:

Subject	SEE Examination	CIE Examination	Total Marks
BASIC WORKSHOP	70 Marks	30 Marks	100

IV DELIVERY / INSTRUCTIONAL METHODOLOGIES:

✓	Demo Video	✓	Lab Worksheets	✓	Viva Questions	✓	Probing Further Experiments

V EVALUATION METHODOLOGY:

Each laboratory will be evaluated for a total of 100 marks consisting of 30 marks for internal assessment and 70 marks for semester end lab examination. Out of 30 marks of internal assessment, continuous lab assessment will be done for 20 marks for the day-to-day performance and 10 marks for the final internal lab assessment.

Semester End Examination (SEE): The semester end lab examination for 70 marks shall be conducted by two examiners, one of them being Internal Examiner and the other being External Examiner, both nominated by the principal from the panel of experts recommended by Chairman, BOS.

The emphasis on the experiments is broadly based on the following criteria given in Table: 1

	Experiment Based	Programming based
20 %	Objective	Purpose
20 %	Analysis	Algorithm
20 %	Design	Programme
20 %	Conclusion	Conclusion
20 %	Viva	Viva

Continuous Internal Assessment (CIA):

CIA is conducted for a total of 30 marks (Table 1), with 20 marks for continuous lab assessment during day to day performance, 10 marks for final internal lab assessment.

Component	**Laboratory**		Total Marks
Type of Assessment	**Day to day performance**	**Final internal lab assessment**	
CIA Marks	20	10	30

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.

A. Experiment Based

Objective	**Analysis**	**Design**	**Conclusion**	**Viva**	**Total**
2	2	2	2	2	10

B. Programming Based

Purpose	**Algorithm**	**Program**	**Conclusion**	**Viva**	**Total**
2	2	2	2	2	10

VI COURSE OBJECTIVES:

The students will try to learn:

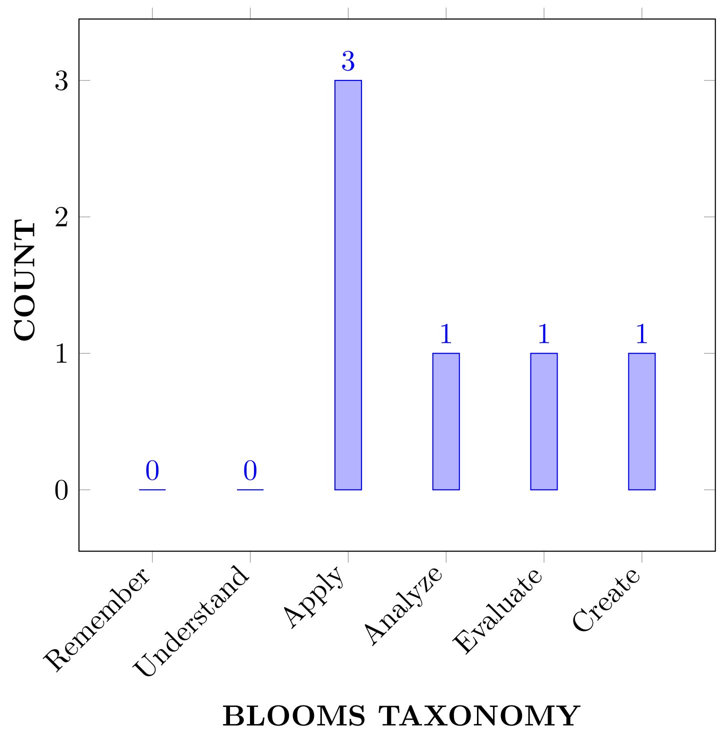
I	The application of jigs and fixtures, measuring, marking and cutting tools in various types of manufacturing processes.
II	The preparation of different joints in carpentry and fitting and also familiarizes wood working machinery.
III	The concepts of forming processes by forging, black-smithy and tin-smithy with an application extracts of Engineering Drawing.
IV	The standard electrical wiring practices for domestic and industrial appliances.
V	The current advancements in developing the prototype models through digital manufacturing facilities.

VII COURSE OUTCOMES:

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

CO 1	**Identify** the conventional representation of materials and machine elements for making a desired product with given work piece.	Apply
CO 2	**Determine** the ability to Produce Fitting jobs as per specified dimensions in addition to demonstrating proficiency with hand tools common in fitting.	Evaluate
CO 3	**Create** a desired shape with given metal rod by using fire and furnaceto convert given shape into useable elements using basic blacksmith techniques.	Create
CO 4	**Organize** the moulding techniques along with suitable tools for producing casting of different and complex shapes using various patterns.	Apply
CO 5	**Develop** the various engineering and household products by using tin simthy instruments/machinesfor manufacturing the tin boxes, cans, funnels, ducts etc., from a flat sheet of metal.	Apply
CO 6	**Compare** various electrical circuits by using conduit system of wiring to prepare different types of electrical connection on the given circuit boards using appropriate electrical tools.	Analyze

COURSE KNOWLEDGE COMPETENCY LEVEL



VIII HOW PROGRAM OUTCOMES ARE ASSESSED:

Program		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.	2	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.	2	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.	2	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.	3	SEE

3 = High; 2 = Medium; 1 = Low

IX HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

Program		Strength	Proficiency Assessed by
PSO 3	Make use of modern computer tools for creating innovative career paths, to be an entrepreneur and desire for higher studies.	2	Lab Exercises

3 = High; 2 = Medium; 1 = Low

X JUSTIFICATIONS FOR CO – (PO, PSO) MAPPING -DIRECT:

COURSE OUTCOMES	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key Competencies
CO 1	PO 1	Apply the knowledge of engineering fundamentals to join given wooden pieces according to given sketch to develop required joint.	1
	PO 3	Conversion of given design into a practical output using design solution for complex engineering problems and design system components	2

	PO 5	Develop the given resources and engineering tools into proper fitment as given in the diagrammatical representation.	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
	PSO 3	Make use of Experimental tools for Building Career Paths towards Innovation Startups, Employability in different mechanical trades.	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.	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
	PSO 3	Make use of Experimental tools for Building Career Paths towards Innovation Startups, Employability in different mechanical trades.	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.	2
	PSO 3	Make use of Experimental tools for Building Career Paths towards Innovation Startups, Employability in different mechanical trades.	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
	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.	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 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.	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
	PSO 3	Make use of Experimental tools for Building Career Paths towards Innovation Startups, Employability in different mechanical trades.	2

XI MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

COURSE OUTCOMES	PROGRAM OUTCOMES				PSO'S
	PO 1	PO 3	PO 5	PO 11	PSO 3
CO 1	1	2	2	2	2
CO 2	1	-	2	2	2
CO 3	1	-	2	-	2
CO 4	1	2	-	2	-
CO 5	-	-	2	2	-
CO 6	1	-	2	2	2

3 = High; 2 = Medium; 1 = Low

XII ASSESSMENT METHODOLOGY DIRECT:

CIE Exams	✓	SEE Exams	✓	Seminars	-
Laboratory Practices	✓	Student Viva	✓	Certification	-
Assignments	-				

XIII ASSESSMENT METHODOLOGY INDIRECT:

✓	Early Semester Feedback	✓	End Semester OBE Feedback
X	Assessment of Mini Projects by Experts		

XIV SYLLABUS:

WEEK 1	**CARPENTRY-I**
	Batch I: Preparation of Tenon joint as per given dimensions. Batch II: Preparation of Mortise joint as per given taper angle.
WEEK 2	**CARPENTRY-II**
	Batch I: Preparation of dove tail joint as per given taper angle. Batch II: Preparation of lap joint as per given dimensions.
WEEK 3	**FITTING - I**
	Batch I: Make a straight fit for given dimensions. Batch II: Make a square fit for given dimensions.
WEEK 4	**FITTING - II**
	Batch I: Make a V fit for given dimensions. Batch II: Make a semicircular fit for given dimensions.
WEEK 5	**BLACKSMITHY- I**
	Batch I: Prepare S-bend for given MS rod using open hearth furnace. Batch II: Prepare J-bend for given MS rod using open hearth furnace.
WEEK 6	**BLACKSMITHY- II**
	Batch I: Prepare Fan hook for given dimensions. Batch II: Prepare Round to Square for given dimensions.
WEEK 7	**MOULD PREPARATION-I**
	Batch I: Prepare a wheel flange mould using a given wooden pattern. Batch II: Prepare a bearing housing using an aluminum pattern.
WEEK 8	**MOULD PREPARATION-II**
	Batch I: Prepare a bearing housing using an aluminum pattern. Batch II: Prepare a wheel flange mould using a given wooden pattern.
WEEK 9	**TINSMITHY- I**
	Batch I: Prepare the development of a surface and make a rectangular tray for given dimensions. Batch II: Prepare the development of a surface and make a round tin for given dimensions.
WEEK 10	**TINSMITHY- II**
	Batch I: Prepare the development of a surface and make a Square Tin, for given dimensions. Batch II: Prepare the development of a surface and make a Conical Funnel for given dimensions.
WEEK 11	**ELECTRICAL WIRING-I**
	Batch I: Make an electrical connection of two bulbs connected in series. Batch II: Make an electrical connection of two bulbs connected in parallel.
WEEK 12	**ELECTRICAL WIRING-II**
	Batch I: Make an electrical connection of one bulb controlled by two switches connected. Batch II: Make an electrical connection of tube light.

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, Vol. I 2008 and Vol. II 2010.
2. Kalpakjian S, Steven S. Schmid, Manufacturing Engineering and Technology, Pearson Education India Edition, 4th Edition, 2002.
3. Gowri P. Hariharan, A. Suresh Babu, Manufacturing Technology – I, Pearson Education, 2008.
4. Roy A. Lindberg, Processes and Materials of Manufacture, Prentice Hall India, 4 th Edition, 1998.
5. Rao P.N., Manufacturing Technology, Vol. I and Vol. II, Tata McGraw-Hill House, 2017

REFERENCE BOOKS:

1. Gowri P. Hariharan, A. Suresh Babu, Manufacturing Technology – I, Pearson Education, 2008.
2. Roy A. Lindberg, Processes and Materials of Manufacture, Prentice Hall India, 4th Edition, 1998.
3. Rao P.N., Manufacturing Technology, Vol. I and Vol. II, Tata McGraw-Hill House, 2017.

XV 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	Tenon joint and Mortise joint.	CO 1, CO 2	T1:1.4, R1:1.2
2	Dove tail joint and Lap joint.	CO 1, CO 2	T1:1.5, R1:1.3
3	Straight fit and Square fit.	CO 3, CO 4	T2:12.2, R2:13.1
4	V fit and Semicircular fit.	CO 3, CO 4	T2:12.3, R2:13.4
5	S-bend and J-bend.	CO 5, CO 6	T3:9.1, R3:3
6	Fan and Round to Square shape.	CO 5, CO 6	T3:9.1, R3:3
7	Wheel flange and bearing housing.	CO 6	T4:1.9, R2:1.8
8	Bearing housing and Wheel flange.	CO 6	T4:2, R2:1.9
9	Rectangular tray and Round tin.	CO 6	T5:1.4, R1:1.2
10	Make a Square Tin and Conical Funnel.	CO 6	T5:1.7, R2:1.3
11	Series connection and parallel Connection.	CO 6	T4:1.4, R1:1.2

12	One bulb controlled by two switches and tube light connection.	CO 6,	T5:7.1, R3:3.8

XVI EXPERIMENTS FOR ENHANCED LEARNING (EEL):

S.No	Design 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	**Hexagonal Headed Bolt:** Hexagonal bolts are large bolts with a six-sided head used to fasten wood to wood, or metal to wood. These will have a tendency to spin as you tighten them.
4	**Open scoop:** Open scoop is used for accurately dispensing powders and granules hygienically. It is suitable for any hygienic application.
5	**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.
6	**Grooved Pulley:** Grooved pulley often used to for holding a belt, wire rope or rope and incorporated into a pulley. These sheave pins on a axle or bearing inside the frame of the pulley. This allows wire or rope to move freely, minimizing friction and wear on the cable.
7	**Bell Indicator circuit:** Bell indicator circuit is used where a bell and buzzers are needed to control from different locations. Bell indicator circuit is also known as hoteling circuit where an electric bell is controlled from more than one locations.

Signature of Course Coordinator **HOD,CE**
Mr.Gooty Rohan, Assistant Professor

INSTITUTE OF AERONAUTICAL ENGINEERING
(Autonomous)
Dundigal, Hyderabad - 500 043

COURSE DESCRIPTION

Department	**CIVIL ENGINEERING**				
Course Title	**ENGINEERING MECHANICS**				
Course Code	AME002				
Program	B. Tech				
Semester	II				
Course Type	Foundation				
Regulation	IARE - R16				
Course Structure	Theory			Practical	
	Lecture	Tutorials	Credits	Laboratory	Credits
	3	1	4	-	-
Course Coordinator	Mr. B D Y Sunil, Assistant Professor				

I COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites
B.Tech	AHS002	1	Linear Algebra and Ordinary Differential Equations

II COURSE OVERVIEW:

Engineering Mechanics is a branch of Physics that deals with the study of the system of forces acting on a particle which is at rest or in motion. The course emphasizes thorough understanding of theories and principles related to static and dynamic equilibrium of rigid bodies to acquire the analytical capability required for solving engineering problems and is one of the foundation courses that forms the basis of many of the traditional branches of engineering such as aerospace, civil and mechanical engineering.

III MARKS DISTRIBUTION:

Subject	SEE Examination	CIE Examination	Total Marks
Engineering Mechanics	70 Marks	30 Marks	100

IV CONTENT DELIVERY / INSTRUCTIONAL METHODOLOGIES:

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

V EVALUATION METHODOLOGY:

The course will be evaluated for a total of 100 marks, with 30 marks for Continuous Internal Assessment (CIA) and 70 marks for Semester End Examination (SEE). Out of 30 marks allotted for CIA during the semester, marks are awarded by taking average of two CIE examinations or the marks scored in the make-up examination.

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 14 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
%	Remember
%	Understand
%	Apply
%	Analyze

Continuous Internal Assessment (CIA):
CIA is conducted for a total of 30 marks, with 25 marks for Continuous Internal Examination (CIE) and 05 marks for Quiz \Alternative Assessment Tool (AAT).

Component	Theory		Total Marks
Type of Assessment	CIE Exam	Quiz \AAT	
CIA Marks	25	05	30

Continuous Internal Examination (CIE):
Two CIE exams shall be conducted at the end of the 8^{th} and 17^{th} week of the semester respectively. The CIE exam is conducted for 25 marks of 2 hours duration consisting of two parts. Part–A shall have five compulsory questions of one mark each. In part–B, four out of five questions have to be answered where, each question carries 5 marks. Marks are awarded by taking average of marks scored in two CIE exams.

Quiz - Online Examination
Two Quiz exams shall be online examination consisting of 25 multiple choice questions and are to be answered by choosing the correct answer from a given set of choices (commonly four). Such a question paper shall be useful in testing of knowledge, skills, application, analysis, evaluation and understanding of the students. Marks shall be awarded considering the average of two quiz examinations for every course.

Alternative Assessment Tool (AAT)
This AAT enables faculty to design own assessment patterns during the CIA. The AAT converts the classroom into an effective learning center. The AAT may include tutorial hours/classes, seminars, assignments, term paper, open ended experiments, METE (Modeling and Experimental Tools in Engineering), five minutes video, MOOCs etc. The AAT chosen for this course is given in table

Concept Video	Tech-talk	Complex Problem Solving
40%	40%	20%

VI COURSE OBJECTIVES:

The students will try to learn:

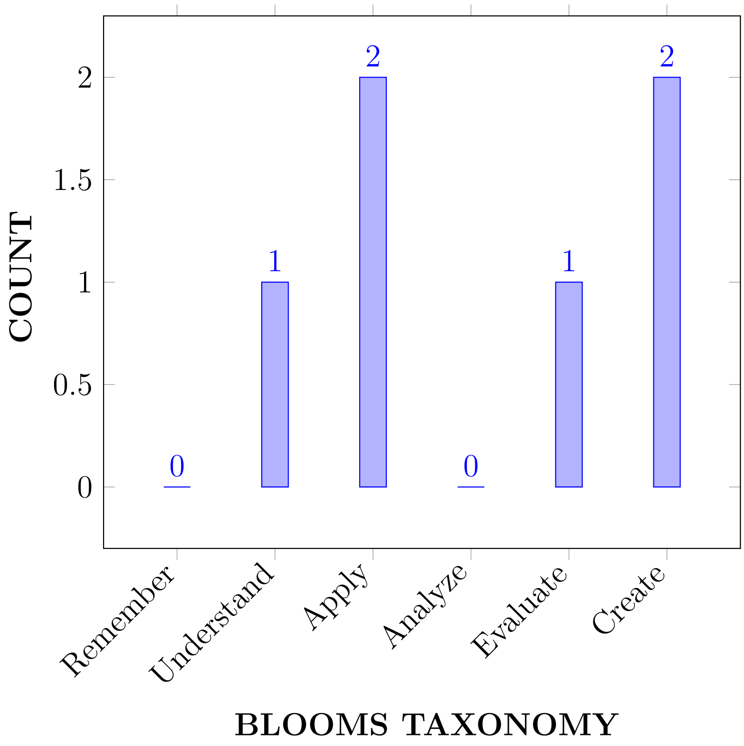
I	Develop the ability to work comfortably with basic engineering mechanics concepts required for analyzing dynamic structures.
II	Identify an appropriate structural system to studying a given problem and isolate it from its environment, model the problem using good free-body diagrams and accurate equilibrium equations.
III	Identify and model various types of loading and support conditions that act on structural systems, apply pertinent mathematical, physical and engineering mechanical principles to the system to solve and analyze the problem .
IV	Understand the meaning of impulse and momentum, virtual work and solve the field problems .
V	Solve the problem of equilibrium by using the principle of work and energy and vibrations for preparing the students for higher level courses such as, Mechanics of Solids, Mechanics of Fluids etc .

VII COURSE OUTCOMES:

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

CO 1	**Make use of** principles for rectilinear motion of particles to solve problems in motion curves, rigid body motion and fixed axis rotation.	Apply
CO 2	**Apply** D'Alembert's principle to a dynamic equilibrium system by introducing the inertia force for knowing the acceleration and forces involved in the system.	Apply
CO 3	**Develop** the relations for the motion of body in lift and on inclined plane to identify the unknown forces and the forces due to gravity.	Create
CO 4	**Understand** the concept of virtual work to solve problems involving displacements and time with respect to impact and impulse momentum equation.	Understand
CO 5	**Determine** the effect of law of conversation of energy when the system involves before and after collision.	Evaluate
CO 6	**Develop** the governing equation for momentum and vibrational phenomenon of mechanical system by using energy principles for obtaining co efficient and circular frequency.	Create

COURSE KNOWLEDGE COMPETENCY LEVEL



VIII PROGRAM 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.

Program Outcomes	
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

IX 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.	1	[CIE/Quiz/AAT]
PO 4	**Conduct Investigations of Complex Problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.	1	Seminar/ Conferences / Research papers

3 = High; 2 = Medium; 1 = Low

X HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

PROGRAM SPECIFIC OUTCOMES		Strength	Proficiency Assessed by
PSO 1	Design and Supervise Sub-Structures and Super Structures for Residential and Public Buildings, Industrial Structures, Irrigation Structures, Power Houses, Highways, Railways, Airways, Docs and Harbours.	3	Research papers / Group discussion / Short term courses

3 = High; 2 = Medium; 1 = Low

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

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	✓	✓	-	-	-	-	-	-	-	-	-		-	-	-
CO 2	-	✓	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 3	-	✓	-	✓	-	-	-	-	-	-	-	-	-	-	-
CO 4	✓	-	-	-		-	-	-	-	-	-		-	-	-
CO 5	✓	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 6	-	✓	-	✓		-	-	-	-	-	-	-	✓	-	

XII 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 matched.
CO 1	PO 1	Apply the knowledge and principals of mathematics to engineering problems for determining reactions and resultants of forces using the knowledge of mathematics and science fundamentals	2
	PO 2	Analyze and formulate the engineering problems to determine the reactions and resultants of given force systems. Analyze and identify the problem statement, formulation and abstraction for the development of solution.	4
CO2	PO 2	Collect the data from complex engineering problems and implement them to draw the free body diagrams and interpret the results	3
CO 3	PO 2	Formulate the force system of friction problem and identify the appropriate equilibrium equation and develop the solution from the first principles of mathematics.	4
	PO 4	Understand the principles of engineering and apply them to the friction systems by analyzing the condition of motion of rest of the body	2

Course Outcomes	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key competencies matched.
CO 4	PO 1	Apply the mathematical principles and engineering fundamentals to identify the centroid and centre of gravity in engineering problems.	2
CO 5	PO 1	Use the fundamentals of engineering and science in identifying the moment of inertia for regular and composite sections and solids.	2
CO 6	PO 2	Formulate the problem statement and model the system for getting the solution for the movement of bodies involving forces	3
	PO 4	Understand the technical concepts of D'Alembert's principle and interpret the equilibrium conditions for various applications.	2
	PSO 1	Formulate and evaluate engineering concepts of design, thermal and production to provide solutions for technology aspects in digital manufacturing.	2

XIII 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	2	4	-	-	-	-	-	-	-	-	-		-	-	-
CO 2	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 3	-	4	-	2	-	-	-	-	-	-	-	-	-	-	-
CO 4	2	-	-	-		-	-	-	-	-	-	-	-	-	-
CO 5	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 6	-	3	-	2	-	-	-	-	-	-	-		2	-	-

XIV 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	66.7	40.0	-	-	-	-	-	-	-	-	-		-	-	-
CO 2	-	30	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 3	-	40	-	18.2	-	-	-	-	-	-	-	-	-	-	-
CO 4	66.7	-	-	-		-	-	-	-	-	-		-	-	-
CO 5	66.7	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 6	-	30.0	-	18.2		-	-	-	-	-	-		100	-	-

XV COURSE ARTICULATION MATRIX (PO / PSO MAPPING):

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

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

1 -5 <C$\leq$ 40% – Low/ Slight

2 - 40 % <C < 60% –Moderate

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

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	3	1	-	-	-	-	-	-	-	-	-	-	-	-	
CO 2	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 3	-	1	-	1	-	-	-	-	-	-	-	-	-	-	-
CO 4	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 5	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 6	-	1	-	1	-	-	-	-	-	-	-	-	3	-	-
TOTAL	9	4	-	2	-	-	-	-	-	-	-	-	3	-	-
AVERAGE	3.0	1.0	-	1.0	-	-	-	-	-	-	-	-	3.0	-	-

XVI ASSESSMENT METHODOLOGY-DIRECT:

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

XVII ASSESSMENT METHODOLOGY-INDIRECT:

	Assessment of mini projects by experts	✓	End Semester OBE Feedback

XVIII SYLLABUS:

MODULE I	**KINEMATICS OF PARTICLES- RECTILINEAR MOTION**
	Motion of a particle – Rectilinear motion – motion curves – Rectangular components of curvilinear motion Kinematics of Rigid Body - Types of rigid body motion - Angular motion - Fixed Axis Rotation .
MODULE II	**KINETICS OF PARTICLE**
	Introduction-Definitions of Matter, body, particle, mass, weight, inertia, momentum. Newton's law of motion. Relation Between force and mass. Motion of a particle in rectangular coordinates. D'Alembert's Principle.Motion of Lift. Motion of body on an inclined plane. Motion of connected Bodies.
MODULE III	**IMPULSE AND MOMENTUM, VIRTUAL WORK**
	IMPULSE AND MOMENTUM Impulse And Momentum: Introduction-Impact, Momentum, Impulse and Impulsive forces, Units. Law of conservation of Momentum, Newton's law of collision of elastic bodies-coefficient of Restitution. Recoil of Gun. Impulse Momentum Equation. VIRTUAL WORK: Introduction – Principle of virtual work – Applications – Beams, Lifting machines, Simple framed structures
MODULE IV	**WORK ENERGY METHOD**
	Law of conservation of Energy, Application of Work Energy Method to particle motion and connected system- Work energy applied to Connected Systems - Work energy applied to Fixed Axis Rotation.

MODULE V	**MECHANICAL VIBRATIONS**
	Definitions and Concepts – Simple Harmonic Motion – Free vibrations, simple and Compound Pendulums – Torsion Pendulum – Free vibrations without damping: General cases.

TEXTBOOKS

1. R.C. Hibbler, “Engineering Mechanics”, Prentice Hall, 12th Edition, 2009.
2. Engineering Mechanics - Statics and Dynamics by Ferdinand.L. Singer / Harper International Edition.
3. Engineering Mechanics/ S. Timoshenko and D.H. Young, Mc Graw Hill Book Company.

REFERENCE BOOKS:

1. S. Bhavikatti, “A Text Book of Engineering Mechanics”, New Age International, 1st Edition, 2012.
2. A.K Tayal ,“Engineering Mechanics”, Uma Publications, 14th Edition, 2013.
3. R.K. Bansal “Engineering Mechanics”, Laxmi Publications, 8th Edition, 2013.

WEB REFERENCES:

1. https://nptel.ac.in/courses/112105171/1

COURSE WEB PAGE:

1. https://www.iare.ac.in/?q=pages/mech-btech-course-syllabi-ug20

XIX 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	Discussion on Objectives and Outcomes of the course Engineering Mechanics		
	CONTENT DELIVERY (THEORY)		
1	Introduction to motion of a particle	CO 1	T2:5.5 R1:1.12.1
2	Rectilinear motion	CO 1	T2:5.6 R1:1.12.3
3	Motion curves	CO 1	T2:5.10 R1:1.15
4	Rectangular components of curvilinear motion	CO 1	T2:5.15 R1:1.16
5	Difference between rectilinear motion and curvilinear motion	CO 1	T2:5.17 R1:1.13.1
6	Kinematics of Rigid Body	CO 1	T2:5.18 R1:1.13.2
7	Types of rigid body motion	CO 1	T2:5.19 R1:1.13.3
8	Angular motion	CO 1	T2:5.20 R1:1.7.1

9	Fixed Axis Rotation	CO 1	T2:5.24 R1:1.17.3
10	Introduction to kinetics	CO 2	T2:6.3 R1:2.6.1
11	Definitions of Matter, body, particle, mass, weight, inertia, momentum	CO 2	T2:6.5 R1:2.6.2
12	Newton's law of motion	CO 2	T2:5.5 R1:1.12.1
13	Relation Between force and mass	CO 2	T2:5.6 R1:1.12.3
14	Motion of a particle in rectangular coordinates	CO 2	T2:5.10 R1:1.15
15	D'Alembert's Principle.Motion of Lift	CO 2	T2:5.15 R1:1.16
16	Motion of body on an inclined plane, motion of connected Bodies	CO 2	T2:5.17 R1:1.13.1
17	Impulse And Momentum: Introduction- Impact, Momentum	CO 3	T2:5.18 R1:1.13.2
18	Impulse and Impulsive forces, Units	CO 3	T2:5.19 R1:1.13.3
19	Law of conservation of Momentum, Newton's law of collision of elastic bodies- coefficient of Restitution	CO 3	T2:5.20 R1:1.7.1
20	Recoil of Gun. Impulse Momentum Equation	CO 3	T2:5.24 R1:1.17.3
21	Introduction to virtual work	CO 4	T2:5.5 R1:1.12.1
22	Principle of virtual work – Applications	CO 4	T2:5.6 R1:1.12.3
23	Beams, Lifting machines	CO 4	T2:5.10 R1:1.15
24	Simple framed structures	CO 4	T2:5.15 R1:1.16
25	Introduction to work energy method	CO 5	T2:5.17 R1:1.13.1
26	Law of conservation of Energy	CO 5	T2:5.18 R1:1.13.2
27	Applications of Work Energy Method	CO 5	T2:5.19 R1:1.13.3
28	Applications of Work Energy Method to particle motion	CO 5	T2:5.20 R1:1.7.1
29	Applications of Work Energy Method to connected system	CO 5	T2:5.24 R1:1.17.3
30	Work energy applied to Connected Systems	CO 5	T2:6.3 R1:2.6.1
31	Work energy applied to Fixed Axis Rotation	CO 5	T2:6.5 R1:2.6.2
32	Introduction to mechanical vibrations	CO 6	T2:5.5 R1:1.12.1

33	Definitions and Concepts	CO 6	T2:5.6 R1:1.12.3
34	Simple Harmonic Motion	CO 6	T2:5.10 R1:1.15
35	Free vibrations	CO 6	T2:5.15 R1:1.16
36	Simple pendulum	CO 6	T2:5.17 R1:1.13.1
37	Compound pendulum	CO 6	T2:5.18 R1:1.13.2
38	Torsional pendulum	CO 6	T2:5.19 R1:1.13.3
39	Free vibrations without damping	CO 6	T2:5.20 R1:1.7.1
40	Free vibrations without damping general cases	CO 6	T2:5.24 R1:1.17.3
PROBLEM SOLVING/ CASE STUDIES			
1	Rectilinear motion of a particle	CO 1	T2:5.5 R1:1.12.1
2	Kinematics of Rigid Body	CO 1	T2:5.6 R1:1.12.3
3	Fixed Axis Rotation	CO 1	T2:5.10 R1:1.15
4	D'Alembert's Principle	CO 2	T2:5.15 R1:1.16
5	Motion of Lift	CO 2	T2:5.17 R1:1.13.1
6	Motion of body on an inclined plane	CO 2	T2:5.18 R1:1.13.2
7	Motion of connected Bodies	CO 2	T2:5.19 R1:1.13.3
8	Impact, Momentum, Impulse and Impulsive forces	CO 3	T2:5.20 R1:1.7.1
9	Newton's law of collision of elastic bodies	CO 3	T2:5.24 R1:1.17.3
10	Applications – Beams, Lifting machines, Simple framed structures	CO 4	T2:6.3 R1:2.6.1
11	Work energy applied to Connected Systems	CO 5	T2:6.5 R1:2.6.2
12	Work energy applied to Fixed Axis Rotation	CO 5	T2:5.5 R1:1.12.1
13	Simple Harmonic Motion	CO 6	T2:5.6 R1:1.12.3
14	simple and Compound Pendulums	CO 6	T2:5.10 R1:1.15
15	Torsion Pendulum	CO 6	T2:5.15 R1:1.16

DISCUSSION OF DEFINITION AND TERMINOLOGY			
1	Module – 1 – Kinematics of Particles - Rectilinear Motion	CO 1	T2:5.5 R1:1.12.1
2	Module – 2 – Kinetics of Particle	CO 2	T2:5.6 R1:1.12.3
3	Module – 3 – Impulse and Momentum, Virtual Work	CO 3, CO4	T2:5.10 R1:1.15
4	Module – 4 – Work Energy Method	CO 5	T2:5.15 R1:1.16
5	Module – 5 – Mechanical Vibrations	CO 6	T2:5.17 R1:1.13.1
DISCUSSION OF QUESTION BANK			
1	Module – 1 – Kinematics of Particles - Rectilinear Motion	CO 1	T2:5.5 R1:1.12.1
2	Module – 2 – Kinetics of Particle	CO 2	T2:5.6 R1:1.12.3
3	Module – 3 – Impulse and Momentum, Virtual Work	CO 3, CO4	T2:5.10 R1:1.15
4	Module – 4 – Work Energy Method	CO 5	T2:5.15 R1:1.16
5	Module – 5 – Mechanical Vibrations	CO 6	T2:5.17 R1:1.13.1

Signature of Course Coordinator **HOD,CE**

INSTITUTE OF AERONAUTICAL ENGINEERING
(Autonomous)
Dundigal, Hyderabad - 500 043

COURSE DESCRIPTION

Department	**CIVIL ENGINEERING**				
Course Title	**COMPUTATIONAL MATHEMATICS AND INTEGRAL CALCULUS**				
Course Code	AHS003				
Program	B. Tech				
Semester	II				
Course Type	Foundation				
Regulation	R-16				
Course Structure	Theory			Practical	
	Lecture	Tutorials	Credits	Laboratory	Credits
	3	1	4	-	-
Course Coordinator	Ms. V Subbalaxmi, Assistant Professor				

I COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites
-	-	-	-

II COURSE OVERVIEW:

The course focuses on more advanced Engineering Mathematics topics which provide with the relevant mathematical tools required in the analysis of problems in engineering and scientific professions. The course includes Types of Interpolation, Curve fitting, Numerical solutions of Ordinary Differential Equations, Multiple Integrals, Vector Calculus and Special functions. The mathematical skills derived from this course form a necessary base to analytical and design concepts encountered in the program.

III MARKS DISTRIBUTION:

Subject	SEE Examination	CIE Examination	Total Marks
Computational Mathematics And Integral Calculus	70 Marks	30 Marks	100

IV CONTENT DELIVERY / INSTRUCTIONAL METHODOLOGIES:

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

V EVALUATION METHODOLOGY:

The course will be evaluated for a total of 100 marks, with 30 marks for Continuous Internal Assessment (CIA) and 70 marks for Semester End Examination (SEE). CIA is conducted for a total of 30 marks, with 20 marks for Continuous Internal Examination (CIE), and 10 marks for Alternative Assessment Tool (AAT).

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 14 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
0%	Remember
36 %	Understand
64 %	Apply
0 %	Analyze

Continuous Internal Assessment (CIA):

CIA is conducted for a total of 30 marks, with 20 marks for continuous internal examination (CIE) and 10 marks for Alternative Assessment Tool (AAT).

Component	Theory			Total Marks
Type of Assessment	CIE Exam	Quiz	AAT	
CIA Marks	20	05	05	30

Continuous Internal Examination (CIE):

Two CIE exams shall be conducted at the end of the 8^{th} and 16^{th} week of the semester respectively for 10 marks each of 2 hours duration consisting of five descriptive type questions out of which four questions have to be answered.

Alternative Assessment Tool (AAT)

This AAT enables faculty to design own assessment patterns during the CIA. The AAT converts the classroom into an effective learning center. The AAT may include tutorial hours/classes, seminars, assignments, term paper, open ended experiments, METE (Modeling and Experimental Tools in Engineering), five minutes video, MOOCs etc. The AAT chosen for this course is given in table

Concept Video	Tech-talk	Complex Problem Solving
40%	40%	20%

VI COURSE OBJECTIVES:

The students will try to learn:

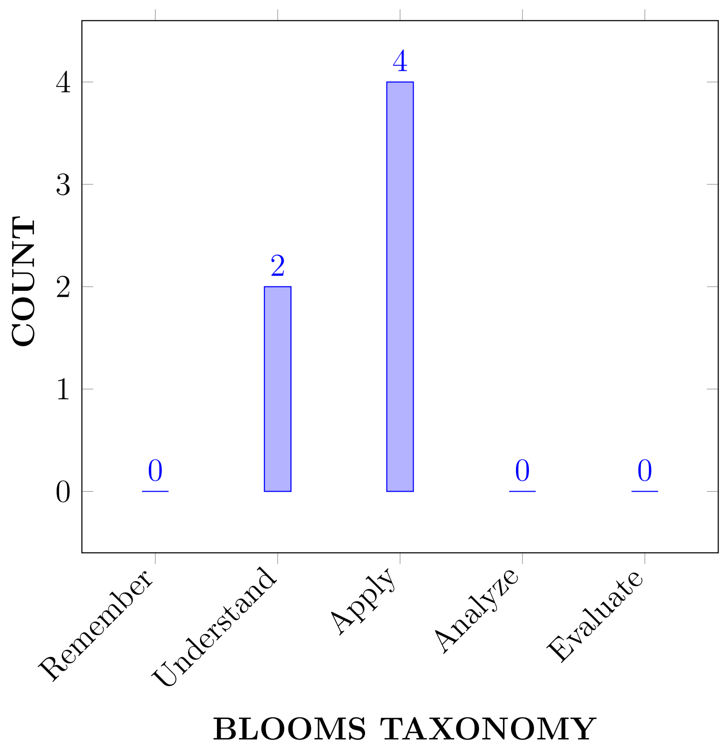
I	Enrich the knowledge of solving algebraic, transcendental and differential equation by numerical methods.
II	Apply multiple integration to evaluate mass, area and volume of the plane
III	Apply gradient, divergence and curl to evaluate the integration over a vector field
IV	Apply the Bessel's equation to solve them under special conditions with the help of series solutions.

VII COURSE OUTCOMES:

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

CO 1	**Apply** numerical methods for solving algebric ,transcendental equations and interpolating the data	Apply
CO 2	**Make use of** least squares methods for fitting straight lines,the second degree, exponential and power curves .	Apply
CO 3	**Utilize** numerical methods for solving linear diffrential equations with initial conditions	Apply
CO 4	**Identify** the limits of definite integrals for calculating the area of solids.	Understand
CO 5	**Extend** vector operations and theorems for finding line,surface and volume integrals .	Apply
CO 6	**Determine** characterstics of special functions for solving proper and improper integrals	Understand

COURSE KNOWLEDGE COMPETENCY LEVEL



VIII PROGRAM 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

IX 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

3 = High; 2 = Medium; 1 = Low

X HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

PROGRAM SPECIFIC OUTCOMES		Strength	Proficiency Assessed by
PSO 1	Design and Supervise Sub-Structures and Super Structures for Residential and Public Buildings, Industrial Structures, Irrigation Structures, Power Houses, Highways, Railways, Airways, Docs and Harbours.	-	Seminar/ Conferences/ Research Papers
PSO 2	Focus on Improving Performance of Structures with reference to Safety, Serviceability and Sustainable Green Building Technology.	-	-
PSO 3	Make use of Advanced Structural Analysis and Project Management Software for creating Modern Avenues to succeed as an Entrepreneur, Pursue Higher Studies and Career Paths.	-	-

3 = High; 2 = Medium; 1 = Low

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

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	✓	✓	-	-	-	-	-	-	-	-	-		-	-	-
CO 2	✓	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 3	✓	✓	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 4	✓	✓	-	-		-	-	-	-	-	-		-	-	-
CO 5	✓	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 6	✓	✓	-	-		-	-	-	-	-	-	-	-	-	

XII 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 matched.
CO 1	PO 1	**Apply** the **basic properties** of numerical methods for solving algebric ,transcendental equations and interpolating the data algebra and applicability in solving (complex) majority of functions by applying **Mathematical principles**.	2
	PO 2	**Apply** the of numerical methods as a **formulation** of mathematical function in **complex engineering problems** which transformations a algibric and transcendental equations using **principle of mathematics** to attain conclusion by the **interpretation of results** .	4
CO 2	PO 1	**Make use of** the **basic properties** of least squares methods for solving fitting straight lines,the second degree, exponential and power curves by using **Mathematical principle** .	2
CO3	PO 1	**Utilize** the **basic properties** of numerical methods for solving linear diffrential equations with initial conditions by applying **Mathematical principles**.	2
	PO 2	**Apply** the of numerical methods as a **formulation** of mathematical function in **complex engineering problems** linear diffrential equations with initial conditions using **principle of mathematics** to attain conclusion by the **interpretation of results** .	4
CO4	PO 1	**Identify** the **basic properties** of the limits of definite integrals for calculating the area of solids by applying **Mathematical principles**.	2
	PO 2	**Identify** the integrals for calculating the area as a **formulation** of mathematical function in **complex engineering problems** which multiple integral using **principle of mathematics** to attain conclusion by the **interpretation of results**	4
CO5	PO1	**Extend** the vector operations and theorems for finding line,surface and volume integrals by using **priniciples of Mathematics** .	2
CO6	PO1	**Identify** the **Formulation** of improper integrals and their classification for applicability in solving special functions by applying the **principles of mathematics**.	2
	PO 2	**Solve** the of improper integrals as a **formulation** of mathematical function in **complex engineering problems** which transformatimations of equations using **principle of mathematics** to attain conclusion by the **interpretation of results** .	4

XIII 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	2	4	-	-	-	-	-	-	-	-	-		-	-	-
CO 2	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 3	2	4	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 4	2	4	-	-		-	-	-	-	-	-		-	-	-
CO 5	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 6	2	4	-	-	-	-	-	-	-	-	-		-	-	-

XIV 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	66.7	40	-	-	-	-	-	-	-	-	-		-	-	-
CO 2	66.7	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 3	66.7	40	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 4	66.7	40	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 5	66.7	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 6	66.7	40	-	-		-	-	-	-	-	-		-	-	-

XV COURSE ARTICULATION MATRIX (PO / PSO MAPPING):

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

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

1 -$5 < C \leq 40\%$ – Low/ Slight

2 - $40\% < C < 60\%$ –Moderate

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

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

XVI ASSESSMENT METHODOLOGY-DIRECT:

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

XVII ASSESSMENT METHODOLOGY-INDIRECT:

✓	Early Semester OBE Feedback	✓	End Semester OBE Feedback

XVIII SYLLABUS:

MODULE I	**ROOT FINDING TECHNIQUES AND INTERPOLATION**
	Solving algebraic and transcendental equations by bisection method, method of false position Newton-Raphson method; Interpolation: Finite differences, forward differences, backward differences and central differences; Symbolic relations; Newton's forward interpolation, Newton's backward interpolation; Gauss forward central difference formula, Gauss backward central difference formula; Interpolation of unequal intervals: Lagrange's interpolation, Newton's divided difference interpolation.
MODULE II	**CURVE FITTING AND NUMERICAL SOLUTION OF ORDINARY DIFFERENTIAL EQUATIONS**
	Fitting a straight line; Second degree curves; Exponential curve, power curve by method of least squares. Taylor's series method; Step by step methods: Euler's, modified Euler's and Runge-Kutta method.
MODULE III	**MULTIPLE INTEGRALS**
	Double and triple integrals; Change of order of integration. Change of variables: Polar, cylindrical and spherical; Finding the area of a region using double integration and volume of a region using triple integration.
MODULE IV	**VECTOR CALCULUS**
	Scalar and vector point functions; Gradient, divergence, curl and their related properties; Solenoidal and irrotational vector point functions; Scalar potential function; Laplacian operator; Line integral, surface integral and volume integral; Vector integral theorems: Green's theorem in a plane, Stoke's theorem and Gauss divergence theorem without proofs.
MODULE V	**SPECIAL FUNCTIONS**
	Gamma function, properties of gamma function; Ordinary point and regular singular point of differential equations; Series solutions to differential equations around zero, Frobenius method about zero; Bessel's differential equation: Bessel functions properties, recurrence relations, orthogonality, generating function, trigonometric expansions involving Bessel functions.

TEXTBOOKS

1. Erwin Kreyszig, "Advanced Engineering Mathematics", John Wiley & Sons Publishers, 10th Edition,2010

2. B. S. Grewal, "Higher Engineering Mathematics", Khanna Publishers, 43rd Edition,2015

REFERENCE BOOKS:

1. T.K.V Iyengar, B.Krishna Gandhi, "Engineering Mathematics - III", S. Chand & Co., 12th Edition, 2015..

2. Churchill, R.V. and Brown, J.W, "Complex Variables and Applications", Tata Mc Graw-Hill, 8th Edition, 2012.

WEB REFERENCES:

1. http://www.efunda.com/math/math_home/math.cfm
2. http://www.ocw.mit.edu/resourcs/#Mathematics
3. http://www.sosmath.com
4. http://www.mathworld.wolfram.com

XIX COURSE PLAN:

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

S.No	Topics to be covered	CO's	Reference T1: 4.1
OBE DISCUSSION			
1	Introduction to outcome based education		
CONTENT DELIVERY (THEORY)			
2	Define Algebraic and Transcendental equations	CO 1	T1:12.1,R1:4.2
3	Apply Bisection method to find the root	CO 1	T1:12.3, R1:4.4
4	Apply False Position method to find the root	CO 1	T1:12.3, R1:4.6
5	Apply Newton-Raphson method to find roots	CO 1	T1:12.3, R1:4.7
6	Define what interpolation is	CO 1	T1:12.4, R1:4.13
7	Explain the relation between symbols	CO 1	T1:12.4, R1:4.15
8	Solve the problems by Newton's forward method	CO 1	T1:12.4, R1:4.20
9	Solve the problems by Newton's backward method	CO 1	T1:22.9 R1:5.8
10	Solve the problems by Gauss forward method	CO 1	T1:13.1, R1:5.3
11	Solve the problems by Gauss backward method	CO 1	T1:13.2, R1:5.5
12	Solve the problems by lagrange's and Newtons dividend difference	CO 1	T1:13.3, R1:5.9

13	Define Algebraic and Transcendental equations	CO 1	T1:13.4, R1:5.10
14	Apply Bisection method to find the root	CO 1	T1:14.1, R1:6.1
15	Solve the problems by lagrange's and Newtons dividend difference	CO 1	T1:14.2 , R1:6.1
16	Solve a straight line	CO 2	T1:14.4, R1:6.2
17	Solve a second degree parabola	CO 2	T1:15.2 , R1:6.6
18	Solve an exponential curve	CO 2	T1:15.1, R1:7.4,
19	Solve the ODE by Taylor's series method	CO 3	T1:15.1, R1:6.5
20	Solve the ODE by Euler's Method- Euler's modified method	CO 3	T1:15.3, R1:7.9
21	Explain the ODE by Taylor's series method	CO 3	T2: 7.14, R1:1.6
22	Explain the ODE Euler's modified method	CO 3	T2: 7.15, R1:1.63
23	Solve the ODE by Runge-Kutta Methods	CO 3	T2: 7.15, R1:1.65
24	Calculate double and triple integrations	CO 4	T2: 16.5, R1:7.32
25	Use the Change of order for multiple integrals	CO 4	T2: 16.6, R1:7.36
26	Use the Change of variables in multiple integrals	CO 4	T2: 16.7, R1:7.36
27	Apply double integration for finding the area	CO 4	T2: 16.8, R1:7.41
28	Apply triple integration for finding the volume	CO 4	T2: 16.9, R1:7.42
29	Define vector calculus and vector fields and their properties	CO 5	T2: 16.9, R1:7.42
30	Determine Gradient, divergent and curl of vector fields	CO 5	T2: 7.14, R1:1.6
31	Calculate line integral along smooth path and find work done	CO 5	T2: 7.15, R1:1.65
32	Calculate the surface area of field	CO 5	T2: 7.15, R1:1.65
33	Calculate volume of field	CO 5	T2: 7.15, R1:1.65
34	Use Green's theorem to evaluate line integrals along simple closed contours on the plane	CO 5	T2: 16.5, R1:7.32
35	Use Stokes' theorem to give a physical interpretation of the curl of a vector field	CO 5	T2: 16.6, R1:7.36
36	Use the divergence theorem to give a physical interpretation of the divergence of a vector field	CO 5	T2: 16.7, R1:7.36

37	Apply gamma function for improper integrals	CO 6	T2: 16.7, R1:7.36
38	Motivation for series solution Ordinary and regular point of a differential equation	CO 6	T2: 16.8, R1:7.41
39	Transformation of non-zero singular point to zero singular point series solutions of differential equations around zero	CO 6	T2: 16.8, R1:7.41
40	Frobenius Method about zero	CO 6	T2: 16.9, R1:7.42
41	Explain the Bessel functions	CO 6	T2: 16.5, R1:7.32
42	Determine the solution of ordinary differential equations in series form	CO 6	T1:12.3, R1:4.4
43	Apply the Frobenius method to obtain a series solution for the given linear ODE	CO 6	T1:12.3, R1:4.7
44	Demonstrate Bessel's Differential equation	CO 6	T1:12.4, R1:4.13
PROBLEM SOLVING/ CASE STUDIES			
45	Solving problems on bisection,false position method	CO 1	T1:17.1-17.2 R1:16.1-16.2
46	Solving problems on Newton Raphson method	CO 1	T1:17.5-17.6 R1:16.3.1
47	Solving problems on interpolation methods	CO 1	T1:17.1-17.2 R1:16.1-16.2
48	Solving problems on straightlines ,second degree .exponential curves least squares method	CO 2	T1:17.5-17.6 R1:16.3.1
49	Solving problems onTaylor's series method	CO 3	T1:17.1-17.2 R1:16.1-16.2
50	Solving problems onStep by step methods: Euler's, modified Euler's	CO 3	T1:23.10 R1:8.1
51	Solving problems on Runge-Kutta method	CO 3	T1:23.1 R1:9.2
52	Solving problems on Double and triple integrals	CO 4	T1:23.1 R1:9.4
53	Solving problems on Vector integral theorems	CO 5	T1:23.1 R1:9.9
54	Solving problems on properties of gamma function	CO 6	T1:23.10 R1:8.1
55	Solving problems on properties of Bessel function, Recurrence relations of Bessel function, Generating function and orthogonality of Bessel function	CO 6	T1:17.1-17.2 R1:16.1-16.2

56	Solving problems onTrigonometric expansions involving Bessel function.	CO 6	T1:17.1-17.2 R1:16.1-16.2
DISCUSSION OF DEFINITION AND TERMINOLOGY			
57	Definitions and terminology of Module I on Root finding techniques and interpolation	CO 1	T1:23.10 R1:6.8
58	Definitions and terminology of Module II on Curve fitting and numerical solution of ordinary differential equations	CO 2, CO 3	T1:23.10 R1:7.5
59	Definitions and terminology of Module III on Multiple integrals	CO 4	T1:23.10 R1:8.1
60	Definitions and terminology of Module IV on Vector calculus	CO 6	T2:27.12 R1:11.10
61	Definitions and terminology of Module V on Special functions	CO 6	T1:17.1-17.2 R1:16.1-16.2
DISCUSSION OF QUESTION BANK			
62	Discussion of Question Bank of Module I on Root Finding Techniques and Interpolation	CO 1	T1:23.10 R1:8.1
63	Discussion of Question Bank of Module II on Curve Fitting and Numerical Solution of Ordinary Differential Equations	CO 2, CO 3	T1:23.10 R1:6.8
64	Discussion of Question Bank of Module III on Multiple Integrals	CO 4	T1:23.10 R1:7.5
65	Discussion of Question Bank of Module IV on Vector calculus	CO 5	T2:27.12 R1:11.10
66	Discussion of Question Bank of Module V on Special Functions	CO 6	T1:17.1-17.2 R1:16.1-16.2

Course Coordinator: **HOD, CE**
Ms V Subbalaxmi , Assistant Professor

INSTITUTE OF AERONAUTICAL ENGINEERING
(Autonomous)
Dundigal, Hyderabad - 500 043

COURSE DESCRIPTION

Department	**CIVIL ENGINEERING**				
Course Title	**MODERN PHYSICS**				
Course Code	**AHS008**				
Program	**B. Tech.**				
Semester	**II**				
Course Type	**FOUNDATION**				
Regulation	IARE-R16				
Course Structure	Theory			Practical	
	Lecture	Tutorials	Credits	Laboratory	Credits
	3	1	4	-	-
Course Coordinator	Dr. Rizwana, Professor.				

I COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites
-	-	-	-

II COURSE OVERVIEW:

This course develops abstract and critical reasoning by studying mathematical and logical proofs and assumptions as applied in basic physics and to make connections between physics and other branches of sciences and technology. The topics covered include crystallography, X-ray diffraction, defects in crystals, LASERs, sensors, fiber optics, interference and diffraction. The course helps students to gain knowledge of basic principles and appreciate the diverse applications in technological fields in respective branches and also in their lives.

III MARKS DISTRIBUTION:

Subject	SEE Examination	CIE Examination	Total Marks
Modern Physics	70 Marks	30 Marks	100

IV CONTENT DELIVERY / INSTRUCTIONAL METHODOLOGIES:

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

V EVALUATION METHODOLOGY:

The course will be evaluated for a total of 100 marks, with 30 marks for Continuous Internal Assessment (CIA) and 70 marks for Semester End Examination (SEE). CIA is conducted for a total of 30 marks, with 20 marks for Continuous Internal Examination (CIE), and 10 marks for Alternative Assessment Tool (AAT).

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 14 marks. There could be a maximum of two sub divisions in a question.
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Continuous Internal Examination (CIE):
Two CIE exams shall be conducted at the end of the 8^{th} and 16^{th} week of the semester respectively for 10 marks each of 2 hours duration consisting of five descriptive type questions out of which four questions have to be answered.

Alternative Assessment Tool (AAT)
This AAT enables faculty to design own assessment patterns during the CIA. The AAT converts the classroom into an effective learning center. The AAT may include tutorial hours/classes, seminars, assignments, term paper, open ended experiments, METE (Modeling and Experimental Tools in Engineering), five minutes video, MOOCs etc. The AAT chosen for this course is given in table

Concept Video	Tech-talk	Complex Problem Solving
40%	40%	20%

VI COURSE OBJECTIVES:

The students will try to learn:

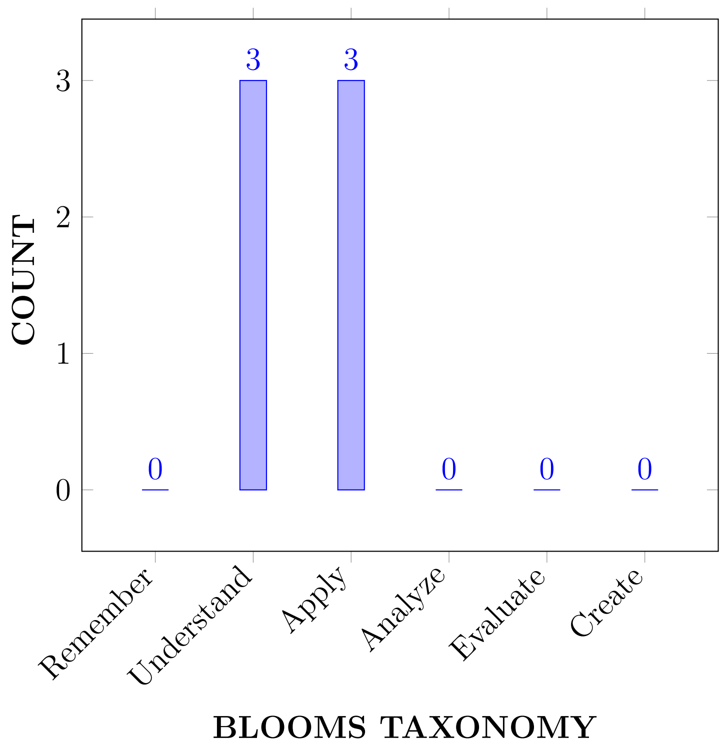
I	Develop strong fundamentals of crystal structures and properties.
II	Meliorate the knowledge of theoretical and technological aspects of LASERs and optical fibers.
III	Correlate principles with applications of the x-ray diffraction and defects in crystals.
IV	Enrich knowledge in modern engineering principles of interference and diffraction.

VII COURSE OUTCOMES:

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

CO 1	**Make use of** space lattice, unit cell, lattice parameters and coordination number to calculate the packing factor of different crystal structures.	Apply
CO 2	**Apply** Bragg's law of X-Ray diffraction to study the defects in crystal with illustrative examples of point and line defects.	Apply
CO 3	**Compare** the concepts of Laser and normal lightin terms of mechanism and working principles for applications in different fields and scientific practices.	Understand
CO 4	**Utilize** the importance of sensor materialsin different real time applications.	Apply
CO 5	**Explain** functionality of components in optical fiber communication systemby using the basics of signal propagation, attenuation and dispersion.	Understand
CO 6	**Interpret** the phenomenon of interference and diffractionby using the principles of wave motion and superposition.	Understand

COURSE KNOWLEDGE COMPETENCY LEVEL



VIII PROGRAM 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.

Program 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

IX HOW PROGRAM OUTCOMES ARE ASSESSED:

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

3 = High; 2 = Medium; 1 = Low

X HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

Program		**Strength**	**Proficiency Assessed by**
PSO1	Design and Supervise Sub-Structures and Super Structures for Residential and Public Buildings, Industrial Structures, Irrigation Structures, Power Houses, Highways, Railways, Airways, Docs and Harbours.	1	

3 = High; 2 = Medium; 1 = Low

XI MAPPING OF EACH CO WITH POs, PSOs:

COURSE OUTCOMES	**PROGRAM OUTCOMES**												**PSOs**		
	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	✓	✓	-	-	-	-	-	-	-	-	-		-	-	✓

XII JUSTIFICATIONS FOR CO – (PO/PSO) MAPPING -DIRECT:

Course Outcomes	**POs PSOs**	**Justification for mapping (Students will be able to)**	**No. of Key competencies matched.**
CO 1	PO 1	**Make use of** basic concept of Crystallography and coordination number calculate the packing factor of BCC structure solid.	3
	PO 2	**Explain** the given problem statement and **formulate** the interplanar spacing of orthogonal crystal system for a given crystal structure information and data in reaching substantial conclusions by the **interpretation** of results.	4
CO 2	PO 1	**Illustrate** the X-Ray diffraction phenomena by Bragg's law.	3
	PO 2	**Understand** the given problem statement and **formulate** the concept of Burger's vector for material from the provided information and data in reaching substantial conclusions by the **interpretation** Defects in Solids.	4

Course Outcomes	POs PSOs	Justification for mapping (Students will be able to)	No. of Key competencies matched.
CO 3	PO 1	**Summarize** detailed knowledge of fundamental and applied aspects of LASER, **analyze** key parameters and apply them to the functioning for real time application.	3
CO 4	PO 1	**Apply** the key concepts of characteristics of LASER for deriving Einstein coefficients and illustrate basic working mechanism of lasing action.	3
	PO 2	**Explain** the given problem statement and **formulate** the population inversion condition provided information and data by the **interpretation** of stimulated emission and excitation.	4
CO 5	PO 1	**Relate** functionality of components in optical fiber communication system by using the basics idea of signal propagation, attenuation and dispersion in optical fiber for solving engineering problems by **applying principles** of total internal reflection.	3
	PO 2	**Understand** the given **problem statement** and **derive the expression** for numerical aperture and acceptance angle for optical fibre from the provided **information** and **data** by the **interpretation** of attenuation in optical fibers.	4
	PSO3	**Determine** the attenuation coefficient value for step index and graded index optical fibres by make use of modern computer tools and for gaining knowledge helpful for higher studies.	1
CO 6	PO 1	**Compare** the concepts of constructive and destructive interference phenomena and **working principles** for **applications** in different fields and **scientific practices**.	3
	PO 2	**Identify the given problem** and **formulate** Fraunhofer diffraction due to single slit with the given **information and data** by applying principles of maxima and minima.	4

XIII TOTAL COUNT OF KEY COMPETENCIES FOR CO – (PO/PSO) MAPPING:

COURSE OUTCOMES	PROGRAM OUTCOMES												PSOs		
	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	-	-	-	-	-	-	-	-	-		-	-	-
CO 2	3	4	-	2	-	-	-	-	-	-	-	-	-	-	-
CO 3	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 4	3	4	-	-	-	-	-	-	-	-	-		-	-	-

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

XIV PERCENTAGE OF KEY COMPETENCIES FOR CO – (PO/PSO):

COURSE OUTCOMES	PROGRAM OUTCOMES												PSOs		
	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	-	-	-	-	-	-	-	-	-		-	-	-
CO 2	100	40	-	20	-	-	-	-	-	-	-	-	-	-	-
CO 3	100	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 4	100	40	-	-	-	-	-	-	-	-	-		-	-	-
CO 5	100	40	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 6	100	40	-	-	-	-	-	-	-	-	-		-	-	50

XV COURSE ARTICULATION MATRIX (CO-PO/PSO MAPPING):

CO'S and PO'S and CO'S and PSO'S on the scale of 0 to 3, 0 being no correlation, 1 being the low correlation, 2 being medium correlation and 3 being high correlation.
0 - $0 \leq C \leq 5\%$ – No correlation
1-5 $< C \leq 40\%$ – Low/ Slight
2 - $40\ \% < C < 60\%$ –Moderate
3 - $60\% \leq C < 100\%$ – Substantial /High

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

XVI ASSESSMENT METHODOLOGY DIRECT:

CIE Exams	✓	SEE Exams	✓	Seminars	✓
Laboratory Practices	-	Student Viva	-	Mini Project	-
Presentations	✓	Certification	-	Assignments	✓
Term paper	✓				

XVII ASSESSMENT METHODOLOGY INDIRECT:

✓	Early Semester Feedback	✓	End Semester OBE Feedback
X	Assessment of Mini Projects by Experts		

XVIII SYLLABUS:

UNIT I	**CRYSTALLOGRAPHY AND CRYSTAL STRUCTURES**
	Crystallography and crystal structures: Space lattice, unit cell, lattice parameters, crystal systems, Bravais lattices, directions and planes in crystals, Miller indices, interplanar spacing of orthogonal crystal systems, atomic radius, coordination number and packing factor of SC, BCC, FCC, NaCl and diamond structures.
UNIT II	**X-RAY DIFFRACTION AND DEFECTS IN CRYSTALS**
	X-ray diffraction: Bragg's law, Laue method, powder method and applications; Defects in crystals: Concepts of point defects, vacancies, substitutional, interstitial, frenkel, schottky defects, line defects and Burger's vector.
UNIT III	**LASERS AND SENSORS**
	Lasers: Characteristics of LASERS, spontaneous and stimulated emission of radiation, metastable state, population inversion, lasing action, ruby LASER, semiconductor diode LASER and applications of LASERS. Sensors: Introduction, basic principles, sensor materials and applications: principle of pressure, optical, acoustic and thermal sensing.
UNIT IV	**FIBER OPTICS**
	Fiber optics: Principle and construction of an optical fiber, acceptance angle, numerical aperture, types of optical fibers (Single mode, multimode, step index, graded index), attenuation in optical fibers, application of optical fibers and optical fiber communication system with block diagram.
UNIT V	**INTERFERENCE AND DIFFRACTION**

	Interference: Phase difference, path difference, coherence, conditions for constructive and destructive interference, interference in thin films due to reflected light, Newton rings experiment. Diffraction: Introduction, differences between interference and diffraction, types of diffraction, Fraunhofer diffraction due to single slit, N-slits, diffraction grating experiment.

TEXTBOOKS

1. Dr. K. Vijaya Kumar, Dr. S. Chandralingam, "Modern Engineering Physics", S.Chand & Co. New Delhi, 1^{st} Edition, 2010.
2. V. Rajendran, "Engineering Physics", Tata Mc Graw Hill Book Publishers, 1^{st} Edition, 2010.

REFERENCE BOOKS:

1. P. K. Palanisamy, "Engineering Physics", Scitech Publishers, 4^{th} Edition, 2014.
2. R. K. Gaur, S. L. Gupta, "Engineering Physics", Dhanpat Rai Publications, 8^{th} Edition, 2001.
3. A. J. Dekker, "Solid State Physics", Macmillan India ltd, 1^{st} Edition, 2000.

XIX 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 THEORY(DELIVERY)			
2	Space lattice, unit cell, lattice parameters.	CO 1	T1, T2, R1, R2
3	Crystal systems, Bravais lattices.	CO 1	T1, T2, R1, R2
4	Directions and planes in crystals, Miller indices	CO 1	T1, T2, R1, R2
5	Interplanar spacing of orthogonal crystal systems	CO 1	T1, T2, R1, R2,
6	Atomic radius, coordination number and packing factor of SC structure.	CO 1	T1, T2, R1, R2
7	Atomic radius, coordination number and packing factor of BCC structure	CO 2	T1, T2, R1, R2
8	Atomic radius, coordination number and packing factor of FCC structure	CO 2	T1, T2, R1, R2
9	Atomic radius, coordination number and packing factor of Diamond structure	CO 2	T1, T2, R1, R2

10	NaCl structure	CO 2	T1, T2, R1, R2
11	X-ray diffraction: Bragg's law	CO 2	T1, T2, R1, R2
12	Laue method	CO 2	T1, T2, R1, R2
13	Powder method and applications	CO 2	T1, T2, R1, R2
14	Defects in crystals: Concepts of point defects	CO 2	T1, T2, R1, R2
15	Frenkel, Schottky defects	CO 2	T1, T2, R1, R2
16	Line defects	CO 2	T1, T2, R1, R2
17	Line defects	CO 2	T1, T2, R1, R2
18	Burger's vector	CO 2	T1, T2, R1, R2
19	Problems	CO 2	T1, T2, R1, R2
20	Characteristics of LASERS, spontaneous and stimulated emission of radiation	CO 3	T1, T2, R1, R4
21	Metastable state, population inversion, lasing action	CO 3	T1, T2, R1, R4
22	Ruby LASER	CO 3	T1, T2, R1, R4
23	He-Ne LASER	CO 3	T1, T2, R1, R4
24	Semiconductor diode LASER and applications of LASERS	CO 4	T1, T2, R1, R4
25	Introduction to sensors, Basic principles of sensors	CO 4	T1, T2, R1, R4
26	Sensors	CO 4	T1, T2, R1, R4
27	Applications: pressure, force, strain sensors, magnetic sensing	CO 4	T1, T2, R1, R4
28	Optical sensing, acoustic and thermal sensing	CO 4	T1, T2, R1, R4
29	Fiber optics: Principle and construction of an optical fiber	CO 4	T1, T2, R1, R2
30	Acceptance angle	CO 4	T1, T2, R1, R2
31	Numerical aperture	CO 5	T1, T2, R1, R2

32	Types of optical fibers: Single mode, multimode fibers	CO 5	T1, T2, R1, R2
33	Step index, graded index fibers	CO 5	T1, T2, R1, R2
34	Attenuation in optical fibers	CO 5	T1, T2, R1, R2
35	Application of optical fibers	CO 5	T1, T2, R1, R2
36	Optical fiber communication system with block diagram	CO 5	T1, T2, R1, R2
37	Problems	CO 5	T1, T2, R1, R2
38	Interference: Phase difference, path difference, coherence, conditions for constructive and destructive interference	CO5	T1, T2, R1, R2
39	Interference in thin films due to reflected light	CO 5	T1, T2, R1, R2
40	Newton's rings experiment	CO 5	T1, T2, R1, R2
41	Newton's rings experiment	CO 6	T1, T2, R1, R2
PROBLEM SOLVING/ CASE STUDIES			
1	Space lattice, unit cell, lattice parameters.	CO 1	T1, T2, R1, R2
2	Crystal systems, Bravais lattices.	CO 1	T1, T2, R1, R2
3	Directions and planes in crystals, Miller indices	CO 1	T1, T2, R1, R2
4	Interplanar spacing of orthogonal crystal systems	CO 1	T1, T2, R1, R2,
5	Atomic radius, coordination number and packing factor of SC structure.	CO 1	T1, T2, R1, R2
6	Atomic radius, coordination number and packing factor of BCC structure	CO 2	T1, T2, R1, R2
7	Atomic radius, coordination number and packing factor of FCC structure	CO 2	T1, T2, R1, R2
8	Atomic radius, coordination number and packing factor of Diamond structure	CO 2	T1, T2, R1, R2
9	NaCl structure	CO 2	T1, T2, R1, R2
10	X-ray diffraction: Bragg's law	CO 2	T1, T2, R1, R2
11	Laue method	CO 2	T1, T2, R1, R2
12	Powder method and applications	CO 2	T1, T2, R1, R2

13	Defects in crystals: Concepts of point defects	CO 2	T1, T2, R1, R2
14	Frenkel, Schottky defects	CO 2	T1, T2, R1, R2
15	Line defects	CO 2	T1, T2, R1, R2
DISCUSSION OF DEFINITION AND TERMINOLOGY			
1	Crystallography and crystal structures	CO1,CO1	T1,T2
2	X-ray diffraction and defects in crystals	CO2, CO2	T1,T2
3	Lasers and sensors	CO3,CO4	T1,T2
4	Fiber Optics	CO5,CO5	T1,T2
5	Interference and Diffraction	CO6,CO6	T1,T2
DISCUSSION OF QUESTION BANK			
1	Crystallography and crystal structures	CO1, CO1	T1,T2
2	X-ray diffraction and defects in crystals	CO2, CO2	T1,T2
3	Lasers and sensors	CO3, CO4	T1,T2
4	Fiber Optics	CO5, CO5	T1,T2
5	Interference and Diffraction	CO6,CO6	T1,T2

Signature of Course Coordinator **HOD, FE**
Dr. Rizwana, Professor

INSTITUTE OF AERONAUTICAL ENGINEERING
(Autonomous)
Dundigal, Hyderabad - 500 043

COURSE DESCRIPTION

Department	**CIVIL ENGINEERING**				
Course Title	**ENVIRONMENTAL STUDIES**				
Course Code	AHS009				
Program	B.Tech				
Semester	II				
Course Type	FOUNDATION				
Regulation	R-16				
Course Structure	Theory			Practical	
	Lecture	Tutorials	Credits	Laboratory	Credits
	3	-	3	-	-
Course Coordinator	Dr V Anitha Rani, Associate Professor				

I COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites	Credit
-	-	-	-	-

II COURSE OVERVIEW:

Environmental study is interconnected interrelated and interdependent subject. Hence, it is multidisciplinary in nature. The present course is framed by expert committee of UGC under the direction of honorable supreme court to be as a core module syllabus for all branches of higher education and to be implemented in all universities over India. The course is designed to create environmental awareness and consciousness among the present generation to become environmental responsible citizens. The course description is multidisciplinary nature of environmental studies, natural resources Renewable and non-renewable resources Ecosystems Biodiversity and its conservation Environmental pollution Social issues and the environment Human population and the environment Pollution control acts and field work. The course is divided into five chapters for convenience of academic teaching followed by field visits.

III MARKS DISTRIBUTION:

Subject	SEE Examination	CIA Examination	Total Marks
Environmental Studies	70 Marks	30 Marks	100

IV CONTENT DELIVERY / INSTRUCTIONAL METHODOLOGIES:

x	Chalk & Talk	✓	Quiz	✓	Assignments	x	MOOC's
✓	LCD / PPT	✓	Seminars	x	Mini Project	✓	Videos
✓	Open Ended Experiments						

V EVALUATION METHODOLOGY:

The course will be evaluated for a total of 100 marks, with 30 marks for Continuous Internal Assessment (CIA) and 70 marks for Semester End Examination (SEE). CIA is conducted for a total of 30 marks, with 20 marks for Continuous Internal Examination (CIE), and 10 marks for Alternative Assessment Tool (AAT).

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 14 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
0%	Remember
36 %	Understand
64 %	Apply
0 %	Analyze

Continuous Internal Assessment (CIA):
CIA is conducted for a total of 30 marks, with 20 marks for continuous internal examination (CIE) and 10 marks for Alternative Assessment Tool (AAT).

Component	Theory			Total Marks
Type of Assessment	CIE Exam	Quiz	AAT	
CIA Marks	20	05	05	30

Continuous Internal Examination (CIE):
Two CIE exams shall be conducted at the end of the 8^{th} and 16^{th} week of the semester respectively for 10 marks each of 2 hours duration consisting of five descriptive type questions out of which four questions have to be answered.

Alternative Assessment Tool (AAT)
This AAT enables faculty to design own assessment patterns during the CIA. The AAT converts the classroom into an effective learning center. The AAT may include tutorial hours/classes, seminars, assignments, term paper, open ended experiments, METE (Modeling and Experimental Tools in Engineering), five minutes video, MOOCs etc. The AAT chosen for this course is given in table

Concept Video	Tech-talk	Complex Problem Solving
40%	40%	20%

VI COURSE OBJECTIVES:

The students will try to learn:

I	The interrelationship between living organism and environment.
II	The importance of environment by assessing its impact on the human world
III	The knowledge on themes of biodiversity, natural resources, pollution control and waste management.
IV	The constitutional protection given for the safety of environment.

VII COURSE OUTCOMES:

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

CO 1	**Explain** the basic concept of environment, earths major cycle and its function related food chain, food web, and ecological pyramid for the importance of ecosystem and flow of energy in ecosystem	Understand
CO 2	**Classify** natural resource and necessity of natural resource conservationfor sustainable use and proper use.	Understand
CO 3	**Utilize** renewable and non-renewable energy resource for future growing energy needs.	Apply
CO 4	**Explain** the value of biodiversity hotspots, endangered and endemic species, in- situ and ex situ conservation methods for protecting the biodiversity.	Apply
CO 5	**Relate** the cause and effects of pollution related to Air, Water, Soil and Noise their control and treatment technologies.	Understand
CO 6	**Summarize** the concepts of Environmental Impact Assessment, global environmental problem, international summits, to minimize the problems towards sustainable future.	Understand

COURSE KNOWLEDGE COMPETENCY LEVEL

VIII PROGRAM 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

IX 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.	2	CIE/Quiz/AAT
PO 4	**Conduct investigations of complex problems:**Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.	2	CIE/Quiz/AAT
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.	3	CIE/Quiz/AAT

3 = High; 2 = Medium; 1 = Low

X HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

PROGRAM SPECIFIC OUTCOMES		Strength	Proficiency Assessed by
PSO 1	Design and Supervise Sub-Structures and Super Structures for Residential and Public Buildings, Industrial Structures, Irrigation Structures, Power Houses, Highways, Railways, Airways, Docs and Harbours.	-	-
PSO 2	Focus on Improving Performance of Structures with reference to Safety, Serviceability and Sustainable Green Building Technology. .	-	-
PSO 3	Make use of Advanced Structural Analysis and Project Management Software for creating Modern Avenues to succeed as an Entrepreneur, Pursue Higher Studies and Career Paths.	-	-

3 = High; 2 = Medium; 1 = Low

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

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	✓	-	-	-	-	-	✓	-	-	-	-	-	-	-	-
CO 2	✓	-	-	-	-	-	✓	-	-	-	-	-	-	-	-
CO 3	✓	-	-	-	-	-	✓	-	-	-	-	-	-	-	-
CO 4	✓	-	-	-	-	-	✓	-	-	-	-	-	-	-	-
CO 5	✓	-	-	-	-	-	✓	-	-	-	-	-	-	-	-
CO 6	✓	-	-	✓	-	-	✓	-	-	-	-	-	-	-	

XII 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 matched.
CO 1	PO 1	Explain the basic concept of environment, earths major cycle and its function related food chain, food web, and ecological pyramid for the importance of ecosystem and flow of energy in ecosystem by using principles of science for solving engineering problems.	2
	PO 7	Summarize about the toxicity of heavy metals on the biotic and abiotic components in in socio economic Environmental and politics contexts for Sustainable development.	3
CO 2	PO 1	Classify about different types of natural resources and their applicability and illustrate the utility of renewable resources efficiency by using principles of science for solving engineering problems.	2
	PO 7	Identify renewable and non renewable resources, Alternate energy resources and understand the impact in socio economic Environmental and politics contexts for Sustainable development.	3
CO3	PO 1	Explain the renewable and non renewable energy resource by using principles of science for solving engineering problems.	2
	PO 7	Utilize renewable and non renewable resources, Alternate energy resources and understand the impact in socio economic, politics and Environmental contexts for Sustainable development.	3
CO4	PO 1	Explain the fundamentals of Biodiversity and biotic resources, importance of biodiversity, the ecological values, India is mega diversity nation, the threats to biodiversity and importance of conservation of biodiversity by applying the principle of science for solving engineering problems.	2

Course Outcomes	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key competencies matched.
	PO 7	Demonstrate a comprehensive understanding of the world's biodiversity and the importance of its conservation, impact of biodiversity loss and National biodiversity act with the in socio economic, politics and Environmental contexts for Sustainable development.	3
CO5	PO 1	Relate the effect of pollutants on air, water and soil that causes the environmental pollution for solving engineering problems by applying the principles of science.	2
	PO 7	Explain the causes and effects of air pollution, water pollution, soil pollution and noise pollution and understand the impact in socio economic, politics and environmental contexts for sustainable development.	3
CO 6	PO 1	Explain the concepts of environmental impact assessment, global environmental problems, international summits, to minimize the problems towards sustainable future for solving engineering problems by applying the principles of science.	2
	PO 4	Recognize the methods and process of primary, secondary and tertiary treatment of waste water and understand the technology behind the pollution control devices.	2
	PO 7	Identify the environmental laws, population and its explosion green buildings in the context in socio economic, politics and Environmental contexts for Sustainable development.	3

XIII 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	2	-	-	-	-	-	3	-	-	-	-		-	-	-
CO 2	2	-	-	-	-	-	3	-	-	-	-	-	-	-	-
CO 3	2	-	-	-	-	-	3	-	-	-	-	-	-	-	-
CO 4	2	-	-	-	-	-	3	-	-	-	-	-	-	-	-
CO 5	2	-	-	-	-	-	3	-	-	-	-	-	-	-	-
CO 6	2	-	-	2	-	-	3	-	-	-	-	-	-	-	-

XIV 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	-	-	-	-	-	100	-	-	-	-	-	-	-	-
CO 2	66.6	-	-	-	-	-	100	-	-	-	-	-	-	-	-

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 3	66.6	-	-	-	-	-	100	-	-	-	-	-	-	-	-
CO 4	66.6	-	-	-	-	-	100	-	-	-	-	-	-	-	-
CO 5	66.6	-	-	-	-	-	100	-	-	-	-	-	-	-	-
CO 6	66.6	-	-	18	-	-	100	-	-	-	-	-	-	-	-

XV COURSE ARTICULATION MATRIX (PO / PSO MAPPING):

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

0 - $0 \leq C \leq 5\%$ – No correlation
1 - $5 < C \leq 40\%$ – Low/ Slight
2 - $40\% < C < 60\%$ –Moderate
3 - $60\% \leq C < 100\%$ – Substantial /High

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

XVI ASSESSMENT METHODOLOGY-DIRECT:

CIE Exams	✓	SEE Exams	✓	Assignments	✓	Seminars	✓
Concept Video	-	Mini Project	-	Student Viva	-	Mini Project	-

XVII ASSESSMENT METHODOLOGY-INDIRECT:

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

XVIII SYLLABUS:

UNIT I	**ENVIRONMENT AND ECOSYSTEMS**
	Environment: Definition, scope and importance of environment, need for public awareness; Ecosystem: Definition, scope and importance of ecosystem, classification, structure and function of an ecosystem, food chains, food web and ecological pyramids, flow of energy; Biogeochemical cycles Hydrological cycle, Phosphorous cycle, Nitrogen cycle. Biomagnifications.
UNIT II	**NATURAL RESOURCES**
	INatural resources: Classification of resources, living and nonliving resources; Water resources: Use and over utilization of surface and ground water, floods and droughts, dams, benefits and problems; Mineral resources: Use and exploitation; Land resources; Energy resources: Growing energy needs, renewable and non renewable energy sources, use of alternate energy source, case studies.
UNIT III	**BIODIVERSITY AND BIOTIC RESOURCES**
	Biodiversity and biotic resources: Introduction, definition, genetic, species and ecosystem diversity; Value of biodiversity: Consumptive use, productive use, social, ethical, aesthetic and optional values; India as a mega diversity nation; Endangered and Endemic species, Hot spots of biodiversity.Threats to biodiversity: Habitat loss, poaching of wildlife, human-wildlife conflicts; Conservation of biodiversity: In situ and ex situ conservation; National biodiversity act.
UNIT IV	**ENVIRONMENTAL POLLUTION, POLLUTION CONTROL TECHNOLOGIES AND GLOBAL ENVIRONMENTAL PROBLEMS**
	Environmental pollution: Definition, causes and effects of air pollution, water pollution, soil pollution, noise pollution; Solid waste: Municipal solid waste management, composition and characteristics of e-waste and its management; Pollution control technologies: Waste water treatment methods, primary, secondary and tertiary; Concepts of bioremediation; Global environmental problems and global efforts: Global Warming, Climate change, Sea level rise, ozone depletion, ozone depleting substances, deforestation and desertification; International conventions / protocols: Earth summit, Kyoto protocol and Montreal protocol.
UNIT V	**ENVIRONMENTAL LEGISLATIONS AND SUSTAINABLE DEVELOPMENT**
	Environmental legislations: Environmental protection act, air act1981, water act, forest act. municipal solid waste management and handling rules, biomedical waste management and handling rules2016, hazardous waste management and handling rules, Environmental impact assessment(EIA); Towards sustainable future: Concept of sustainable development, population and its explosion, crazy consumerism, environmental education, urban sprawl, concept of green building.

TEXTBOOKS

1. Benny Joseph, "Environmental Studies", Tata Mc Graw Hill Publishing Co. Ltd, New Delhi, 1st Edition, 2006.
2. Erach Bharucha, "Textbook of Environmental Studies for Under Graduate Courses", Orient Black Swan, 2nd Edition, 2013.
3. Dr. P. D Sharma, "Ecology and Environment", Rastogi Publications, New Delhi, 12th Edition, 2015.

REFERENCE BOOKS:

1. Tyler Miller, Scott Spoolman, "Environmental Science", Cengage Learning, 14th Edition, 2012.
2. Anubha Kaushik, "Perspectives in Environmental Science", New Age International, New Delhi.4th Edition, 2006.
3. Gilbert M. Masters, Wendell P. Ela, "Introduction to Environmental Engineering and Science, Pearson, 3rd Edition, 2007

XIX 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	Explain the scope and importance of Environment and need for Public Awareness	CO 1	T1:1.1.3 R1:2.1
2	Identify scope and importance of ecosystem	CO1	T1:1.1.4 R1:2.7.1
3	Explain Structure and function of ecosystem	CO1	T1:1.1.6 R1:2.7.4
4	Relate the Food chain food web and pyramids	CO1	T1:1.7.2 R1:2.15
5	Realate the Flow of energy	CO1	T1:1.7.2 R1:2.16
6	Explain the Biogeochemical cycles.	CO1	T1:1.7.6 R1:2.17
7	Interpret the Biomagnifications.	CO1	T1:1.7.3 R1:2.19
8	Classify the Living and non living resources	CO 2	T1:2.1 R1:2.21
9	Explain the Water resources: use and over utilization of surface and ground water	CO 2	T1:2.2.2 R1:2.3
10	Explain the Floods and Drought	CO 2	T1:2.2.4 R1:4.1

11	Relate dams: befit and problems	CO 2	T1:2.3.1 R1:4.3
12	Explain the Mineral resources: use and exploitation of minerals	CO 2	T1:2.4 R1:4.8
13	Relate the Energy resources and introduction and applications	CO 3	T1:2.5.2 R1:4.6
14	Explain the Wind energy and its application	CO 3	T1:2.5.3 R1:4.6
15	Explain Land resources	CO 2	T1:2.4 R1:4.8
16	Identify renewable and non renewable resources	CO 3	T1:2.5.3 R1:4.6
17	Recall the Biodiversity and Biotic introduction and definition.	CO 4	T1:3.1 R1:4.5
18	Relate the Classification of biodiversity	CO 4	T1:3.2.2 R1:4.8
19	Explain the Values of biodiversity	CO 4	T1:3.3.1 R1:4.7
20	Identify India is mega diversity nation	CO 4	T1:3.4 R1:4.9
21	Recognize Hot spots of biodiversity	CO 4	T1: 3.4 R1:4.10
22	Explain the Threats to biodiversity	CO 4	T1: 3.5 R1:1.10
23	Explain the Man wild life conflict	CO 4	T1:3.5.2 R1:1.10
24	Relate the Conservation of Biodiversity	CO 4	T1:3.7 R1:1.16
25	Recall National biodiversity act	CO 4	T1: 3.9 R1:1.16
26	Recall the Environmental pollution : Introduction and classification	CO 5	T1: 4.1 R1:1.16
27	Explain the Air pollution: primary and secondary pollutants, effects and its control	CO 5	T1: 4.2 R1:1.11
28	Explain the Water pollution: types effects and control of water pollution	CO 5	T1:4.6 R1:5.2
29	Explain the Soil pollution: sources effects and control of soil pollution	CO 5	T1: 4.8 R1:5.2
30	Explain the Noise pollution: sources effects and control of noise pollution	CO 5	T1: 4.13 R1:5.10
31	Explain the Municipal waste management	CO 5	T1: 4.16 R1:5.2.3
32	Explain the solid waste management	CO 5	T1:4.16.3 R1:5.2.4
33	Identify the E-waste: characteristics and its management	CO 5	T1: 5.5 R1:5.4
34	Explain the Global environmental problems: climate change and impact on human	CO 5	T1: 5.6 R1:5.5

35	Recognize the Ozone depletion and consequences	CO 5	T1: 5.10 R1:5.6
36	Summarize the International protocols	CO 5	T1: 4.1 R1:1.16
37	Relate the Environmental protection act.	CO 6	T1:7.3
38	Relate the air act, water act	CO 6	T1:7.3
39	Relate forest act, wild life act	CO 6	T1:7.3
40	Relate the Hazardous waste management and handling rules 2016	CO 6	T1:7.10
41	Illustrate the EIA structure and concept of sustainable development	CO 6	T1: 8.1
42	Identify towards sustainable features: concepts of sustainable development	CO 6	T1: 8.2
43	Relate the Consequences of population and its explosion	CO 6	T2: 8.2.3 T3:2
44	Explain the Crazy consumerism urban sprawl	CO 6	T2:8.2.3, T3:7
45	Explain the Environmental education	CO 6	T2:8.4, T3:7
46	Explain the Environmental ethics and concepts of green buildings	CO 6	T2:8.12, T3:15,21
PROBLEM SOLVING			
1	Food chain and pyramids	CO 1	T1:3.3.1; R3:3.2
2	Probelms on utilization of water	CO 1	T2:16.5; R3:8.10
3	Biodiversity	CO 2	T2:16.5; R3:8.10
4	kyto protocol	CO 3	T1:3.3.1; R3:3.2
5	Deforestation	CO 3	T2:16.5; R3:8.10
6	population	CO 4	T2:16.5; R3:8.10
DISCUSSION OF DEFINITION AND TERMINOLOGY			
1	Environment and Ecosystems	CO 1	T2:16.5; R3:8.10
2	Natural Resources	CO 2	T1:3.3.1; R3:3.2
3	Biodiversity and Biotic Resouces	CO 3	T2:16.5; R3:8.10
4	Enivironment pollution	CO 4	T2:16.5; R3:8.10
5	Environmental Legistration and sustainable development	CO 6	T2:16.5; R3:8.10

DISCUSSION OF QUESTION BANK			
1	Environment and Ecosystems	CO 1	T2:16.5; R3:8.10
2	Natural Resources	CO 2	T1:3.3.1; R3:3.2
3	Biodiversity and Biotic Resouces	CO 3	T2:16.5; R3:8.10
4	Enivironment pollution	CO 4	T2:16.5; R3:8.10
5	Environmental Legistration and sustainable development	CO 6	T2:16.5; R3:8.10

Signature of Course Coordinator **HOD,CE**

INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

Dundigal, Hyderabad - 500 043

CIVIL ENGINEERING

COURSE DESCRIPTION

Course Title	**COMPUTER PROGRAMMING**
Course Code	ACS001
Program	B.Tech
Semester	II
Course Type	Foundationl
Regulation	IARE - R16

Course Structure	Theory			Practical	
	Lecture	Tutorials	Credits	Laboratory	Credits
	3	0	3	-	-

Course Coordinator	Mr.P Ravinder , Assistant Professor

I COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites	Credits
B.Tech	ACS001	I	Basic Programming Concepts	-

II COURSE OVERVIEW:

The course emphasis on the problem-solving aspects in using C programming. It is the fundamental course and is interdisciplinary in nature for all engineering applications. The students will understand programming language, programming, concepts of loops, reading a set of data, step wise refinements, functions, control structures, arrays, dynamic memory allocations, enumerated data types, structures, unions, and file handling. This course provides adequate knowledge to solve problems in their respective domains.

III MARKS DISTRIBUTION:

Subject	SEE Examination	CIE Examination	Total Marks
Computer Programming	70 Marks	30 Marks	100

IV DELIVERY / INSTRUCTIONAL METHODOLOGIES:

✓	PPT	✓	Chalk & Talk	✓	Assignments	✓	MOOC
x	Open Ended Experiments	✓	Seminars	✓	Mini Project	✓	Videos
✓	Others: Quiz						

V EVALUATION METHODOLOGY:

The course will be evaluated for a total of 100 marks, with 30 marks for Continuous Internal Assessment (CIA) and 70 marks for Semester End Examination (SEE). Out of 30 marks allotted for CIA during the semester, marks are awarded by taking average of two CIE examinations or the marks scored in the make-up examination.

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 14 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
30 %	Understand
60 %	Apply
0 %	Analyze
0 %	Evaluate
0 %	Create

Continuous Internal Assessment (CIA):
CIA is conducted for a total of 30 marks, with 25 marks for Continuous Internal Examination (CIE) and 05 marks for Quiz \Alternative Assessment Tool (AAT).

Component	Theory		Total Marks
Type of Assessment	CIE Exam	Quiz \AAT	
CIA Marks	25	05	30

Continuous Internal Examination (CIE):
Two CIE exams shall be conducted at the end of the 8^{th} and 17^{th} week of the semester respectively. The CIE exam is conducted for 25 marks of 2 hours duration consisting of two parts. Part–A shall have five compulsory questions of one mark each. In part–B, four out of five questions have to be answered where, each question carries 5 marks. Marks are awarded by taking average of marks scored in two CIE exams.

Quiz - Online Examination
Two Quiz exams shall be online examination consisting of 25 multiple choice questions and are to be answered by choosing the correct answer from a given set of choices (commonly four). Such a question paper shall be useful in testing of knowledge, skills, application, analysis, evaluation and understanding of the students. Marks shall be awarded considering the average of two quiz examinations for every course.

Alternative Assessment Tool (AAT)

This AAT enables faculty to design own assessment patterns during the CIA. The AAT converts the classroom into an effective learning center. The AAT may include tutorial hours/classes, seminars, assignments, term paper, open ended experiments, METE (Modeling and Experimental Tools in Engineering), five minutes video, MOOCs etc. The AAT chosen for this course is given in table

Concept Video	Tech-talk	Complex Problem Solving
40%	40%	20%

VI COURSE OBJECTIVES:

The students will try to learn:

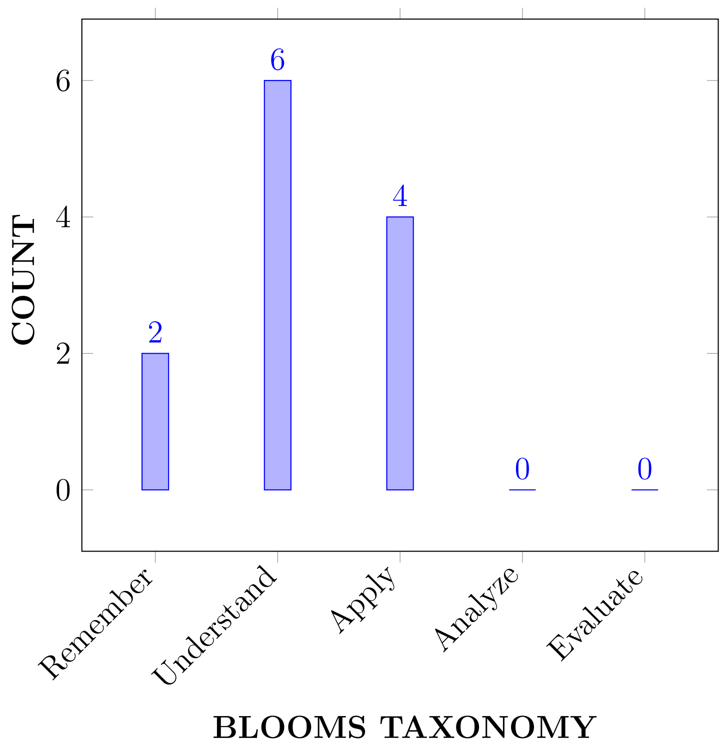
I	Learn adequate knowledge by problem solving techniques.
II	Understand programming skills using the fundamentals and basics of C Language.
III	Improve problem solving skills using arrays, strings, and functions
IV	Understand the dynamics of memory by pointers.
V	Study files creation process with access permissions.

VII COURSE OUTCOMES:

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

CO 1	**Illustrate** problem solving steps in terms of algorithms, pseudocode, flowcharts and programs with basic data types and operations for Mathematical and Engineering problems.	Understand
CO 2	**Implement** derived data types, operators in C program statements.	Apply
CO 3	**Construct** programs involving decision structures, loops, arrays and strings.	Apply
CO 4	**Make use of** various types of functions, parameters, and return values for complex problem solving.	Apply
CO 5	**Illustrate** the static and dynamic memory management with the help of structures, unios and pointers.	Understand
CO 6	**Extend** file input and output operations in implementation of real time applications.	Understand

COURSE KNOWLEDGE COMPETENCY LEVEL



VIII PROGRAM OUTCOMES ARE ASSESSED:

Program	
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

3 = High; 2 = Medium; 1 = Low

IX HOW PROGRAM OUTCOMES ARE ASSESSED:

Program		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	Assignments
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	Assignments
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	2	Seminars, Viva
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	1	5 minutes video

3 = High; 2 = Medium; 1 = Low

X HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

Program		Strength	Proficiency Assessed by
PSO 1	Focus on Ideation and Research towards Digital manufacturing in Product development using Additive manufacturing, Computer Numerical Control (CNC) simulation and high speed machining.	2	Projects
PSO 2	Formulate and Evaluate concepts of Thermo-Fluid Systems to provide solutions for Inter Disciplinary Engineering Applications.	3	Lectures, Assign-ments
PSO 3	Make use of Computational and Experimental tools for Building Career Paths towards Innovation Startups, Employability and Higher Studies.	3	Lectures, Assign-ments

3 = High; 2 = Medium; 1 = Low

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

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

XII 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 the basics of computers; **Fundamentals** of Computer System and memory organization, and **identify** the components of the computer system.	3
CO 2	PO 1	Developing algorithms and draw flowcharts for solving **mathematical** and **engineering problems** related to **areas of computer science.**	3
	PO 2	Understand the various symbols to **drawa** flowchart, **identify** the appropriate symbols to solve a problem, then **formulate** the solution, and **interpret** the result for the **improvement** of the solution.	5
	PO3	**Recognize** an appropriate control structure to **design** and **develop** a solution for a **real-time** scenario, and communicating effectively with engineering community.	3

	PO5	Describe the operators, their precedence, and associativity while evaluating expressions in **software program**.	1
	PSO1	Understand the features of procedural programming for **designing** and **analysing** computer programs for **problem-solving**.	3
CO 3	PO 1	Apply the knowledge of **mathematics, C language fundamentals** to design, develop, and debug programs to solve **engineering** problems	3
	PO 2	Understand the **problem statement**, identify the **data requirements, design**, and **develop** a system for an engineering problem, **validate** and **interpret** the results.	5
	PSO 1	**Understand** automatic type conversion rules to **determine** the magnitude and precision of a mixed datatype expression in the areas of **software development.**	4
CO 4	PO 1	Describe the **fundamental programming** constructs, and articulate how they are used to **develop a program** with a desired runtime execution flow.	3 2-4
	PO 2	**Identify** the appropriate datatypes to **formulate, develop** and **analyze** the solution to achieve **engineering** objectives.	5
	PO 3	Recognize right **data representation** formats based on the **requirements** for **developing programs** in **real-time scenarios** by **managing** the **design process**, and communicating effectively with **engineering** community.	7
	PO 5	Describe the operators, their precedence, and associativity while evaluating expressions in **software program.**	1
CO 5	PO 1	Understand branching statements, loop statements, and apply the fundamentals of **mathematics, science** and **engineering.**	3
	PO 2	Understand the **problem statement, control** the flow of data, **design** the solution and **analyse** the same to **validate** the results in a program to solve complex engineering problems.	5
	PO 3	**Recognize** an appropriate control structure to **design** and **develop** a solution for a **real-time** scenario, and **communicating** effectively with engineering community.	6
CO 6	PO 1	Make use of **engineering techniques** to design and develop solutions for real-time **computational problems.**	3

	PSO 1	**Identify** tasks in which the numerical techniques are **applicable, develop** programs, and hence use computers effectively to solve**real-time applications.**	2

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

COURSE OUTCOMES	Program Outcomes/ No. of Key Competencies Matched												PSO'S		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO 1	3	-	-	-	1	-	-	-	-	2	-	4	-	-	-
CO 2	3	5	3	-	1	-	-	-	-	2	-	3	3	-	-
CO 3	3	5	-	-	1	-	-	-	-	2	-	3	4	1	1
CO 4	3	5	7	-	1	-	-	-	-	2	-	3	-	1	1
CO 5	3	5	6	-	1	-	-	-	-	2	-	3	-	-	-
CO 6	3	-	-	-	1	-	-	-	-	2	-	3	2	-	-

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

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO 1	100	-	-	-	100	-	-	-	-	40	-	50	-	-	-
CO 2	100	50	30	-	100	-	-	-	-	40	-	50	50	-	-
CO 3	100	50	-	-	100	-	-	-	-	40	-	50	67	50	50
CO 4	100	50	70	-	100	-	-	-	-	40	-	50	-	50	50
CO 5	100	50	60	-	100	-	-	-	-	40	-	50	-	-	-
CO 6	100	-	-	-	100	-	-	-	-	40	-	50	34	-	-

XV 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		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO 1	3	-	-	-	3	-	-	-	-	2	-	2	-	-	-
CO 2	3	2	1	-	3	-	-	-	-	2	-	2	2	-	-

CO 3	3	2	-	-	3	-	-	-	-	2	-	2	3	-	2
CO 4	3	2	3	-	3	-	-	-	-	2	-	2	-	-	2
CO 5	3	2	3	-	3	-	-	-	-	2	-	2	-	-	-
CO 6	3	-	-	-	3	-	-	-	-	2	-	2	1	-	-
TOTAL	18	8	7	-	18	-	-	-	-	10	-	10	6	-	4
AVERAGE	3	2	2	-	3	-	-	-	-	1.67	-	1.67	2	-	2

XVI ASSESSMENT METHODOLOGY DIRECT:

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

XVII ASSESSMENT METHODOLOGY INDIRECT:

X	Early Semester Feedback	✓	End Semester OBE Feedback
X	Assessment of Mini Projects by Experts		

XVIII SYLLABUS:

MODULE I	**INTRODUCTION**
	Introduction to computers: Computer systems, computing environments, computer languages, creating and running programs, algorithms, flowcharts; Introduction to C language: History of C, basic structure of C programs, process of compiling and running a C program, C tokens, keywords, identifiers, constants, strings, special symbols, variables, data types; Operators and expressions: Operators, arithmetic, relational and logical, assignment operators, increment and decrement operators, bitwise and conditional operators, special operators, operator precedence and associativity, evaluation of expressions, type conversions in expressions, formatted input and output.
MODULE II	**CONTROL STRUCTRES**
	Control structures: Decision statements; if and switch statement; Loop control statements: while, for and do while loops, jump statements, break, continue, goto statements; Arrays: Concepts, one dimensional arrays, declaration and initialization of one dimensional arrays, two dimensional arrays, initialization and accessing, multi dimensional arrays; Strings concepts: String handling functions, array of strings.

MODULE III	**ARRAYS AND FUNCTIONS**
	Functions: Need for user defined functions, function declaration, function prototype, category of functions, inter function communication, function calls, parameter passing mechanisms, recursion, passing arrays to functions, passing strings to functions, storage classes, preprocessor directives. Pointers: Pointer basics, pointer arithmetic, pointers to pointers, generic pointers, array of pointers, pointers and arrays, pointers as functions arguments, functions returning pointers.
MODULE IV	**POINTERS AND STRUCTURES**
	Structures and unions: Structure definition, initialization, accessing structures, nested structures, arrays of structures, structures and functions, passing structures through pointers, self referential structures, unions, bit fields, typedef, enumerations; Dynamic memory allocation: Basic concepts, library functions.
MODULE V	**FILE HANDLING AND APPLICATIONS IN C**
	Files: Streams, basic file operations, file types, file opening modes, file input and output functions, file status functions, file positioning functions, command line arguments.

TEXT BOOKS

1. Byron Gottfried, —Programming with C, Schaum's Outlines Series, McGraw Hill Education, 3rd Edition, 2017.
2. Reema Thareja —Programming in C, Oxford university press, 2nd Edition, 2016.

REFERENCE BOOKS:

1. W. Kernighan Brian, Dennis M. Ritchie —The C Programming Language, PHI Learning, Second Edition, 1988.
2. YashavantKanetkar —Exploring C, BPB Publishers, Second Edition, 2003..
3. Schildt Herbert —C: The Complete Reference, Tata McGraw Hill Education, Fourth Edition, 2014.

Web References:

1. https://www.bfoit.org/itp/Programming.html
2. https://www.khanacademy.org/computing/computer-programming
3. https://www.edx.org/course/programming-basics-iitbombayx-cs101-1x-0
4. https://www.edx.org/course/introduction-computer-science-harvardx-cs50x

E-Text Books:

1. http://www.freebookcentre.net/Language/Free-C-Programming-Books-Download.htm
2. http://www.imada.sdu.dk/ svalle/courses/dm14-2005/mirror/c/
3. http://www.enggnotebook.weebly.com/uploads/2/2/7/1/22718186/ge6151-notes.pdf

MOOC Course:

1. https://www.alison.com/courses/Introduction-to-Programming-in-c
2. http://www.ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-s096-effective- programming-in-c- and-c-january-iap-2014/index.htm

XIX COURSE PLAN:

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

S.No	Topics to be covered	CO's	Reference T1: 4.1
1-2	Introduction to Computers: computer systems, computing environments, Computer languages, creating and running programs	CO 1	T2: 1.1-1.2
3-4	Algorithms, flowcharts; Introduction to C language: Computer languages, History of C, basic structure of C programs, process of compiling and running a C program	CO 2	T2: 2.1-2.2
5-6	C tokens, keywords, identifiers, constants, strings	CO 2	T2: 1.4-1.5
7-8	Special symbols, variables, data types	CO 3	T2:2.1-2.2
9-10	Operators and expressions	CO 3	T2: 2.3-2.6,7
11-12	Simple if, if-else, else if ladder, Nested if and Case Statement-switch statement	CO 3	T2:3.1-3.5
13-14	While, for and do while loops	CO 5	T2: 5.2-5.3
15–16	Jump statements, break, continue, goto statements	CO 2	T2: 6.1-6.6
17–18	Concepts, one dimensional arrays, declaration and initialization of one-dimensional arrays	CO 2	T2: 6.7
19–20	Two dimensional arrays, initialization and accessing	CO 2	T2: 8.1-8.3
21-22	Multi-dimensional arrays; Strings: Arrays of characters	CO 2	T2: 11.1-11.5
23-24	Variable length character strings, inputting character strings, character library functions, string handling functions	CO 3	T2: 4.1-4.5
25	Need for user defined functions, function declaration, function prototype	CO 3	T1:7 T2: 6.9
26	Category of functions, inter function communication, function calls	CO 3	T1:10
27	Parameter passing mechanisms, recursion, passing arrays to functions, passing strings to functions,	CO 3	T2:10.3-10.5
28	Storage classes, preprocessor directives	CO 3	T1:8.9

29	Structure definition, initialization, accessing structures, nested structures	CO 3	T2: 12.3-12.4
30	Unions, C programming examples, BitFields, typedef, enumerations	CO 3	T2:12.4
31-32	Arrays of structures, structures and functions, passing structures through pointers, self-referential structures	CO 3	T2:2.1-2.2
33-34	Unions, bit fields, typedef, enumerations	CO 5	T2: 2.3-2.6,7
35–36	Pointer basics, pointer arithmetic, pointers to pointers, generic pointers, array of pointers, pointers and arrays	CO 6	T2: 5.2-5.3
37	Pointers as functions arguments, functions returning pointers	CO 5	T2: 5.2-5.3
38	Dynamic memory allocation: Basic concepts, library functions	CO 5	T2: 6.1-6.6
39	Streams, basic file operations, file types, file opening modes, input and output operations with files	CO 5	T2:10.4
40-41	Special functions for working with files, file positioning functions	CO 6	R3:12.1-12.3
42	Command line arguments. Searching	CO 6	R3:12.4
43	Sorting algorithms bubble, insertion, selection	CO 6	T2:11.4 R7:13.1
44-45	Algorithm complexity through example programs	CO 6	T2:11.4 R7:13.1
46	Algorithms and Flowcharts	CO 1	T2:2.1-2.2, R4:1.4
47-48	Operators, Precedence and Associativity of Operators, Expression Evaluation	CO 4	T2:2.3-2.6
49-50	Simple if, if-else, else if ladder, Nested if and Case Statement-switch statement	CO 2	T2:3.1-3.5
51	While, for and do while loops, Jump statements, break, continue, goto statements	CO 3	T2:5.2-5.3,T2:6.1-6.6
52-53	One dimensional arrays	CO 3	T2: 8.1-8.2, R4:15.1
54-55	Strings and its operations	CO 3	T2: 8.3, R4: 15.1
56-57	User defined Functions, Parameter passing mechanisms, passing arrays to functions, passing strings to functions,	CO 4	T1:10, T2:10.1 10.2, T2:10.3-10.4, R4:8.3-8.5

58	Recursion	CO 4	T2:10.5
59	Pointer basics, pointer arithmetic, pointers to pointers, generic pointers, array of pointers, pointers and arrays Pointers as functions arguments, functions returning pointers, Dynamic Memory Allocation	CO 4	T2:3.1,
60	Storage classes, pre-processor directives	CO 5	T2:6.1-6.6
61-62	Structure definition, initialization, accessing structures	CO 5	T1:8.9
63	Unions, bit fields, typedef, enumerations, command line arguments	CO 5	T2: 12.3-12.4,R4:13
64	File Handling	CO 6	T2:10.4
65	Introduction	CO 2	T2:1.1-1
66	Control Structures	CO 3	T2: 3.1 –3.5, T2:5.2 – 5.3
67	Arrays and Functions	CO 4	T2: 8.1 –8.3, R4:15.1
68	Pointer and Structures	CO 5	T2: 12.3–12.4,R4: 13.2–13.4,T1: 8.9
69	File Handling and Applications In C	CO 6	T2: 10.4,T2: 14.1– 14.4

Signature of Course Coordinator **HOD,CE**
Mr. P Ravinder Assistant Professor

INSTITUTE OF AERONAUTICAL ENGINEERING
(Autonomous)
Dundigal, Hyderabad - 500 043

CIVIL ENGINEERING
COURSE DESCRIPTION

Course Title	COMPUTATIONAL MATHEMATICS LABORATORY				
Course Code	AHS102				
Program	B.Tech				
Semester	II	CE			
Course Type	Foundation				
Regulation	IARE- R16				
Course Structure	Theory			Practical	
	Lecture	Tutorials	Credits	Laboratory	Credits
	-	-	-	2	1
Course Coordinator	Ms. B Praveena, Assistant Professor				

I COURSE OVERVIEW:

II. The aim of this course is to know about the basic principles of Engineering Mathematics and itsapplication in MATLAB by means of software. Nowadays the principles of MATLAB find widerange of applications in many situations such as signal processing and communications, imageandvideoprocessing,controlsystems,testandmeasurement,computationalfinance,andcomputational biology. Using MATLAB, one can analyze data, develop algorithms, and createmodelsandapplications.

II COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites
-	-	-	-

III MARKS DISTRIBUTION:

Subject	SEE Examination	CIE Examination	Total Marks
Computational Mathematics Laboratory	70 Marks	30 Marks	100

IV DELIVERY / INSTRUCTIONAL METHODOLOGIES:

✓	Demo Video	✓	Lab Worksheets	✓	Viva Questions	✓	Probing further Questions

V EVALUATION METHODOLOGY:

Each laboratory will be evaluated for a total of 100 marks consisting of 30 marks forinternal assessment and 70 marks for semester end lab examination. Out of 30 marks ofinternal assessment, continuous lab assessment will be done for 20 marks for the day today performance and 10 marks for the final internal lab assessment.

Semester End Examination (SEE): The semester end labexamination for 70 marks shall be conducted by two examiners, one of them beingInternal Examiner and the other being External Examiner, both nominated by thePrincipal from the panel of experts recommended by Chairman, BOS. The emphasis on the experiments is broadly based on the following criteria given in Table: 1

	Experiment Based	Programming based
20 %	Objective	Purpose
20 %	Analysis	Algorithm
20 %	Design	Programme
20 %	Conclusion	Conclusion
20 %	Viva	Viva

Continuous Internal Assessment (CIA):

CIA is conducted for a total of 30 marks (Table 1), with 20 marks for continuous lab assessment during day to day performance, 10 marks for final internal lab assessment.

Component			Total Marks
Type of Assessment	**Day to day performance**	**Final internal lab assessment**	
CIA Marks	20	10	30

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.

1. **Experiment Based**

Objective	Analysis	Design	Conclusion	Viva	Total
2	2	2	2	2	10

2. **Programming Based**

Objective	Analysis	Design	Conclusion	Viva	Total
2	2	2	2	2	10

VI COURSE OBJECTIVES:

The students will try to learn:

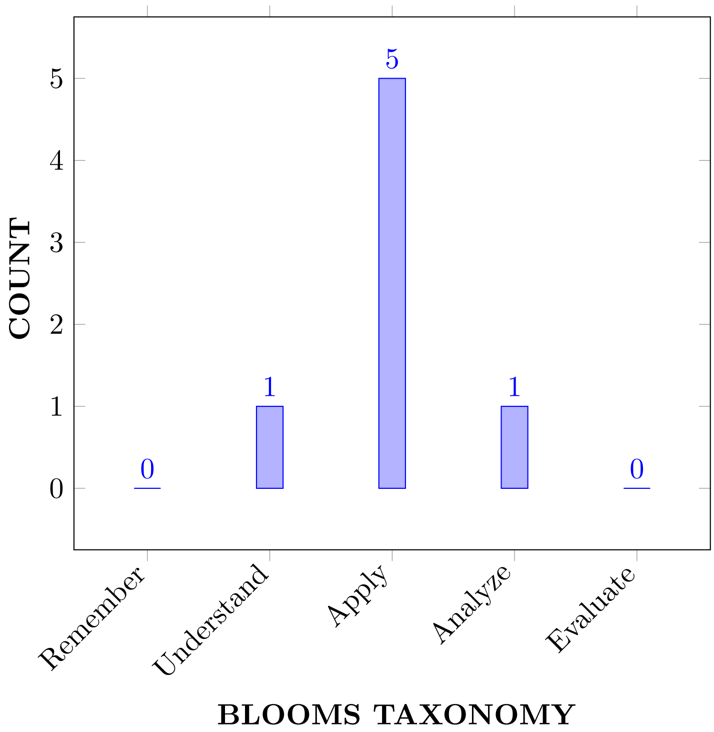
I	DemonstratethebasicprinciplesofMATLAB.
II	Analyze the applications of Algebraand Calculus using MATLAB software.
III	Estimate the roots of Algebraic and Transcendental equations..
IV	Evaluate the characteristics of given curves bymeans of plottingagraph.

VII COURSE OUTCOMES:

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

CO 1	**Solve** the algebraic and transcendental equations with in given range rangeusing MAT LAB programs. .	Apply
CO 2	**Utilize** MAT LAB programs for verifying properties of limits,derivatives of a function.	Apply
CO 3	**Interpret** rank,eigen values and vectors with matrix transformations.	Understand
CO 4	**Utilize** MAT LAB programs for solving differential equations and multiple integrals.	Apply
CO 5	**Make use of** of MAT LAB programs for interpolating values of differential equations numerically.	Apply
CO 6	**Use** MAT LAB programs for vector operations on vector field.	Apply

COURSE KNOWLEDGE COMPETENCY LEVEL



VIII HOW PROGRAM OUTCOMES ARE ASSESSED:

Program		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	Lab Exercises

PO 2	**Problem analysis:** Problem analysis: Identify, formulate, review research literature, and analyze complexengineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences	2	CIA
PO 4	**Conduct investigations of complex problems:**Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.	2	Lab Exercises

3 = High; 2 = Medium; 1 = Low

IX HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

Program		**Strength**	**Proficiency Assessed by**
PSO 1	Design and Supervise Sub-Structures and Super Structures for Residential and Public Buildings, Industrial Structures, Irrigation Structures, Power Houses, Highways, Railways, Airways, Docs and Harbours	1	Presentation on real-world problems

3 = High; 2 = Medium; 1 = Low

X 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	Utilize the concept of calibration to a considerable extent appreciate (understanding) their importance and applicability (apply) in solving (complex) fluid flow engineering problems by applying the **principles of Mathematics and Engineering**	3
	PO 2	Identify (given **problem statement**)MAT LAB commands for synthesizing and analyzing the given data (provided **information and data**) by principles of Mathematics.	4
	PO 4	Apply (given **problem statement**)MAT LAB commands for analyzing the given data **information and data**) by using various algebraic functions numerically.	2
	PSO 1	Apply (**knowledge**) properties, various types and patterns of fluid flow configurations (apply) for solving design problems by applying the **in various engineering streams following mathematical rules and conditons.**	1

CO 2	PO 1	Identify (understanding) the appropriate MAT LAB programs for verifying limitsand derivatives of the givenfunctions and Understand the major role of these functions which exists as solutions **for integrals and differential equations of elementary functions by applying the principles of mathematics.**	3
	PO 2	Identify (given **problem statement**) the given problem and formulate MAT LAB program for solving and make use of mathematical method **information**to facilitate physical interpretation of the results obtained.	4
	PO 4	Apply (given **problem statement**) the given problem and formulate MAT LAB program for solving and make use of mathematical method MAT LABcommands for synthesizing and analyzing the given data **information**in various engineering streams following mathematical rules and conditons.	2
	PSO 1	Apply (knowledge) MAT LAB commands for synthesizing and analyzing the given data **in various engineering streams following mathematical rules and conditons.**	1
CO 3	PO 1	Interpret (**knowledge**) the rank and inverse of real and complex matrices using MAT LAB programs.	3
	PO 2	Apply **problem statement** MAT LAB program for decomposing the given matrix for (**complex**) solving complex engineering problems following principles ofmathematics. **results**.	4
	PO4	Apply (knowledge) MAT LAB programfor finding Eigen values and Eigen vectors along **with basic principles of mathematics to develop the solution.**	2
	PSO 1	Apply (knowledge)MAT LAB commands for synthesizing and analyzing the given data **in various engineering streams following mathematical rules and conditons.**	1
CO 4	PO 1	Identify (knowledge) appropriate MAT LAB programsforfinding length of the curves and area of the surfacefor with respect to **the fundamental operations of arithmetic(knowledge) for majority of functions by principlesofMathematics.**	3
	PO 2	Interpret **problem statement and formulate** the suitable MAT LAB program for solving double and triple integral in the given region.	2
	PSO 1	Apply (knowledge) MAT LAB commands for synthesizing and analyzing the given data in various engineering streams	1
CO 5	PO 1	Apply the knowledge of **Mathematics and Engineering fundamentals**the knowledge of MAT LAB programs. toSolve the algebraic and transcendental equations numerically with in given range .	3

	PSO 1	Apply **problem statement** MAT LAB commands for synthesizing and analyzing the given data in various engineering streams following mathematical rules and conditons.	1
CO 6	PO 1	Develop **Mathematics and Engineering fundamentals** the formulation of differential calculus of complex engineering problems which transforms vector functions, gradient, Divergence and curl using principle of mathematics to the realworld engineering problems by using MAT LAB programs.	3
	PO 2	Apply **principles of Sciences and Engineering fundamentals** the formulation of integral transformations to complex engineering problems related to surface and volume, line and surface of different geometrical models using principle of mathematics in the domain of engineering to reach conclusions by interpretation of results.	2
	PSO 1	Apply **understand the innovative and dynamic challenges** MAT LAB commands for synthesizing and analyzing the given data in various engineering streams following mathematical rules and conditons.	1

XI MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

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

XII ASSESSMENT METHODOLOGY DIRECT:

CIE Exams	✓	SEE Exams	✓	Seminars	-
Laboratory Practices	✓	Student Viva	✓	Certification	-
Assignments	-				

XIII ASSESSMENT METHODOLOGY INDIRECT:

✓	Early Semester Feedback	✓	End Semester OBE Feedback
X	Assessment of Mini Projects by Experts		

XIV SYLLABUS:

WEEK I	**BASIC FEATURES**
	To Know the history and features of MATLAB, To Know the loca lenvironment of MATLAB
WEEK II	**ALGEBRA**
	Solving basic algebraic equations, Solving system of equations, Two dimensional plots.
WEEK III	**CALCULUS**
	Calculating limits, Solving differential equations, Finding definite integral.
WEEK IV	**MATRICES**
	Addition,subtraction and multiplication of matrices, Transpose of a matrix, Inverse of a matrix.
WEEK V	**SYSTEMOF LINEAREQUATIONS**
	Rank of a matrix, Gauss Jordan method, LU decomposition method.
WEEK VI	**LINEARTRANSFORMATION**
	Characteristic equation, Eigen values, Eigen vectors.
WEEK VII	**DIFFERENTIATIONANDINTEGRATION**
	a. Higher order differential equations, Double integrals, Triple integrals.
WEEK VIII	**INTERPOLATION AND CURVEFITTING**
	Lagrange polynomial, Straight linefit, Polynomial curve fit.
WEEK IX	**ROOT FINDING TECHNIQUES**
	Bisection method, Regulafalsemethod, NewtonRaphsonmethod.
WEEK X	**NUMERICAL DIFFERENTION AND INTEGRATION**
	Trapezoidal, Simpson‘smethod, Eulermethod, RungeKuttamethod.
WEEK XI	**3D PLOTTING**
	Line plotting, Surfaceplotting Volumeplotting.
WEEK XII	**VECTORCALCULUS**
	Gradient, Divergent, Curl.

TEXTBOOKS

1. 1. Dean G.Duffy, Advanced Engineering Mathematics with MATLAB, CRC Press,Taylorand Francis Group,6thEdition,NewDelhi,2015.

REFERENCE BOOKS:

1. 1.Cleve Moler,Numerical Computing with MATLAB,SIAM,Philadelphia,2ndEdition,2008.

XV 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	Understanding thebasic featuresof MATLAB.	CO 1	T1:1.1 R1:2.21
2	Determination of roots of agiven polynomial.	CO 1	T1:15.1 R1:2.25
3	Verification of basic properties of limits.	CO 2	T1:2.1 R1:2.21
4	Determination ofrank,inverse,transpose and obtaining the solution to linear system of equationsofamatrix.	CO 3	T1-15.6 R1:2.32
5	Interpret the Eigen values and Eigenvectors of a matrix.	CO 3	T1:15.5 R1:2
6	Determination of derivatives and integration toa Given function.	CO 4	T1:2.1 R1:2.8
7	Determination of bestfit curve to the given data	CO 6	T1:3.0 R1:2.9
8	Calculation of areaenclosed bounded bya region.	CO 4	T1:14.5 R1:5.1
9	Solving the higher order differential equations.	CO 4	T1:3.1 R1:5.21
10	Plotting agiven surface bounded in a region.	CO 4	T1:14.3-14.8 R1:5.1
11	Determination of gradient,divergence and cur of avector. .	CO 5	T1:14.2 R1:2.2
12	Determination of roots to algebraic and transcendental equations by bisection method, Method of false position and Newton-Raphson method	CO 6	T1:2.2 R1:2.25

XVI EXPERIMENTS FOR ENHANCED LEARNING (EEL):

S.No	Design Oriented Experiments
1	**Algebraic equations:** Apply MAT LAB programs to algebraic equations
2	**Differentiation:** Apply MAT LAB programs differential equations and matrices .
3	**Matrices:** Apply MAT LAB programs to eigen values and eigen vectors.
4	**Numerical methods** Apply MAT LAB programs to numerical methods
5	**Vector calculus:** Apply MAT LAB programs to vector calculus

Signature of Course Coordinator **HOD,CE**

Ms. B Praveena, Assistant Professor

INSTITUTE OF AERONAUTICAL ENGINEERING
(Autonomous)
Dundigal, Hyderabad - 500 043
CIVIL ENGINEERING
COURSE DESCRIPTION

Course Title	ENGINEERING PHYSICS LABORATORY				
Course Code	AHS105				
Program	B.Tech				
Semester	II	CE			
Course Type	FOUNDATION				
Regulation	IARE - R16				
Course Structure	Theory			Practical	
	Lecture	Tutorials	Credits	Laboratory	Credits
	-	-	-	2	1
Course Coordinator	Mr. K Saibaba, Assistant Professor				

I COURSE OVERVIEW:

This lab course provides hands on experience in a number of experimental techniques and developscompetenceintheinstrumentationtypicallyusedinphysics.This also develops student's expertise in applying physical concepts to practical problem and in learning about experimental techniques with advanced equipments. This laboratory includes experiments involving electromagnetism and optoelectronics.

II COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites	Credits
-	-	-	-	-

III MARKS DISTRIBUTION:

Subject	SEE Examination	CIE Examination	Total Marks
Engineering Physics laboratory	70 Marks	30 Marks	100

IV DELIVERY / INSTRUCTIONAL METHODOLOGIES:

✓	Demo Video	✓	Lab Worksheets	✓	Viva Questions	✓	Probing Further Experiments

V EVALUATION METHODOLOGY:

Each laboratory will be evaluated for a total of 100 marks consisting of 30 marks for internal assessment and 70 marks for semester end lab examination. Out of 30 marks of internal assessment, continuous lab assessment will be done for 20 marks for the day-to-day performance and 10 marks for the final internal lab assessment.

Semester End Examination (SEE): The semester end lab examination for 70 marks shall be conducted by two examiners, one of them being Internal Examiner and the other being External Examiner, both nominated by the principal from the panel of experts recommended by Chairman, BOS.

The emphasis on the experiments is broadly based on the following criteria given in Table: 1

	Experiment Based	Programming based
20 %	Objective	Purpose
20 %	Analysis	Algorithm
20 %	Design	Programme
20 %	Conclusion	Conclusion
20 %	Viva	Viva

Continuous Internal Assessment (CIA):

CIA is conducted for a total of 30 marks (Table 1), with 20 marks for continuous lab assessment during day to day performance, 10 marks for final internal lab assessment.

Component	**Laboratory**		Total Marks
Type of Assessment	**Day to day performance**	**Final internal lab assessment**	
CIA Marks	20	10	30

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.

A. Experiment Based

Objective	**Analysis**	**Design**	**Conclusion**	**Viva**	**Total**
2	2	2	2	2	10

B. Programming Based

Purpose	**Algorithm**	**Program**	**Conclusion**	**Viva**	**Total**
2	2	2	2	2	10

VI COURSE OBJECTIVES:

The students will try to learn:

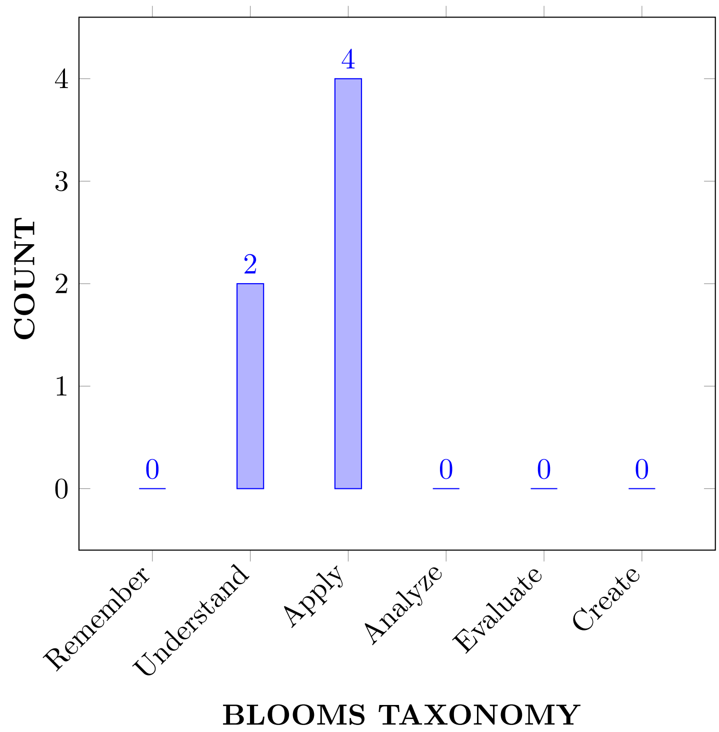
I	To familiarize with the lab facilities, equipment, standard operating procedures.
II	About the different kinds of functional electric and magnetic materials which paves a way for them to use in various technical and engineering applications.
III	The analytical techniques and graphical analysis to study the experimental data for optoelectronic devices.
IV	The applications of variation in the intensity of light due to natural phenomena like interference and diffraction.

VII COURSE OUTCOMES:

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

CO 1	**Interpret** the least count values of Vernier calipers and Screw guage Apply the concept of hook's law and determine the rigidity modulus of wire.	Apply
CO 2	**Illustrate** principle, working and application of wave propagation and compare results with theoretical harmonics and overtones.	Understand
CO 3	**Investigate** the magnetic field induction produced at various points along the axis of current carrying coil and the magnetic field produced in a coil to verify the Tangent's law.	Apply
CO 4	**Examine** launching of light through optical fiber from the concept of light gathering capacity of numerical aperture.	Understand
CO 5	**Utilize** the method of minimum deviation and adjust the spectrometer to minimum deviation position also determine the dispersive power of prism by using spectrometer.	Apply
CO 6	**Investigate** V-I/L-I characteristics of various optoelectronic devices like Light Emitting Diode, Laser diode to understand their basic principle of functioning	Apply

COURSE KNOWLEDGE COMPETENCY LEVEL



VIII HOW PROGRAM OUTCOMES ARE ASSESSED:

Program		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	Laboratory experiments, internal and external lab examinations.
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	Laboratory experiments, internal and external lab examinations.
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.	1	Laboratory experiments, internal and external lab examinations.

3 = High; 2 = Medium; 1 = Low

IX HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

Program		Strength	Proficiency Assessed by
PSO 3	Make use of Advanced Structural Analysis and Project Management Software for creating Modern Avenues to succeed as an Entrepreneur, Pursue Higher Studies and Career Paths.	1	Laboratory experiments and Surveys

3 = High; 2 = Medium; 1 = Low

X 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	Identify basic principle of Vernier caliperse and screw guage to determine their least count values and also finding the rigidity modulus of given wire.	2
	PO 2	Understand the Hoocks law and the rigidity modulus finding by using the given wire and bross or any metal disk .	4
	PO 1	Determine the energy gap of a semiconductor diode by making use of graphical analysis of current versus temperature curve.	2

CO 2	PO 1	Recall the theory of propagation of longitudinal and transverse waves and make use of number of loops formation in string to determine frequency of an electronically maintained tuning fork.	2
	PO 2	Understand the given problem statement of stationary wave propagation and formulate harmonics and overtones of fundamental frequency from experimental collection of information and data in reaching substantial conclusions by the interpretation of results.	4
CO 3	PO 1	Explain the variation of magnetic field at various points along the axis of current carrying coil and make use of mathematical expression of Tangent's law using Stewart Gee's apparatus.	2
	PO 2	Understand the given problem statement of current loop and formulate magnetic field induction at various points along the axis of current loop from experimental collection of information and data in reaching substantial conclusions by the interpretation of results.	4
	PO 1	Investigate the method of minimum deviation position and also determine the dispersive power of prism by using spectrometer. and adjust the spectrometer to minimum deviation position	2
	PO 2	Investigate the method of minimum deviation position and also determine the dispersive power of prism by using spectrometer. and adjust the spectrometer to minimum deviation position	4
	PO 4	Apply the concept of Newton's rings to determine the radius of curvature of convex lens	1
	PSO 3	Make use of modern simulation tool to get information about energy losses associated with a ferromagnetic material.	1
CO 4	PO 1	Interpret launching of light through optical fiber and make use of mathematical expression for analyzing light gathering capacity through numerical aperture.	2
	PO 4	Make use of optical fiber trainer kit and understand conversion of electrical to light energy..	1
CO 5	PO 1	Explain the concept of interference in Newton's rings and make use of it to determine the radius of curvature of convex lens.	2
	PO 4	Make use of microscope to get Newton's rings and understand the phenomenon of interference in reflected light.	1
	PO 1	Recollect the phenomena of diffraction from N-slits and make use of it for the determination of wavelength of a given laser.	1
	PO 1	Determine the thickness of a wire and radius of a disc using screw gauge and vernier calipers	1

CO 6	PO 1	Explain the V-I characteristics of light emitting diode with different colours of LEDs for different threshold voltage values.	2
	PO 1	Understand the phenomenon of recombination of electron-hole pair and determine the value of threshold voltage of a given LED.	2
	PO 1	Illustrate the variation of photo current with light intensity in a Laser diode.	1

XI MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

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

3 = High; 2 = Medium; 1 = Low

XII ASSESSMENT METHODOLOGY DIRECT:

CIE Exams	✓	SEE Exams	✓	Seminars	-
Laboratory Practices	✓	Student Viva	✓	Certification	-
Assignments	-				

XIII ASSESSMENT METHODOLOGY INDIRECT:

✓	Early Semester Feedback	✓	End Semester OBE Feedback
X	Assessment of Mini Projects by Experts		

XIV SYLLABUS:

WEEK 1	**MEASUREMENT OF THICKNESS OF A WIRE AND RADIUS OF DISC**
	Determine the thickness of a wire and radius of a disc using screw gauge and vernier calipers .
WEEK 2	**TORSIONAL PENDULUM**
	Determination of rigidity modulus of the material of given wire using a torsional pendulum .
WEEK 3	**STEWART GEE'S APPARATUS**
	Determination of Magnetic field along the axis of current carrying coil – Stewart and Gee's method.
WEEK 4	**DETERMINATION OF FREQUENCY OF LONGITUDINAL WAVES**
	Determination of frequency of a given tuning fork in longitudinal mode.
WEEK 5	**DETERMINATION OF FREQUENCY OF TRANSVERSE WAVES**
	Determination of frequency of a given tuning fork in transverse mode.
WEEK 6	**WAVELENGTH OF LASER SOURCE-DIFFRACTION GRATING**
	To determine the wavelength of given source of laser using a plane transmission grating.
WEEK 7	**ADJUSTMENT AND MINIMUM DEVIATION IN SPECTROMETER**
	To study about spectrometer and to adjust spectrometer in minimum deviation position.
WEEK 8	**DISPERSIVE POWER OF A MATERIAL OF PRISM**
	Determination of the dispersive power the material of the given prism.
WEEK 9	**NEWTONS RINGS**
	Determination of radius of curvature of a given plano-convex lens.
WEEK 10	**NUMERICAL APERTURE OF GIVEN FIBER**
	To determine the numerical aperture of a given optical fiber.
WEEK 11	**LIGHT EMITTING DIODE**
	Studying V-I characteristics of LED
WEEK 12	**CHARACTERISTICS OF LASER DIODE**
	To study L-I characteristics of a laser diode.

TEXTBOOKS

1. 1 CL Arora, "Practical Physics", S Chand and Co.,New Delhi, 3rd Edition,2012.
2. 2 Vijay Kumar, Dr. T. Radha krishna, "Practical Physics for Engineering Students", S M Enterprises, 2nd Edition, 2014.

REFERENCE BOOKS:

1. 1 CF Coombs,"Basic Electronic Instrument Handbook", McGraw - HillBookCo.,1972.
2. 2 CH Bernardand CD Epp, John Wiley and Sons, " Laboratory Experiments in College Physics" Inc.,NewYork,1995.

XV 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	Determine the thickness of a wire and radius of a disc using screw gauge and vernier calipers .	CO 1	T1:13.5
2	Determination of rigidity modulus of the material of given wire using a torsional pendulum .	CO 2	T1:13.5
3	Determination of Magnetic field along the axis of current carrying coil – Stewart and Gee's method.	CO 3, CO 4	TT1:14.7
4	Determination of frequency of a given tuning fork in longitudinal mode.	CO 3	T1:15.7
5	Determination of frequency of a given tuning fork in transverse mode.	CO 1	T1:16.8
6	To determine the wavelength of given source of laser using a plane transmission grating.	CO 6	T1:16.9
7	To study about spectrometer and to adjust spectrometer in minimum deviation position.	CO 4	T1:17.9
8	Determination of the dispersive power the material of the given prism.	CO 5	T1:18.10
9	Determination of radius of curvature of a given plano-convex lens.	CO 6	T1:19.10
10	Determine the numerical aperture of a given optical fiber.	CO 6	T1:19.9
11	Studying V-I characteristics of LED	CO 5	T1:23.10
12	Study L-I characteristics of a laser diode.	CO 5	T1:23.10

XVI EXPERIMENTS FOR ENHANCED LEARNING (EEL):

S.No	Design Oriented Experiments
1	To determine the width of slit by using Laser light source by diffraction method
2	To study the bending losses and transmission losses of an optical Fiber
3	To Calculate carrier concentration og given semiconductor by using Hall Effect.
4	Study the characteristics of Photo diode.
5	To illustrate the interference pattern produced from the air wedge.
6	To determine energy loss of ferromagnetic material

Signature of Course Coordinator **HOD,CE**
Mr.K Saibaba, Assistant Professor

INSTITUTE OF AERONAUTICAL ENGINEERING
(Autonomous)
Dundigal, Hyderabad - 500 043

CIVIL ENGINEERING
COURSE DESCRIPTION

Course Title	**COMPUTER PROGRAMMING LABORATORY**					
Course Code	ACS101					
Program	B.Tech					
Semester	I	|CE				
Course Type	Foundation					
Regulation	IARE - R18					
	Theory			Practical		
Course Structure	Lecture	Tutorials	Credits	Laboratory	Credits	
	-	-	-	3	2	
Course Coordinator	Mr,Ravinder, Assistant Professor					

I COURSE OVERVIEW:

The course covers the basics of programming and demonstrates fundamental programming techniques, customs and terms including the most common library functions and the usage of the preprocessor. This course helps the students in gaining the knowledge to write simple C language applications, mathematical and engineering problems. This course helps to undertake future courses that assume this programming language as a background in computer programming. Topics include variables, data types, functions, control structures, pointers, strings, arrays and dynamic allocation principles. This course in reached to student by power point presentations, lecture notes, and lab involve the problem solving in mathematical and engineering areas..

II COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites
			-

III MARKS DISTRIBUTION:

Subject	SEE Examination	CIE Examination	Total Marks
Computer Programming Laboratory	70 Marks	30 Marks	100

IV DELIVERY / INSTRUCTIONAL METHODOLOGIES:

✓	Demo Video	✓	Lab Worksheets	✓	Viva Questions	✓	Probing further Questions

V EVALUATION METHODOLOGY:

Each laboratory will be evaluated for a total of 100 marks consisting of 30 marks forinternal assessment and 70 marks for semester end lab examination. Out of 30 marks ofinternal assessment, continuous lab assessment will be done for 20 marks for the day today performance and 10 marks for the final internal lab assessment.

Semester End Examination (SEE): The semester end labexamination for 70 marks shall be conducted by two examiners, one of them beingInternal Examiner and the other being External Examiner, both nominated by thePrincipal from the panel of experts recommended by Chairman, BOS. The emphasis on the experiments is broadly based on the following criteria given in Table: 1

	Experiment Based	Programming based
20 %	Objective	Purpose
20 %	Analysis	Algorithm
20 %	Design	Programme
20 %	Conclusion	Conclusion
20 %	Viva	Viva

Continuous Internal Assessment (CIA):

CIA is conducted for a total of 30 marks (Table 1), with 20 marks for continuous lab assessment during day to day performance, 10 marks for final internal lab assessment.

Component			Total Marks
Type of Assessment	**Day to day performance**	**Final internal lab assessment**	
CIA Marks	20	10	30

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.

1. **Experiment Based**

Objective	Analysis	Design	Conclusion	Viva	Total
2	2	2	2	2	10

2. **Programming Based**

Objective	Analysis	Design	Conclusion	Viva	Total
2	2	2	2	2	10

VI COURSE OBJECTIVES:

The students will try to learn:

I	The hands on experience in design, develop, implementation and evaluation by using Asymptotic notation.
II	The demonstration knowledge of basic abstract data types (ADT) and associated algorithms for organizing programs into modules using criteria that are based on the data structures of the program.

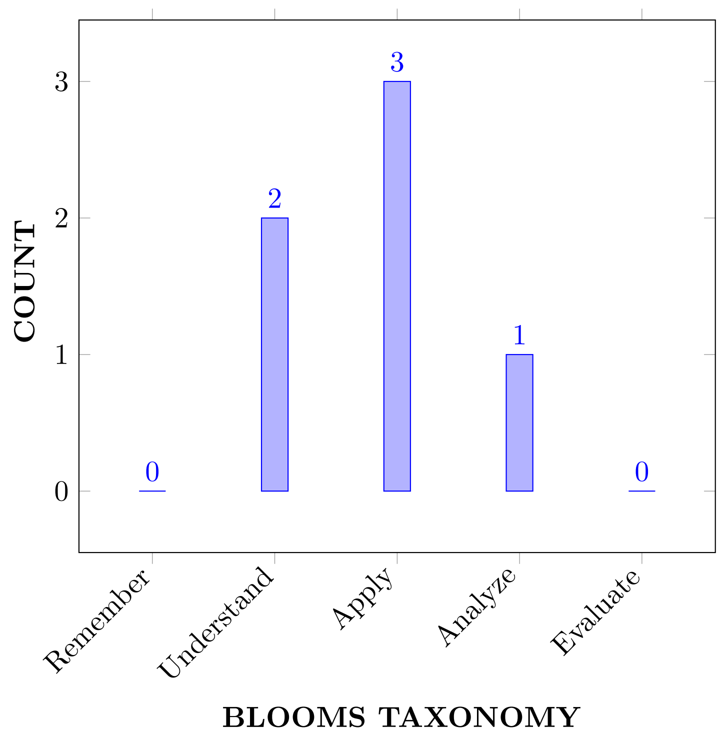
III	The practical implementation and usage of non linear data structures for solving problems of different domain.
IV	The knowledge of more sophisticated data structures to solve problems involving balanced binary search trees, AVL Trees, B-trees and B+ trees, hashing.
V	The graph traversals algorithms to solve real-world challenges such as finding shortest paths on huge maps and assembling genomes from millions of pieces

VII COURSE OUTCOMES:

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

CO 1	**Demonstrate** problem solving steps in terms of algorithms, pseudocode and flowcharts for Mathematical and Engineering problems. .	Understand
CO 2	**Make use** the concept of operators, precedence of operators, conditional statements and looping statements to solve real time applications.	Apply
CO 3	**Demonstrate** the concept of pointers, arrays and perform pointer arithmetic, and use the pre-processor.m.	Understand
CO 4	**Analyze** the complexity of problems, modularize the problems into small modules and then convert them into programs.	Apply
CO 5	**Implement** the programs with concept of file handling functions and pointer with real time applications of C.	Apply
CO 6	**Explore** the concepts of searching and sorting methods with real time applications using c	Analyze

COURSE KNOWLEDGE COMPETENCY LEVEL



VIII HOW PROGRAM OUTCOMES ARE ASSESSED:

Program		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.	2	Viva-voce/Laboratory Practices
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	Viva-voce/Laboratory Practices
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.	2	Viva-voce/Laboratory Practices
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	Viva-voce/Laboratory Practices
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	Viva-voce/Laboratory Practices
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	Viva-voce/Laboratory Practices

3 = High; 2 = Medium; 1 = Low

IX HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

Program		Strength	Proficiency Assessed by
PSO 1	**Professional Skills:** The ability to research, understand and implement computer programs in the areas related to algorithms, system software, multimedia, web design, big data analytics, and networking for efficient analysis and design of computer-based systems of varying complexity. .	2	Viva-voce Laboratory Practices

PSO 2	**Software Engineering Practices:** The ability to apply standard practices and strategies in software service management using open-ended programming environments with agility to deliver a quality service for business success .	2	Viva-voce Laboratory Practices
PSO 3	**Successful Career and Entrepreneurship:** The ability to employ modern computer languages, environments, and platforms in creating innovative career paths, to be an entrepreneur, and a zest for higher studies. .	2	Viva-voce Laboratory Practices

3 = High; 2 = Medium; 1 = Low

X 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 algorithm analysis which provides theoretical estimates for the resources needed by any algorithm for a given computational problem. These estimates provide an insight into reasonable directions of search for efficient algorithms by applying the principles of **mathematics and science**	3
	PO 5	Understand the (given **knowledge**) appropriate techniques, resources, and modern Engineering and IT tools including prediction and modeling to complex Engineering activities with an understanding of the limitations.	3
CO 2	PO 1	Understand (knowledge)the basic concept of algorithm analysis which provides theoretical estimates for the resources needed by any algorithm for a given computational problem. These estimates provide an insight into reasonable directions of search for efficient algorithms by applying the principles of **mathematics and science.**	3
	PO 5	Understand the (**knowledge**) appropriate techniques, resources, and modern Engineering and IT tools including prediction and modeling to complex Engineering activities with an understanding of the limitations.	2
CO 3	PO 1	Understand (**knowledge**) the basic concept of algorithm analysis which provides theoretical estimates for the resources needed by any algorithm for a given computational problem. These estimates provide an insight into reasonable directions of search for efficient algorithms by applying the principles of **mathematics and science.**	3
	PO 5	Understand the (knowledge) appropriate techniques, resources, and modern Engineering and IT tools including prediction and modeling to complex Engineering activities with an understanding of the limitations.	3

CO 4	PO 1	Describe (knowledge) the use sorting techniques as a basic building block in algorithm design and problem solving **using principles of mathematics, science, and engineering fundamentals.**	3
	PO 5	Understand the **knowledge** appropriate techniques, resources, and modern Engineering and IT tools including prediction and modeling to complex Engineering activities with an understanding of the limitations.	2
	PO 10	Apply (knowledge) concept of dimensional analysis and similarity parameters for predicting physical parameters (understanding) for the fluid flow analysis used in designing prototypes devices (apply) solving design problems by applying the **communicating effectively with engineering community.**	3
CO 5	PO 1	Outline the importance of searching algorithms to retrieve an element from any data structure where it is stored by **understanding and applying the fundamentals of mathematics, science and engineering.**	3
	PO 10	Understand the use of searching techniques that retrieve information stored within some data structure by **communicating effectively with engineering community**.	2
CO 6	PO 1	Outline the importance of searching algorithms to retrieve an element from any data structure where it is stored by **understanding and applying the fundamentals of mathematics, science and engineering**	2
	PO 10	Understand the use of searching techniques that retrieve information stored within some data structure by **communicating effectively with engineering communit.**	3

XI MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

COURSE OUTCOMES	PROGRAM OUTCOMES				
PO	PO 2	PO 3	PO 5	PO 10	PSO 1
CO 1	3			2	
CO 2	3			2	
CO 3	3			2	3
CO 4	3			2	2
CO 5	2				2
CO 6	3				2

XII ASSESSMENT METHODOLOGY DIRECT:

CIE Exams	✓	SEE Exams	✓	Seminars	-
Laboratory Practices	✓	Student Viva	✓	Certification	-
Assignments	-				

XIII ASSESSMENT METHODOLOGY INDIRECT:

✓	Early Semester Feedback	✓	End Semester OBE Feedback
X	Assessment of Mini Projects by Experts		

XIV SYLLABUS:

WEEK I	**SEARCHING TECHNIQUES**
	Write python program for implementing the following searching techniques. a. Linear search. b. Binary search. c. Fibonacci search.
WEEK II	**SORTING TECHNIQUES**
	Write Python programs for implementing the following sorting techniques to arrange a list of integers in ascending order. a. Bubble sort. b. Insertion sort. c. Selection sort.
WEEK III	**SORTING TECHNIQUES**
	Write Python programs for implementing the following sorting techniques to arrange a list of integers in ascending order. a. Quick sort. b. Merge sort.
WEEK IV	**IMPLEMENTATION OF STACK AND QUEUE**
	Write Python programs to a. Design and implement Stack and its operations using Lists. b. Design and implement Queue and its operations using Lists
WEEK V	**APPLICATIONS OF STACK**
	Write Python programs for the following: a. Uses Stack operations to convert infix expression into postfix expression. b. Uses Stack operations for evaluating the postfix expression. .
WEEK VI	**IMPLEMENTATION OF SINGLE LINKED LIST**
	Write Python programs for the following: a. Uses functions to perform the following operations on single linked list. (i) Creation (ii) insertion (iii) deletion (iv) traversal b. To store a polynomial expression in memory using linked list. .
WEEK VII	**IMPLEMENTATION OF CIRCULAR SINGLE LINKED LIST**
	Write Python programs for the following: Uses functions to perform the following operations on Circular linked list. (i) Creation (ii) insertion (iii) deletion (iv) traversal .
WEEK VIII	**IMPLEMENTATION OF DOUBLE LINKED LIST**
	Write Python programs for the following: Uses functions to perform the following operations on double linked list. (i) Creation (ii) insertion (iii) deletion (iv) traversal in both ways .
WEEK IX	**IMPLEMENTATION OF STACK USING LINKED LIST**
	Write Python programs to implement stack using linked list.

WEEK X	**MPLEMENTATION OF QUEUE USING LINKED LIST**
	Write Python programs to implement queue using linked list
WEEK XI	**GRAPH TRAVERSAL TECHNIQUES**
	Write Python programs to implement the following graph traversal algorithms: a. Depth first search. b. Breadth first search.
WEEK XII	**IMPLEMENTATION OF BINARY SEARCH TREE**
	Write a Python program that uses functions to perform the following: a. Create a binary search tree. b. Traverse the above binary search tree recursively in pre-order, post-order and in-order. Count the number of nodes in the binary search tree.

TEXTBOOKS

1. Sutton, G.P., et al., —Rocket Propulsion Elements, John Wiley Sons Inc., New York, 1993
2. Martin J.L Turner , Rocket Space Craft Propulsion, Springers oraxis publishing, 2001

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1. Mathur, M., and Sharma, R.P., —Gas Turbines and Jet and Rocket Propulsion, Standard Publishers, New Delhi 1998
2. Cornelisse, J.W., Rocket Propulsion and Space Dynamics, J.W., Freeman & Co. Ltd., London, 1982.
3. Parker, E.R., Materials for Missiles and Spacecraft, McGraw-Hill Book Co. Inc., 1982.

XV 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	Calibration of Venturimeter and Orifice meter.	CO 1	R1: 1.2
2	Determination of pipe flow losses in rectangular and circular pipes.	CO 2	R2: 3.5
3	Verification of Bernoulli‘s theorem	CO 3	R1: 3.4
4	Determination of Reynolds Number of fluid flow	CO 4	R1: 2.2
5	Determine the reaction forces produced by the change in momentum.	CO 5	R1: 2.4
6	Determine the efficiencyand draw theperformance curves ofcentrifugal pump.	CO 6	R3: 4.5
7	Determine the efficiencyand draw theperformance curves of reciprocating pump.	CO 6	R3: 4.6
8	Determine the performance characteristics of pelton wheel under constant head.	CO 6	R2: 5.1
9	Determine the performance characteristics of Francis turbine.	CO 6	R2: 5.2
10	Determine the rate of flow through weir.	CO 6	R1: 7.1
11	Determine the rate of flow through Nothches.	CO 6	R1:7.2
12	Determine the rate of flow through a Orifice meter	CO 6	R1:7.3

XVI EXPERIMENTS FOR ENHANCED LEARNING (EEL):

S.No	Design Oriented Experiments
1	**Twin vortex formation:** Demonstration of twin vortex formation and calculation of vortex size for different geometries.
2	**Open channel:** Demonstration of streamline at different angle of attack and calculation of separation point for different Reynolds number.
3	**Capillary action:** By modeling capillary action using two cups of water and a paper towel, you'll gain a better understanding of the importance of this process in trees.
4	**Buoyancy** Calculation of meta center and displacement volume for various geometries and materials.
5	**Flow through pipes:** Encourage students to design and analyze flow through pipes using ANSYS

Signature of Course Coordinator **HOD,CE**
Mr. P Ravinder, Assistant Professor

INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

Dundigal, Hyderabad -500 043

CIVIL ENGINEERING

COURSE DESCRIPTION

Course Title	**COMPUTER AIDED ENGINEERINGDRAWING PRACTICE**				
Course Code	AME102				
Programme	B.Tech				
Semester	II				
Course Type	Core				
Regulation	R16				
Course Structure	**Theory**			**Practical**	
	Lectures	**Tutorials**	**Credits**	**Laboratory**	**Credits**
	1	-	-	2	1.5
Chief Coordinator	Mr. R.Srinivas, Assistant Professor, ME				

I. COURSE OVERVIEW:

Drawing is the accurate technique that develops the ability to visualize any object with all physical anddimensional configurations. During the process of design, the designer may have to carry out a large amountof computations to generate optimum design and develops engineering drawings for manufacturing a productusing interactive computer graphics. The computer aided engineering drawing assists in preparation of 3Dand 2D drawings to carry out sophisticated design and analysis. This course forms the foundation for thedevelopment of computer graphics and CAD/CAM technologies in the era of digital manufacturing

II. COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites	Credits
UG	AHS002	I	Linear Algebra and Ordinary Differential Equations	4

III. MARKSDISTRIBUTION:

Subject	SEE Examination	CIA Examination	Total Marks
Computer Aided Engineering Drawing Practice	70 Marks	30 Marks	100

IV. DELIVERY / INSTRUCTIONAL METHODOLOGIES:

✔	Open Ended Experiments	✔	Demo Video	✔	Lab Worksheets	✔	Viva Questions

V. EVALUATION METHODOLOGY:

VI. The course will be evaluated for a total of 100marks, with 30 marks for Continuous Internal Assessment (CIA) and 70 marks for Semester End Examination (SEE). Out of 30 marks allotted for CIA during the semester, marks are awarded by taking average of two CIA examinations or the marks scored in the make-up examination.

VII. **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 14 marks. There could be a maximum of two subdivisions 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
20%	Remember
60%	Understand
20%	Apply
0%	Analyze
0%	Evaluate
0%	Create

Continuous Internal Assessment (CIA):

CIA is conducted for a total of 30 marks, with 25 marks for Continuous Internal Examination (CIE), 05 marks for Quiz and 05 marks for Alternative Assessment Tool (AAT).

Component	Theory		Total Marks
Type of Assessment	CIE Exam	Quiz \ AAT	
CIA Marks	25	05	30

Continuous Internal Examination (CIE):

Two CIE exams shall be conducted at the end of the $8^{th}$and 17^{th}week of the semester respectively. The CIE exam is conducted for 25 marks of 2hours duration consisting of 5 descriptive type questions out of which 4 questions have to be answered where, each question carries 5marks. Marks are awarded by taking average of marks scored in two CIE exams.

Quiz-Online Examination

Two Quiz exams shall be online examination consisting of 25 multiple choice questions and are to be answered by choosing the correct answer from a given set of choices (commonly four). Such a question paper shall be useful infesting of knowledge, skills, application, analysis, evaluation and understanding of the students. Marks shall be awarded considering the average of two quiz examinations for every course.

Alternative Assessment Tool (AAT)

This AAT enables faculty to design own assessment patterns during the CIA. The AAT converts the classroom into an effective learning center. The AAT may include tutorial hours/classes, seminars, assignments, term paper, open ended experiments, METE (Modeling and Experimental Tools in Engineering), five minutes video, MOOCs etc. The AAT chosen for this course is given in table

VIII.

Concept Video	Tech-talk	Complex Problem Solving
40%	40%	20%

IX. HOW PROGRAM OUTCOMES ARE ASSESSED:

Program Outcomes		Strength	Proficiency assessed by
PO 1	**Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and engineering specialization to the solution of complexengineering problems.	3	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.	3	Lab exercises
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	Videos

3 = High; 2 = Medium; 1 = Low

X. HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

Program Specific Outcomes		Strength	Proficiency assessed by
PSO 3	Make use of Computational and Experimental tools for Building Career Paths towards Innovation Startups, Employability and Higher Studies.	3	Assignments/Lab exercises

3 = High; 2 = Medium; 1 = Low

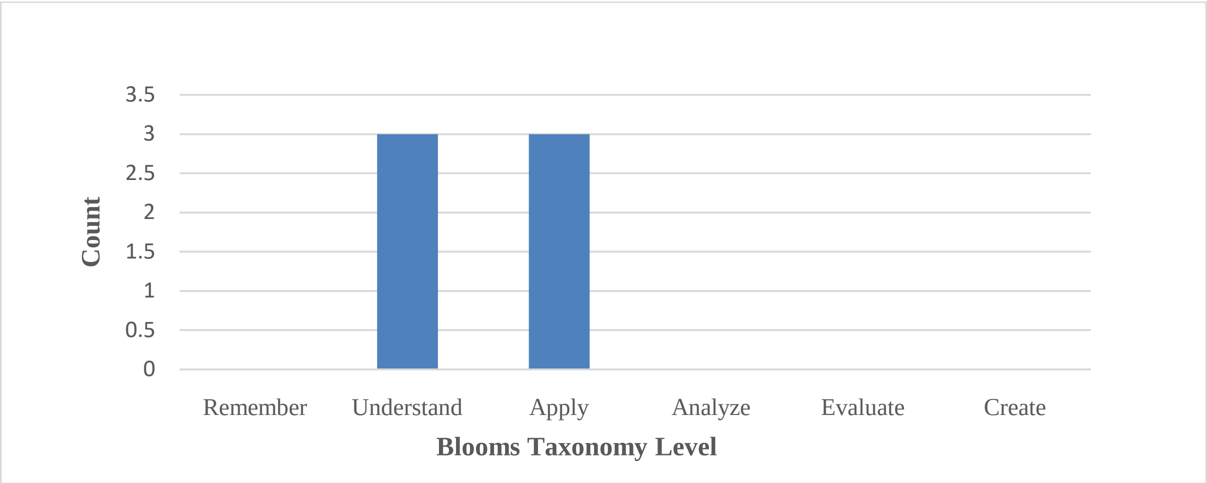
XI. COURSE OBJECTIVES:

The course should enable the students to:	
I	The basic knowledge about engineering drawing as a communicative language of engineers in ideation
II	The ability to visualize, create and edit any object with all the physical and dimensional configurationsusing computer aided drawing tools
III	The code of engineering drawing practice as per the Bureau of Indian Standards and Internationalpractices

XII. COURSE OUTCOMES:

After successful completion of the course, students will be able to:		
CO No	**Course Outcomes**	**Knowledge Level (Bloom's Taxonomy)**
CO 1	**Illustrate bureau of Indian standards conventions of engineering drawing with basic concepts, ideas and methodology for different geometries and their execution.**	Understand
CO 2	**Apply the commands used in AutoCAD for development of multi-aspect sketches, additional and sectional view.**	Apply
CO 3	**Construct parabolic, Hyperbolic and elliptical curves for profiles likes buildings and bridges. Construct Cycloidal and involutes profiles for developing new products like gears and other engineering applications.**	Apply
CO 4	**Explain various types of scales for engineering applications like maps, buildings, bridges.**	Understand
CO 5	**Explain the concept of projection of solids inclined to both the planes for interpretation of different views and orthographic projection concepts in solid modeling**	Understand
CO 6	**Recall the orthographic projection concepts in solid modeling for use in conversation to isometric and Vice-versa**	Apply

COURSE KNOWLEDGE COMPETENCY LEVELS



XIII. JUSTIFICATIONS FOR CO – (PO, PSO) MAPPING

Course Outcomes	POs / PSOs	Justification for mapping (Students will be able to)	No. of key competencies
CO 1	**PO 1**	Recall the basic commands of AutoCAD for various curves and scales using **scientific principles** and **engineering fundamentals.**	2
	PO 5	Understand Scales and Curves with different methods conceptually and apply them in modeling a **complex engineering** activity	1
	PSO 3	Make use of design **computational** and modeling **experimental tools** for building career paths towards innovative startups to be an entrepreneur.	2

CO 2	**PO 1**	Recall the basic commands of AutoCAD for various drawings and draw using **scientific principles** and **engineering fundamentals.**	2
	PO 3	Understand the given **problem statement** related to question formatted for engineering drawings and based upon type use different AutoCAD commands .	1
	PO 10	**Demonstrate** the autocad commands to develop sketches in multi sectional views of a solid object and **Illustrate** to other views	2
CO 3	**PO 1**	Develop expression for eccentricity and Identify the appropriate type of curve for **problem solving** using **engineering sciences.**	2
	PO 3	Use research based knowledge for different methods of drawing engineering curves and draw with **modern tools**	1
	PO 10	Develop the 3D images of the machine objects and check the **Interference** of the post manufactured objects	1
CO 4	**PO 1**	Apply the **engineering knowledge** to classify Cycloidal and involutes profiles in user Coordinate System to draw engineering problems.	1
	PO 3	Build practical experience in building the real time products, using **industry standard** and **collaboration technique** in the field of curves.	2
	PO 9	**Classify** the scales for all types of drawings and **Simplify** the image understanding	2
CO 5	**PO 5**	Recall various types of scales and **use principles of BIS**, and **engineering fundamentals** for engineering applications like maps, buildings, bridges.	2
CO 6	**PO 1**	Make a use of an appropriate plane to draw different position of points and lines to solve **engineering problems** for **solution enhancement**	2
	PO 5	Recall various positions in coordinate system for points and lines **use principles of views**, and **engineering fundamentals** for completing the drawing	2
	PO 12	**Develop**the views of the plane projects and extend it to **Solve**unknown images and provide solutions apart from four planes of projections	2

3 = High; 2 = Medium; 1 = Low

XIV. MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

Course Outcomes	Program Outcomes						Program Specific Outcomes		
	PO1	PO3	PO5	PO 9	PO10	PO12	PSO1	PSO2	PSO3
CO 1	2	-	1	-	-	-	-	-	2
CO 2	2	1	-	-	2	-	-	-	-
CO 3	2	1	-	-	1	-	-	-	-
CO 4	1	2	-	2	-	-	-	-	-
CO 5	-	-	2	-	-	-	-	-	-
CO 6	2	-	2	-	-	2	-	-	-

3 = High; 2 = Medium; 1 = Low

XV. MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:

Course Learning Outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	2	-	-	-	1	-	-	-	-	-	-	-	-	-	2
CO 2	2	-	1	-	-	-	-	-	-	2	-	-	-	-	-
CO 3	2	-	1	-	-	-	-	-	-	1	-	-	-	-	-
CO 4	1	-	2	-	-	-	-	-	2	-	-	-	-	-	-
CO 5	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-
CO 6	2	-	-	-	2	-	-	-	-	-	-	-	-	-	-

3 = High; 2 = Medium; 1 = Low

XVI. ASSESSMENT METHODOLOGIES–DIRECT

CIE Exams	✔	SEE Exams	✔	Assignments	✔	Seminars	-
Laboratory Practices	✔	Student Viva	✔	Mini Project	-	Certification	-

XVII. ASSESSMENT METHODOLOGIES–INDIRECT

✔	Early Semester Feedback	✔	End Semester OBE Feedback
✘	Assessment of Mini Projects by Experts		

XVIII. SYLLABUS

MODULE – I	Introduction to Engineering Drawing and Overview of Computer Graphics
Principles of Engineering Graphics and their significance, usage of Drawing instruments, lettering. Listing the computer technologies that impact on graphical communication, Demonstrating knowledge of the theory of CAD software	
MODULE – II	**Conic Sections and Scales**
Conic sections including the Rectangular Hyperbola (General method only); Cycloid, Epicycloid, Hypocycloid and Involute; Scales-Plain, Diagonal and Vernier Scales	
MODULE – III	**Projection of Points and Lines**
Principles of Orthographic Projections-Conventions-Projections of Points and lines inclined to both planes. Projections of planes, Planes inclined to both the planes.	
MODULE – IV	**Projection of Regular Solids**
Draw the orthographic views of geometrical solids of Prism, Pyramid, Cylinder and Cone.	

MODULE – V	Isometric and Orthographic Projections

Principles of Isometric projection–Isometric Scale, Isometric Views, Conventions; Isometric Views of lines,Planes, Simple and compound Solids; Conversion of Isometric Views to Orthographic Views and Vice-versa

Text Books:

1. N. D. Bhatt, "Engineering Drawing", Charotar Publications, New Delhi, 49th Edition, 2010.
2. C.M. Agarwal, Basant Agarwal, "Engineering Drawing", Tata McGraw Hill, 2nd Edition, 2013.

Reference Books:

1. K. Venugopal, "Engineering Drawing and Graphics". New Age Publications, 2nd Edition, 2010.
2. Dhananjay. A. Johle, "Engineering Drawing", Tata McGraw Hill, 1st Edition, 2008.
3. S.Trymbaka Murthy, "Computer Aided Engineering Drawing", I.K. International Publishers, 3rd Edition, 2011.
4. A.K.Sarkar, A.P Rastogi, "Engineering graphics with Auto CAD", PHI Learning, 1stEdition, 2010.

Web References:

1. http://nptel.ac.in/courses/112103019
2. http://www.autocadtutorials.net/
3. http://gradcab.com/questions/tutorial-16-for-beginner-engineering-drawing-I

XIX. COURSE PLAN:

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

Week No.	Topics to be covered	Course Outcomes	Reference
1	Principles of engineering drawing – Geometrical construction.	CO 1	T1:1.4 R1:1.2
2	Principles of dimensions and their execution.Introduction to auto-cad.	CO 1, CO2	T1:1.5 R1:2.4
3	Familiarization of auto-cadcommands. Draw and modify commands, dimensions, line properties, status bar, etc..,	CO 2	T1:2.5 R1:2.5
4	Construction of Ellipse – General method	CO 3	T2:2.5 R1:2.6
5	Construction of parabola curves. – General method	CO 3	T1:22.7
6	Construction of hyperbola curves-General method	CO 3	T1:6.3 R2:5.3
7	Construction of various curves cycloid, epicycloids, hypocycloid and involutes	CO 4	T1:7.5 R1:6.3
8	Construction of various scales for engineering use- plain, diagonal, and vernier.	CO 5	T1:8.5 R1:6.8
9	Projection of points and lines inclined to single plane and both the planes.	CO 6	T1:12.2 R3:13.1
10	Projection of planes- inclined to single plane and both the planes.	CO 7	T1:12.3 R1:13.2
11	Projection of solids inclined to single plane and both the planes.	CO 8	T1:1.4 R1:1.2
12	Draw the basic isometric views. Convert the pictorial views to orthographic views and vice versa.	CO 9	T1:1.5 R1:2.4

XX. EXPERIMENTS FOR ENHANCED LEARNING (EEL):

S. No.	Design Oriented Experiments

S. No.	Design Oriented Experiments
1	Construction of Parabola curves. –rectangle method, and parallelogram methods.
2	Construction of hyperbolic curves. –rectangle method, and parallelogram methods.
3	Draw the development of lateral surfaces of cube
4	Draw the development of lateral surfaces of prism
5	Draw the development of lateral surfaces of pyramid
6	Draw the development of lateral surfaces ofcylinder
7	Draw the development of lateral surfaces of cone

Signature of Faculty **HOD CE**
Mr. C. Labesh Kumar, Assistant Professor

INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

Dundigal, Hyderabad - 500 043

COURSE DESCRIPTION

Department	**CIVIL ENGINEERING**				
Course Title	**PROBABILITY AND STATISTICS**				
Course Code	AHS010				
Program	B.Tech				
Semester	III	CE			
Course Type	Foundation				
Regulation	R-16				
Course Structure	Theory			Practical	
	Lecture	Tutorials	Credits	Laboratory	Credits
	3	1	4	-	-
Course Coordinator	Mr. J Suresh Goud, Assistant Professor				

I COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites
	-	-	

II COURSE OVERVIEW:

The course focuses on more advanced Engineering Mathematics topics which provide with the relevant mathematical tools required in the analysis of problems in engineering and scientific professions. The course includes probability, random variables, probability distributions, correlation, regression, sampling distribution, testing of hypothesis and analysis of variance. The mathematical skills derived from this course form a necessary base to analytical and design concepts encountered in the program.

III MARKS DISTRIBUTION:

Subject	SEE Examination	CIE Examination	Total Marks
Fluid Dynamics	70 Marks	30 Marks	100

IV CONTENT DELIVERY / INSTRUCTIONAL METHODOLOGIES:

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

V EVALUATION METHODOLOGY:

The course will be evaluated for a total of 100 marks, with 30 marks for Continuous Internal Assessment (CIA) and 70 marks for Semester End Examination (SEE). Out of 30 marks allotted for CIA during the semester, marks are awarded by taking average of two CIE examinations or the marks scored in the make-up examination.

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 14 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
30 %	Understand
60%	Apply
0 %	Analyze

Continuous Internal Assessment (CIA):
CIA is conducted for a total of 30 marks, with 25 marks for Continuous Internal Examination (CIE) and 05 marks for Quiz \Alternative Assessment Tool (AAT).

Component	Theory		Total Marks
Type of Assessment	CIE Exam	Quiz \AAT	
CIA Marks	25	05	30

Continuous Internal Examination (CIE):
Two CIE exams shall be conducted at the end of the 8^{th} and 17^{th} week of the semester respectively. The CIE exam is conducted for 25 marks of 2 hours duration consisting of two parts. Part–A shall have five compulsory questions of one mark each. In part–B, four out of five questions have to be answered where, each question carries 5 marks. Marks are awarded by taking average of marks scored in two CIE exams.

Quiz - Online Examination
Two Quiz exams shall be online examination consisting of 25 multiple choice questions and are to be answered by choosing the correct answer from a given set of choices (commonly four). Such a question paper shall be useful in testing of knowledge, skills, application, analysis, evaluation and understanding of the students. Marks shall be awarded considering the average of two quiz examinations for every course.

Alternative Assessment Tool (AAT)
This AAT enables faculty to design own assessment patterns during the CIA. The AAT converts the classroom into an effective learning center. The AAT may include tutorial hours/classes, seminars, assignments, term paper, open ended experiments, METE (Modeling and Experimental Tools in Engineering), five minutes video, MOOCs etc. The AAT chosen for this course is given in table

Concept Video	Tech-talk	Complex Problem Solving
40%	40%	20%

VI COURSE OBJECTIVES:

The students will try to learn:

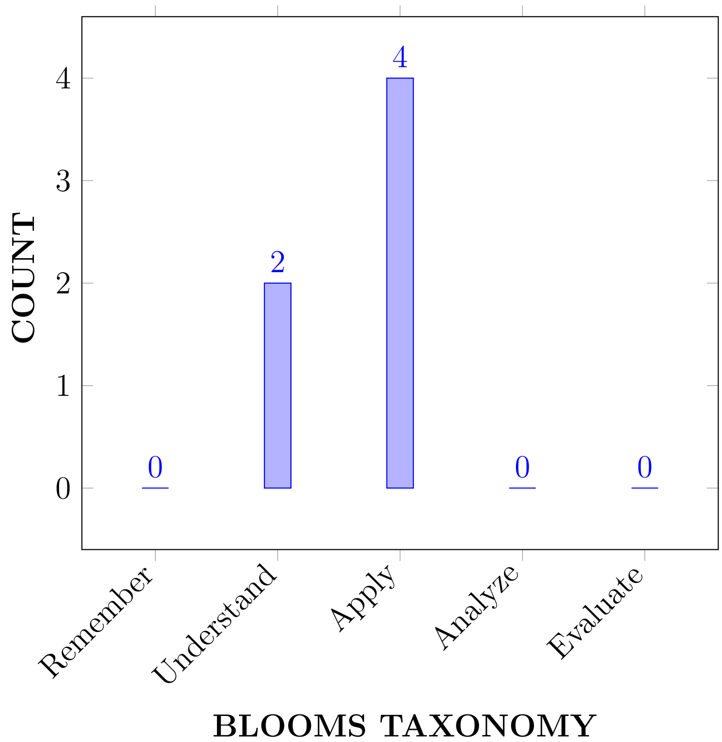
I	Enrich the knowledge of probability on single random variables and probability distributions.
II	Apply the concept of correlation and regression to find covariance.
III	Analyze the given data for appropriate test of hypothesis.

VII COURSE OUTCOMES:

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

CO 1	**Explain** the parameters of random variate Probability distributions including Binomial, Poisson and Normal distribution by using their probability functions, expectation and variance.	Understand
CO 2	**Interpret** the concepts of discrete and continuous probability distribution, CLT problems, correlations and Regression Analysis for statistical forecasting.	Understand
CO 3	**Make use of** the concept of sampling distribution of statistical data by using behavior of the sample mean.	Apply
CO 4	**Apply** the concept of estimation in real-world problems of signal processing and testing of hypothesis to predict the significance difference, types of errors in the sample means.	Apply
CO 5	**Calculate** the role of statistical hypotheses, confidence intervals, the tests of hypotheses for large samples in making decisions over statistical claims in hypothesis testing	Apply
CO 6	**Identify** the tests of hypothesis for small samples and comparing three variables of ANOVA in making decisions over statistical claims in hypothesis testing	Apply

COURSE KNOWLEDGE COMPETENCY LEVEL



VIII PROGRAM 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

IX 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	Presentation on real-world 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.	2	Seminar
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.	1	Term Paper

3 = High; 2 = Medium; 1 = Low

X HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

PROGRAM SPECIFIC OUTCOMES		Strength	Proficiency Assessed by
PSO 1	Design and Supervise Sub-Structures and Super Structures for Residential and Public Buildings, Industrial Structures, Irrigation Structures, Power Houses, Highways, Railways, Airways, Docs and Harbours.	-	-
PSO 2	Focus on Improving Performance of Structures with reference to Safety, Serviceability and Sustainable Green Building Technology.	-	-
PSO 3	Make use of Advanced Structural Analysis and Project Management Software for creating Modern Avenues to succeed as an Entrepreneur, Pursue Higher Studies and Career Paths.	-	-

3 = High; 2 = Medium; 1 = Low

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

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	✓	-	-	✓	-	-	-	-	-	-	-	-	-	-	-
CO 2	✓	✓	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 3	✓	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 4	✓	-	-	✓	-	-	-	-	-	-	-	-	-	-	-

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

XII 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 matched.
CO 1	**PO 1**	Explain (understanding) the concept of random variables and their role in solving complex engineering problems involving random events and uncertainty by using Mathematical functions (principles of mathematics).	2
	PO 4	The expected values, variances for the given discrete random variables will be quantitatively measured by using statistical computer software (R-software).	1
CO 2	**PO 1**	Interpret the Probability distributions such as Binomial, Poisson and Normal distribution (Understanding) with the support of evaluation of integrals (principles of mathematics) and appreciate their importance and applicability (Apply) in solving complex engineering problems involving uncertainty.	2
	PO 2	Understand the statement and formulation of a complex engineering problem which involves the events of uncertainty, Model it with suitable probability distribution and Apply the concepts of discrete or continuous distributions along with basic principles of mathematics to develop the solution and reaching substantiated conclusions by the interpretation of results	5
CO 3	**PO 1**	Interpret (Understand) the results of Bivariate and Correlation Analysis by using ratios, square roots, straight lines and planes (principles of mathematics) for statistical forecasting (Apply)in complex engineering problems involving bivariate or multivariate data.	2
CO 4	**PO 1**	Select appropriate statistical methods (understand) for solving some real-time complex engineering problems governed by correlation with the knowledge of fundamental principles of mathematics.	2
	PO 4	Interpret the results of Bivariate and Multivariate Regression and quantifying the degree of closeness between two or more variables by using statistical computer software (R-software, SPSS-software).	1

Course Outcomes	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key competencies matched.
CO 5	**PO 1**	Apply tests of hypotheses which involves the role of mathematical tools like statements, sets, ratios and percentages (principles of mathematics) for both large samples and small samples (knowledge) in making decisions over statistical claims that arise in complex engineering problems which requires sampling inspections.	2
	PO 2	Understand the statement and formulation of a complex engineering problem which needs verification of truth values of numerical or statistical hypothesis, collect the necessary information and data through sampling techniques, apply tests of hypotheses (both large and small samples) along with basic principles of mathematics to develop the solution and reaching substantiated conclusions by the interpretation of results	5
	PO 4	Make Use of R software package in computing confidence intervals, statistical averages and hypothesis testing. (Computer software relevance)	1
CO 6	**PO 1**	Identify the role of types of statistical hypotheses, types of errors, sampling distributions of means and confidence intervals with the aid of statements and sets, percentages (principles of mathematics) in hypothesis testing of complex engineering problems which requires sampling inspections.	2
	PO 4	Test for the assessment of goodness of fit of the given probability distribution model by using statistical quantitative methods and statistical computer software (R-software).	1

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

XIV 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	66.7	-	-	9.0	-	-	-	-	-	-	-		-	-	-
CO 2	66.7	50.0	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 3	66.7	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 4	66.7	-	-	9.0	-	-	-	-	-	-	-	-	-	-	-
CO 5	66.7	50.0	-	9.0	-	-	-	-	-	-	-	-	-	-	-
CO 6	66.7	-	-	9.0	-	-	-	-	-	-	-		-	-	-

XV COURSE ARTICULATION MATRIX (PO / PSO MAPPING):

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

0 - $0 \leq C \leq 5\%$ – No correlation
1 - $5 < C \leq 40\%$ – Low/ Slight
2 - $40\% < C < 60\%$ –Moderate
3 - $60\% \leq C < 100\%$ – Substantial /High

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

XVI ASSESSMENT METHODOLOGY-DIRECT:

CIE Exams	✓	SEE Exams	✓	Seminars	-
Laboratory Practices	-	Student Viva	-	Certification	-
Term Paper	-	5 Minutes Video	PO 4	Open Ended Experiments	-
Assignments	✓				

XVII ASSESSMENT METHODOLOGY-INDIRECT:

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

XVIII SYLLABUS:

MODULE I	**SINGLE RANDOM VARIABLES AND PROBABILITY DISTRIBUTION**
	Random variables: Basic definitions, discrete and continuous random variables; Probability distribution: Probability mass function and probability density functions; Mathematical expectation; Binomial distribution, Poisson distribution and normal distribution.
MODULE II	**MULTIPLE RANDOM VARIABLES**
	Joint probability distributions, joint probability mass, density function, marginal probability mass, density functions; Correlation: Coefficient of correlation, the rank correlation; Regression: Regression coefficient, the lines of regression, multiple correlation and regression.
MODULE III	**SAMPLING DISTRIBUTION AND TESTING OF HYPOTHESIS**
	Sampling: Definitions of population, sampling, statistic, parameter; Types of sampling, expected values of sample mean and variance, sampling distribution, standard error, sampling distribution of means and sampling distribution of variance. Estimation: Point estimation, interval estimations; Testing of hypothesis: Null hypothesis, alternate hypothesis, type I and type II errors, critical region, confidence interval, level of significance. One sided test, two sided test.
MODULE IV	**LARGE SAMPLE TESTS**
	Test of hypothesis for single mean and significance difference between two sample means, Tests of significance difference between sample proportion and population proportion and difference between two sample proportions.
MODULE V	**SMALL SAMPLE TESTS AND ANOVA**
	Small sample tests: Student t-distribution, its properties: Test of significance difference between sample mean and population mean; difference between means of two small samples. Snedecor's F-distribution and its properties; Test of equality of two population variances Chi-square distribution and it's properties; Test of equality of two population variances Chi-square distribution, it's properties, Chi-square test of goodness of fit; ANOVA: Analysis of variance, one way classification, two way classification.

TEXTBOOKS

1. Erwin Kreyszig, "Advanced Engineering Mathematics", John Wiley and Sons Publishers, 9th Edition, 2014.
2. B. S. Grewal, "Higher Engineering Mathematics", Khanna Publishers, 43rd Edition, 2012.

REFERENCE BOOKS:

1. T.K.V Iyengar, B.Krishna Gandhi, "Probability and Statistics", S. Chand & Co., 6th Edition, 2014.
2. G.C.Beri, "Business Statistics", Tata McGraw-Hill Publications, 2nd Edition, 2005.
3. Richard Arnold Johnson, Irwin Miller and John E. Freund, "Probability and Statistics for Engineers", Prentice Hall, 8th Edition, 2013.

WEB REFERENCES:

1. http://e4uhu.com/down/Applied/9th

2. https://toaz.info/32fa2f50-8490-42cf-9e6a-f50cb7ea9a5b
3. http://www.mathworld.wolfram.com

XIX COURSE PLAN:

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

S.No	Topics to be covered	Course outcomes	Reference
OBE DISCUSSION			
1	Identify the types of sampling (random, stratified, systematic, cluster). Identify the misuses of statistics. Student will use appropriate statistical methods to collect, organize, display, and analyze relevant data. Probability & Statistics introduces students to the basic concepts and logic of statistical reasoning and gives the students introductory-level practical ability to choose, generate, and properly interpret appropriate descriptive and inferential methods. Identify the types of data (qualitative, quantitative, discrete, and continuous).		
CONTENT DELIVERY (THEORY)			
2	Introduction on probability, conditional probability	CO 1	T2:26.3
3	Mathematical mean, Discrete Random variables	CO 1	R2:21.48
4	Mean and variance, probability distribution of discrete Random variables.	CO 1	T2:26.6 R2:21.50
5	Continuous Random variables	CO 1	T2:26.7 R2:21.51
6	Mean and variance, probability distribution of continuous Random variables.	CO 1	T2:26.8
7	Properties of random variables	CO 1	T2:26.10
8	Binomial distribution	CO 1	T2:26.14 R2:21.55
9	Poisson distribution	CO 1	T2:26.15 R2:21.58
10	Normal distribution.	CO 1	T2:26.16 R2:21.61
11	Joint probability distributions	CO 2	T2:25.12 R2:21.24
12	joint probability mass, density function	CO 2	T2:25.16 R2:21.29
13	marginal probability mass, density functions	CO 2	T2:25.14 R2:21.31
14	Correlation	CO 2	T2:25.14 R2:21.33
15	Karl Pearson's Coefficient of correlation	CO 2	R2:21.33
16	Rank correlation and Properties of correlation	CO 2	T2:27.2 R2:21.64

17	The linear model to a bivariate data	CO 2	T2:27.2
18	Regression coefficients	CO 2	T2:27.2 R2:21.67
19	Properties of Regression coefficients	CO 2	T2:27.2
20	Angle between two lines of regression	CO 2	T2:27.3 R2:21.71
21	Lines of regression and the multiple correlation of bivariate data	CO 2	T2:27.4 R2:21.68
22	Sampling: Definitions	CO 3	T2:27.7 R2:21.74
23	Types of sampling	CO 3	T2:27.12 R2:21.75
24	Parameter vs. statistics, standard error	CO 3	T2:27.8 R2:21.72
25	Type I and type II errors,	CO 3	T2:27.8 R2:21.73
26	Estimation	CO 4	T2:27.14 R2:21.78
27	Point estimation	CO 4	T2:27.19 R2:21.814
28	interval estimations	CO 4	T2:27.12 R2:21.82
29	Critical region, confidence interval, level of significance. One sided test, two-sided test.	CO 5	T2:27.18 R2:21.82
30	Tests of significance of single mean	CO 5	T2:26.15 R2:21.58
31	Test of difference between means	CO 5	T2:26.16 R2:21.61
32	Tests of significance of single proportion	CO 5	T2:25.14 R2:21.33
33	Test of difference between proportions	CO 5	R2:21.33
34	Small sample tests Test of equality of two population variances	CO 6	T2:27.2 R2:21.64
35	Student t-distribution, its properties. Test of significance difference between sample mean and population mean.	CO 6	T2:27.2
36	difference between means of two small samples	CO 6	T2:26.16 R2:21.61
37	Snedecor's F-distribution properties.	CO 6	T2:25.12 R2:21.24
38	Chi-square distribution and it's properties	CO 6	T2:25.16 R2:21.29
39	Applications of chi square –Distribution	CO 6	T2:27.14 R2:21.78
40	Definition of Analysis of variance	CO 6	T2:27.19 R2:21.814
41	One way classification, two way classification	CO 6	T2:27.12 R2:21.82

PROBLEM SOLVING/ CASE STUDIES			
42	Problem solving session on discrete random variable	CO 1	T2:26.3
43	Problem solving session on continuous random variables	CO 1	R2:21.48
44	Problem solving session on Binomial distribution	CO 1	T2:26.6 R2:21.50
45	Problem solving session on Poisson distribution	CO 1	T2:26.7 R2:21.51
46	Problem solving session on Normal distribution	CO 1	T2:26.8
47	Problem solving session on Joint probability distributions	CO 1	T2:26.10
48	Problem solving session on Karl Pearson's correlation	CO 2	T2:26.14 R2:21.55
49	Problem solving session on Spearman's rank correlation, linear regression	CO 2	T2:26.15 R2:21.58
50	Problem solving session on sampling distribution of means	CO 3	T2:26.16 R2:21.61
51	Problem solving session on Estimation	CO 4	T2:25.12 R2:21.24
52	Problem solving session on point and internal estimation	CO 4	T2:25.16 R2:21.29
53	Problem solving session on large sample tests	CO 5	T2:25.14 R2:21.31
54	Problem solving session on t-test	CO 6	T2:25.14 R2:21.33
55	Problem solving session on F-test and chi square – test	CO 6	R2:21.33
56	Problem solving session on One way classification, two way classification	CO 6	T2:27.2 R2:21.64
DISCUSSION OF DEFINITION AND TERMINOLOGY			
57	Definitions & terminology discussion on probability and random variables	CO 1	T2:26.6 R2:21.50
58	Definitions & terminology discussion on joint probability distributions, correlation and regression..	CO 2	T2:26.7 R2:21.51
59	Definitions & terminology discussion on sampling distribution and Estimation.	CO 3, CO 4	T2:25.14 R2:21.33
60	Definitions & terminology discussion on Tests of Hypothesis.	CO 5	R2:21.33
61	Definitions & terminology discussion on Tests of significance and ANOVA.	CO 6	R2:21.33

DISCUSSION OF QUESTION BANK			
62	Question bank discussion on probability and random variables.	CO 1	T2:26.6 R2:21.50
63	Question bank discussion on joint probability distributions and correlation, regression.	CO 2	T2:26.7 R2:21.51
64	Question bank discussion on sampling distribution and Estimation.	CO 3,CO 4	T2:25.14 R2:21.33
65	Question bank discussion on Tests of Hypothesis.	CO 5	R2:21.33
66	Question bank discussion on Tests of significance and ANOVA.	CO 6	R2:21.33

Course Coordinator: **HOD CE**
Mr. J Suresh Goud

INSTITUTE OF AERONAUTICAL ENGINEERING
(Autonomous)
Dundigal, Hyderabad - 500 043

COURSE DESCRIPTION

Department	**CIVIL ENGINEERING**				
Course Title	**STRENGTH OF MATERIALS-I**				
Course Code	ACE001				
Program	B.Tech				
Semester	III				
Course Type	CORE				
Regulation	R16				
Course Structure	Theory			Practical	
	Lecture	Tutorials	Credits	Laboratory	Credits
	3	1	4	-	-
Course Coordinator	Mr K. Tarun Kumar, Assistant Professor				

I COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites
B.Tech	AME002	II	Engineering Mechanics

II COURSE OVERVIEW:

This course deals with the engineering behavior of earth materials by using various soil testing methodologies to devise appropriate solution for the problematic soils. The soils at construction sites are not always totally suitable for supporting physical infrastructure such as buildings, bridges, highways, tunnels and dams. Under these conditions, soil needs to be treated using ground improvement techniques. This course discusses specific types of soil improvement techniques are required in the case of expansive soils and collapsible soil and in the case of earthquake prone areas.

III MARKS DISTRIBUTION:

Subject	SEE Examination	CIE Examination	Total Marks
Strength of Materials-I	70 Marks	30 Marks	100

IV CONTENT DELIVERY / INSTRUCTIONAL METHODOLOGIES:

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

V EVALUATION METHODOLOGY:

The course will be evaluated for a total of 100 marks, with 30 marks for Continuous Internal Assessment (CIA) and 70 marks for Semester End Examination (SEE). Out of 30 marks allotted for CIA during the semester, marks are awarded by taking average of two CIE examinations or the marks scored in the make-up examination.

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 14 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
15%	Remember
35%	Understand
50%	Apply
0%	Analyze
0%	Evaluate
0%	Create

Continuous Internal Assessment (CIA):
CIA is conducted for a total of 30 marks, with 25 marks for Continuous Internal Examination (CIE) and 05 marks for Quiz \Alternative Assessment Tool (AAT).

Component	Theory		Total Marks
Type of Assessment	CIE Exam	Quiz \AAT	
CIA Marks	25	05	30

Continuous Internal Examination (CIE):
Two CIE exams shall be conducted at the end of the 8^{th} and 17^{th} week of the semester respectively. The CIE exam is conducted for 25 marks of 2 hours duration consisting of two parts. Part–A shall have five compulsory questions of one mark each. In part–B, four out of five questions have to be answered where, each question carries 5 marks. Marks are awarded by taking average of marks scored in two CIE exams.

Quiz - Online Examination
Two Quiz exams shall be online examination consisting of 25 multiple choice questions and are to be answered by choosing the correct answer from a given set of choices (commonly four). Such a question paper shall be useful in testing of knowledge, skills, application, analysis, evaluation and understanding of the students. Marks shall be awarded considering the average of two quiz examinations for every course.

Alternative Assessment Tool (AAT)
This AAT enables faculty to design own assessment patterns during the CIA. The AAT converts the classroom into an effective learning center. The AAT may include tutorial hours/classes, seminars, assignments, term paper, open ended experiments, METE (Modeling and Experimental Tools in Engineering), five minutes video, MOOCs etc. The AAT chosen for this course is given in table

Concept Video	Tech-talk	Complex Problem Solving
40%	40%	20%

VI COURSE OBJECTIVES:

The students will try to learn:

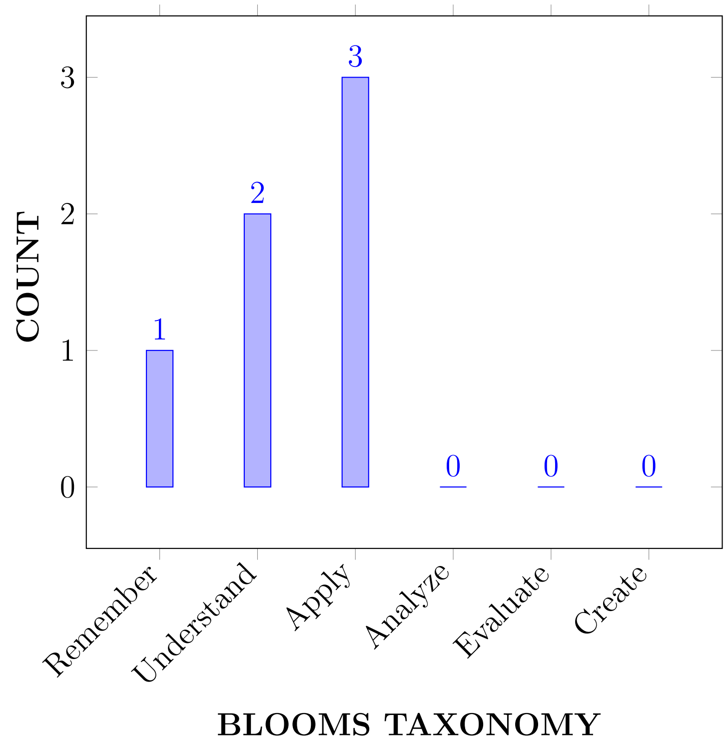
I	The importance and fundamentals of Ground improvement techniques for measuring field parameters by using traditional and modern methods involved in civil construction.
II	The mechanical methods and suitable equipment to proliferate the ground for making the soil to withstand all the loads acting on it.
III	The physical, chemical and hydraulic modification methods and its applications for strengthen the soil.
IV	The applications of modern methods in civil construction alteration works, short creating, soil reinforcement, soil nailing, bolting involved in inclusion and confinement process.

VII COURSE OUTCOMES:

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

CO 1	**Recall** the problems associated with existing ground conditions to propose a suitable method for ground improvement. .	Remember
CO 2	**Explain** the various methods of mechanical modification to increase the bearing capacity of soil.	Understand
CO 3	**Interpret** the existing ground condition for design of the dewatering systems to control the seepage of ground water..	Understand
CO 4	**Select** the appropriate geosynthetics to increase the bearing capacity of the subgrade soil.	Apply
CO 5	**Identify** the suitable grouting technique based on the in-situ evidences to prevent the foundation settlements.	Apply
CO 6	**Choose** the appropriate soil -reinforcement techniques to increase the stability of soils..	Apply

COURSE KNOWLEDGE COMPETENCY LEVEL



VIII PROGRAM 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 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.

Program Outcomes	
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

IX 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.	2	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.	3	CIE / SEE / AAT
PO 4	**Conduct Investigations of Complex Problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.	3	AAT

3 = High; 2 = Medium; 1 = Low

X HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

PROGRAM SPECIFIC OUTCOMES		Strength	Proficiency Assessed by
PSO 1	Design and supervise sub-structures and superstructures for residential and public buildings, industrial structures, irrigation structures, powerhouses, highways, railways, airways, docks and harbours.	3	CIE / SEE / AAT
PSO 2	Focus on Improving Performance of Structures with reference to Safety, Serviceability and Sustainable Green Building Technology.	2	CIE / SEE / AAT

3 = High; 2 = Medium; 1 = Low

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

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	✓	✓	-	-	-	-	-	-	-	-	-	-	✓	-	-
CO 2	✓	✓	-	✓	-	-	-	-	-	-	-	-	-	✓	-
CO 3	✓	✓	-	-	-	-	-	-	-	-	-	-	✓	-	-
CO 4	✓	✓	-	-	-	-	-	-	-	-	-	-	✓	-	-
CO 5	✓	✓	-	✓	-	-	-	-	-	-	-	-	-	✓	-
CO 6	✓	✓	-	-	-	-	-	-	-	-	-	-	-	-	-

XII 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 matched.
CO 1	PO 1	Recollect the basic concept of soil, and to an extent appreciate (understand) the importance of better load bearing soils and get to know major soils in India and its stability by **using science and engineering fundamentals**.	2
	PO 2	Analyse the properties of the soil and **identify** the problems related to design of engineered ground, stability characteristics in longitudinal/ lateral direction stresses acting on beneath soils by **using first principals engineering sciences.**	2
	PSO 1	Understand the various soils testing procedures used for determining engineering properties of soils with the help of **material knowledge, codes of practice.**	2
CO 2	PO 1	Analyze and formulate the engineering problems to determine exact field measurements to serve as a legal record. analyse and identify the problem statement and abstraction for the development of solution. And know the major problems with soils and the solution **using science and engineering fundamentals.**	2
	PO 2	Analyse the properties of soil based on the **data collected** and **implement the various techniques** by **interpreting the results.**	3
	PO 4	Examine the properties of soils by the knowledge of **codes of practice, industry standards and quality issues.**	3
	PSO 2	Examine the mechanical behavior of ground **to improve the performance** of structures by **enhancing safety and serviceability.**	2
CO 3	PO 1	Illustrate the various methods of dewatering systems to increase the bearing capacity of soils and apply the knowledge of science, engineering fundamentals.	2

Course Outcomes	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key competencies matched.
	PO 2	Choose the different methods of dewatering techniques for the soils depending upon the **data collected** and by **interpretation of results**.	2
	PSO 1	Understand the properties of the soils by conducting the **soil investigation and geological survey** procedures to design the dewatering systems such that there will be less **impact on environment**	3
CO 4	PO 1	Illustrate the various functions of geosynthetics to increase the drainage charcteristics of soils and apply the knowledge of science, engineering fundamentals.	2
	PO 2	Choose the different geosynthetics for the soils depending upon the **data collected** and by **interpretation of results**.	2
	PSO 1	Understand the properties of the soils by conducting the **soil investigation and geological survey** procedures to select the appropriate geosynthetic materials.	2
CO 5	PO 1	Identify the suitable method based on the ground requirement, analyze the characteristics of grout and increase the soil bearing capacity by **using science and engineering fundamentals.**	2
	PO 2	Classify the soils depending upon the **data collected** and **implement** the grouting techniques for the weak soils.	2
	PO 4	Understand the **use of technical literature** and other information related to the effects of soils on stability by conducting **synthesis of the information.**	2
	PSO 2	Extend the focus to understand the **innovative and dynamic challenges involve in** improving soils strength	1
CO 6	PO 1	Analyze different soil reinforcing techniques using **fundamentals of mathematics, science, and engineering fundamentals.**	2
	PO 2	Identify the different types of soils by **collecting the information** and **implement the solution** by **interpreting the results**	3

XIII 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	2	2	-	-	-	-	-	-	-	-	-	-	2	-	-
CO 2	2	3	-	3	-	-	-	-	-	-	-	-	-	2	-
CO 3	2	2	-	-	-	-	-	-	-	-	-	-	3	-	-
CO 4	2	2	-	-	-	-	-	-	-	-	-	-	2	-	-

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

XIV 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	67	20	-	-	-	-	-	-	-	-	-	-	20	-	-
CO 2	67	30	-	27	-	-	-	-	-	-	-	-	-	67	-
CO 3	67	20	-	-	-	-	-	-	-	-	-	-	30	-	-
CO 4	67	20	-	-	-	-	-	-	-	-	-	-	20	-	-
CO 5	67	20	-	18	-	-	-	-	-	-	-	-	-	33	-
CO 6	67	30	-	-	-	-	-	-	-	-	-	-	-	-	-

XV COURSE ARTICULATION MATRIX (PO / PSO MAPPING):

CO'S and PO'S and CO'S and PSO'S on the scale of 0 to 3, 0 being no correlation, 1 being the low correlation, 2 being medium correlation and 3 being high correlation.
0 - $0 \leq$ C$\leq$ 5% – No correlation
1 -5 <C$\leq$ 40% – Low/ Slight
2 - 40 % <C < 60% –Moderate
3 - 60% $\leq$ C < 100% – Substantial /High

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	2	2	-	-	-	-	-	-	-	-	-	-	2	-	-
CO 2	2	3	-	3	-	-	-	-	-	-	-	-	-	2	-
CO 3	2	2	-	-	-	-	-	-	-	-	-	-	3	-	-
CO 4	2	2	-	-	-	-	-	-	-	-	-	-	2	-	-
CO 5	2	2	-	2	-	-	-	-	-	-	-	-	-	1	-
CO 6	2	3	-	-	-	-	-	-	-	-	-	-	-	-	-
TOTAL	12	14		5									7	3	
AVERAGE	2	3		3									3		2

XVI ASSESSMENT METHODOLOGY-DIRECT:

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

XVII ASSESSMENT METHODOLOGY-INDIRECT:

	Assessment of mini projects by experts	✓	End Semester OBE Feedback

XVIII SYLLABUS:

UNIT-I	**STRESSES AND STRAINS(SIMPLE AND PRINCIPAL)**
	Concept of stress and strain, elasticity and plasticity, Hooke‘s law, stress-strain diagram for mild steel, Poisson‘s ratio, volumetric strain, elastic module and the relationship between them bars of varying section, composite bars, temperature stresses; Strain energy, modulus of resilience, modulus of toughness; stresses on an inclined section of a bar under axial loading; compound stresses; Normal and tangential stresses on an inclined plane for biaxial stresses; Two perpendicular normal stresses accompanied by a state of simple shear; Mohr‘s circle of stresses; Principal stresses and strains; Analytical and graphical solutions. Theories of Failure: Introduction, various theories of failure, maximum principal stress theory, maximum principal strain theory, strain energy and shear strain energy theory
UNIT-II	**SHEAR FORCE AND BENDING MOMENT**
	Definition of beam, types of beams, concept of shear force and bending moment, shear force and bending moment diagrams for cantilever, simply supported and overhanging beams subjected to point loads, uniformly distributed load, uniformly varying loads and combination of these loads, point of contraflexure, relation between Shear force, bending moment and rate of loading at a section of a beam.
UNIT-III	**FLEXURAL AND SHEAR STRESSES IN BEAMS**
	Flexural Stresses: Theory of simple bending, assumptions, derivation of bending equation: $M/I = f/y = E/R$ - neutral axis: Determination of bending stresses; Section modulus of rectangular and circular sections (Solid and Hollow), IT angle and channel sections; Design of simple beam sections. Shear Stresses: Derivation of formula - shear stress distribution across various beam sections like rectangular, circular, triangular, IT angle sections.
UNIT-IV	**TORSION OF CIRCULAR SHAFTS**
	Theory of pure torsion: derivation of torsion equations: ; Assumptions made in the theory of pure torsion, torsional moment of resistance, polar section modulus, power transmitted by shaft, combined bending and torsion and end thrust, design of shafts according to theories of failure. Introduction to springs, types of springs, deflection of close and open coiled helical springs under axial pull and axial couple, springs in series and parallel.
UNIT-V	**COLUMNS AND STRUTS: BUCKLING**

	Introduction: Types of columns, short, medium and long columns, axially loaded compression members, crushing load, Euler's theorem for long columns, assumptions, derivation of Euler's critical load formulae for various end conditions. Equivalent length of a column, slenderness ratio, Euler's critical stress, limitations of Euler's theory, Rankine's and Gordon formula, long columns subjected to eccentric loading, secant formula, empirical formulae, straight line formula and Prof. Perry's formula. Laterally loaded struts, subjected to uniformly distributed and concentrated loads, maximum bending moment and stress due to transverse and lateral loading

TEXTBOOKS

1. Hausmann, M.R "Engineering principles of Ground Modifications", Tata McGraw-Hill publications, 1990..
2. Pillai and Menon, "Reinforced Concrete Design", Tata McGraw-Hill Publishing Company, 2009.

REFERENCE BOOKS:

1. Koener, R.M, "Designing with Geosynthetics", Prentice Hall, New Jersey, 1994.
2. Jones C.J.P, "Earth Reinforcement and soil structures", Butterworths, London, 1985.

WEB REFERENCES:

1. https://nptel.ac.in/courses/105/106/105106050/
2. https://nptel.ac.in/courses/105/106/105106113/

COURSE WEB PAGE:

1. https://lms.iare.ac.in/index?route=course/details&course_id=221

XIX COURSE PLAN:

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

S.No	Topics to be covered	CO's	Reference T: R:
OBE DISCUSSION			
1	Course Objectives, Course Outcomes, Program Outcomes, CO-PO Mapping		
CONTENT DELIVERY (THEORY)			
2	Introduction to ground modification	CO 1	T1:11.1
3-4	Need and objectives of ground modification techniques.	CO 1	T1:11.4
5-6	Identification of soil types.	CO 2	T1:16.6
7-8	In Situ and laboratory tests to characterize problematic soils.	CO 3	T1:13.1
9-10	Mechanical, hydraulic, physic-chemical methods of ground Improvement techniques.	CO 4	R1:13.15
11	Electrical, Thermal methods, and their applications of groundModification.	CO 4	T1:13.3 R1:15.5
12	Introduction to mechanical modification	CO 4	T1:13.8
13-14	Analyzing Deep Compaction techniques	CO 4	T1:13.9
15-16	Blasting vibro- compaction	CO 4	T1:14.3
17-18	Objectives and techniques of hydraulic modification	CO 4	T1:15.9
19-20	Traditional dewatering methods and their choice	CO 4	T1:15.5
21-22	Design of dewatering system	CO 4	T1:15.6
23-24	Electro-osmosis technique.	CO 4	T1:15.8
25	Electro kinetic dewatering technique.	CO 4	T1:16.9
26	Filtration technique used in geo-synthetics.	CO 4	T1:16.5
27-28	Preloading the vertical drains.	CO 4	T1:16.3
29-30	Shotcreting and Guniting Technology.	CO 5	T1:17.22
31-32	Modification at depth by grouting.	CO 5	T1:17.22
33-34	Crack grouting and compaction grouting.	CO 5	T1:19.3
35-36	Jet grouting technique, Thermal modification, Ground freezing.	CO 6	T1:19.6.1
37-38	Modification by inclusions and confinement.	CO 6	R2:19.6.2
39-40	Soil reinforcement and grid reinforced soil.	CO 6	R2:21.6.2
41-42	Physical and Chemical Modification of admixtures.	CO 6	R2:22.6.3
43-44	Reinforced soils, grid soils	CO 6	T1:17.4
45-46	Rock bolting and soil nailing	CO 6	R2:17.2.1
PROBLEM SOLVING/ CASE STUDIES			
1	Identification of soil types	CO 3	T1: 5.1-5.4 R2: 5.1-5.5

2	In situ and laboratory tests	CO 3	T1: 6.1-6.8 R2: 6.1-6.4
3	Compaction factor test sieve analysis.	CO 3	T1: 7.1-7.6
4	Index properties tests.	CO 3	T1: 5.2; 6.2
5	Permeability tests	CO 3	T2: 6.3 R4: 10.6
6	Hydraulic methods	CO 3	T2: 6.3 R4: 10.7
7	Application of GIT methods	CO 3	T2: 6.2 R4: 10.3-10.5
8	Deep compaction techniques.	CO 5	T2: 14.7-14.8
9	Dynamic tamping.	CO 5	T2: 26.5-26.10 R4: 3 - 5
10	Compaction piles	CO 6	T3: 10.2-10.8
11	Electro-osmosis, electro kinetic dewatering	CO 6	T1: 14.1-14.3
12	Filtration, drainage and seepage control	CO 6	T2: 14.4-14.6
13	Types of geosynthetics-I.	CO 6	T2: 3.1-3.12 R1: 8.1-8.7
14	Application of GIT methods	CO 6	T3: 2.2-2.7 R2: 7.1-7.6
15	Thermal methods	CO 6	T3: 2.8-2.13 R2: 7.1-7.6
DISCUSSION OF DEFINITION AND TERMINOLOGY			
1	identification of soil types, in situ and laboratory tests to characterize problematic Soils, mechanical, hydraulic, physical, chemical, electrical, thermal methods and their applications	CO 1	T1: 5.1-5.4, 6.1-6.8, 7.1-7.6 R2: 5.1-5.5, 6.1-6.4
2	Deep compaction techniques, blasting, vibro compaction, dynamic tamping and compaction piles	CO 2	T1: 6.1-6.8 R2: 6.1-6.4
3	traditional dewatering methods and their choice, design of dewatering system, electro-osmosis, electro kinetic dewatering. Filtration, drainage and seepage control with geosynthetics, preloading the vertical drains.	CO 3, 4	T1: 10.2-10.8 T2:14.7-14.8 R2: 3 – 5
4	Modification by admixtures, shotcreting and guniting technology, modification at depth by grouting, crack grouting and compaction grouting. Jet grouting, thermal modification, ground freezing.	CO 5	T2: 10.2-10.8 T2: 14.1-14.3 T2: 14.4-14.6
5	Soil reinforcement, reinforcement with strip, and grid reinforced soil. In-situ ground reinforcement, and ground anchors, rock bolting and soil nailing.	CO 6	T3: 2.1-3.12 R4: 7.1-7.6, 8.1-8.7
DISCUSSION OF QUESTION BANK			
1	Introduction to Ground Modification	CO 1	T1: 5.1-5.4, 6.1-6.8, 7.1-7.6 R2: 5.1-5.5, 6.1-6.4

2	Mechanical Modification	CO 2	T1: 6.1-6.8 R2: 6.1-6.4
3	Hydraulic Modification	CO 3, 4	T2: 10.2-10.8
4	Physical and Chemical Modification	CO 5	T1: 10.2-10.8 T2: 14.1-14.3
5	Modification by Inclusions and Confinement	CO 6	T2: 2.1-3.12 R2: 7.1-7.6, 8.1-8.7

Signature of Course Coordinator **HOD,CE**
Mr K Tarun Kumar, Assistant Professor

INSTITUTE OF AERONAUTICAL ENGINEERING
(Autonomous)
Dundigal, Hyderabad - 500 043

CIVIL ENGINEERING

COURSE DESCRIPTION

Department	**CIVIL ENGINEERING**				
Course Title	**SURVEYING**				
Course Code	ACE002				
Program	B.Tech				
Semester	III	CE			
Course Type	CORE				
Regulation	R16				
Course Structure	Theory			Practical	
	Lecture	Tutorials	Credits	Laboratory	Credits
	3	1	4	-	-
Course Coordinator	Mr. B Suresh, Assistant Professor				

I COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites
B.Tech	AHS002	I	Linear algebra and ordinary differential equations

II COURSE OVERVIEW:

Surveying is the technique, profession, science and art of making all essential measurements to determine the relative position of points or physical and cultural details above, on, or beneath the surface of the Earth, and to depict them in a their objectives. Surveyors use elements of mathematics (geometry and trigonometry), physics, engineering and law. Surveyor measures certain dimensions that generally occur on the surface of the Earth. Surveying equipment, such as levels and theodolites, are used for accurate measurement of angular deviation, horizontal, usable form, or to establish the position of points or details. These points are usually on the surface of the earth, and they are often used to establish land maps and boundaries for ownership or governmental purposes. To accomplish vertical and slope distances with computerization, electronic distance measurement (EDM), total stations, remotes sensing, Photogrammetry, GPS surveying and laser scanning have supplemented to a large extent.

III MARKS DISTRIBUTION:

Subject	SEE Examination	CIE Examination	Total Marks
Surveying	70 Marks	30 Marks	100

IV CONTENT DELIVERY / INSTRUCTIONAL METHODOLOGIES: :

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

V EVALUATION METHODOLOGY:

The course will be evaluated for a total of 100 marks, with 30 marks for Continuous Internal Assessment (CIA) and 70 marks for Semester End Examination (SEE). Out of 30 marks allotted for CIA during the semester, marks are awarded by taking average of two CIA examinations or the marks scored in the make-up examination.

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 14 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 Table: 1.

Percentage of Cognitive Level	Blooms Taxonomy Level
33.3%	Remember
50 %	Understand
0 %	Apply
16.7 %	Analyze
0 %	Evaluate
0 %	Create

Continuous Internal Assessment (CIA):

CIA is conducted for a total of 30 marks, with 20 marks for Continuous Internal Examination (CIE), 05 marks for Quiz and 05 marks for Alternative Assessment Tool (AAT).

Component	Theory		Total Marks
Type of Assessment	CIE Exam	Quiz \AAT	
CIA Marks	25	05	30

Continuous Internal Examination (CIE):

Two CIE exams shall be conducted at the end of the 8^{th} and 16^{th} week of the semester respectively. The CIE exam is conducted for 20 marks of 2 hours duration consisting of five descriptive type questions out of which four questions have to be answered where, each question carries 5 marks. Marks are awarded by taking average of marks scored in two CIE exams.

Quiz - Online Examination

Two Quiz exams shall be online examination consisting of 50 multiple choice questions and are to be answered by choosing the correct answer from a given set of choices (commonly four). Such a question paper shall be useful in testing of knowledge, skills, application, analysis, evaluation and understanding of the students. Marks shall be awarded considering the average of two quiz examinations for every course.

Alternative Assessment Tool (AAT)
This AAT enables faculty to design own assessment patterns during the CIA. The AAT converts the classroom into an effective learning center. The AAT may include tutorial hours/classes, seminars, assignments, term paper, open ended experiments, METE (Modeling and Experimental Tools in Engineering), five minutes video, MOOCs etc. The AAT chosen for this course is given in table

Concept Video	Tech-talk	Complex Problem Solving
40%	40%	20%

VI COURSE OBJECTIVES:

The students will try to learn:

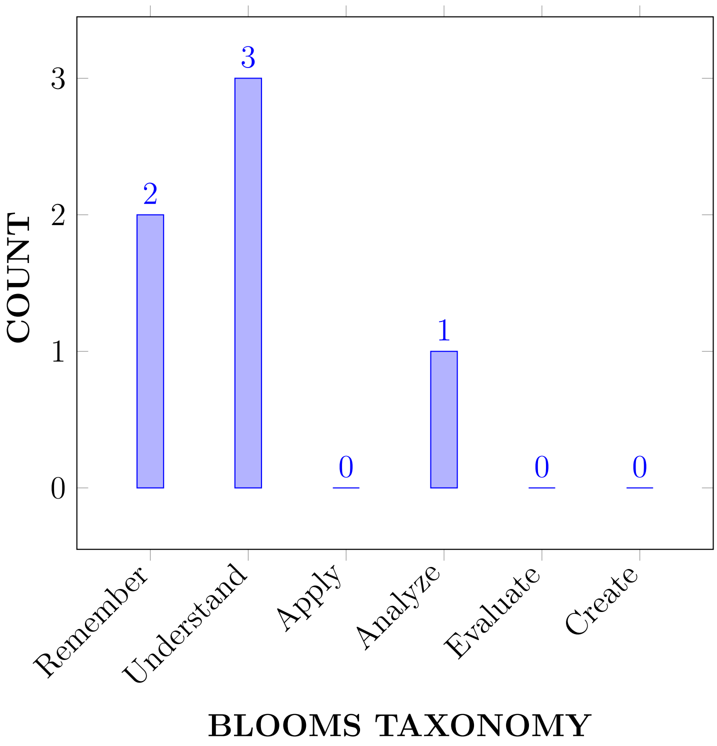
I	Evaluate the basic principles of surveying and its classification.
II	Identify, formulate and solve the problems in the field of advanced surveying
III	Determine the contour points and their importance in surveying.
IV	Analyze survey data and design the civil engineering projects.

VII COURSE OUTCOMES:

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

CO 1	**List** the needs for accurate and thorough note taking field work in serving as a legal record.	Remember
CO 2	**Illustrate** the various methods of survey lines in tracing tracing area and volumes at suitable locations .	Understand
CO 3	**Explain** the practical application on total station using the principle of Electronic Distance Measurement for minimizing local errors.	Understand
CO 4	**Outline** the co-ordinate transformation and accuracy considerations associated with inaccessible heights and distances with trigonometric levelling.	Understand
CO 5	**Recall** the importance of tacheometric surveying staff inclined and held vertical. for preparing 2D geographical maps	Remember
CO 6	**Analyze** remote sensing data acquisition on platforms and sensors using satellite images in providing base maps for graphical reference in real time.	Analyze

COURSE KNOWLEDGE COMPETENCY LEVEL



VIII PROGRAM OUTCOMES:

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

Program Outcomes	
PO 7	**Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO 8	**Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO 9	**Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO 10	**Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO 11	**Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO 12	**Life-Long Learning:** Recognize the need for and having the preparation and ability to engage in independent and life-long learning in the broadest context of technological change

IX HOW PROGRAM OUTCOMES ARE ASSESSED:

Program		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.	1	CIE/Quiz/AAT
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	3	CIE/Quiz/AAT

3 = High; 2 = Medium; 1 = Low

X HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

Program	Strength	Proficiency Assessed by

PSO 1	Design and supervise sub-structures and superstructures for residential and public buildings, industrial structures, irrigation structures, powerhouses, highways, railways, airways, docks and harbours.	1	CIE, SEE, AAT

3 = High; 2 = Medium; 1 = Low

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

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

XII 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 and principals of mathematics to engineering problems in determining an area enclosed by irregular boundary line using the knowledge of **mathematics and science fundamentals**	2
	PO 2	Analyse and formulate the engineering problems to determine exact field measurements to serve as a legal record. Analyse and **identify the problem statement,formulation and abstraction** for the **development of solution.**	4
CO 2	PO 1	Use the **fundamentals of engineering** and **science** in identifying the suitable alignment or path for curves at various terrains.	2
CO 3	PO 2	Identify the practical application of total station in **identifying the local errors** from the first principals of mathematics and **generate the solution.**	2
	PO 5	Understand the technical concepts of advanced surveying instruments and **simulate** the data recorded for various applications.	1
CO 4	PO 1	Derive the co-ordinate transformation and accuracy considerations using the **engineering fundamentals and mathematical applications**.	2

	PO 2	**Formulate** the problem associated in co-ordinate transformation and accuracy considerations for **analysing the given engineering problems** and **generate the solution**.	3
	PSO 1	Understand the co-ordinate transformation and accuracy considerations associated with Global Positioning System in **design of substructures and superstructures** for residential and public buildings using **standard codes of practice**.	2
CO 5	PO 1	Apply the knowledge of **mathematics and science** to determine the unknown variables using Stereoscopy for preparing 3D geographical maps	2
	PSO 1	Recall the importance of terrestrial photogrammetry, flight planning and Stereoscopy to **design** and **supervise** substructures and superstructures for residential and public buildings using **standard codes of practice**	2
CO 6	PO 2	**Collect the data** by **identifying** platforms and sensors using satellite images and **generate the solution** for graphical reference in remote sensing	3

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

COURSE OUTCOMES	Program Outcomes/ No. of Key Competencies Matched												PSO'S		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
	3	10	10	11	1	5	3	3	12	5	12	8	10	3	3
CO 1	2	4	-	-	-	-	-	-	-	-	-		-	-	-
CO 2	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 3	-	2	-	-	1	-	-	-	-	-	-	-	-		-
CO 4	2	3	-	-	-	-	-	-	-	-	-	-	2	-	-
CO 5	2	-	-	-	-	-	-	-	-	-	-	-	2	-	-
CO 6	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-

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

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
	3	10	10	11	1	5	3	3	12	5	12	8	10	3	3
CO 1	66.7	40	-	-	-	-	-	-	-	-	-		-	-	-
CO 2	66.7	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 3	-	20	-	-	100	-	-	-	-	-	-	-	-		-
CO 4	66.7	30	-	-	-	-	-	-	-	-	-	-	20	-	-

CO 5	66.7	-	-	-	-	-	-	-	-	-	-	-	20	-	-
CO 6	-	30	-	-	-	-	-	-	-	-	-	-	-	-	-

XV COURSE ARTICULATION MATRIX (PO – PSO MAPPING):

CO'S and PO'S and CO'S and PSO'S on the scale of 0 to 3, 0 being no correlation, 1 being the low correlation, 2 being medium correlation and 3 being high correlation.
0 - $0 \leq C \leq 5\%$ – No correlation
1 $5\% < C \leq 40\%$ – Low/ Slight
2 - $40\% < C < 60\%$ –Moderate
3 - $60\% \leq C < 100\%$ – Substantial /High

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

XVI ASSESSMENT METHODOLOGY DIRECT:

CIE Exams	✓	SEE Exams	✓	Seminars	-
Term Paper	-	Concept Video	✓	Open Ended Experiments	-
Assignments	-	Mini project	-	Tech Talk	✓

XVII ASSESSMENT METHODOLOGY-INDIRECT:

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

XVIII SYLLABUS:

MODULE I	**INTRODUCTION, LINEAR AND ANGULAR MEASUREMENTS**
	Definitions, primary divisions of surveying, objectives, principles and classifications, plan and map, errors due to wrong scale. Linear and angular measurements; Direct and in direct methods, use of chain and tape, errors inchaining, meridians, azimuths and bearings, declination, dip, computation of angle, errors due to local attraction.
MODULE II	**LEVELING AND CONTOURING**
	Leveling: Concept and terminology, temporary and permanent adjustments, method of leveling, height of instrument and rise and fall method; Contouring: Characteristics and uses of contours; Methods of conducting contour surveys and their plotting.
MODULE III	**COMPUTATION OF AREAS AND VOLUMES**
	Computation of areas directly from field measurements methods, computation of areas along irregular boundaries and regular boundaries. Embankments and cutting for a level section and two level sections with and without transverse slopes, determination of the capacity of reservoir, volume of barrow pits. .
MODULE IV	**THEODOLITE AND TRAVERSE SURVEYING**
	Theodolite, description of transit theodolite, definitions and terms, temporary and permanent adjustments, measurement of horizontal and vertical angles. Trigonometric leveling height and distance problems, traverse survey and methods of traversing, closing errors in traversing.
MODULE V	**TACHEOMETRIC AND ADVANCED SURVEYING**
	Tachometry: Stadia and tangential methods of tachometry. Distance elevation and depression formulae for staff held in vertical and inclined position. Curves: Definition, types of curves, design and setting out, simple andcompound curves. Advanced Surveying: Basic principles of total station, global positioning system and geographic information system.

TEXTBOOKS

1. Duggal S. K.,Surveying (Vol-1and 2), Tata McGraw-Hill Publishers, New Delhi, 10^{th} Edition, 2004.

2. C. Venkatramaiah, Textbook of Surveying, Universities Press Pvt. Ltd., India, 3^{rd} Edition, 2013

3. Dr A. M. Chandra, Surveying Problem Solving with theory and objective type questions, New AgeInternational Pvt. Ltd. Publishers, New Delhi, 2^{nd} Edition, 2005

REFERENCE BOOKS:

1. R. Subramanian, Surveying and Leveling‖, Oxford University Press, New Delhi. 2^{nd} Edition, 2012.

2. M. James, Anderson Edward Mikhail, Surveying Theory and Practice‖, Tata McGraw Hill, New Delhi, 7^{th} Edition, 2000.
3. Arthur R Benton, Philip J Taety, Elements of Plane Surveying‖, McGraw-Hill Education, New Delhi. 8^{th} Edition, 2000

WEB REFERENCES:

1. https://nptel.ac.in/courses/105/101/105101087/

COURSE WEB PAGE:

1. https://lms.iare.ac.in/index?route=course/detailscourseid=374

XIX 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.	Outcome Based Education, CO PO attainment and Blooms Taxonomy		
	CONTENT DELIVERY (THEORY)		
1-2	Understand Definitions, primary divisions of surveying.	CO 1	T1:3.1
3	Explain objectives, principles and classifications.	CO 1	T1:3.14.
4-5	Understand plan and map, errors due to wrong scale.	CO 1	T1:11.1
6-7	Identify Linear and angular measurements Direct and in direct methods, use of chain and tape	CO 1	T1:9.1
8-9	Identify Errors in chaining, meridians, azimuths and bearings, declination, dip, computation of angle, errors due to local attraction.	CO 1	T1:9.4
10-11	Describe Leveling: Concept and terminology, temporary and permanent adjustments, method of leveling, height of instrument and rise and fall method	CO 1	R3:13.1
12-13	Explain Contouring: Characteristics and uses of contours; Methods of conducting contour surveys and their plotting.	CO 1	R3:14.1
14-15	Computation of areas directly from field measurements methods, computation of areas along irregular boundaries and regular boundaries.	CO 1	R3:14.4
16	Identify the components of an Embankments and cutting for a level section and two level sections with and without transverse slopes	CO 1	R3:9.26
17-20	Understand the different types of Computation of areas directly from field measurements methods.	CO 2	T2:8.1
21-25	Explain the foundations for computation of areas along irregular boundaries and regular boundaries.	CO 2	T2: 6.1

26-28	Explain Embankments and types of Embankments .	CO 2	T2: 6.4
29-31	Identify cutting for a level section and two level sections with and without transverse slopes.	CO 2	T1: 4.1-4.16
32	Determination of the capacity of reservoir.	CO 3	T1: 4.1
33-35	compute volume of barrow pits.	CO 3	T1: 4.2
36-39	Explain Theodolite, description of transit theodolite, definitions and terms, temporary.	CO 4	T2:11.5
40-43	Identify permanent adjustments, measurement of horizontal and vertical angles	CO 4	T2: 5.2
44-47	Explain Trigonometric leveling height and distance problems, traverse survey and methods of traversing, closing errors in traversing.	CO 4	T2:11.13
48	Describe the fundamentals of Trigonometric leveling height and distance problems, traverse survey and methods of traversing, closing errors in traversing.	CO 4	T2:11.13
49	Tachometry: Stadia and tangential methods of tachometry. .	CO 5	R2:7.2
50-52	Differentiate Curves: Definition, types of curves, design and setting out. Simple and compound curves	CO 5	T1: 4.15
53-54	Understand Advanced Surveying. Basic principles of total station	CO 6	T1: 6.3
55-56	Explain Global positioning system and Geographic information system and	CO 6	T1: 6.6
57-60	Applications and advantages of Geographic information system in civil engineering .	CO 6	T1: 6.6
PROBLEM SOLVING/ CASE STUDIES			
1	Calculate the linear and angular measurements of a closed traverse	CO 1	R2:7.5
2	Determine the terrain slope using leveling instruments	CO 1	T2:3
3	Calculate an area enclosed by an irregular boundary line	CO 1	R2:7.5
4	Explain about trapezoidal rule and derive an equation to calculate area	CO 4	R2:7.5
5	Explain about mid-ordinate rule and derive an equation to calculate area	CO 1	T1: 4.1
6	Define Right observation of a theodolite	CO 2	T3:4.5
7	Measure degree of curve for 20m chain length.	CO 2	R4:5.2
8	Analyze the method of setting out a circular curve with two theodolites. What are its advantages and disadvantages over Rankine’s method.	CO 3	T2:5.2
9	Explain the procedure of setting out simple circular curve by Perpendicular offset from tangent method.	CO 3	R2:7.5
10	Explain the important features of total station.	CO 4	R2:7.5

11	Explain about errors and biases of Global Positioning System.	CO 5	R2:7.5
12	Explain about control and operating segment in Global Positioning System.	CO 5	R2:7.5
13	Explain in detail about the field procedure of total station to calculate an area of field.	CO 6	R2:7.5
14	Explain about various types of cameras used in Photogrammetry.	CO 6	R2:7.5
15	Explain low oblique photograph and high oblique photograph.	CO 6	R2:7.5
DISCUSSION OF DEFINITION AND TERMINOLOGY			
1	levelling,areas and volumes, Triangulation and Trilateration Theodolite survey	CO 1	R4:2.1
2	Elements of simple and compound curves, Method of setting out	CO 2	T4:7.3
3	Distance Measurement, Modulation, Types of EDM instruments, Distomat, Total Station, Parts of a Total Station	CO 3,4	R4:5.1
4	Geometry of aerial photograph, relief and tilt displacements, terrestrial photogrammetry,	CO 5	T1:7.5
5	Electromagnetic Spectrum, interaction of electromagnetic radiation with the atmosphere and earth surface.	CO 6	T1: 4.1
DISCUSSION OF QUESTION BANK			
1	A 20m chain was found to be 10cm too long after chaining a distance of 1500m. It was found to be 18 cm too long at the end of the day's work after chaining a total distance of 2900m. Find the true distance if the chain was corrected before the commencement of the work.	CO 1	R4:2.1
2	A horizontal curve is designed with a 600 m radius and is known to have a tangent length of 52 m. The PI is at station 200. Determine the stationing of the PT.	CO 2	T4:7.3
3	Explain the disadvantages of total station in detail and what are the different types of modes available in total station	CO 3, 4	R4:5.1
4	A vertical photo graph was taken at an altitude of 1200m above mean sea level determine scale of photo graph at an elevation of 80m with the focal length of the camera is 15cm.	CO 5	T1:7.5
5	Explain about RADAR Imaging Satellite (RISAT) of India. It acts as a platform for Active Senor or Passive sensor? Why?	CO 6	T1: 4.1

Signature of Course Coordinator **HOD CE**
Mr. B Suresh Assistant Professor

INSTITUTE OF AERONAUTICAL ENGINEERING
(Autonomous)
Dundigal, Hyderabad - 500 043

CIVIL ENGINEERING
COURSE DESCRIPTION

Course Title	**ENGINEERING GEOLOGY**				
Course Code	ACE003				
Program	B.Tech				
Semester	III	CE			
Course Type	CORE				
Regulation	IARE-R16				
Course Structure	Theory			Practical	
	Lecture	Tutorials	Credits	Laboratory	Credits
	3	-	3	-	-
Course Coordinator	Mrs. P Sri Poojitha Professor				

I COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites
-	-	-	-

II COURSE OVERVIEW:

This course provides engineers and geologists with an overview of engineering geology. Engineering geology routinely deals with the application of geologic site characterization and the evaluation of geological and geotechnical conditions for the design, construction, operation, and maintenance of engineering structures. This course is designed to provide a general background of geologic considerations, identification, classification and engineering properties of soil and rock. Additionally, geotechnical field exploration methods used in engineering geology will be covered. The intent is to give the reader a basic understanding of some of the investigation and classification methods for soil and rock when used as a construction material in engineering applications.

III MARKS DISTRIBUTION:

Subject	SEE Examination	CIE Examination	Total Marks
Engineering Geology	70 Marks	30 Marks	100

IV CONTENT DELIVERY / INSTRUCTIONAL METHODOLOGIES:

✓	PPT	✓	Chalk & Talk	✓	Assignments	x	MOOC
✓	Open Ended Experiments	✓	Tech talk	x	Mini Project	✓	Videos
x	Others						

V EVALUATION METHODOLOGY:

The course will be evaluated for a total of 100 marks, with 30 marks for Continuous Internal Assessment (CIA) and 70 marks for Semester End Examination (SEE). Out of 30 marks allotted for CIA during the semester, marks are awarded by taking average of two CIA examinations or the marks scored in the make-up examination.

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 14 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 Table: 1.

Percentage of Cognitive Level	Blooms Taxonomy Level
16.7%	Remember
83.3 %	Understand
0 %	Apply
0 %	Analyze
0 %	Evaluate
0 %	Create

Continuous Internal Assessment (CIA):

CIA is conducted for a total of 30 marks, with 25 marks for Continuous Internal Examination (CIE) and 05 marks for Quiz \Alternative Assessment Tool (AAT).

Component	Theory		Total Marks
Type of Assessment	CIE Exam	Quiz \AAT	
CIA Marks	25	05	30

Continuous Internal Examination (CIE):

Two CIE exams shall be conducted at the end of the 8^{th} and 17^{th} week of the semester respectively. The CIE exam is conducted for 25 marks of 2 hours duration consisting of two parts. Part–A shall have five compulsory questions of one mark each. In part–B, four out of five questions have to be answered where, each question carries 5 marks. Marks are awarded by taking average of marks scored in two CIE exams.

Quiz - Online Examination

Two Quiz exams shall be online examination consisting of 25 multiple choice questions and are to be answered by choosing the correct answer from a given set of choices (commonly four). Such a question paper shall be useful in testing of knowledge, skills, application, analysis, evaluation and understanding of the students. Marks shall be awarded considering the average of two quiz examinations for every course.

Alternative Assessment Tool (AAT)

This AAT enables faculty to design own assessment patterns during the CIA. The AAT converts the classroom into an effective learning center. The AAT may include tutorial hours/classes, seminars, assignments, term paper, open ended experiments, METE (Modeling and Experimental Tools in Engineering), five minutes video, MOOCs etc. The AAT chosen for this course is given in table

Concept Video	Tech-talk	Complex Problem Solving
40%	40%	20%

VI COURSE OBJECTIVES:

The students will try to learn:

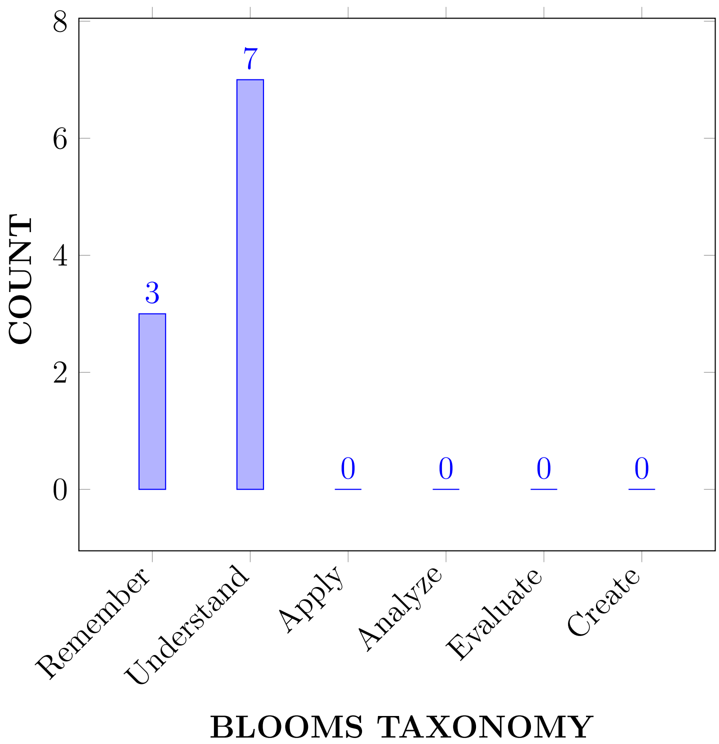
I	Discuss the process of formation of rocks, their classifications and properties of minerals
II	Identify different geological structures encountered in nature.
III	Recognize different hazards such as earthquakes, landslides etc causes and their effects
IV	Explain the importance of geophysical and geological studies of sites for tunnels, dams and reservoirs

VII COURSE OUTCOMES:

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

CO 1	**Classify** rocks using basic geological systems for selective construction material..	Understand
CO 2	**Relate** the concepts of how minerals form and their uses for identifying the rock forming..	Understand
CO 3	**Interpret** graphs and models used in structural geology for demonstrating stress, strain and tectonics.	Understand
CO 4	**Classify** the relationship between plate tectonics and production of rock terrains for characterization of rocks.	Understand
CO 5	**Interpret** the geologic literature to establish the geotechnical framework for proper design of constructing civil engineering projects.	Understand
CO 6	**List out** the design and construction procedures required for controlling safety of rock behaviour in underground openings.	Remember

COURSE KNOWLEDGE COMPETENCY LEVEL



VIII PROGRAM 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.

Program 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

IX 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.	2	CIE/SEE/AAT
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	CIE / SEE/ AAT
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.	2	CIE / SEE/ AAT

3 = High; 2 = Medium; 1 = Low

X HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

Program		Strength	Proficiency Assessed by
PSO 1	Design and supervise sub-structures and superstructures for residential and public buildings, industrial structures, irrigation structures, powerhouses, highways, railways, airways, docks and harbours.	1	CIE, SEE, AAT
PSO 2	Focus on improving performance of structures with reference to safety and serviceability, and sustainable green building technology.	3	CIE, SEE, AAT

3 = High; 2 = Medium; 1 = Low

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

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	✓	-	✓	-	-	-	✓	-	-	-	-	-	✓	-	-
CO 2	✓	-	-	-	-	-	✓	-	-	-	-	-	-	✓	-
CO 3	✓	-	-	-	-	-	-	-	-	-	-	-	✓	-	-
CO 4	-	-	✓	-	-	-	✓	-	-	-	-	-	✓	✓	-
CO 5	-	-	-	-	-	-	-	-	-	-	-	-	✓	-	-
CO6	✓	-	-	-	-	-	✓	-	-	-	-	-	✓	-	-

XII JUSTIFICATIONS FOR CO – (PO, PSO) MAPPING -DIRECT:

COURSE OUTCOMES	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key Competencies
CO 1	PO 1	Recall the basic knowledge about scientific principles of natural material like rocks and minerals and their usage as well as their availability.	1
	PO 3	Minerals and rocks will get acquainted with environmental conditions by natural dynamic processes and their actions.	1
	PO 7	Understand the influence of natural processes and environmental conditions to take decision while planning, design and execution stage of the structures in their professional life.	2
	PSO 1	Explain the significance of materials knowledge for civil engineering projects and site selection as well as for the strength assessment and others.	2

CO 2	PO 1	Choose retrofitting techniques to improve the aesthetics and safety of structures by considering commercial and economic context of engineering processes (Engineering Knowledge).	3
	PO 7	Determine favorable and unfavorable conditions, nature of rocks, suitability of site for construction of Building, Road, Dam, Tunnel and treatment to unfavorable rocks(Environmental and sustainability).	1
	PSO 2	Focus on improving performance of structures using suitable techniques with reference to safety, serviceability and strength assessment.	2
CO 3	PO 1	Identify the materials for repair and rehabilitation of structures by understanding the characteristics and applications with the basic knowledge of engineering fundamentals and scientific principles.	2
	PSO 1	Explain environmental impact, strength assessment, mass processes, and good building stones.	2
CO 4	PO 3	Understand the engineering principles, system approach to evaluate the deterioration of structure based on characteristics of particular materials, equipment, processes, or products(engineering problems).	3
	PO 7	Incorporate socio economic, remote sensing and GIS techniques and environmental impacts in design and construction.	2
	PSO 1	Determine favorable and unfavorable conditions, nature of rocks, structural design and material knowledge in procurement and construction.	2
	PSO 2	Explain geological hazards, geo-hydrological characters of the rocks, mass wasting processes, and good building stones.	2
CO 5	PSO 1	Recognize tectonic effects, Geological structures and their significance in Civil Engineering.	3
CO 6	PO 1	Choose suitable techniques due to the quality issues of structures with the knowledge of characteristics of particular materials, equipment, processes and understanding the contexts in which engineering knowledge can be applied (Engineering Knowledge).	1
	PO 7	Select and apply appropriate demolition technique by understanding the effect of damage of structure(Environmental and sustainability).	1
	PSO 1	Use techniques of damaged structures by adopting the new technology(Quality assurance).	1

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

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

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

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	33.3	-	10	-	-	-	66.7	-	-	-	-	-	20	-	-
CO 2	100	-	-	-	-	-	33.3	-	-	-	-	-	-	66.7	-
CO 3	66.7	-	-	-	-	-	-	-	-	-	-	-	20	-	-
CO 4	-	-	33.3	-	-	-	66.7	-	-	-	-	-	20	66.7	-
CO 5	-	-	-	-	-	-	-	-	-	-	-	-	33.3	-	-
CO 6	33.3	-	-	-	-	-	33.3	-	-	-	-	-	10	-	-

XV COURSE ARTICULATION MATRIX (PO – PSO MAPPING):

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

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

2 - 40 % <C < 60% –Moderate

1-5 <C≤ 40% – Low/ Slight

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

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	1	-	1	-	-	-	3	-	-	-	-	-	1	-	-
CO 2	3	-	-	-	-	-	1	-	-	-	-	-	-	3	-
CO 3	3	-	-	-	-	-	-	-	-	-	-	-	1	-	-
CO 4	-	-	1	-	-	-	3	-	-	-	-	-	1	3	-
CO 5	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-
CO 6	1	-	-	-	-	-	1	-	-	-	-	-	1	-	-
TOTAL	8	-	2	-	-	-	8	-	-	-	-	-	5	6	-
AVERAGE	2.0	-	1.0	-	-	-	2.0	-	-	-	-	-	1.0	3.0	-

XVI ASSESSMENT METHODOLOGY DIRECT:

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

XVII ASSESSMENT METHODOLOGY INDIRECT:

✓	Early Semester Feedback	✓	End Semester OBE Feedback
X	Assessment of Mini Projects by Experts		

XVIII SYLLABUS:

MODULE I	**WEATHERING OF ROCKS**
	Introduction: Importance of geology from civil engineering point of view. Brief study of case histories of failures of some civil engineering constructions due to geological draw backs. Importance of physical geology, petrology and structural geology. Weathering of rocks: Its effect over the properties of rocks importance of weathering with reference to dams, reservoirs and tunnels weathering of common rock like granite.

MODULE II	**MINERALOGY AND PETROLOGY**
	Mineralogy: Definition of mineral, importance of study of minerals, different methods of study of minerals. Advantages of study of minerals by physical properties. Role of study of physical properties of minerals in the identification of minerals. Study of physical properties of following common rock forming minerals: Feldsper, Quartz, Flint, Jasper, Olivine, Augite, Hornblende, Muscovite, Biotite, Asbestos, Chlorite, Kyanite, Garnet, Talc, Calcite. Study of other common economics minerals such as Pyrite, Hematite, Magnetite, Chrorite, Galena, Pyrolusite, Graphite, Magnesite, and Bauxite. Petrology: Definition of rock, geological classification of rocks into igneous, sedimentary and metamorphic. Dykes and Sills, common structures and textures of igneous, sedimentary and metamorphic rocks. Megascopic study of Granite, Dolerite, Basalt, Pegmatite, Laterite, Conglomerate, Sand Stone, Shale, Limestone, Gneiss, Schist, Quartzite, Marble and Slate. Rock excavation, stone aggregates.
MODULE III	**STRUCTURAL GEOLOGY**
	Indian stratigraphy, palaeontology and geological time scale, out crop, strike and dip study of common geological structures associating with the rocks such as fold, faults unconformities, and joint types. Ground water: Water table, common types of ground water movement, ground water exploration. Earth quakes, their causes and effects, shield hazards, water in landslides their causes and effects, measures to be taken to prevent their occurrence. Importance of study of ground water, earthquake and landslides
MODULE IV	**GEOLOGY OF DAMS AND RESERVOIRS**
	Types of dams and bearing of geology of site in their selection, geological considerations in the selection of a dam site. Factors contributing to the success of a reservoir, geological factors influencing water tightness and life of reservoirs, geo hazards, ground subsidence. Geophysical studies: Importance of geophysical studies principles of geophysical study by gravity methods, magnetic methods, electrical methods, seismic methods, radio metric methods and geothermal method. Special importance of electrical 80 — P a g e resistivity methods and seismic refraction methods. Improvement of competence of sites by grouting etc. Fundamental aspects of rock mechanics and environmental geology.
MODULE V	**TUNNELS**
	Purpose of tunnelling, effects of tunnelling on the ground, role of geological considerations in tunnelling over break and lining in tunnels, tunnels in rock, subsidence over old mines, mining substances.

TEXTBOOKS

1. N.Chennkesavulu, Engineering Geology, Mc Milan India Private Limited, New Delhi, India, 12th Edition,2009.

REFERENCE BOOKS:

1. 1. F.G.Bell, Fundamentals of Engineering Geology, Butterworth's Publications, 3 rd Edition, New Delhi, 1992.

2. K.V.G.K.Gokhale, Principles of Engineering Geology, BS Publications, New Delhi, India, 5th Edition, 2008.

XIX COURSE PLAN:

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

S.No	Topics to be covered	CO's	Reference T1: 4.1
OBE DISCUSSION			
	Dicuss on Outcome Based Education and PO and PSO		
CONTENT DELIVERY (THEORY)			
1	Introduce the subject and importance.	CO 1	T2:24.6 T2:24.8
2	To know the importance of geology.	CO 1	T1:12.14
3	To know various case histories of failures of some major Constructions due to geological drawbacks.	CO 1	T2:3.10 T2:24.7
4-5	Able to understand various branches of geology.	CO 1	T2:3.11 T2:3.12
6-7	To know the process of weathering.	CO 1	T2:3.11 T2:3.12
8-9	To avoid failures due to weathering.	CO 1	T1:16.6.2
10-11	To avoid reservoir failures due to weathering.	CO 1	T2:26.9
12-13	To know how the granite respond to weathering.	CO 1	T2:26.11
14	To understand the importance of minerals and study.	CO 1	T1:16.7
15-16	To understand the different methods of study of minerals.	CO 2	T2:26
17-18	Ability to identify the mineral based on their physical properties.	CO 2	T2:20.4
19	Ability to study on different physical properties of minerals such as feldspar, quartz, flint minerals.	CO 2	T2:23.4
20	Ability to identify jasper, olivine, hornblende and Augite minerals.	CO 2	T2:20.9
21-22	Ability to identify muscovite, biotite, asbestos, chlorite and kyanite minerals.	CO 2	T2:5.13
23-24	Ability to identify Garnet, Talc.	CO 2	T2:5.13
25-26	Ability to study on common Economic minerals such as Pyrite, Hematite, Magnetite, Chlorite, Galina	CO 2	T2:21.12
27	Ability to study on common Economic minerals such as Pyrolusite, Graphite, magnesite, Bauxite.	CO 2	T1:6.5
28-30	To know about petrology ,definition of rock, classification of rock	CO 3	T1:21.3 T1:21.4
31-33	Ability to study about distinguishing features of sand stone, shale, limestone, gneiss, schist	CO 3	T2:27.2
34-36	Ability to understand the importance of Richter scale, precautions to be taken for building construction in seismic areas.	CO 3	T1:27.9

37-39	Ability to understand the importance of landslides, hazards, water in landslides their causes and effects and measures to be taken to prevent their occurrence	CO 3	T1:12.6.2
40-42	Ability to understand the importance of ground water, earth quakes and land slides	CO 3	T1:12.7.2
43-44	Ability to understand the importance of geology of dams and reservoirs and types of dams	CO 4	T1:12.8.2
45-46	Ability to understand the importance bearing capacity of geology of site in their selection	CO 4	T1:12.8.6
47-49	Ability to understand the importance of geological considerations in the selection of a dam site and the analysis dam failure in the past	CO 4	T1:7.2.5
50-51	Ability to understand the importance of factors contributing to the success of a reservoir.	CO 4	T1:10.7
52-53	Ability to understand the importance of geological factors influencing water tightness and life of reservoirs, geo hazards and ground subsidence.	CO 4	T1:8.4.2 R1:1.3.4
54	Ability to understand the importance of geophysical studies, principles of geophysical study in gravity methods, magnetic and electric methods.	CO 5	T1:8.8
55	Ability to understand the importance of seismic, radiometric and geothermal methods.	CO 5	T1:8.12.2
56	Ability to understand the importance of electrical resistivity methods, seismic refraction methods.	CO 5	T4:23.22
57	Ability to understand the importance of improvement of competence of sites by grouting etc. . . . , fundamental aspects of rock mechanics and environmental geology.	CO 6	T1:25.15 R1:4.7
58	Ability to understand the importance of tunnels, purposes of tunneling, effects of tunneling on geological considerations (litho logical, structural and ground water)in tunneling.	CO 6	T2:32.17
59	Ability to understand the importance of over break and Lining in tunnels.	CO 6	T1:10.7
60	Ability to understand the importance of tunnels in rock, subsidence over old mines, mining substances.	CO 6	T1:8.4.2 R1:2.4
PROBLEM SOLVING/ CASE STUDIES			
1	Ability to study on different physical properties of minerals such as feldspar, quartz, flint minerals.	CO 2	T2:23.4
2	Ability to identify jasper, olivine, hornblende and Augite minerals.	CO 2	T2:20.9
3	Ability to identify muscovite, biotite, asbestos, chlorite and kyanite minerals.	CO 2	T2:5.13
4	Ability to identify Garnet, Talc.	CO 2	T2:5.13
5	Ability to study on common Economic minerals such as Pyrite, Hematite, Magnetite, Chlorite, Galina	CO 2	T2:21.12

6	Ability to understand the importance of geology of dams and reservoirs and types of dams	CO 4	T1:12.8.2
7	Ability to understand the importance bearing capacity of geology of site in their selection	CO 4	T1:12.8.6
8	Ability to understand the importance of geological considerations in the selection of a dam site and the analysis dam failure in the past	CO 4	T1:7.2.5
9	Ability to understand the importance of improvement of competence of sites by grouting etc. . . , fundamental aspects of rock mechanics and environmental geology.	CO 6	T1:25.15 R1:4.7
10	Ability to understand the importance of tunnels, purposes of tunneling, effects of tunneling on geological considerations (litho logical, structural and ground water)in tunneling.	CO 6	T2:32.17
11	Ability to understand the importance of over break and Lining in tunnels.	CO 6	T1:10.7
12	Ability to understand the importance of tunnels in rock, subsidence over old mines, mining substances.	CO 6	T1:8.4.2 R1:2.4
13	To understand the importance of minerals and study.	CO 1	T1:16.7
14	To understand the different methods of study of minerals.	CO 2	T2:26
15	Ability to identify the mineral based on their physical properties.	CO 2	T2:20.4
DISCUSSION OF DEFINITION AND TERMINOLOGY			
1	Geology, Minerology, Petrology, Mining geology, Structural geology, Stratigraphy	CO 1	R4:2.1
2	Rock, Petrology, Lithology, Igneous rocks, Sedimentary rocks, Metomophic rocks.	CO 2	T4:7.3
3	Physical geology, Loess, Peat, Muck, Loam	CO 3	R4:5.1
4	Dam, Earthquake, Landslide, slope stability	CO 5	T1:7.5
5	Reservoir, F.R.L, M.W.L	CO 6	T1: 4.1
DISCUSSION OF QUESTION BANK			
1	Geology, Minerology, Petrology, Mining geology, Structural geology, Stratigraphy	CO 1	R4:2.1
2	Rock, Petrology, Lithology, Igneous rocks, Sedimentary rocks, Metomophic rocks.	CO 2	T4:7.3
3	Physical geology, Loess, Peat, Muck, Loam	CO 3	R4:5.1
4	Dam, Earthquake, Landslide, slope stability	CO 5	T1:7.5
5	Reservoir, F.R.L, M.W.L	CO 6	T1: 4.1

Signature of Course Coordinator **HOD,CE**
Mrs. P Sri Poojitha, Assistant Professor

INSTITUTE OF AERONAUTICAL ENGINEERING
(Autonomous)
Dundigal, Hyderabad - 500 043

COURSE DESCRIPTION

Department	**CIVIL ENGINEERING**					
Course Title	**BASICS OF ELECTRICAL AND ELECTRONICS ENGINEERING**					
Course Code	AEE018					
Program	B.Tech					
Semester	III	CE				
Course Type	Foundation					
Regulation	IARE - R16					
Course Structure	Theory			Practical		
	Lecture	Tutorials	Credits	Laboratory	Credits	
	3	1	4	-	-	
Course Coordinator	Ms.B Navothna, Assistant Professor					

I COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites
B.Tech	AHS002	I	Linear Algebra and Ordinary Differential Equations
B.Tech	AHS003	I	Computational Mathematics and Integral Calculus

II COURSE OVERVIEW:

Basic Electrical and Electronics Engineering course deals with the concepts of electrical circuits, basic law's of electricity, different methods to solve the electrical networks and the instruments to measure the electrical quantities. This course focuses on the construction, operational features of energy conversion devices such as DC and AC machines, Transformers. It also emphasis on basic electronics semiconductor devices and their characteristics and operational features.

III MARKS DISTRIBUTION:

Subject	SEE Examination	CIE Examination	Total Marks
Basics of Electrical and Electronics Engineering	70 Marks	30 Marks	100

IV CONTENT DELIVERY / INSTRUCTIONAL METHODOLOGIES:

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

V EVALUATION METHODOLOGY:

The course will be evaluated for a total of 100 marks, with 30 marks for Continuous Internal Assessment (CIA) and 70 marks for Semester End Examination (SEE). Out of 30 marks allotted for CIA during the semester, marks are awarded by taking average of two CIE examinations or the marks scored in the make-up examination.

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67%	Understand
33%	Apply
0%	Analyze

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Alternative Assessment Tool (AAT)
This AAT enables faculty to design own assessment patterns during the CIA. The AAT converts the classroom into an effective learning center. The AAT may include tutorial hours/classes, seminars, assignments, term paper, open ended experiments, METE (Modeling and Experimental Tools in Engineering), five minutes video, MOOCs etc. The AAT chosen for this course is given in table

Concept Video	Tech-talk	Complex Problem Solving
40%	40%	20%

VI COURSE OBJECTIVES:

The students will try to learn:

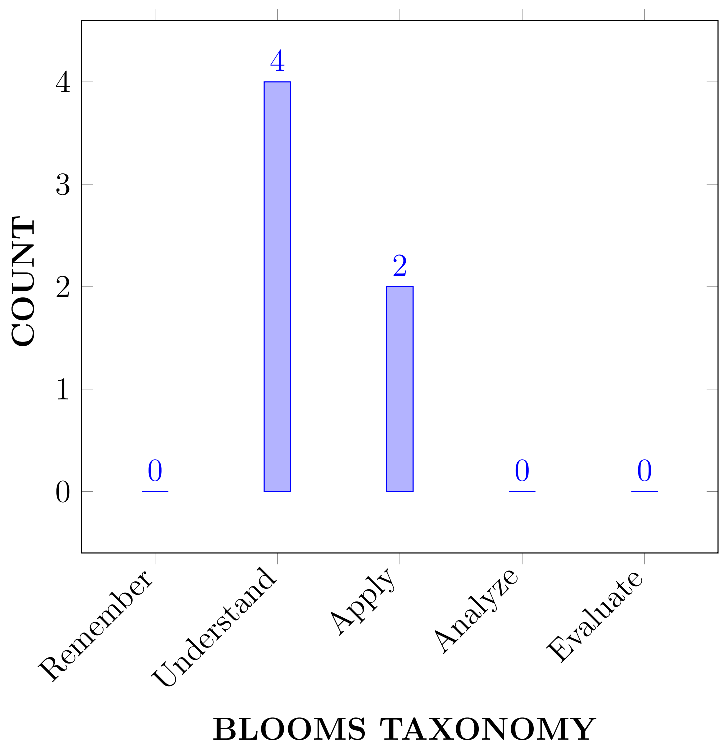
I	Understanding of the basic elements encountered in electric networks, and operation of measuring instruments.
II	The construction and working principle of DC generator, DC motor, andtypes of DC machines based on field excitation method.
III	Analyze the characteristics of alternating quantities and AC machines.
IV	Illustrate the V-I characteristics of various diodes and bi-polar junction transistor.

VII COURSE OUTCOMES:

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

CO 1	**Solve** complex electrical circuits by applying network reduction techniques for reducing into a simplified circuit.	Apply
CO 2	**Differentiate** the working of moving iron and moving coil type instruments for computing electrical qunatities using suitable instrument.	Understand
CO 3	**Demonstrate** the construction, principle and working of DC machines for their performance analysis.	Understand
CO 4	**Illustrate** alternating quantities of sinusoidal waveform and working , construction of single phase transformers,induction motors, alternators for analysis of AC waveforms and AC machines.	Understand
CO 5	**Apply** the PN junction characteristics for the doide applications such as switch and rectifier.	Apply
CO 6	**Extend** the biasing techniques for bipolar and uni-polar transistor amplifier circuits considering stability condition for establishing a proper operating point.	Understand

COURSE KNOWLEDGE COMPETENCY LEVEL



VIII PROGRAM 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

IX 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	SEE / CIE / 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	SEE / CIE / AAT

3 = High; 2 = Medium; 1 = Low

X HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

PROGRAM SPECIFIC OUTCOMES		Strength	Proficiency Assessed by
PSO 1	Design and Supervise Sub-Structures and Super Structures for Residential and Public Buildings, Industrial Structures, Irrigation Structures, Power Houses, Highways, Railways, Airways, Docs and Harbours.	1	-

3 = High; 2 = Medium; 1 = Low

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

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	✓	✓	-	-	-	-	-	-	-	-	-	-	✓	-	-
CO 2	✓	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 3	✓	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 4	✓	-	-	-	-	-	-	-	-	-	-	-	✓	-	-
CO 5	✓	✓	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 6	✓	✓	-	-	-	-	-	-	-	-	-	-	-	-	-

XII 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 matched.
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 mathematical principles and various source transformation techniques are adopted for solving complex circuits.	3
	PO 2	Derive standard expressions for equivalent resistances, inductances and capacitance by using series-parallel networks i.e mathematical calculations.	1
	PSO 1	Solve complex electrical circuits by applying basic circuit concepts by using computer programs.	1
CO 2	PO 1	Understand the working principles of indicating instruments and classify types based on construction engineering disciplines.	3
CO 3	PO 1	The principle of operation and characteristics of DC machines are explained by applying engineering fundamentals including device physics.	3
CO 4	PO 1	Understand about alternating quantities of an AC signal and working of single phase transformers,induction motors and alternators using engineering principles and mathematical equations.	3
	PSO 1	Develop equivalent circuit of single phase transformer referred to both sides by developing computer programs.	1
CO 5	PO 1	Outline of materials and brief description of formation of semi-conductor devices by using basic fundamentals of science and engineering.	3
	PO 2	Recognize (knowledge) the working and characteristics of diode and understand application which is rectifier circuit using engineering knowledge, and types of rectifiers.	3
CO 6	PO 1	List out various transistor configurations and discuss their working using principles of science and mathematical principles.	3
	PO 2	Explain the concept of biasing and load lines and their applicability in solving problems and working of transistors as switch and amplifier.	3

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

XIV 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	10	-	-	-	-	-	-	-	-	-	-	25	-	-
CO 2	100	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 3	100	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 4	100	-	-	-	-	-	-	-	-	-	-	-	25	-	-
CO 5	100	25	-	-	-	-	-	-	-	-	-		-	-	-
CO 6	100	25	-	-	-	-	-	-	-	-	-		-	-	-

XV COURSE ARTICULATION MATRIX (PO / PSO MAPPING):

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

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

1 -5 <C$\leq$ 40% – Low/ Slight

2 - 40 % <C < 60% –Moderate

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

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	3	1	-	-	-	-	-	-	-	-	-	-	1	-	-
CO 2	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 3	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 4	3	-	-	-	-	-	-	-	-	-	-	-	1	-	-
CO 5	3	1	-	-	-	-	-	-	-	-	-		-	-	-
CO 6	3	1	-	-	-	-	-	-	-	-	-		-	-	-
TOTAL	**18**	**3**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**2**	**0**	**0**
AVERAGE	**3**	**0.5**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0.3**	**0**	**0**

XVI ASSESSMENT METHODOLOGY-DIRECT:

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

XVII ASSESSMENT METHODOLOGY-INDIRECT:

	Assessment of mini projects by experts	✓	End Semester OBE Feedback

XVIII SYLLABUS:

MODULE I	**ELECTRICCIRCUITS,ELECTROMAGNETISM AND INSTRUMENTS**
	Electrical Circuits: Basic definitions, types of elements, Ohm's Law, resistive networks, inductive networks, capacitive networks, Kirchhoff's Laws, series, parallel circuits and star delta transformations, simple problems, Faradays law of electromagnetic induction; Instruments: Basic principles of indicating instruments, permanent magnet moving coil and moving iron instruments.
MODULE II	**DC MACHINES**
	DC Machines: Principle of operation of DC generator, EMF equation, principle of operation of DC motors, torque equation, types of DC machines, applications, three point starter.
MODULE III	**ALTERNATING QUANTITIES AND AC MACHINES**
	Alternating Quantities: Sinusoidal AC voltage, average and RMS values, form and peak factor, concept of three phase alternating quantity; Transformer: Principle of operation, EMF equation, losses, efficiency and regulation. Three Phase Induction Motor: Principle of operation, slip, slip torque characteristics, efficiency, applications; Alternator: Principle of operation, EMF Equation, efficiency, regulation by synchronous impedance method.
MODULE IV	**SEMICONDUCTOR DIODE AND APPLICATIONS**
	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 V	**BIPOLAR JUNCTION TRANSISTOR AND APPLICATIONS**
	Bipolar junction: Working principle of transistors, DC characteristics, CE, CB, CC configurations, biasing, load line, applications.

TEXTBOOKS

1. A Chakrabarti, "Circuit Theory", Dhanpat Rai Publications, 6thEdition,2004.

2. K S Suresh Kumar, "Electric Circuit Analysis", Pearson Education, 1stEdition,2013.

3. WillianmHayt, Jack E Kemmerly S M Durbin, "Engineering Circuit Analysis", Tata McGraw Hill, 7thEdition,2010.

4. J P J Millman, C CHalkias, SatyabrataJit, "Millmans Electronic Devices and Circuits", Tata McGraw Hill, 2ndEdition,1998.

5. R L Boylestad, Louis Nashelsky, “Electronic Devices and Circuits”, PEI / PHI, 9th Edition, 2006.

6. V K Mehta, Rohit Mehta, —Principles of electrical engineering, S CHAND, 1st Edition, 2003.

REFERENCE BOOKS:

1. David A Bell, “Electric Circuits”, Oxford University Press, 9thEdition,2016.

2. U A Bakshi,Atul P Godse “Basic Electrical and Electronics Engineering”TechnicalPublications, 9thEdition,2016.

3. A Bruce Carlson, “Circuits”, Cengage Learning, 1stEdition,2008.

4. M Arshad, “Network Analysis and Circuits”, Infinity Science Press, 9thEdition,2016.

WEB REFERENCES:

1. http://www.igniteengineers.com

2. http://www.ocw.nthu.edu.tw

3. http://www.uotechnology.edu.iq

COURSE WEB PAGE:

1. https://www.iare.ac.in/?q=courses/aeronautal-engineering-autonomous/basics -of-electrical-and-electronics-engineering

XIX COURSE PLAN:

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

S.No	Topics to be covered	CO's	Reference T1: 4.1
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)			
2	Electrical Circuits: Basic definitions, Types of elements	CO 1	T1-5.2 to 5.3
3	Ohm's Law, Kirchhoff Laws	CO 1	T1-5.4 to 5.5
4	Series, parallel circuits	CO 1	T1-5.5 to 5.8
5	Derivation for Star-delta and delta-star transformations	CO 1	T1-5.8 to 5.9
6	Mesh analysis and Nodal Analysis	CO 1	T1-5.11 to 5.12
7	Working of moving iron type instruments	CO 2	T1-5.14 to 5.15
8	Working of moving coil type inst0ruments	CO 2	T1-5.16 to 5.16

9	Principle of operation for DC generators	CO 3	R2-7.1 to 7.2
10	Construction and EMF equation for DC generators	CO 3	R2-7.4
11	Types of DC generators	CO 3	R2-7.3
12	Principle of operation for DC motors	CO 3	R2-7.3.1 to 7.3.2
13	Back EMF, torque equation for DC motors	CO 3	R2-7.3.3 to 7.3.6
14	Types of DC motors	CO 3	R2-7.6
15	Losses and efficiency for DC generators, motors	CO 3	T1-13.1 to 13.3
16	Principle of operation for Single Phase Transformers	CO 4	T1-13.1 to 13.3
17	Construction and EMF equation for Single Phase Transformers	CO 4	T1-13.5 to 13.6
18	Types of transformers and turns ratio	CO 4	T1-13.6 to 13.7
19	Operation of transformer under no load	CO 4	T1-13.7 to 13.9
20	Operation of transformer under on load	CO 4	T1-13.8
21	Equivalent circuit for Transformers	CO 4	T1-17.1 to 17.2
21	Phasor diagrams of transformer	CO 4	T1-17.3 to 17.4
22	Losses of Transformers	CO 4	T1-17.6 to 17.7
23	Efficiency of Transformers	CO 4	T1-13.11
24	Regulation for Transformers	CO 4	T1-13.12
25	Three Phase Induction motor: Principle of operation	CO 4	T1-13.13
26	slip, slip -torque characteristics	CO 4	T1-13.14
27	Alternators: Introduction, principle of operation	CO 4	T1-13.19
28	Constructional features	CO 4	T1-13.20
29	Understand the concept of P-N junction diode, symbol	CO 5	T1-13.8
30	Learn the V-I characteristics of P-N junction diode	CO 5	T1-17.1 to 17.2
31	Discuss the concept of half wave rectifier and full wave rectifier	CO 5	T1-17.3 to 17.4
32	Understand the bridge rectifiers and filters	CO 5	T1-17.6 to 17.7
33	Discuss the concept of diode as a switch, Zener diode as a voltage regulator	CO 5	T1-13.11
34	Know the concept of Transistors and Understand the configurations	CO 6	T1-13.12
35	Understand the DC characteristics of transistor	CO 6	T1-13.13
36	Understand the biasing and load line analysis.	CO 6	T1-13.13
37	Discuss how transistor acts as an amplifier.	CO 6	T1-13.13

PROBLEM SOLVING/ CASE STUDIES			
38	Numerical Examples on electrical quantities, Ohm's law, KCL, KVL	CO 1	T1-5.8 to 5.9
39	Numerical Examples on series, parallel elements and star to delta transformation and mesh analysis	CO 1	T1-5.5 to 5.8
40	Numerical Examples on nodal analysis and alternating quantities	CO 1	T1-6.8 to 6.9
41	Numerical Examples on Superposition theorem	CO 1	T1-6.2 to 6.3
42	Numerical Examples on reciprocity and maximum power transfer theorems	CO 1	R2-7.1 to 7.2
43	Numerical Examples on Thevenin's and Norton's theorems	CO 1	T1-13.1 to 13.3
44	Numerical Examples on EMF equation and types of DC generators	CO 3	T1-13.6 to 13.7
45	Numerical Examples on torque equation of DC motor	CO 3	T1-13.1 to 13.3
46	Numerical Examples on types of DC motors	CO 3	T1-13.13
47	Numerical Examples on EMF equation and equivalent circuit of 1 phase transformer	CO 4	T1-13.16 to 13.18
48	Numerical Examples on, efficiency for Transformers	CO 4	T1-13.14
49	Numerical Examples on, regulation for Transformers	CO 4	T1-13.16 to 13.18
50	Numerical Examples on EMF of Alternators	CO 4	T1-13.19
51	Numerical Examples on regulation of Alternators	CO 4	T1-13.20
52	Numerical Examples on Rectifiers	CO 5	T1-13.19
53	Numerical Examples on transistors	CO 6	T1-13.19
DISCUSSION OF DEFINITION AND TERMINOLOGY			
54	Definitions on basics of electrical circuits and electrical instruments	CO 1	T1-5.1 to 5.3
55	Definitions on DC machines	CO 2	T1-6.1 to 6.3
56	Definitions on single phase AC circuits and AC machines	CO 3	R2-7.1 to 7.2
57	Definitions on semiconductor diode and applications	CO 5	T1-13.1 to 13.3
58	Definitions on bipolar junction transistor and applications	CO 6	T1-13.11

DISCUSSION OF QUESTION BANK			
59	Questions from electrical circuits and electrical instruments	CO 1	T1-5.1 to 5.3
60	Questions from DC machines	CO 2	T1-6.1 to 6.3
61	Questions from single phase AC circuits and AC machines	CO 3	R2-7.1 to 7.2
62	Questions from semiconductor diode and applications	CO 5	T1-13.1 to 13.3
63	Questions from bipolar junction transistor and applications	CO 6	T1-13.11

Signature of Course Coordinator **HOD,CE**

INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

Dundigal, Hyderabad - 500 043

CIVIL ENGINEERING

COURSE DESCRIPTION

Department	**CIVIL ENGINEERING**				
Course Title	**SURVEYING LABORATORY**				
Course Code	ACE101				
Program	B.Tech				
Semester	III	CE			
Course Type	CORE				
Regulation	R16				
Course Structure	Theory			Practical	
	Lecture	Tutorials	Credits	Laboratory	Credits
	-	-	-	3	2
Course Coordinator	Mr. B Suresh , Assistant Professor				

I COURSE OVERVIEW:

Surveying is the application of technology and scientific principles for tracing, design, operation and management of facilities.Surveying refers to tracing points on ground or field. This course gives an overview on surveying with respect to tracing of points locating inaccessible points, curve and path, contours etc., This course also focuses on advanced surveying techniques, including EDM, photogrammetry and Remote sensing. Further the course is useful to solve the complex problems related to the inaccessible distances, remote elevation and remote distances by collecting and evaluating the data such as horizontal distances, vertical distances,slopes and elevations

II COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites
B.Tech	AHS002	I	Linear Algebra and Ordinary Differential Equations

III MARKS DISTRIBUTION:

Subject	SEE Examination	CIE Examination	Total Marks
Surveying Laboratory	70 Marks	30 Marks	100

IV DELIVERY / INSTRUCTIONAL METHODOLOGIES:

✓	Demo Video	✓	Lab Worksheets	✓	Viva Questions	✓	Probing further Questions

V EVALUATION METHODOLOGY:

Each laboratory will be evaluated for a total of 100 marks consisting of 30 marks forinternal assessment and 70 marks for semester end lab examination. Out of 30 marks ofinternal assessment, continuous lab assessment will be done for 20 marks for the day today performance and 10 marks for the final internal lab assessment.

Semester End Examination (SEE): The semester end labexamination for 70 marks shall be conducted by two examiners, one of them beingInternal Examiner and the other being External Examiner, both nominated by thePrincipal from the panel of experts recommended by Chairman, BOS. The emphasis on the experiments is broadly based on the following criteria given in Table: 1

	Experiment Based	Programming based
20 %	Objective	Purpose
20 %	Analysis	Algorithm
20 %	Design	Programme
20 %	Conclusion	Conclusion
20 %	Viva	Viva

Continuous Internal Assessment (CIA):

CIA is conducted for a total of 30 marks (Table 1), with 20 marks for continuous lab assessment during day to day performance, 10 marks for final internal lab assessment.

Component			Total Marks
Type of Assessment	**Day to day performance**	**Final internal lab assessment**	
CIA Marks	20	10	30

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.

1. **Experiment Based**

Objective	Analysis	Design	Conclusion	Viva	Total
2	2	2	2	2	10

2. **Programming Based**

Objective	Analysis	Design	Conclusion	Viva	Total
-	-	-	-	-	-

VI COURSE OBJECTIVES:

The students will try to learn:

I	The types of surveys, methods and technology involved in measuring field parameters using traditional and modern instruments.
II	The operating principles of various levelling instruments and analyze their performance characteristics under various terrains.

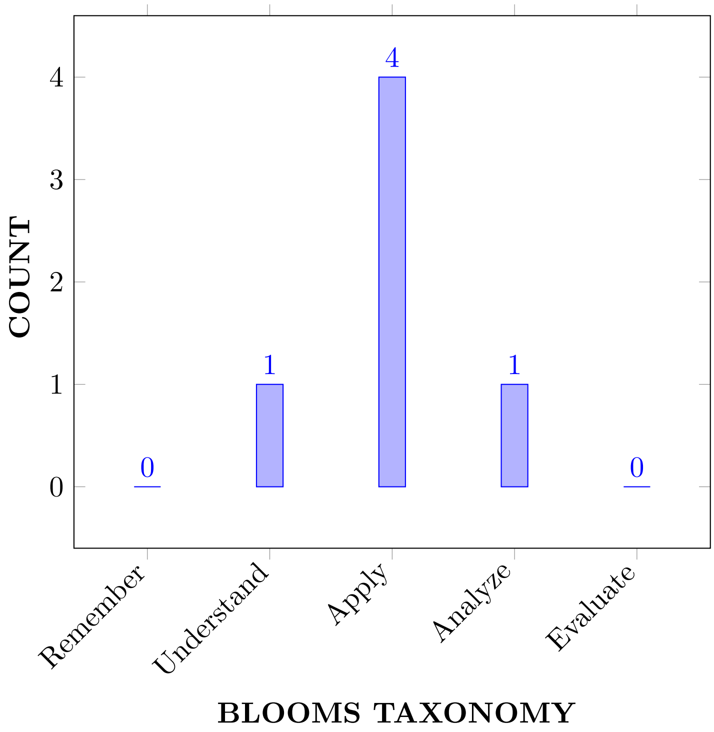
III	The measurement of alteration works, detecting land use and land cover, creating base maps for visual reference.

VII COURSE OUTCOMES:

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

CO 1	**Utilize** the concept of traversing to measure irregular boundaries and survey lines in filed.	Apply
CO 2	**Make use of** prismatic compass to measure bearings, dip, declination and local attractions.	Apply
CO 3	**Demonstrate** the two point and three point problem in plane table surveying for tracing out the centering point or station point.	Understand
CO 4	**Identify** the reduced levels using leveling apparatus for illustrating longitudinal section and cross section and plotting.	Apply
CO 5	**Make use of** contours for investigating the suitable path along the alignment and conflict points.	Apply
CO 6	**Distinguish** Tacheometry and trigonometry surveying apparatus for various operating conditions and data record keeping.	Analyze

COURSE KNOWLEDGE COMPETENCY LEVEL



VIII HOW PROGRAM OUTCOMES ARE ASSESSED:

Program		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	Lab Exercises/CIA/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	1	Lab Exercises/CIA/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 Exercises/CIA/SEE
PO 9	**Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.	1	Lab Exercises/CIA/SEE

3 = High; 2 = Medium; 1 = Low

IX HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

Program		Strength	Proficiency Assessed by
PSO 1	Design and Supervise Sub-Structures and Super Structures for Residential and Public Buildings, Industrial Structures, Irrigation Structures, Power Houses, Highways, Railways, Airways, Docs and Harbours.	1	Lab Exercises

3 = High; 2 = Medium; 1 = Low

X 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	Utilize the concept of bearing system to a considerable extent appreciate (understanding) their importance and applicability (apply) in solving (complex) bearing angle measurement problems by applying the **principles of Mathematics and Engineering**	3

	PO 2	Understand the calibration procedure of compass for (**information and data**) reaching substantiated conclusions by the interpretation of results	1
CO 2	PO 1	Explain (understanding) various parts of theodolite in detail and apply the principle of traversing, in calculating horizontal and vertical angles by applying **principles of Mathematics, Science and Engineering**	3
CO 3	PO 2	Understand the given **problem statement** and formulate (complex) two point and three point problems in plane table surveying (understanding)and their importance, applicability (apply) in solving complex engineering problems from the provided information and substantiate with the interpretation of variations results.	1
	PO 9	Recall the fundamental of plane table surveying and understand the concept of orientation resection and radiation which helps the **Ability to work with all levels of people in an organization .**	1
CO 4	PO 1	Recognize (knowledge) the importance and application (apply) of leveling, in solving (complex) problems associated with leveling by applying the **principles of Mathematics, Science and Engineering**	3
	PO 5	Understand the given problem statement and apply the **simulation packages** for the analysis of longitudinal and cross sectional analysis and similarity parameters for predicting physical parameters that govern the plotting on ground	1
	PO 9	Recall the fundamental of EDM and understand the concept of RDM and REM which helps the **Ability to work with all levels of people in an organization.**	1
	PSO 1	Apply (knowledge) Design and Supervise Sub-Structures and Super Structures for Residential and Public Buildings, (apply) for illustrating longitudinal section and cross section by applying the **Quantitative building survey and quality assurance**	1
CO 5	PO 1	Apply the basic conservation laws of science for various curves setting in surveying and use **mathematical principles** for investigating the suitable path along the alignment and conflict points. (complex) engineering equations by understanding the appropriate parametric assumptions and limitations based on **engineering fundamentals** of surveying and Geomatics.	3
	PSO 1	Apply (knowledge) Design and Supervise Sub-Structures and Super Structures for Residential and Public Buildings, (apply) for illustrating longitudinal section and cross section by applying the **Quantitative building survey and quality assurance**	1
CO 6	PO 2	Using standard stadia diaphragm derive the Tacheometric equation to analyze complex surveying problems with help of **Problem or opportunity identification.**	1

	PO 5	Understand the given problem statement and apply the appropriate techniques of advances **Computer software simulation packages** for the analysis of electronic distance measurements and similarity parameters for predicting physical parameters that govern the plotting on ground **technically**	3

XI MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

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

XII ASSESSMENT METHODOLOGY DIRECT:

CIE Exams		SEE Exams		Seminars	-
Laboratory Practices		Student Viva		Certification	-
Assignments	-				

XIII ASSESSMENT METHODOLOGY INDIRECT:

✓	Early Semester Feedback	✓	End Semester OBE Feedback
X	Assessment of Mini Projects by Experts		

XIV SYLLABUS:

WEEK I	**INTRODUCTION TO SURVEYING LABORATORY -I**
	Introduction to surveying laboratory. Do's and Don'ts in surveying lab .
WEEK II	**SURVEY OF AN AREA BY CHAIN SURVEY (CLOSED TRAVERSE) AND PLOTTING.**
	Measurement of an area by chain survey
WEEK III	**CHAINING ACROSS OBSTACLES.**
	CHAINING ACROSS OBSTACLES.
WEEK IV	**DETERMINATION OF DISTANCE BETWEEN TWO INACCESSIBLE POINTS WITH COMPASS**
	Calculation of distance between two points with compass survey.
WEEK IV	**CORRECTION FOR LOCAL ATTRACTION BY PRISMATIC COMPASS**
	Corrections for local attraction by prismatic compass
WEEK V	**SURVEYING OF A GIVEN AREA BY PRISMATIC COMPASS (CLOSED TRAVERSE) AND PLOTTING AFTER ADJUSTMENT**
	SURVEYING OF A GIVEN AREA BY PRISMATIC COMPASS (CLOSED TRAVERSE) AND PLOTTING AFTER ADJUSTMENT .
WEEK VI	**CORRECTION FOR LOCAL ATTRACTION BY PRISMATIC COMPASS**
	CORRECTION FOR LOCAL ATTRACTION BY PRISMATIC COMPASS.
WEEK VII	**RADIATION METHOD, INTERSECTION METHODS BY PLANE TABLE SURVEY.**
	Measurement of horizontal angles.
WEEK VIII	**TWO POINT PROBLEMS IN PLANE TABLE SURVEY.**
	TWO POINT PROBLEMS IN PLANE TABLE SURVEY.
WEEK IX	**THREE POINT PROBLEMS IN PLANE TABLE SURVEY.**
	THREE POINT PROBLEMS IN PLANE TABLE SURVEY..
WEEK X	**TRAVERSING BY PLANE TABLE SURVEY**
	TRAVERSING BY PLANE TABLE SURVEY
WEEK XI	**FLY LEVELING (DIFFERENTIAL LEVELING).**
	FLY LEVELING (DIFFERENTIAL LEVELING)..
WEEK XII	**AN EXERCISE OF LONGITUDINAL SECTION AND CROSS SECTION AND PLOTTING.**
	AN EXERCISE OF LONGITUDINAL SECTION AND CROSS SECTION AND PLOTTING.
WEEK XIII	**TWO EXERCISES ON CONTOURING.**
	TWO EXERCISES ON CONTOURING..

TEXTBOOKS

1. H. S. Moondra, Rajiv Gupta, "Laboratory Manual for Civil Engineering", CBS Publishers Pvt .Ltd., New Delhi, 2^{nd} Edition, 2013
2. S. S. Bhavikatti, "Surveying Theory and Practice", IK Books, New Delhi, 2010

REFERENCE BOOKS:

1. James M. Anderson, Edward M. Mikhail, "Surveying: Theory and Practice", Tata Mc Graw Hill Education, 2012.

XV 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	Introduction to surveying laboratory. Do's and Don'ts in surveying lab.	CO 1, CO 2,CO 3, CO 4,CO 5, CO 6	T1: 1.1
2	Measurement of an area by chain survey.	CO 1, CO 2,CO 3, CO 4,CO 5, CO 6	T1: 2.1
3	Chaining across obstacles.	CO 1, CO 2,CO 3, CO 4,CO 5, CO 6	T2: 3.9
4	Calculation of distance between two points with compass survey.	CO 1, CO 2,CO 3, CO 4,CO 5, CO 6	R1: 1.4
5	Surveying of a given area by prismatic compass.	CO 1, CO 2,CO 3, CO 4,CO 5, CO 6	T1: 5.4
6	Corrections for local attraction by prismatic compass.	CO 1, CO 2,CO 3, CO 4,CO 5, CO 6	T1: 6.6
7	Radiation method and intersection methods by plane table survey.	CO 1, CO 2,CO 3, CO 4,CO 5, CO 6	R1: 5.4
8	Two point problems in plane table survey.	CO 1, CO 2,CO 3, CO 4,CO 5, CO 6	T1: 8.8
9	Three point problems in plane table survey.	CO 1, CO 2,CO 3, CO 4,CO 5, CO 6	R1: 9.2
10	Traversing by plane table survey.	CO 1, CO 2,CO 3, CO 4,CO 5, CO 6	T1: 10.6
11	Fly leveling.	CO 1, CO 2,CO 3, CO 4,CO 5, CO 6	R1:7.2
12	An exercise of longitudinal section and cross section and plotting.	CO 1, CO 2,CO 3, CO 4,CO 5, CO 6	R1:11.4
13	Two exercises on contouring.	CO 1, CO 2,CO 3, CO 4,CO 5, CO 6	T1:12.3

XVI EXPERIMENTS FOR ENHANCED LEARNING (EEL):

S.No	Design Oriented Experiments
1	**SURFER 13:** Surfer is a Contouring and surface modelling software used for Graphical representation of drawing.
2	**ArcGIS:** Encourage students to Collect and manage data, create professional maps, perform traditional and advanced spatial analysis, and solve real problems .

Signature of Course Coordinator **HOD,CE**
Mr. B Suresh, Assistant Professor

INSTITUTE OF AERONAUTICAL ENGINEERING
(Autonomous)
Dundigal, Hyderabad - 500 043

CIVIL ENGINEERING
COURSE DESCRIPTION

Course Title	**Computer Aided Drafting of Buildings**				
Course Code	ACE102				
Program	B.Tech				
Semester	III	CE			
Course Type	Foundation				
Regulation	IARE - R16				
Course Structure	Theory			Practical	
	Lecture	Tutorials	Credits	Laboratory	Credits
	-	-	-	2	2
Course Coordinator	Mr. K Lokesh, Assistant Professor				

I COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites
-	-	-	-

II COURSE OVERVIEW:

CADLab is a product that bridges the gap between simulation/numerical engines like MATLAB and SOLIDWORKS. It creates a seamless link between SOLIDWORKS and simulation/numerical engine software products to help the customers accomplish their design objectives easily and efficiently.

III MARKS DISTRIBUTION:

Subject	SEE Examination	CIE Examination	Total Marks
Computer Aided Drafting of Buildings	70 Marks	30 Marks	100

IV DELIVERY / INSTRUCTIONAL METHODOLOGIES:

✓	Demo Video	✓	Lab Worksheets	✓	Viva Questions	✓	Probing further Questions

V EVALUATION METHODOLOGY:

Each laboratory will be evaluated for a total of 100 marks consisting of 30 marks forinternal assessment and 70 marks for semester end lab examination. Out of 30 marks ofinternal assessment, continuous lab assessment will be done for 20 marks for the day today performance and 10 marks for the final internal lab assessment.

Semester End Examination (SEE): The semester end labexamination for 70 marks shall be conducted by two examiners, one of them beingInternal Examiner and the other being External Examiner, both nominated by thePrincipal from the panel of experts recommended by Chairman, BOS. The emphasis on the experiments is broadly based on the following criteria given in Table: 1

	Experiment Based	Programming based

20 %	Objective	Purpose
20 %	Analysis	Algorithm
20 %	Design	Programme
20 %	Conclusion	Conclusion
20 %	Viva	Viva

Continuous Internal Assessment (CIA):

CIA is conducted for a total of 30 marks (Table 1), with 20 marks for continuous lab assessment during day to day performance, 10 marks for final internal lab assessment.

Component			Total Marks
Type of Assessment	**Day to day performance**	**Final internal lab assessment**	
CIA Marks	20	10	30

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.

1. **Experiment Based**

Objective	Analysis	Design	Conclusion	Viva	Total
2	2	2	2	2	10

2. **Programming Based**

Objective	Analysis	Design	Conclusion	Viva	Total
-	-	-	-	-	-

VI COURSE OBJECTIVES:

The students will try to learn:

I	Understand and study CAD commands for drafting any type of civil engineering drawings.
II	Implement building regulations for designing of buildings.
III	Draft plans of single and multistoried buildings.
IV	Develop the detailing of building components such as roof truss, doors, windows etc.

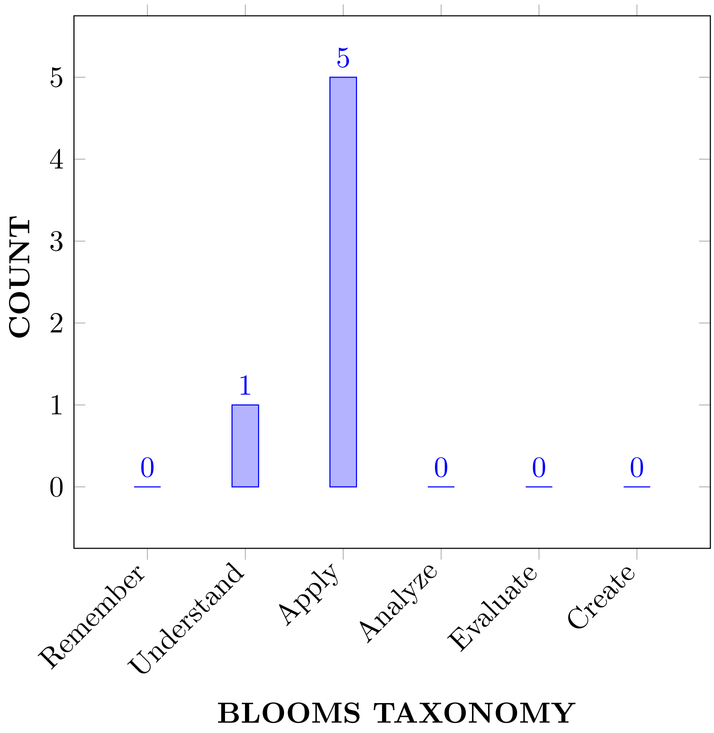
VII COURSE OUTCOMES:

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

CO 1	**Illustrate** bureau of Indian standards, conventions of engineering drawing with basic concepts, ideas and methodology for different geometries and their execution.	Understand
CO 2	**Apply** AutoCAD software for development of multi-aspect sketches, additional and sectional view.	Apply
CO 3	**Construct** parabolic, Hyperbolic and elliptical curves for profiles likes buildings and bridges.	Apply
CO 4	**Solve** projection in planes located in various quadrants to use in manufacturing processes.	Apply

CO 5	**Construct** projection of solids inclined to both the planes for interpretation of different views.	Apply
CO 6	**Draw** the orthographic projections for solid modeling to using in conversation of isometric and Vice-versa.	Apply

COURSE KNOWLEDGE COMPETENCY LEVEL



VIII 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	Lab Exercises/CIA/ 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	1	Lab Exercises/CIA/ SEE
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	3	Lab Exercises/CIA/ SEE

3 = High; 2 = Medium; 1 = Low

IX HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

Program		Strength	Proficiency Assessed by
PSO 2	Make use of multi physics, computational fluid dynamics and flight simulation tools for building career paths towards innovative startups, employability and higher studies.	1	LAB Exercises

3 = High; 2 = Medium; 1 = Low

X JUSTIFICATIONS FOR CO – (PO, PSO) MAPPING -DIRECT:

COURSE OUTCOMES	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key Competencies
CO 1	PO 1	Recall the basic commands of AutoCAD for various curves and scales using scientific principles and engineering fundamentals.	2
	PO 5	Understand Scales and Curves with different methods conceptually and apply them in modeling a complex engineering activity	1
	PSO 3	Make use of computational and experimental tools for building career paths towards innovative startups to be an entrepreneur.	2
CO 2	PO 1	Recall the commands of AutoCAD and draw engineering curves using mathematics, scientific principles and engineering fundamentals.	3
	PO 3	Understand the given problem statement related to question formatted for engineering drawings and based upon type use different AutoCAD commands .	1
CO 3	PO 1	Develop expression for eccentricity and Identify the appropriate type of curve for problem solving using engineering sciences.	2
	PO 3	Use research based knowledge for different methods of drawing engineering curves and draw with modern tools.	1
CO 4	PO 1	Recall theory of projection in planes located in various quadrants to draw using scientific principles and engineering fundamentals	2
	PO 5	Understand various positions in coordinate system for Planes use principles of views, and engineering fundamentals completing the drawing.	2
CO 5	PO 1	Recognize the representation concept of projection of solids inclined to both the planes for interpretation of different views for problem solving.	1
	PO 5	Understand the principle of solids inclined to both the planes principles of views, and engineering fundamentals for completing the drawing.	1

CO 6	PO 1	Identify the concept of orthographic projections and isometric projections use principles of views, and engineering fundamentals for completing the drawing	2
	PSO 3	Make use of computational and modeling experimental tools for building career paths towards innovative startups to be an entrepreneur.	2

XI MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

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

XII 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	66.7	-	-	-	100	-	-	-	-	-	-	-	-	20	-
CO 2	100	10	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 3	66.7	10	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 4	66.7	-	-	-	100	-	-	-	-	-	-	-	-	-	-
CO 5	33.3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 6	66.7	-	-	-	-	-	-	-	-	-	-	-	-	20	-

XIII COURSE ARTICULATION MATRIX (PO – PSO MAPPING):

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

0 - $0 \leq C \leq 5\%$ – No correlation
1-5 $< C \leq 40\%$ – Low/ Slight
2 - $40\% < C < 60\%$ –Moderate
3 - $60\% \leq C < 100\%$ – Substantial /High

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

CO 4	3	-	-	-	3	-	-	-	-	-	-	-	-	-	-
CO 5	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 6	3	-	-	-	-	-	-	-	-	-	-	-	-	1	-
TOTAL	16	2	-	-	6	-	-	-	-	-	-	-	-	2	-
AVERAGE	2.67	1	-	-	3	-	-	-	-	-	-	-	-	1	-

XIV ASSESSMENT METHODOLOGY DIRECT:

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

XV ASSESSMENT METHODOLOGY INDIRECT:

✓	Early Semester Feedback	✓	End Semester OBE Feedback
X	Assessment of Mini Projects by Experts		

XVI SYLLABUS:

WEEK I	INTRODUCTION TO COMPUTER AIDED DRAFTING
	Introduction to computer aided drafting. Do's and Don'ts in CAD lab.
WEEK II	**AUTO CAD COMMANDS**
	Batch I: Explanation of CAD commands. Batch II: Explanation of CAD commands
WEEK III	**PRACTISE ON CAD COMMANDS**
	Batch I: Practice exercises on CAD commands. Batch II: Practice exercises on CAD commands
WEEK IV	**PLANS OF BUILDING**
	Batch I: Basic drawing of plans of building using software. Batch II: Basic drawing of plans of building using software.
WEEK V	PLAN OF SINGLE STOREYED BUILDING
	Batch I: Single storeyed building. Batch II: Single storeyed building.
WEEK VI	PLAN OF MULTI STOREYED BUILDING
	Batch I: Multi storeyed building. Batch II: Multi storeyed building.
WEEK VII	**DETAILING OF BUILDING COMPONENTS**
	Batch I: Detailing of building components like doors, windows, roof trusses etc. using CAD software. Batch II: Detailing of building components like doors, windows, roof trusses etc. using CAD software.
WEEK VIII	**DEVELOPMENT OF BUILDING**
	Batch I: Exercises on development of working of buildings. Batch II: Exercises on development of working of buildings.

WEEK IX	**REVISION**
	Revision

TEXTBOOKS

1. M. N. Sesha Prakash, Dr. G. S. Servesh, —Computer Aided Design Laboratory‖, Laxmi Publications, 2012.

REFERENCE BOOKS:

1. P.J.Sha, —Engineering Graphics‖, S. Chand Publishers, 2014.

XVII 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	Introduction to computer aided drafting. Do's and Don'ts in CAD lab	CO 1,CO 3	T1:1.4,R1:1.2
2	Explanation of CAD commands.	CO 1,CO 2	T1:1.5,R1:1.3
3	Practice exercises on CAD commands	CO 2,CO 4	T2:12.2, R2:13.1
4	Basic drawing of plans of building using software.	CO 3,CO 4	T2:12.3,R2:13
5	Single storeyed building.	CO 3,CO 4	T1:9.1,R2:3
6	Multi storeyed building.	CO 3,CO 4	T1:9.1,R2:3
7	Detailing of building components like doors, windows, roof trusses etc. using CAD software.	CO 2 CO 4	T2:1.9, R2:1.8
8	Exercises on development of working of buildings.	CO 2 CO 4	T2:2, R2:1.9
9	Revision	CO 4 CO 5	T2:1.4, R1:1.2

XVIII EXPERIMENTS FOR ENHANCED LEARNING (EEL):

S.No	Design Oriented Experiments
1	Detailing of Hospital Building
2	Detailing of School Building
3	Detailing irrigation structures
4	Detailing of roads

Signature of Course Coordinator **HOD, CE**
Mr. K Lokesh, Assistant Professor

INSTITUTE OF AERONAUTICAL ENGINEERING
(Autonomous)
Dundigal, Hyderabad - 500 043
COURSE DESCRIPTION

Department	CIVIL ENGINEERING				
Course Title	ENGINEERING GEOLOGY LABORATORY				
Course Code	ACE103				
Program	B.Tech				
Semester	III	CE			
Course Type	CORE				
Regulation	R16				
Course Structure	Theory			Practical	
	Lecture	Tutorials	Credits	Laboratory	Credits
	-	-	-	3	2
Course Coordinator	Mr K Tarun Kumar, Assistant Professor				

I COURSE OVERVIEW:

Engineering Geology is one of the most widely used structural analysis and design software products worldwide. It supports over 90 international steel, concrete, timber and aluminium design codes. It can make use of various forms of analysis from the traditional static analysis to more recent analysis methods like p-delta analysis, geometric non-linear analysis, Pushover analysis (Static-Non Linear Analysis) or a buckling analysis. It can also make use of various forms of dynamic analysis methods from time history analysis to response spectrum analysis. The response spectrum analysis feature is supported for both user defined spectra as well as a number of international code specified spectra.

II COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites
-	-	-	-

III MARKS DISTRIBUTION:

Subject	SEE Examination	CIE Examination	Total Marks
Engineering Geology Laboratory	70 Marks	30 Marks	100

IV DELIVERY / INSTRUCTIONAL METHODOLOGIES:

✓	Demo Video	✓	Lab Worksheets	✓	Viva Questions	✓	Probing further Questions

V EVALUATION METHODOLOGY:

Each laboratory will be evaluated for a total of 100 marks consisting of 30 marks for b internal assessment and 70 marks for semester end lab examination. Out of 30 marks ofinternal assessment, continuous lab assessment will be done for 20 marks for the day today performance and 10 marks for the final internal lab assessment.

Semester End Examination (SEE): The semester end labexamination for 70 marks shall be conducted by two examiners, one of them beingInternal Examiner and the other being External Examiner, both nominated by thePrincipal from the panel of experts recommended by Chairman, BOS. The emphasis on the experiments is broadly based on the following criteria given in Table: 1

	Experiment Based	Programming based
20 %	Objective	Purpose
20 %	Analysis	Algorithm
20 %	Design	Programme
20 %	Conclusion	Conclusion
20 %	Viva	Viva

Continuous Internal Assessment (CIA):

CIA is conducted for a total of 30 marks (Table 1), with 20 marks for continuous lab assessment during day to day performance, 10 marks for final internal lab assessment.

Component			Total Marks
Type of Assessment	**Day to day performance**	**Final internal lab assessment**	
CIA Marks	20	10	30

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.

1. **Experiment Based**

Objective	Analysis	Design	Conclusion	Viva	Total
2	2	2	2	2	10

2. **Programming Based**

Objective	Analysis	Design	Conclusion	Viva	Total
-	-	-	-	-	10

VI COURSE OBJECTIVES:

The students will try to learn:

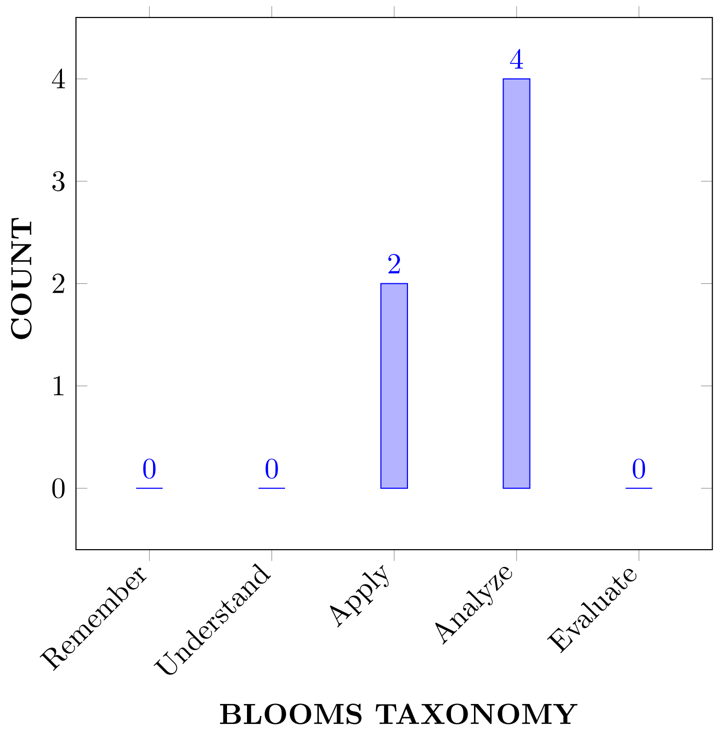
I	The basic elements with different loading types and supports with the aid of STAAD Pro software.
II	The analysis and design of 2D Frame and multi-storey buildings with different load sets.
III	The synthesize steel structures with truss elements subjected to lateral load.
IV	The Modeling and analysis of bridge truss and deck slab for moving loads.

VII COURSE OUTCOMES:

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

CO 1	**Analyze** continues beam, Single and Multistoried frame structures for maximum shear force, bending moment due to vertical loads and Gravity loads	Analyze
CO 2	**Design** of beam, slab, column for multistoried Buildings	Analyze
CO 3	**Analyze** Reinforced Concrete Structures for Horizontal load.	Apply
CO 4	**Design** of tension members, compression members and connections for Trusses used in industrial structures and workshop sheds.	Analyze
CO 5	**Design** of Isolated and Combined Footings for reinforced Concrete Structures and Steel Structures.	Analyze
CO 6	**Analyze** the bridge Deck for maximum Shear forces and bending moments due to vertical and Horizontal loads.	Apply

COURSE KNOWLEDGE COMPETENCY LEVEL



VIII HOW PROGRAM OUTCOMES ARE ASSESSED:

Program		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.	2	Lab Exercises
PO 2	**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	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 modelling to complex Engineering activities with an understanding of the limitations	1	Lab Exercises

3 = High; 2 = Medium; 1 = Low

IX HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

Program		Strength	Proficiency Assessed by
PSO 1	Design and Supervise Sub-Structures and Super Structures for Residential and Public Buildings, Industrial Structures, Irrigation Structures, Power Houses, Highways, Railways, Airways, Docs and Harbours	1	Lab Exercises

3 = High; 2 = Medium; 1 = Low

X JUSTIFICATIONS FOR CO – (PO, PSO) MAPPING -DIRECT:

COURSE OUTCOMES	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key Competencies
CO 1	PO 1	Recall (knowledge) the different beam generally come across in design, and calculate tension by applying the principles of **mathematics and engineering fundamentals.**	2

	PO 2	Understand the given **problem statement** of structural members related to young's modulus from the provided **information and data** in reaching substantiated solutions by the **interpretation of results.**	3
	PO 5	Make use of **modern engineering tools** for calculation of tension in members.	1
	PSO 1	Select the appropriate method for the analysis of structures using **Safety** and **serviceability of structure** for different loads for the design purpose.	2
CO 2	PO 1	Understand the different components in the engineering structures (multistoried structures and bridges) and its behavior by **using mathematics and engineering fundamentals.**	2
	PO 2	Analyse the flat slabs and deep foundations for critical load combinations to know the design forces using the structural analysis concepts **formulate** and **state a problem,** and **develop solution** and **document the results.**	4
	PO 3	Design of flat slabs and deep foundations includes **Investigate problems** associated with these structures in site locations and **define problems and identify constraints including environmental and sustainability limitations, safety assessment**issues.	5
	PSO 1	Understand the design of flat slabs and deep foundations based on Indian standards using **mathematical principles; engineering knowledge and document the results to support** their applications in next-level courses of the program	4
CO 3	PO 1	Understand the different components in the engineering structures (multistoried structures and bridges) and its behavior by **using mathematics and engineering fundamentals.**	2
	PO 2	Analyse structures for critical wind load combinations to know the design forces using the structural analysis concepts, **formulate and state a problem, and develop solution and document the results**	4
	PO 5	Analysis of RCC structures by the use of modern engineering and IT tools including prediction and modeling to complex engineering activities with an **understanding of the limitations**	1
CO 4	PO 1	Understand the different components in the engineering structures (multistoried structures and bridges) and its behavior by **using mathematics and engineering fundamentals.**	2
	PO 2	Analyze steel specimen for the concept of sudden load acting on a specimen using Izod and Charpy test by **formulate** and **state a problem,** and **develop solution** and **document the results.**	4

	PO 3	Design of trusses includes **Investigate problems** associated with these structures in site locations and **define problems define problems and identify constraints including environmental and sustainability limitations, safety assessment issues**	5
	PO 5	Use of **Modern tools** in the design of steel by the concept of sudden loading in steel specimen.	1
	PSO 1	Understand the design of trusses and deep foundations based on Indian standards using **mathematical principles; engineering knowledge and document the results to support their applications in next-level courses** of the program (own engineering discipline).	4
CO 5	PO 1	Understand the different components in the engineering structures (multistoried structures and bridges) and its behavior by **using mathematics and engineering fundamentals.**	2
	PO 5	Design of trusses by the Use of modern engineering and IT tools including prediction and modeling to complex engineering activities with an **understanding of the limitations**	1
CO 6	PO 1	Make use of advanced methods of analysis for solving engineering problems related to structures by applying the principles of **engineering fundamentals** and their **integration and support with other engineering disciplines, mathematics.**	2
	PO 2	Analyze the structures for critical load combinations to know the design forces using the structural analysis concepts, **formulate and state a problem, and develop solution and document the results**	4
	PO 3	Design of civil engineering structures includes **Investigate problems** associated with these structures in site locations and **define problems define problems and identify constraints including environmental and sustainability limitations, safety assessment issues**	5

XI MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

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

XII ASSESSMENT METHODOLOGY DIRECT:

CIE Exams	✓	SEE Exams	✓	Seminars	-
Laboratory Practices	✓	Student Viva	✓	Certification	-
Assignments	-				

XIII ASSESSMENT METHODOLOGY INDIRECT:

	Assessment of Mini Projects by Experts	✓	End Semester OBE Feedback

XIV SYLLABUS:

WEEK I	**INTRODUCTION TO ENGINEERING GEOLOGY LABORATORY**
	Basic commands used in STAAD Pro
WEEK II	**PHYSICAL PROPERTIES AND IDENTIFICATION OF MINERALS**
	Analysis of continuous beam using STAAD Pro.
WEEK III	**MEGASCOPIC AND MICROSCOPIC STUDY**
	Analysis of single storey frame
WEEK IV	**MEGASCOPIC AND MICROSCOPIC IDENTIFICATION**
	Analysis of multi-storey frame.
WEEK V	**INTERPRETATION AND DRAWING OF GEOLOGICAL MAPS**
	Design of multi-storey frame design.
WEEK VI	**STRUCTURE GEOLOGY PROBLEMS**
	Determine the stiffness of the spring and the Modulus of rigidity of wire material.
WEEK VII	**STRUCTURE GEOLOGY PROBLEMS**
	Design of multi-storeyed building
WEEK VIII	**STRUCTURE GEOLOGY PROBLEMS**
	Wind load analysis on RCC building.
WEEK IX	**ANALYSIS AND DESIGN OF STEEL TRUSS**
	Analysis and design of steel truss.
WEEK X	**STRUCTURE GEOLOGY PROBLEMS**
	Analysis and design of isolated footing
WEEK XI	**ANALYSIS AND DESIGN OF COMBINED FOOTING**
	Analysis and design of combined footing.
WEEK XII	**STRUCTURE GEOLOGY PROBLEMS**
	Analysis of bridge deck slab.

TEXTBOOKS

1. Fred G. Bell, —Engineering Geology and Construction‖ Spon Press, London, 2004.

2. Robert B. Johnson, Jerome V. Degraff , —Engineering Geology: A Lab Manual‖, Macmillan Publishing Company, 1st Edition, 1994.

REFERENCE BOOKS:

1. Strength of Materials by R. Subramanian, Oxford University Press, New Delhi.
2. Mechanics of Materials - Ferdinand P. Beer, E. RusselJhonston Jr., John T. DEwolf – TMH 2002.

XV 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	INTRODUCTION TO ENGINEERING GEOLOGY LABORATORY	CO 1	T2:2.3
2	PHYSICAL PROPERTIES AND IDENTIFICATION OF MINERALS.	CO 1	R1:2.6
3	PHYSICAL PROPERTIES AND IDENTIFICATION OF MINERALS	CO 2	T1:2.6
4	MEGASCOPIC AND MICROSCOPIC STUDY.	CO 2	T2:2.7 R1:2.18
5	MEGASCOPIC AND MICROSCOPIC STUDY.	CO 3	T2:2.22
6	MEGASCOPIC AND MICROSCOPIC STUDY	CO 3	T2:2.25
7	MEGASCOPIC AND MICROSCOPIC IDENTIFICATION	CO 5	T2:2.26 R1:2.55
8	MEGASCOPIC AND MICROSCOPIC IDENTIFICATION	CO 4	T2:2.3
9	MEGASCOPIC AND MICROSCOPIC IDENTIFICATION	CO 5	R1:2.6
10	MEGASCOPIC AND MICROSCOPIC IDENTIFICATION	CO 5	T1:2.6
11	STRUCTURE GEOLOGY PROBLEMS	CO 6	R1:7.2
12	STRUCTURE GEOLOGY PROBLEMS	CO 6	R1:7.2

XVI EXPERIMENTS FOR ENHANCED LEARNING (EEL):

S.No	Design Oriented Experiments
1	Design of Cantilever Beams
2	Design of Grid and Flat Slabs.
3	Design of Steel Framed Structures

Signature of Course Coordinator **HOD,CE**
Mr.K Tarun Kumar, Assistant Professor

INSTITUTE OF AERONAUTICAL ENGINEERING
(Autonomous)
Dundigal, Hyderabad - 500 043

COURSE DESCRIPTION

Department	**CIVIL ENGINEERING**				
Course Title	**MATHEMATICAL TRANSFORM TECHNIQUES**				
Course Code	AHS011				
Program	B. Tech				
Semester	IV				
Course Type	Foundation				
Regulation	R-16				
Course Structure	Theory			Practical	
	Lecture	Tutorials	Credits	Laboratory	Credits
	3	1	4	-	-
Course Coordinator	Ms. P Rajani, Assistant Professor				

I COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites
B.Tech	AHSB02	I	Linear Algebra and Calculus

II COURSE OVERVIEW:

The course focuses on more advanced engineering mathematics topics which provide with the relevant mathematical tools required in the analysis of problems in engineering and scientific professions. The course includes types of matrices, difference calculus methods and differential equations. The mathematical skills derived from this course form a necessary base to analytical and design concepts encountered in the program.

III MARKS DISTRIBUTION:

Subject	SEE Examination	CIE Examination	Total Marks
Mathematical Transform Techniques	70 Marks	30 Marks	100

IV CONTENT DELIVERY / INSTRUCTIONAL METHODOLOGIES:

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

V EVALUATION METHODOLOGY:

The course will be evaluated for a total of 100 marks, with 30 marks for Continuous Internal Assessment (CIA) and 70 marks for Semester End Examination (SEE). Out of 30 marks allotted for CIA during the semester, marks are awarded by taking average of two CIE examinations or the marks scored in the make-up examination.

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 14 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
30%	Understand
60 %	Apply
%	Analyze

Continuous Internal Assessment (CIA):

CIA is conducted for a total of 30 marks, with 25 marks for Continuous Internal Examination (CIE) and 05 marks for Quiz \Alternative Assessment Tool (AAT).

Component	Theory		Total Marks
Type of Assessment	CIE Exam	Quiz \AAT	
CIA Marks	25	05	30

Continuous Internal Examination (CIE):

Two CIE exams shall be conducted at the end of the 8^{th} and 17^{th} week of the semester respectively. The CIE exam is conducted for 25 marks of 2 hours duration consisting of two parts. Part–A shall have five compulsory questions of one mark each. In part–B, four out of five questions have to be answered where, each question carries 5 marks. Marks are awarded by taking average of marks scored in two CIE exams.

Quiz - Online Examination

Two Quiz exams shall be online examination consisting of 25 multiple choice questions and are to be answered by choosing the correct answer from a given set of choices (commonly four). Such a question paper shall be useful in testing of knowledge, skills, application, analysis, evaluation and understanding of the students. Marks shall be awarded considering the average of two quiz examinations for every course.

Alternative Assessment Tool (AAT)

This AAT enables faculty to design own assessment patterns during the CIA. The AAT converts the classroom into an effective learning center. The AAT may include tutorial hours/classes, seminars, assignments, term paper, open ended experiments, METE (Modeling and Experimental Tools in Engineering), five minutes video, MOOCs etc. The AAT chosen for this course is given in table

Concept Video	Tech-talk	Complex Problem Solving
40%	40%	20%

VI COURSE OBJECTIVES:

The students will try to learn:

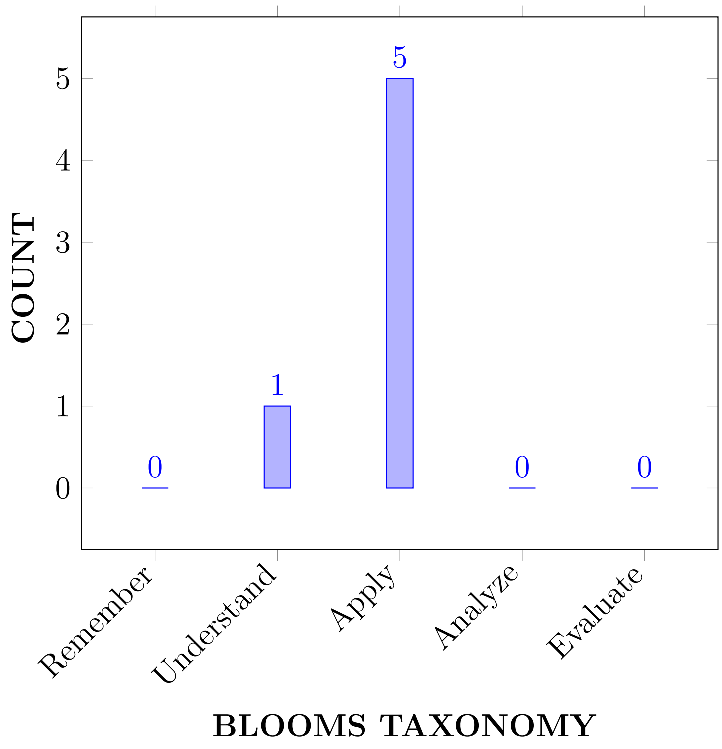
I	The operation of non-periodic functions by Fourier transforms.
II	The transformation of ordinary differential equations in Laplace field and its applications
III	Z-transforms to solve the difference equations
IV	The partial differential equation for solving non-linear equations

VII COURSE OUTCOMES:

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

CO 1	**Explain** the nature of the Fourier series that represent even and odd functions.	Understand
CO 2	**Apply** to compute the Fourier series of the function with one variable.	Apply
CO 3	**Identify** the role of Fourier transform non-periodic functions up to infinity as a mathematical function in transforming a signal from the time domain to the frequency domain	Apply
CO 4	**Explain** the properties of Laplace and inverse transform to various functions the integral transforms operations of calculus to algebra in linear differential equations	Apply
CO 5	**Compute** the Z-transforms and inverse of Z-transforms to difference equations by using the methods of partial fractions and convolution method.	Apply
CO 6	**Solve** the linear, nonlinear partial differential equation by the method of Lagrange's ,separiable and Charpit to concern engineering field	Apply

COURSE KNOWLEDGE COMPETENCY LEVEL



VIII PROGRAM 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

IX 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	
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	

PROGRAM OUTCOMES		**Strength**	**Proficiency Assessed by**
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.	1	

3 = High; 2 = Medium; 1 = Low

X HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

PROGRAM SPECIFIC OUTCOMES		**Strength**	**Proficiency Assessed by**
PSO 1	Design and Supervise Sub-Structures and Super Structures for Residential and Public Buildings, Industrial Structures, Irrigation Structures, Power Houses, Highways, Railways, Airways, Docs and Harbours.	2	Seminar/ Conferences/ Research Papers
PSO 2	Focus on Improving Performance of Structures with reference to Safety, Serviceability and Sustainable Green Building Technology.	-	-
PSO 3	Make use of Advanced Structural Analysis and Project Management Software for creating Modern Avenues to succeed as an Entrepreneur, Pursue Higher Studies and Career Paths.	-	-

3 = High; 2 = Medium; 1 = Low

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

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	✓	-	-	-	-	-	-	-	-	-	-		-	-	-
CO 2	✓	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 3	✓	✓	-	✓	-	-	-	-	-	-	-	-	✓	-	-
CO 4	✓	-	-	-		-	-	-	-	-	-		-	-	-
CO 5	-	✓	-	-	-	-	-	-	-	-	-	-	✓	-	-
CO 6	✓	✓	-	-		-	-	-	-	-	-	-	-	-	

XII 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 matched.
CO 1	PO 1	**Explain** the Fourier Series to the periodic functions for solving complex engineering problems of various functions such as continuous, piecewise continuous, step and impulsive functions with **principle of mathematics.**	2
CO 2	PO 1	**Apply** the Fourier series (understand) to complex engineering problems of various functions such as continuous, piecewise continuous, step and impulsive functions with principle of mathematics.	2
CO3	PO 1	**Identify** the mathematical function as a signal form from the time domain to the frequency domain in the **complex engineering problems** by (apply) Fourier transformation. **Principle of Mathematics**	2
	PO 2	**Apply** the Fourier integral transform as a **formulation** of mathematical function in **complex engineering problems** which transforms a non-periodic functions using **principles of mathematics** to attain conclusions by the **interpretation of results**	4
	PO4	Explain the integral transforms in solving ordinary differential equations will be **quantitatively measured** by using **MATLAB computer software**.	1
	PSO1	Describe the integral transforms concern Mechanical Engineering (apply) which converts operations of calculus to algebra in solving linear differential equations **in the design and implementation of complex systems.**.	1
CO4	PO 1	**Explain** the properties of Laplace and inverse transform (understand) to **complex engineering problems** of various functions the integral transforms operations of calculus to algebra in linear differential equations with **principle of mathematics**	2
CO5	PO2	**Compute** the statement of the Z-transforms and inverse of Z-transforms in **complex engineering problems** which difference equations by using the methods of partial fractions and convolution method using **principle of mathematics** related to engineering by **the interpretation of results**.	4
	PSO 1	**Compute** the properties of complex Z transform concern Mechanical Engineering which intensifies (apply) the boundary value problems in **the design and implementation of complex systems**.	1

Course Outcomes	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key competencies matched.
CO6	PO1	**Solve** the linear, nonlinear partial differential equation related to **complex engineering problems** such as the method of Lagrange's ,separable and Charpit to the physical problems of engineering **Principle of Mathematics**	2
	PO2	**Solve** the **statement and formulation** of Lagrange's linear equation (understand) related to **complex engineering problems**, solutions are attained based on **principles of mathematics** to the physical problems of engineering by **the interpretation of results**	4

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

XIV 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	66.7	-	-	-	-	-	-	-	-	-	-		-	-	-
CO 2	66.7	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 3	66.7	40	-	9	-	-	-	-	-	-	-	-	50	-	-
CO 4	66.7	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 5	-	40	-	-	-	-	-	-	-	-	-	-	50	-	-
CO 6	66.7	40	-	-		-	-	-	-	-	-		50	-	-

XV COURSE ARTICULATION MATRIX (PO / PSO MAPPING):

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

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

1 -5 <C$\leq$ 40% – Low/ Slight

2 - 40 % <C < 60% –Moderate

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

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

XVI ASSESSMENT METHODOLOGY-DIRECT:

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

XVII ASSESSMENT METHODOLOGY-INDIRECT:

✓	Early Semester OBE Feedback	✓	End Semester OBE Feedback

XVIII SYLLABUS:

MODULE I	**FOURIER SERIES**
	Definition of periodic function, determination of Fourier coefficients; Fourier expansion of periodic function in a given interval of$length 2\pi$; Fourier series of even and odd functions; Fourier series in an arbitrary interval; Half- range Fourier sine and cosine expansions.
MODULE II	**FOURIER TRANSFORMS**
	Fourier integral theorem, Fourier sine and cosine integrals; Fourier transforms; Fourier sine and cosine transform, properties, inverse transforms, finite Fourier transforms.
MODULE III	**LAPLACE TRANSFORMS**
	Definition of Laplace transform, linearity property, piecewise continuous function, existence of Laplace transform, function of exponential order, first and second shifting theorems, change of scale property, Laplace transforms of derivatives and integrals, multiplied by t, divided by t, Laplace transform of periodic functions. Inverse Laplace transform: Definition of Inverse Laplace transform, linearity property, first and second shifting theorems, change of scale property, multiplied by s, divided by s; Convolution theorem and applications.
MODULE IV	**Z –TRANSFORMS**
	Z-transforms: Elementary properties, inverse Z-transform, convolution theorem, formation and solution of difference equations.
MODULE V	**PARTIAL DIFFERENTIAL EQUATIONS AND APPLICATIONS**

	Formation of partial differential equations by elimination of arbitrary constants and arbitrary functions, solutions of first order linear equation by Lagrange method; Charpit's method; method of separation of variables; One dimensional heat and wave equations under initial and boundary conditions.

TEXTBOOKS

1. B.S. Grewal, "Higher Engineering Mathematics", Khanna Publishers, 36thEdition, 2010.
2. N.P. Bali and Manish Goyal, "A text book of Engineering Mathematics", Laxmi Publications, Reprint, 2008.
3. Ramana B.V., "Higher Engineering Mathematics", Tata McGraw Hill New Delhi, 11th Reprint,2010.

REFERENCE BOOKS:

1. Erwin Kreyszig, "Advanced Engineering Mathematics", John Wiley & Sons, 9thEdition, 2006.
2. Veerarajan T., "Engineering Mathematics for first year", Tata McGraw-Hill, New Delhi, 2008.
3. D. Poole, "Linear Algebra: A Modern Introduction", Brooks/Cole, 2ndEdition, 2005.
4. Dr. M Anita, "Engineering Mathematics-I", Everest Publishing House, Pune, First Edition, 2016

WEB REFERENCES:

1. http://www.efunda.com/math/math_home/math.cfm
2. http://www.ocw.mit.edu/resourcs/#Mathematics
3. http://www.sosmath.com
4. http://www.mathworld.wolfram.com

COURSE WEB PAGE:

XIX COURSE PLAN:

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

S.No	Topics to be covered	CO's	Reference T1: 4.1
OBE DISCUSSION			
1	Introduction to outcome based education		
CONTENT DELIVERY (THEORY)			
2	Define periodic function	CO 1	T1:22.5 R1:2.3
3	Solve Fourier coefficients	CO 1	T1:22.5 R1:2.4
4	Apply Fourier series for $(0, 2\pi)$	CO 1	T1:22.6 R1:2.6
5	Determine even and odd function	CO 2	T1:22.7 R1:4.4

6	Determine Fourier series in (0,2l), (-l,l) and also half range series in (0, l)	CO 1	T1:22.7 R1:4.10
7	Determine half range series in (0, π)	CO 2	T1:22.8 R1:4.15
8	Apply Fourier integral theorem to find integrals	CO 2	T1:22.9 R1:5.4
9	Apply Fourier sine and cosine integrals to find integrals	CO 3	T1:22.9 R1:5.8
10	Define and apply Fourier transforms	CO 3	T1:23.10 R1:6.8.
11	Use properties to solve the given functions	CO 3	T1:23.10 R1:6.13
12	Define and apply Inverse transforms	CO 3	T1:23.9 R1:7.5
13	Define and apply Finite Fourier transforms	CO 3	T1:23.10 R1:7.5
14	Define Laplace transform and its property	CO 4	T1:23.10 R1:8.1
15	Define piecewise continuous function	CO 4	T1:23.1 R1:9.2
16	Define and apply shifting theorem, change of scale property	CO 4	T1:23.1 R1:9.4
17	Solve derivatives and integrals, multiplied by t,divided by t	CO 74	T1:23.1 R1:9.9
18	Define periodic functions	CO 4	T1:23.1 R1:9.10
19	Solve Inverse Laplace transform	CO 4	T2:27.5 R1:10.2
20	Define and apply shifting theorem	CO 4	T2:27.7 R1:11.3
21	Solve multiplied by s, divided by s	CO 4	T2:27.8 R1:11.6
22	Define change of scale property	CO 4	T2:27.7 R1:11.3
23	Divided by s Define Z-transforms, Elementary properties	CO 5	T2:27.12 R1:11.8
24	Change of scale property Define inverse Z-transform	CO 5	T2:27.12 R1:11.9
25	Define inverse Z-transform	CO 5	T2:27.12 R1:11.10
26	Formulate partial differential equations	CO 6	T2:27.14 R1:12.3
27	Solving difference equations by Z transforms	CO 5	T2:27.1 R1:12.7
28	Solve by Charpit's method	CO 6	T2:27.17 R1:12.15
29	Apply method of separation of variables	CO 6	T2:18.2 R1:13.1

30	Define inverse Z-transform	CO 5	T2:18.3-18.5 R1:13.2 , 13.3
31	Elementary properties	CO 5	T1:17.1-17.2 R1:16.1-16.2
32	Elimination of arbitrary constants(Formation of PDE)	CO 6	T1:17.1-17.2 R1:16.1-16.2
33	Elimination of arbitrary functions(Formation of PDE)	CO 6	T1:17.5-17.6 R1:16.3.1
34	Non-Linear Partial differential equation of first order (Standard forms I, II ,III and IV)	CO 6	T1:17.1-17.2 R1:16.1-16.2
35	Non-Linear Partial differential equation of first order Standard forms V	CO 6	T1:17.5-17.6 R1:16.3.1
36	Non-Linear Partial differential equation	CO 6	T1:17.1-17.2 R1:16.1-16.2
37	Non-Linear Partial differential equation of first order Standard forms VI	CO 6	T1:17.1-17.2 R1:16.1-16.2
38	Lagrange's Linear equation- Method of grouping	CO 6	T1:17.5-17.6 R1:16.3.1
39	Lagrange's Linear Equation -Method of Multipliers	CO 6	T1:17.1-17.2 R1:16.1-16.2
40	Elimination of arbitrary constants(Formation of PDE)	CO 6	T1:17.1-17.2 R1:16.1-16.2
41	Elimination of arbitrary functions(Formation of PDE)	CO 6	T1:17.5-17.6 R1:16.3.1
42	Non-Linear Partial differential equation of first order (Standard forms II)	CO 6	T1:17.5-17.6 R1:16.3.1-16.2

43	Non-Linear Partial differential equation of first order (Standard forms III)	CO 6	T1:17.5-17.6 R1:16.3.1-16.2
44	Non-Linear Partial differential equation of first order (Standard forms IV)	CO 6	T1:17.5-17.6 R1:16.3.1-16.2
PROBLEM SOLVING/ CASE STUDIES			
45	Solving problems on Fourier sine and cosine integral	CO 2	T1:17.1-17.2 R1:16.1-16.2
46	Solving problems on finite Fourier transforms	CO 3	T1:17.5-17.6 R1:16.3.1
47	Solving problems on Laplace Transform of First, second shifting theorems and change of scaleproperty	CO4	T1:17.1-17.2 R1:16.1-16.2
48	Solving problems on Inverse Laplace transforms of derivatives, integrals, multiplied by s, divided by s	CO 4	T1:17.5-17.6 R1:16.3.1
49	Solving problems on Convolution theorem	CO 4	T1:17.1-17.2 R1:16.1-16.2
50	Solving problems on Inverse Laplace transforms of derivatives, integrals, multiplied by s, divided by s	CO 4	T1:23.10 R1:8.1
51	Solving problems on Inverse Laplace transforms of derivatives, integrals, multiplied by s, divided by s	CO 4	T1:23.1 R1:9.2
52	Solving problems on first shifting theorems and change of scale property	CO 4	T1:23.1 R1:9.4
53	Solving problems on second shifting theorems and change of scale property	CO 4	T1:23.1 R1:9.9
54	Gauss divergence theorem	CO 4	T1:23.10 R1:8.1
55	Solving problems on formation of partial differential equations by elimination of arbitrary constants	CO 6	T1:17.1-17.2 R1:16.1-16.2
56	Solving problems on formation of partial differential equations by elimination of arbitrary functions	CO 6	T1:17.1-17.2 R1:16.1-16.2

DISCUSSION OF DEFINITION AND TERMINOLOGY			
57	Definitions and terminology on Fourier series	CO 1,2	T1:23.10 R1:6.8
58	Definitions and terminology on Fourier transforms	CO 3	T1:23.10 R1:7.5
59	Definitions and terminology on Laplace transforms	CO 4	T1:23.10 R1:8.1
60	Definitions and terminology on z transforms	CO 5	T2:27.12 R1:11.10
61	Definitions and terminology on partial differential equations	CO 6	T1:17.1-17.2 R1:16.1-16.2
DISCUSSION OF QUESTION BANK			
62	Desccsion of Fourier series	CO 1,2	T1:23.10 R1:8.1
63	Desccsion of Fourier transforms	CO 3	T1:23.10 R1:6.8
64	Desccsion of Laplace transforms	CO 4	T1:23.10 R1:7.5
65	Desccsion of z transforms	CO 5	T2:27.12 R1:11.10
66	Desccsion of partial differential equations	CO 6	T1:17.1-17.2 R1:16.1-16.2

Signature of Course Coordinator **HOD,CE**

INSTITUTE OF AERONAUTICAL ENGINEERING
(Autonomous)
Dundigal, Hyderabad - 500 043

CIVIL ENGINEERING

COURSE DESCRIPTION

Course Title	**Strength of Materials-II**				
Course Code	ACE004				
Program	B.Tech				
Semester	IV	CE			
Course Type	Core				
Regulation	IARE - R16				
Course Structure	Theory			Practical	
	Lecture	Tutorials	Credits	Laboratory	Credits
	3	1	4	-	-
Course Coordinator	MS. B.Veeralaxmi, Assistant Professor.				

I COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites
B.Tech	ACE001	III	Strength of Materials

II COURSE OVERVIEW:

Civil engineers are required to design structures like buildings, dams, bridges, etc. The time varying nonlinear applied loads on these structures, along with the self-weight, have to be safely transmitted to the ground. A structural engineer must be able to design a structure in such a way that none of its members fail during load transfer process. This foundational course in civil engineering is intended to introduce to concepts of stress and strain due to external loading on a structural member and their calculations. For this, the concept and calculation of slopes and deflections of beams using various methods are covered in depth. Deflections by energy methods and analysis of propped cantilevers, fixed and continuous beams under various load combinations. Through this course content engineers can design the structures for safety and serviceability.

III MARKS DISTRIBUTION:

Subject	SEE Examination	CIE Examination	Total Marks
Strength of Materials-II	70 Marks	30 Marks	100

IV DELIVERY / INSTRUCTIONAL METHODOLOGIES:

✓	PPT	✓	Chalk & Talk	✓	Assignments	x	MOOC
x	Open Ended Experiments	x	Seminars	x	Mini Project	✓	Videos
x	Others						

V EVALUATION METHODOLOGY:

The course will be evaluated for a total of 100 marks, with 30 marks for Continuous Internal Assessment (CIA) and 70 marks for Semester End Examination (SEE). Out of 30 marks allotted for CIA during the semester, marks are awarded by taking average of two CIA examinations or the marks scored in the make-up examination.

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 14 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 Table: 1.

Percentage of Cognitive Level	Blooms Taxonomy Level
10%	Remember
25 %	Understand
50 %	Apply
15 %	Analyze
0 %	Evaluate
0 %	Create

Continuous Internal Assessment (CIA):
CIA is conducted for a total of 30 marks, with 25 marks for Continuous Internal Examination (CIE) and 05 marks for Quiz \Alternative Assessment Tool (AAT).

Component	Theory		Total Marks
Type of Assessment	CIE Exam	Quiz \AAT	
CIA Marks	25	05	30

Continuous Internal Examination (CIE):
Two CIE exams shall be conducted at the end of the 8th and 16th week of the semester respectively. The CIE exam is conducted for 20 marks of 2 hours duration consisting of five descriptive type questions out of which four questions have to be answered where, each question carries 5 marks. Marks are awarded by taking average of marks scored in two CIE exams
Quiz - Online Examination
Two Quiz exams shall be online examination consisting of 25 multiple choice questions and are to be answered by choosing the correct answer from a given set of choices (commonly four). Such a question paper shall be useful in testing of knowledge, skills, application, analysis, evaluation and understanding of the students. Marks shall be awarded considering the average of two quiz examinations for every course.
Alternative Assessment Tool (AAT)
This AAT enables faculty to design own assessment patterns during the CIA. The AAT converts the classroom into an effective learning center. The AAT may include tutorial hours/classes, seminars, assignments, term paper, open ended experiments, METE (Modeling and Experimental Tools in Engineering), five minutes video, MOOCs etc. The AAT chosen for this course is given in table

Concept Video	Tech-talk	Open Ended Experiment
40%	40%	20%

VI COURSE OBJECTIVES:
The students will try to learn:

I	The fundamental concepts of mechanics of deformable structures and their behaviour.

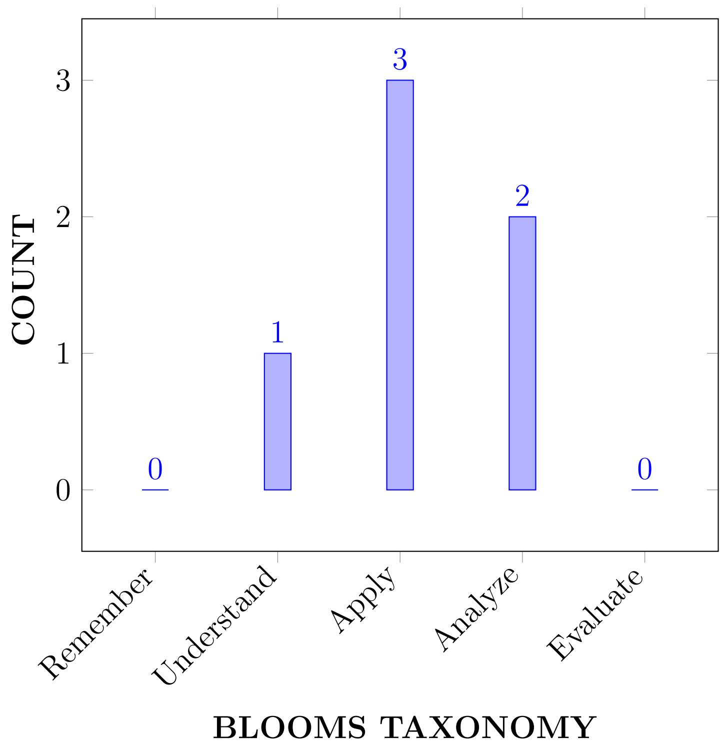
II	Analysis of structural elements with the help of different mathematical, analytical and energy methods for the purpose of design.
III	Analysis of structures independently in real world situations where the design of structures involved.

VII COURSE OUTCOMES:

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

CO 1	**Analyze** propped cantilever beams to know the shear forces and bending moments at various locations in the beam for designing propped cantilever beams.	Analyze
CO 2	**Develop** the slope and deflection equations of fixed beams to know the behaviour of indeterminate structuresfor the design purpose.	Apply
CO 3	**Explain** the concepts of clapeyron's theorem of three moments for analysing continuous beams including sinking of supports.	Understand
CO 4	**Make use of** the behavior of structural elements under different loading conditions to tackle real time situations.	Apply
CO 5	**Develop** the slope and deflection equations of beams subjected to different loads and their combinations using double integration and Macaulay's methods.	Apply
CO 6	**Analyse** the beams for slopes and deflections subjected to various load combinations with the help of Mohr's theorem, conjugate beam and moment area methods.	Analyse

COURSE KNOWLEDGE COMPETENCY LEVEL



VIII HOW PROGRAM OUTCOMES ARE ASSESSED:

Program		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.	1	CIE/Quiz/AAT
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	CIE/Quiz/AAT
PO 4	**Conduct Investigations of Complex Problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.	1	Assignments/ SEE /CIE, AAT, QUIZ
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.	3	Assignments
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.	3	SEE/ CIE, AAT, QUIZ

3 = High; 2 = Medium; 1 = Low

IX HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

Program		Strength	Proficiency Assessed by
PSO 1	Understand, analyze, design and supervise sub-structures and superstructures for residential and public buildings, industrial structures, irrigation structures, powerhouses, highways, railways, airways, docks and harbours.	2	CIE / Quiz / AAT

3 = High; 2 = Medium; 1 = Low

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

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	✓	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 2	-	✓	-	✓	-	-	-	-	-	-	-	-	-	-	-
CO 3	✓	✓	-	✓	-	-	-	-	-	-	-	-	✓	-	-
CO 4	✓	✓	-	✓	-	-	-	-	-	✓	-	-	✓	-	-
CO 5	✓	✓	-	✓	-	-	-	-	-	-	-	-	✓	-	-
CO 6	✓	-	✓	-	-	-	-	-	-	-	-	✓	✓	-	-

XI 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 the buckling of columns and struts due to the axial loading and bending moment by applying the principles of mathematics and science.	2
CO 2	PO 2	Understand the given problem statement related to buckling of columns from the provided information and data for determining the stresses and safe design of columns.	3
	PO 4	Apply the knowledge of characteristics of material and use analytical methods to determine the stresses in columns.	2
CO 3	PO 1	Apply the principles mathematics and science to get the solutions of the beams for defection and slope.	2
	PO 2	Understand the given problem statement of structural members related to slope and deflections from the provided information and data in reaching substantiated solutions by the interpretation of results.	3
	PO 4	Understand the various analytical methods to solve engineering problems in beams by using mathematical and engineering principles.	3
	PSO 1	Understand the double integration and Macaulay's method for slopes and deflections of beams using mathematical principles and engineering knowledge.	2
CO 4	PO 1	Apply the mathematical principles, scientific principles and methodology to get the solutions in the analysis of beams.	2
	PO 2	Understand the given problem statement of structural members related to slope and deflections from the provided information and data in reaching substantiated solutions by the interpretation of results.	3

	PO 4	Make us of various analytical methods like Mohr's theorem and conjugate beam method to solve engineering problems by using mathematical end engineering principles.	2
	PO 10	Make us of various analytical methods like conjugate beam method to solve problems by using mathematical end principles.	2
	PSO 1	Understand the Mohr's theorem, conjugate beam and moment area method for slopes and deflections of beams using mathematical principles and engineering knowledge.	2
CO 5	PO 1	Apply the principles of mathematics and science for understanding the usage of energy methods for solving structural problems.	2
	PO 2	Understand the given problem statement of structural members related to slope and deflections from the provided information and data for developing the substantiated solutions by the interpretation of results.	4
	PO 4	Make use of various analytical methods like work energy method and Castigliano's theorem to solve engineering problems by using mathematical end engineering principles.	2
	PSO 1	Understand the work energy method, virtual work method, Castigliano's theorem for calculating displacements of beams using and engineering principles	2
CO 6	PO 1	Explain the theorems for solving engineering problems by applying the knowledge of mathematics and science.	2
	PO 4	Use various analytical methods like work energy method and Castigliano's theorem to solve engineering problems by using mathematical end engineering principles.	2
	PO 12	Apply various analytical methods like work energy method and Castigliano's theorem to solve engineering problems by using end engineering principles.	3
	PSO 1	Understand the maxwell's reciprocal theorem and unit load method for calculating displacements of beams using mathematical principles and engineering knowledge.	2

XII 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	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 2	-	3	-	2	-	-	-	-	-	-	-	-	-	-	-

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

XIII 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	-	30	-	18.1	-	-	-	-	-	-	-	-	-	-	-
CO 3	66.6	30	-	27.2	-	-	-	-	-	-	-	-	50	-	-
CO 4	66.6	30	-	18.1	-	-	-	-	-	40	-	-	50	-	-
CO 5	66.6	40	-	18.1	-	-	-	-	-	-	-	-	50	-	-
CO 6	66.6	-	18.1	-	-	-	-	-	-	-	-	37.5	50	-	-

XIV COURSE ARTICULATION MATRIX (PO – PSO MAPPING):

CO'S and PO'S and CO'S and PSO'S on the scale of 0 to 3, 0 being no correlation, 1 being the low correlation, 2 being medium correlation and 3 being high correlation.
0 - $0 \leq C \leq 5\%$ – No correlation
2 - 40 % $< C < 60\%$ –Moderate
1-5 $< C \leq 40\%$ – Low/ Slight
3 - $60\% \leq C < 100\%$ – Substantial /High

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

XV ASSESSMENT METHODOLOGY DIRECT:

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

XVI ASSESSMENT METHODOLOGY INDIRECT:

✓	Early Semester Feedback	✓	End Semester OBE Feedback
X	Assessment of Mini Projects by Experts		

XVII SYLLABUS:

MODULE I	**DEFLECTIONS OF BEAMS**
	Bending into a circular arc, slope, deflection and radius of curvature, differential equation for the elastic line of a beam, double integration and Macaulay‘s methods, determination of slope and deflection for cantilever and simply supported beams subjected to various loads, Mohr‘s theorems, moment area method, application to simple cases including overhanging beams; Conjugate beam method, concept of conjugate beam method, difference between a real beam and a conjugate beam, deflections of determinate beams with constant and different moments of inertia.
MODULE II	**DEFLECTIONS BY ENERGY METHODS**
	Strain Energy: Resilience gradual, sudden, impact and shock loadings simple applications; Strain energy in linear elastic system, expression of strain energy due to axial load, bending moment and shear force; Energy Methods: Work energy method, principal of virtual work, unit load method, Castigliano's theorem; Deflections of simple beams and pin jointed trusses; Concept extended to frames and indeterminate structures; Maxwell‘s theorem of reciprocal deflections; Betti‘s Law.
MODULE III	**STRESSES IN CYLINDERS AND SPHERICAL SHELLS**
	Thin seamless cylindrical shells, derivation of formula for longitudinal and circumferential stresses, hoop, longitudinal and volumetrical strains, changes in diameter and volume of thin cylinders, thin spherical shells. Lames theory for thick cylinders, derivation of lames formulae, distribution of hoop and radial stresses across thickness, design of thick cylinders, compound cylinders, necessary difference of radii for shrinkage, thick spherical shells.
MODULE IV	**INDETERMINATE BEAMS: PROPPED CANTILEVER AND FIXED BEAMS**
	Analysis of propped cantilever and fixed beams using the method of consistent deformation, including the beams with varying moments of inertia, subjected to uniformly distributed load, central point load, eccentric point load, number of point loads, uniformly varying load, couple and combination of loads, shear force and bending moment diagrams for propped cantilever and fixed beams, deflection of propped cantilever and fixed beams; Effect of rotation of a support.
MODULE V	**INDETERMINATE BEAMS: CONTINUOUS BEAMS**
	Continuous beams, Clapeyron‘s theorem of three moments, analysis of continuous beams with constant and variable moments of inertia with one or both ends fixed, continuous beams with overhang; Effects of sinking of supports.

TEXTBOOKS

1. F. Beer, E. R. Johnston, J. DeWolf, —Mechanics of Materials, Tata McGraw-Hill Publishing Company Ltd., New Delhi, India, 1st Edition, 2008.

2. B. C. Punmia, Ashok Kumar Jain, Arun Kumar Jain, —Mechanics of Materials, Laxmi Publications Pvt. Ltd., New Delhi, 12th Edition, 2007.

3. S. S. Bhavikatti, "Strength of Materials", Vikas Publishing House Pvt. Ltd., New Delhi, 5th Edition, 2013.

REFERENCE BOOKS:

1. D. S. Prakash Rao, —Strength of Materials A Practical Approach Vol.1, Universities Press (India) Pvt. Ltd., India, 3rd Edition, 2007.
2. J. M. Gere, S.P. Timoshenko, —Mechanics of Materials, SI units edition, CL Engineering, USA, 5th Edition, 2000.
3. E. G. Popov, —Engineering Mechanics of Solids, Pearson Education, India, 21st Edition, 2015.
4. N. Krishan Raju and D.R.Gururaje, —Advanced Mechanics of Solids and Structures, Narosa Publishing House, 4th Edition, 2014.

XVIII COURSE PLAN:

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

S.No	Topics to be covered	CO's	Reference T1: 4.1
OBE DISCUSSION			
1	Discuss on Outcome Based Education		
CONTENT DELIVERY (THEORY)			
1	Introduction to propped cantilevers and fixed beams.	CO 1	T2:13.1, R1: 16.1 – 16.3
2	Introduction to method of consistent deformation.	CO 1	T2:13
3	Analysis of propped cantilever subjected to point load and uniformly distributed load. SFD and BMD.	CO 1	T2:13
4	Analysis of propped cantilever subjected to number of point loads and uniformly varying load. SFD and BMD.	CO 1	T2:9.2 R2: 3.1,3.2
5	Analysis of fixed beam subjected to central point load and eccentric point load. SFD and BMD	CO 1	T1: 1.1, 1.2 R2: 3.3
6	Analysis of fixed beam subjected to uniformly distributed load and couple. SFD and BMD	CO 1	T1: 1.1, 1.2 R2: 3.3
7	Analysis of fixed beam subjected to uniformly varying load. SFD and BMD.	CO 1	T1: 1.1, 1.2 R2: 3.3
8	Effect of rotation and sinking of supports.	CO 1	T1: 1.1, 1.2 R2: 3.3
9	Introduction to continuous beams-Clapeyron's theorem of three moments.	CO 1	T1: 1.1, 1.2 R2: 3.5-3.6

10	Analysis of continuous beam using Clapeyron's theorem of three moments, when all the supports remain at the same level.	CO 1	T1: 1.1, 1.2 R2: 3.5-3.6
11	Analysis of continuous beam using Clapeyron's theorem of three moments, when all the supports remain at the same level and constant flexural rigidity.	CO 1	T1: 63-65 R2: 10.2
12	Analysis of continuous beam using Clapeyron's theorem of three moments, when all the supports remain at the same level and variable flexural rigidity.	CO1	T1: 63-65 R2: 10.2
13	Analysis of continuous beam using Clapeyron's theorem of three moments, with variable flexural rigidity and one end fixed.	CO 1	T2:2.2, 2.12 R2: 9.3
14	Analyze continuous beams with overhangs.	CO 1	T2:2.2, 2.12 R2: 9.3
15	Analyze continuous beams with sinking of supports.	CO 1	T1: 19-20 R2: 4.2
16	Numerical example on Clapeyron's theorem.	CO 1	T1:22 R2: 4.4
17	Introduction to slope and deflections of beams- slope, deflection and radius of curvature of elastic curve.	CO 1	T1:24 R2: 5.4
18	Differential equation for the elastic line of a beam, Double integration and Macaulay's methods.	CO 1	T1:24 R2: 5.4
19	Deflections in cantilever beam by double integration and Macaulay's methods.	CO 1	T1:26 R2: 5.6
20	Deflections in simply supported beam by double integration and Macaulay's methods.	CO2	T1:22 R2: 4.4
21	Numerical examples on Macaulay's method.	CO 2	T1:22 R2: 4.4
22	Mohr's theorem, moment area method, application to simple cases including overhanging beams.	CO 2	T1:22 R2: 4.4
23	Conjugate beam method, concept of conjugate beam method, difference between a real beam and a conjugate beam.	CO 2	T1:21 R2: 4.5
24	Conjugate beam method- Simply supported beam.	CO 2	T1:21 R2: 4.5
25	Numerical examples on moment area and Conjugate beam methods.	CO 2	T1:32 R2: 7.6
26	Numerical examples on moment area and Conjugate beam methods.	CO 2	T1:32 R2: 7.6
27	Introduction to pin-jointed frames- Methods of analysis.	CO 4, CO 5	T1:34-35-36 R2: 7.8
28	Introduction on energy methods, principal of virtual work, unit load method.	CO 4, CO 5	T1:34-35-36 R2: 7.8

29	Castigliano's theorem for displacements of cantilever beam with concentrated load and uniformly distributed load.	CO 4, CO 5	T1:34-35-36 R2: 7.8
30	Deflections of simple beams like cantilever beams, simply supported beams with concentrated loads and uniformly distributed loads.	CO 3	T1:23 R1: 4.1
31	Deflections of pin jointed trusses.	CO 4, CO 5	T1:23 R1: 4.2
32	Analyze structures using Maxwell's theorem of reciprocal deflections and Betti's Law.	CO 4, CO 5	T1:24 R1: 4.3
33	Introduction on columns and struts, types of columns-short, medium and long columns.	CO 6	T1:24 R1: 4.3
34	Axially loaded compression members, crushing load.	CO 6	T1:24 R1: 4.3
35	Euler's theorem for long columns, assumptions.	CO 6	T1:24 R2: 5.4
36	Derivation of Euler's critical load formulae for various end conditions and problems.	CO 6	T2:23.3 R2: 8.3
37	Equivalent length of a column, slenderness ratio.	CO 6	T2:23.4 R2: 8.4
38	Euler's critical stress, limitations of Euler's theory	CO 6	T2:23.7 R2: 8.6
39	Rankine's formula. Laterally loaded struts subjected to uniformly distributed and concentrated loads.	CO 6	T2:23.6 R2: 8.8
40	Numerical examples on Rankine's formula.	CO 6	T3:23.8 R2: 8.10
PROBLEM SOLVING/ CASE STUDIES			
1	Numerical Examples on Propped Cantilevers.	CO 1	R2:7.5
2	Numerical Examples on Propped Cantilevers.	CO 1	T2:3
3	Numerical Examples on Fixed Beams.	CO 1	R2:7.5
4	Numerical Examples on Fixed Beams.	CO 1	R2:7.5
5	Numerical Examples on Clapeyron's theorem.	CO 2	R2:7.5
6	Numerical Examples on Clapeyron's theorem.	CO 2	R2:7.5
7	Numerical Examples on Deflections-Macaulay's method.	CO 3	R4:5.2
8	Numerical Examples on Deflections-Moment Area method.	CO 3	T2:5.2
9	Numerical Examples on Deflections-Conjugate beam method.	CO 3	T1: 4.1
10	Numerical Examples Energy methods- Deflections of simple beams.	CO 4, CO 5	T3:4.5
11	Numerical Examples Energy methods- Deflections of trusses.	CO 4, CO 5	R2:7.5
12	Numerical Examples on Maxwell's reciprocal theorem.	CO 4, CO 5	R2:7.5
13	Numerical Examples Columns and Struts-Euler's formula.	CO 6	R2:7.5
14	Numerical Examples Columns and Struts-Euler's formula.	CO 6	R1:7.5

15	Numerical Examples Columns and Struts-Rankine's formula.	CO 6	R1:7.5
DISCUSSION OF DEFINITION AND TERMINOLOGY			
1	Definitions and terminology from Propped cantilever and fixed beam.	CO 1	T1: 1-2 R2: 3.1,3.2
2	Definitions and terminology from Clapeyron's theorem.	CO 2	T1: 19-20 R2: 4.2
3	Definitions and terminology from Deflections of beams.	CO 3	T1:23 R1: 4.1
4	Definitions and terminology from Energy methods.	CO 4, CO 5	T3:5.1, 5.2 R2: 8.1-8.4
5	Definitions and terminology from Columns and struts.	CO 6	R1: 7.1
DISCUSSION OF QUESTION BANK			
1	Questions bank problems from Propped cantilever and fixed beam.	CO 1	T1: 1.1, 1.2 R2: 3.3
2	Questions bank problems from Clapeyron's theorem.	CO 2	T1:22 R2: 4.4
3	Questions bank problems from Deflections of beams.	CO 3	T1:24 R2: 5.4
4	Questions bank problems from Energy methods.	CO 4, CO 5	T1:61 R2: 12.3
5	Questions bank problems from Columns and struts.	CO 6	R1:7.8

Signature of Course Coordinator **HOD,CE**
Mr. B.Veeralaxmi, Assistant Professor

INSTITUTE OF AERONAUTICAL ENGINEERING
(Autonomous)
Dundigal, Hyderabad - 500 043

COURSE DESCRIPTION

Department	**CIVIL ENGINEERING**				
Course Title	**FLUID MECHANICS**				
Course Code	ACE005				
Program	B.Tech				
Semester	IV	CE			
Course Type	Core				
Regulation	IARE -R16				
Course Structure	Theory			Practical	
	Lecture	Tutorials	Credits	Laboratory	Credits
	3	1	4	-	-
Course Coordinator	Ms Durga Sharma, Assistant Professor				

I COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites
B.Tech	AHS002	I	Linear Algebra and Ordinary Differential Equations
B.Tech	AME002	II	Engineering Mechanics

II COURSE OVERVIEW:

This course provides students with an introduction to principal concepts and methods of fluid mechanics. Topics covered in the course include pressure, hydrostatics, and buoyancy; open systems and control volume analysis; mass conservation and momentum conservation for moving fluids; viscous fluid flows, flow through pipes; dimensional analysis; boundary layers, and lift and drag on objects. Students will work to formulate the models necessary to study, analyze, and design fluid systems through the application of these concepts, and to develop the problem solving skills essential to good engineering practice of fluid mechanics in practical applications.

III MARKS DISTRIBUTION:

Subject	SEE Examination	CIE Examination	Total Marks
Fluid Mechanics	70 Marks	30 Marks	100

IV CONTENT DELIVERY / INSTRUCTIONAL METHODOLOGIES:

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

V EVALUATION METHODOLOGY:

The course will be evaluated for a total of 100 marks, with 30 marks for Continuous Internal Assessment (CIA) and 70 marks for Semester End Examination (SEE). Out of 30 marks allotted for CIA during the semester, marks are awarded by taking average of two CIE examinations or the marks scored in the make-up examination.

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 14 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
16.7%	Remember
33.3%	Understand
50%	Apply
%	Analyze
%	Evaluate
%	Create

Continuous Internal Assessment (CIA):
CIA is conducted for a total of 30 marks, with 25 marks for Continuous Internal Examination (CIE) and 05 marks for Quiz \Alternative Assessment Tool (AAT).

Component	Theory		Total Marks
Type of Assessment	CIE Exam	Quiz \AAT	
CIA Marks	25	05	30

Continuous Internal Examination (CIE):
Two CIE exams shall be conducted at the end of the 8^{th} and 17^{th} week of the semester respectively. The CIE exam is conducted for 25 marks of 2 hours duration consisting of two parts. Part–A shall have five compulsory questions of one mark each. In part–B, four out of five questions have to be answered where, each question carries 5 marks. Marks are awarded by taking average of marks scored in two CIE exams.

Quiz - Online Examination
Two Quiz exams shall be online examination consisting of 25 multiple choice questions and are to be answered by choosing the correct answer from a given set of choices (commonly four). Such a question paper shall be useful in testing of knowledge, skills, application, analysis, evaluation and understanding of the students. Marks shall be awarded considering the average of two quiz examinations for every course.

Alternative Assessment Tool (AAT)
This AAT enables faculty to design own assessment patterns during the CIA. The AAT converts the classroom into an effective learning center. The AAT may include tutorial hours/classes, seminars, assignments, term paper, open ended experiments, METE (Modeling and Experimental Tools in Engineering), five minutes video, MOOCs etc. The AAT chosen for this course is given in table

Concept Video	Tech-talk	Complex Problem Solving
40%	40%	20%

VI COURSE OBJECTIVES:

The students will try to learn:

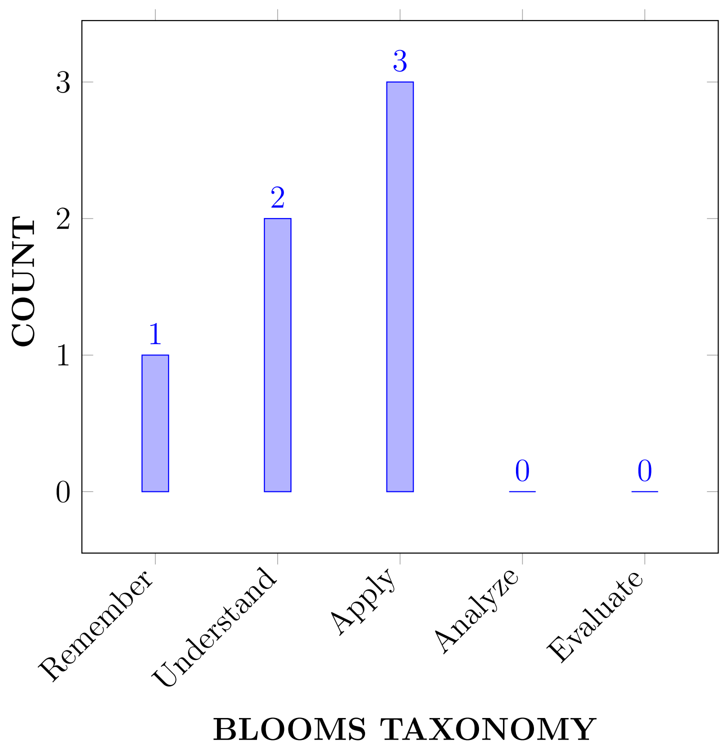
I	Understand and study the effect of fluid properties on a flow system.
II	Apply the concept of fluid pressure, its measurements and applications.
III	Explore the static, kinematic and dynamic behavior of fluids.
IV	Assess the fluid flow and flow parameters using measuring devices.

VII COURSE OUTCOMES:

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

CO 1	**Recall** basic principles and concepts of Fluid Mechanics for ascertaining differences between solids and fluids.	Remember
CO 2	**Utilize** sound knowledge of fundamental properties of fluids and fluid continuum, principle of manometry, Archimedes's for measuring pressure and analysing hydro-static forces on various types of floating and immersed bodies.	Apply
CO 3	**Interpret** different types of fluid flows, concept of continuity equation for analyzing velocity potential functions and flownet	Understand
CO 4	**Make use of** Euler's, Bernoulli's and Momentum equation for understanding concepts of dynamics of fluid flows.	Apply
CO 5	**Understand** the concept of Boundary layer theory, Navier-Stoke's Equations, Vonkarmen momentum integral equation for analysing fluid flow and estimating boundary layer thickness.	Understand
CO 6	**Apply** the principles of dimensional analysis for building the relation between model and prototypes	Apply

COURSE KNOWLEDGE COMPETENCY LEVEL



VIII PROGRAM 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

IX 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 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	2	CIE/Quiz/AAT
PO 4	**Conduct Investigations of Complex Problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.	1	Assignments/ SEE /CIE, AAT, QUIZ
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. e.	2	SEE/ CIE, AAT, QUIZ

3 = High; 2 = Medium; 1 = Low

X HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

PROGRAM SPECIFIC OUTCOMES		Strength	Proficiency Assessed by
PSO 1	Design and Supervise Sub-Structures and Super Structures for Residential and Public Buildings, Industrial Structures, Irrigation Structures, Power Houses, Highways, Railways, Airways, Docs and Harbours.	1	Quiz

3 = High; 2 = Medium; 1 = Low

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

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	✓	✓	-	-	-	-	-	-	-	-	-		-	-	-
CO 2	✓	✓	✓		-	-	-	-	-	✓	-	-	✓	-	-
CO 3	✓	✓	✓		-	-	-	-	-	✓	-	-	✓	-	-
CO 4	✓	✓	-	✓	-	-	-	-	-	-	-	-	✓	-	-
CO 5	✓	-	✓	✓	-	-	-	-	-	✓	-	-	-	-	-
CO 6	✓	✓	-	✓	-	-	-	-	-	-	-	-	✓	-	-

XII 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 matched.
CO 1	PO 1	**Recall** (knowledge) the various properties of fluids**using the knowledge of mathematics, science and engineering fundamental.**	3
	PO 2	**Design the problem statement** associated with the given data and **formulate** their cause to **develop the solutions** using the concept of pressure.	3
CO 2	PO 1	Use the **engineering and scientific principles** to understand the conservation laws in differential forms to **determine** velocities, pressures and acceleration in a moving liquid.	2
	PO 2	Analyze the given **information and data** from the conservation laws in differential forms and **implementing** them for determination of various hydraulic parameters in fluid flows.	2
	PO 3	Use the **fundamentals of engineering and science** with the mass and energy equations for **determining** analytical solutions of fluid flow problems.	2
	PO 10	Communicate clearly in form of**writing**assignments, preparing **subject matter** in form of Tech Talk and five- minute video, and maintain a profound **speaking style.**	3
	PSO 1	Recall the concept of law of conservation of mass and energy in design and analysis of **water conveyance systems with environmental impact and remediation measures.**	2
CO 3	PO 1	Use the **fundamentals of engineering and science** in the determination of total energy of various geometrical cross sections for discharge with applications of Bernoulli's theorem.	2
	PO 2	Understand the concepts of velocity potential, stream function to **develop solutions** using **principles of mathematical and Engineering science**.	3

Course Outcomes	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key competencies matched.
	PO 4	**Understanding** of differential forms of conservation laws and **apply** them to determine the solutions of **engineering problems.**	3
	PSO 1	Recall the concept of law of conservation of mass and energy in design and analysis of **water conveyance systems with environmental impact and remediation measures.**	2
CO 4	PO 1	Use the **fundamentals of engineering and science** in the **determination** of thickness of boundary layer using Boundary layer theory.	2
	PO 2	**Analyze the complex engineering problems** for real flows using Bernoulli's theorem to **develop solutions** for various geometrical cross sections and **validate** with the **experimental design.**	4
	PO 10	**Communicate** clearly in form of **writing** assignments, preparing **subject matter** in form of **Tech Talk** and 5 Minute video, and maintain a profound **speaking style**	5
CO 5	PO 1	Apply the knowledge of **mathematical and science principles** for estimating total energy of various geometrical cross sections in engineering problems using conservation of energy.	2
	PO 2	**Analyze the complex engineering problems** for using Bernouli's equation to **develop solutions** for various geometric cross sections.	2
	PO 3	Use the **fundamentals of engineering and science** with the mass and energy equations for **determining** analytical solutions of fluid flow problems.	2
	PO 4	**Understanding** of differential forms of conservation laws and **apply** them to determine the solutions of **engineering problems.**	3
	PSO 1	Analyze the **procurement and construction**Techniques confining to **codes of practice** to design the geometrical cross sections for various types of open channels.	3
CO 6	PO 1	Apply the knowledge of **mathematical and science principles** for estimating total energy of various geometrical cross sections in engineering problems using conservation of energy.	2
	PO 2	**Analyze the complex engineering problems** for using Bernouli's equation to **develop solutions** for various geometric cross sections.	2
	PO 4	**Understanding** of differential forms of conservation laws and **apply** them to determine the solutions of **engineering problems.**	3
	PSO 1	Analyze the **procurement and construction**Techniques confining to **codes of practice** to design the geometrical cross sections for various types of open channels.	3

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

XIV 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	20	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 3	100	40	-	-	-	-	-	-	-	-	-	-	10	-	-
CO 4	100	-	40	20	-	-	-	-	-	40	-	-	-	-	-
CO 5	66.67	20	20	30	-	-	-	-	-	-	-	-	20	-	-
CO 6	66.67	20	-	30	-	-	-	-	-	-	-	-	20	-	-

XV COURSE ARTICULATION MATRIX (PO / PSO MAPPING):

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

0 - $0 \leq$ C$\leq$ 5% – No correlation
1 -5 <C$\leq$ 40% – Low/ Slight
2 - 40 % <C < 60% –Moderate
3 - 60% $\leq$ C < 100% – Substantial /High

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

XVI ASSESSMENT METHODOLOGY-DIRECT:

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

XVII ASSESSMENT METHODOLOGY-INDIRECT:

	Assessment of mini projects by experts	✓	End Semester OBE Feedback

XVIII SYLLABUS:

MODULE I	**INTRODUCTION AND HYDROSATICS FORCES**
	Dimensions and units – Physical properties of fluids - specific gravity, viscosity, surface tension, Vapour pressure and their influences on fluid motion, Pressure at a point, Pascal's law, Hydrostatic law - atmospheric, gauge and vacuum pressures. Measurement of pressure, Pressure gauges, Manometers: Simple and differential U-tube Manometers. Hydrostatic forces on submerged plane, horizontal, vertical, inclined and curved surfaces. Center of pressure, buoyancy, meta-center, meta-centric height. Derivations and problems.
MODULE II	**FLUID STATICS**
	Fluid Pressure: Pressure at a point, Pascal's law, pressure variation with temperature, density and altitude. Piezometer, U-Tube Manometer, Single Column Manometer, U-Tube Differential Manometer, Micro manometers. Pressure gauges, Hydrostatic pressure and force: horizontal, vertical and inclined surfaces. Buoyancy and stability of floating bodies.
MODULE III	**FLUID KNIEMATICS**
	Description of fluid flow, Stream line, path line and streak lines and stream tube. Classification of flows: Steady and unsteady, uniform and non-uniform, laminar and turbulent, rotational and irrotational flows. Equation of continuity for 1 - D, 2 - D, and 3 - D flows – stream and velocity potential functions, flow net analysis.
MODULE IV	**FLUID DYNAMICS**
	Euler's and Bernoulli's equations for flow along a streamline for 3 - D flow, Navier – Stokes equations (Explanationary), Momentum equation and its applications. Forces on pipe bend. Pitot-tube, Venturimeter and Orifice meter, classification of orifices, flow over rectangular, triangular, trapezoidal and stepped notches, Broad crested weirs.
MODULE V	**DIMENSIONAL ANALYSIS**
	Dimensional Analysis and Dynamic Similitude - Definitions of Reynolds Number, Froude Number, Mach Number, Weber Number and Euler Number; Buckingham's ϕ-Theorem

TEXTBOOKS

1. Frank M. White, ”Fluid Mechanics ”, McGraw Hill Education Private Limited, 8th Edition, 2017 .
2. Modi and Seth, “Fluid Mechanics‖”, Standard book house, 2011.
3. R.K. Rajput, “A text of Fluid mechanics and hydraulic machines”, S. Chand and company Pvt. Ltd, Sixth Edition, 2015.
4. S.K. Som and G. Biswas, —Introduction to Fluid Machines‖, Tata Mc Grawhill publishers Pvt. Ltd, 2010.
5. Ramdurgaia, — Fluid Mechanics and Machinery‖, New Age Publications, 2007.

REFERENCE BOOKS:

1. Yuan S W, “Foundations of fluid Mechanics”, Prentice-Hall, 2nd Edition, 1987.
2. Shiv Kumar, ”Fluid Mechanics Basic Concepts and Principles”, Ane Books Pvt Ltd., 2010.
3. R.K. Bansal ,A text of Fluid mechanics and hydraulic machines- Laxmi Publications (P) ltd., New Delhi, 2011.

WEB REFERENCES:

1. https://nptel.ac.in/courses/112105171/1
1. https://www.iare.ac.in/?q=courseslist/71

COURSE WEB PAGE:

XIX 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	Outcome based education system discussion on hydraulic and hydraulic machinery	-	
CONTENT DELIVERY (THEORY)			
2	Explanation of various units and introduction to fluid mechanics.	CO 1	T1: 2.4 R2:1-1.7
3-4	Vapor pressure, boiling point, cavitation, Surface tension, capillarity, Bulk modulus of elasticity, compressibility.	CO 1	T1: 2.4 R2:1-1.7
5-6	Fluid Pressure: Pressure at a point, Pascal’s law.	CO 2	T1: 2.6-14 R2:1-1.7
7-8	Measurement of pressure using various mechanical gauges	CO 2	T1: 2.15-20 R1:1-1.7
9-10	Single Column Manometer, U -Tube Differential Manometer, Micro manometers.	CO 2	T1: 3.1-.3 R1:2-2.8
11-13	Hydrostatic pressure and force: horizontal, vertical and inclined surfaces, Buoyancy and stability of floating bodies .	CO 2	T1 – T3 R1 - R3
14-17	Classification of fluid flows with respect to time, space and combination of fluid flows.	CO 3	T2: 6.1-5 R1:2-2.8
18-19	Stream line, path line, streak line and stream tube; stream function, velocity potential function.	CO 3	T1: 9.1-5 R2:2-2.8

20-22	Derivation of continuity equations in Cartesian coordinates.	CO 4	T1 – T3 R1 - R3
23-26	Surface and body forces; Equations of motion - Euler's equation.	CO 4	T2: 9.6-7 R2: 3-3.8
27-30	Bernoulli's equation – derivation and application	CO 5	T2: 4.5
31-32	Approximate Solutions of Navier-Stoke's Equations, Boundary layer (BL) – concepts, Prandtl contribution,	CO 5	T1 – T3 R1 - R3
33-34	Vonkarmen momentum integral equation, laminar and turbulent boundary layers (no deviation), BL in transition, separation of BL, control of BL, flow around submerged objects, Drag and Lift forces .	CO 5	T1: 10.1-5 R2: 4-4.8
35-38	Dimensional Analysis and Dynamic Similitude - Buckingham's -Theorem, prototype and model type analysis.	CO 6	T1: 10.5-7 R2: 4-4.8
39-40	Dimensional Analysis and Dynamic Similitude - Definitions of Reynolds Number, Froude Number, Mach Number, Weber Number and Euler Number	CO 6	T1: 10.7 R2: 4-4.8
PROBLEM SOLVING/ CASE STUDIES			
1	Problems on Properties of fluid	CO 1	R2:7.5
2	Problems on Surface tension and Vapour Pressure	CO 1	R2:7.5
3	Problems on Basic equations of fluid statics	CO 1	R2:7.5
4	Problems on Pressure Measuring Devices	CO 2	R2:7.5
5	Problems on Hydrostatic force on submerged surfaces	CO 2	R2:7.5
6	Problems on Buoyancy and Stability	CO 3	R2:7.5
7	Problems on Liquids in Rigid Body Motion	CO 3	R2:7.5
8	Problems on velocity field	CO 4	R2:7.5
9	Problems on continuity equations	CO 4	R2:7.5
10	Problems on Irrotational Flow,Stream Function and velocity Potential	CO 4	R2:7.5
11	Problems on practical applications of Bernoulli's equation – Venturimeter, orifice meter, pitot tube	CO 4	R2:7.5
12	Problems on Dimensional Analysis and Dynamic Similitude - Buckingham's -Theorem, prototype and model type analysis	CO 5	R2:7.5
13	Calculation of Reynolds Number, Froude Number, Mach Number, Weber Number and Euler Number	CO 5	R2:7.5
14	Problems on Reynolds Number, Froude Number, Mach Number,	CO 6	R2:7.5
15	Problems on Weber Number and Euler Number	CO 6	R2:7.5
DISCUSSION OF DEFINITION AND TERMINOLOGY			
1	Discussion on properties of fluid, pascal's law, pressure measuring devices and Hydrostatic forces	CO 1 CO 2	R4:2.1
2	Discussion on fluid flow, types of fluid flow and continuity equation.	CO 3	T4:7.3
3	Discussion on Eulers's, Bernoulli's equation and momentum equation	CO 4	R4:5.1

4	Discussion on Boundary layer theory, Prandtl contribution and Vonkarmen momentum integral equation.	CO 5	T1:7.5
5	Discussion on Dimensional Analysis, dimensionless numbers.	CO 6	T1: 8.1
DISCUSSION OF QUESTION BANK			
1	Basic concepts and definitions - important question and solution (Module I)	CO 1	T1: 11.1-7 R2: 11-11.10
2	Fluid statics - important question and solution (Module II)	CO 2	T4: 2.1 -2.2 R2: 13-13.7
3	Fluid kinematics- important question and solution (Module III)	CO 3	T4: 2.3 -2.6 R2: 13-13.7
4	Fluid dynamics - important question and solution (Module IV)	CO 4	T4: 2.7 - 2.9 R2: 13-13.7
5	Dimensional Analysis, dimensionless numbers (Module V)	CO 6	T1: 8.1

Signature of Course Coordinator **HOD,CE**

INSTITUTE OF AERONAUTICAL ENGINEERING
(Autonomous)
Dundigal, Hyderabad - 500 043

COURSE DESCRIPTION

Department	**CIVIL ENGINEERING**				
Course Title	**GEOTECHNICAL ENGINEERING**				
Course Code	ACE006				
Program	B.Tech				
Semester	IV				
Course Type	Core				
Regulation	R-16				
Course Structure	Theory			Practical	
	Lecture	Tutorials	Credits	Laboratory	Credits
	3	1	4	3	2
Course Coordinator	Dr. V. Anand Reddy, Associate Professor				

I COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites
B.Tech	AME002	II	Engineering Mechanics
B.Tech	ACE003	III	Engineering Geology

II COURSE OVERVIEW:

Geotechnical engineering is the systematic application of techniques which allows construction with soil androck. This course features soil basics, including their derivation, identification and classification andemphasizes Principles of water flow in soils, settlement, heave, and shear strength of soils. The course alsodeals with materials, soil and rock that, by their very nature, exhibit varied and uncertain behavior due to theimprecise physical processes associated with the formation of these materials. Further, The course is usefulfor designing and development of different forms of foundations in industrial and residential constructions.

III MARKS DISTRIBUTION:

Subject	SEE Examination	CIE Examination	Total Marks
Geotechnical Engineering	70 Marks	30 Marks	100

IV CONTENT DELIVERY / INSTRUCTIONAL METHODOLOGIES:

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

V EVALUATION METHODOLOGY:

The course will be evaluated for a total of 100 marks, with 30 marks for Continuous Internal Assessment (CIA) and 70 marks for Semester End Examination (SEE). Out of 30 marks allotted for CIA during the semester, marks are awarded by taking average of two CIA examinations or the marks scored in the make-up examination.

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This AAT enables faculty to design own assessment patterns during the CIA. The AAT converts the classroom into an effective learning center. The AAT may include tutorial hours/classes, seminars, assignments, term paper, open ended experiments, METE (Modeling and Experimental Tools in Engineering), five minutes video, MOOCs etc. The AAT chosen for this course is given in table

Concept Video	Tech-talk	Complex Problem Solving
40%	40%	20%

VI COURSE OBJECTIVES:

The students will try to learn:

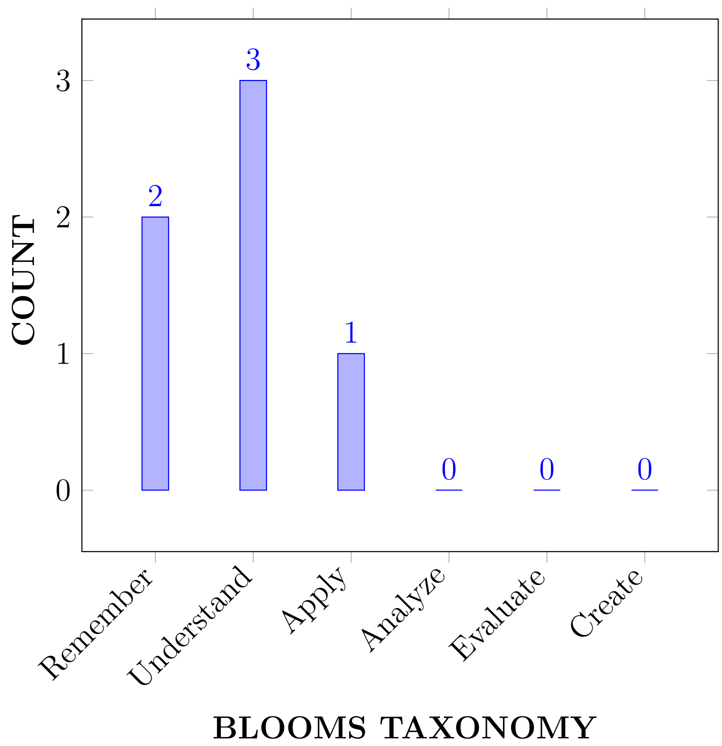
I	The fundamental knowledge on soils, importance in the design and construction process of massive structures.
II	The laboratory, field tests conducted on soils to identify the better ground to construction.
III	The methods employed for soil properties prediction, soil layers and its applications
IV	The role of shear strength in load carrying capacity of soils, restored and durable structures.

VII COURSE OUTCOMES:

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

CO 1	**Relate** the procedure of soil formation, soil structure, clay minerology, determine the grain size and index proportion for classifying the soil types.	Understand
CO 2	**Outline** the concepts of permeability and seepage flow net for estimating and controlling the seepage losses from earthen dams.	Understand
CO 3	**Summarize** stress distribution in soils at different loading conditions based on various theories for estimating intensity of pressure on soil.	Understand
CO 4	**Relate** the effect of compaction and consolidation pressures for estimating the total settlement and time rate of settlement.	Remember
CO 5	**Recognize** different stages of consolidation for predicting stress history on clays.	Remember
CO 6	**Compare** Mohrs- columbs failure theories and lab tests for determining shear strength of soils at various drainage conditions.	Apply

COURSE KNOWLEDGE COMPETENCY LEVEL



VIII PROGRAM 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

IX 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.	2	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
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	2	CIE/SEE/AAT
PO 4	**Conduct Investigations of Complex Problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.	2	CIE/SEE/AAT
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	3	CIE/SEE/AAT

3 = High; 2 = Medium; 1 = Low

X HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

PROGRAM SPECIFIC OUTCOMES		Strength	Proficiency Assessed by
PSO 1	Design and supervise sub-structures and superstructures for residential and public buildings, industrial structures, irrigation structures, powerhouses, highways, railways, airways, docks and harbours	1.5	CIE&SEE
PSO 2	Focus on improving performance of structures with reference to safety and serviceability, and sustainable green building technology	3	CIE&SEE

3 = High; 2 = Medium; 1 = Low

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

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	✓	✓	-	-	✓	-	-	-	-	-	-	-	✓	-	-
CO 2	-	✓	✓	-	-	-	-	-	-	-	-	-	✓	✓	-
CO 3	✓	✓	✓	-	-	-	-	-	-	-	-	-	-	-	-
CO 4	✓	✓	-	✓	-	-	-	-	-	-	-	-	-	-	-
CO 5	✓	-	-	-	-	-	-	-	-	-	-	-	✓	-	-
CO 6	✓	-	-	-	-	-	-	-	-	-	-	-	✓	✓	-

XII 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 matched.**
CO 1	PO 1	Explain the properties of soils by using engineering fundamentals and **principles of science**	1
	PO 2	Classify the different soils based on the **data collected** and **implement** the same in construction based on their properties.	2
	PO 5	Select and apply appropriate techniques for determining the properties of soil by **understanding the limitations.**	1
	PSO 1	Explain the properties of soils for construction of foundations and massive structures with **material** and ensure quality assurance for assessing strength.	1
CO 2	PO 2	Analyse mechanical behaviour of soils, **experimenting** with different types of loads and by **collecting data** from **results**	3
	PO 3	**Recognize** problems related to design of civil construction stability based on soil characteristics by using **engineering sciences.**	2
	PSO 1	Understand the mechanical behaviour of soils for construction of residential, industrial, water treatment and distribution systems based on material knowledge for **assessing strength including quality** by using standard codes of practice	1
	PSO 2	Examine the mechanical behaviour of soils like cohesion and cohesionless to **improve the performance** of structures by enhancing **safety and serviceability.**	2
CO 3	PO 1	Explain the Boussinesq's and Westergaard's theory for uniformly and point load condition for understanding the nature of the soil deposit using basics of **geology, geomorphology and fundamentals in mathematics**	3

Course Outcomes	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key competencies matched.
	PO 2	**Formulate** various **ground improvement techniques and stabilization methods** to **enhance** the bearing capacity of the soils corresponding to identified weak zones that are identified from various loading conditions through Boussinesq's and Westergaard's	4
	PO 3	**Design/Development** of solutions to overcome foundation **setellements** under the structural loading conditions by understanding the **maximum dry density and optimum mositure content** concept of various soils using basic **mathematics and fundamentals in engineering**	6
CO 4	PO 1	Recall the concept of compressibility and apply the techniques to enhance the bearing capacity of the soils in order to withstand the **maximum allowable pressure** transferred by the structure and additional **dynamic loads** from the **earthquakes**	3
	PO 2	Differentiate the **compaction and consolidation** and understand the **settlement** phenomenon of the soil layers by conducting the plate load test to determine the **maximum foundation settlements** of the structures by using the **engineering standards and fundamentals in mathematics**	6
	PO 4	Explain the failure pattern of soils with the knowledge of **characteristics of materials** by understanding the **codes of practice, industry standards, quality issues and fundamentals in mathematics**	5
CO 5	PO 1	Choose different soils to develop for solving complex engineering problems along with enhanced performance by applying principles of **engineering fundamentals** and their **integration and support with other engineering disciplines.**	2
	PSO 1	Examine the **rate of consolidation** at the selected site to choose the proper **design criteria** for safety of the structure against **foundation failures or settlements** by applying **soil mechanics fundamentals, basic engineering and mathematics**	6
CO 6	PO 1	Identify the modes of failures in soils by applying the basic **engineering principles.**	1
	PSO 1	Understand the various soils testing procedures used for determining engineering properties of soils with the help of **material knowledge and standard codes of practice.**	2
	PSO 2	Examine the mechanical behaviour of soils like cohesion and cohesionless to **improve the performance** of structures by enhancing **safety and serviceability.**	3

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

XIV PERCENTAGE OF KEY COMPETENCIES FOR CO – PO/ PSO

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	33.3	20	-	-	100	-	-	-	-	-	-	-	10	-	-
CO 2	-	30	20	-	-	-	-	-	-	-	-	-	10	66.6	-
CO 3	100	40	60	-	-	-	-	-	-	-	-	-	-	-	-
CO 4	100	60	-	45.5	-	-	-	-	-	-	-	-	-	-	-
CO 5	66.6	-	-	-	-	-	-	-	-	-	-	-	60	-	-
CO 6	33.3	-	-	-	-	-	-	-	-	-	-	-	20	100	-

XV COURSE ARTICULATION MATRIX (PO / PSO MAPPING):

CO'S and PO'S and CO'S and PSO'S on the scale of 0 to 3, 0 being no correlation, 1 being the low correlation, 2 being medium correlation and 3 being high correlation.
0 - $0 \leq C \leq 5\%$ – No correlation
1 -$5 < C \leq 40\%$ – Low/ Slight
2 - $40\ \% < C < 60\%$ –Moderate
3 - $60\% \leq C < 100\%$ – Substantial /High

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	1	1	-	-	3	-	-	-	-	-	-	-	1	-	-
CO 2	-	1	1	-	-	-	-	-	-	-	-	-	1	3	-
CO 3	3	2	3	-	-	-	-	-	-	-	-	-	-	-	-
CO 4	3	3	-	2	-	-	-	-	-	-	-	-	-	-	-
CO 5	3	-	-	-	-	-	-	-	-	-	-	-	3	-	-
CO 6	1	-	-	-	-	-	-	-	-	-	-	-	1	3	-
TOTAL	11	7	4	2	3	-	-	-	-	-	-	-	6	6	-
AVERAGE	2	2	2	2	3	-	-	-	-	-	-	-	1.5	3	-

XVI ASSESSMENT METHODOLOGY-DIRECT:

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

XVII ASSESSMENT METHODOLOGY-INDIRECT:

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

XVIII SYLLABUS:

MODULE I	**INTRODUCTION AND INDEX PROPERTIES OF SOILS**
	Soil formation, clay mineralogy and soil structure, moisture content, weight-volume relationships, relative density. Grain size analysis, sieve analysis, principle of hydrometer method, consistency limits and indices, I.S. classification of soils.
MODULE II	**PERMEABILITY, EFFECTIVE STRESS AND SEEPAGE THROUGH SOILS**
	Capillary rise, flow of water through soils, Darcy's Law, Permeability, Factors affecting permeability, Laboratory & field tests for determination of coefficient of permeability, Permeability of layered soils.Total, neutral and effective stress, upward & downward seepage through soils, quick sand condition, flow nets: characteristics and uses.
MODULE III	**STRESS DISTRIBUTION IN SOILS & COMPACTION**
	Boussinesq's theory for point load, uniformly loaded circular and rectangular areas, Westergaard's theory for point load condition, pressure bulb, variation of vertical stress under point load along vertical and horizontal plane, Newmark's influence chart for irregular areas. Mechanism of compaction, factors affecting compaction, effects of compaction on soil properties, field compaction equipment and compaction quality control.
MODULE IV	**CONSOLIDATION**
	Types of compressibility, immediate settlement, primary consolidation and secondary consolidation, stress history of clay, e-p and e-log p curves, normally consolidated soil, over and under consolidated soil, pre-consolidation pressure and its determination, Terzaghi's 1-D consolidation theory, coefficient of consolidation square root time and logarithm of time fitting methods, computation of total settlement and time rate of settlement.
MODULE V	**SHEAR STRENGTH OF SOILS**
	Importance of shear strength, Mohr's-Coulomb failure theories, types of laboratory tests for strength parameters, strength tests based on drainage conditions, strength envelops, shear strength of sands, dilatancy, critical void ratio, liquefaction, shear strength of clays.

TEXTBOOKS

1. Braja M. Das, "Principles of geotechnical engineering" Cengage learning publishers,2002.
2. VNS Murthy, "Soil mechanics and foundation engineering", CBS publishers and distributors,2003.
3. Gopal Ranjan and ASR Rao, "Basic and Applied Soil Mechanics", New age international Pvt. Ltd, New Delhi,2000.

REFERENCE BOOKS:

1. C. Venkataramiah, "Geotechnical engineering", New Age International Pvt. Ltd,2002.
2. Manojdutta and Gulati, "Geotechnical engineering", Tata Mc Graw hill publishers New Delhi,2005.
3. K.R .Arora, "Soil mechanics and foundation engineering", standard publishers and distributors, New Delhi,2005.
4. B.C. Punmia, Ashok Kumar Jain and Arun Kumar Jain, "Soil mechanics and foundation", Laxmi publications Pvt. Ltd, New Delhi,2005.

WEB REFERENCES:

1. http://nptel.ac.in/courses/105107120/1
2. http://www.nptel.ac.in/courses/105105105/
3. http://www.nptel.ac.in/courses/105105104

COURSE WEB PAGE:

1. https://onlinecourses.nptel.ac.in/noc22_ce03/unit?unit=17&lesson=19

XIX COURSE PLAN:

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

S.No	Topics to be covered	CO's	Reference T1: 4.1
OBE DISCUSSION			
1	Discussion on OBE, PO's, PSO's and CO of subject Geotechnical Engineering		
CONTENT DELIVERY (THEORY)			
2	Introduction to geotechnical engineering, properties of Soils, Formation of soil and soil structures	CO 1	T4: 1.3-1.13, R1:4.2
3-4	Clay mineralogy and adsorbed water, Mass volume relationship	CO 1	T4: 6.5-6.12, R2:3.3
5-6	Relative density, Index properties of soils: grain sizes analysis	CO 1	T4:.3.15-3.16, T4:.3.3
7-8	Index properties of soils: grain sizes analysis, Sieve and hydrometer method of analysis	CO1	T4: 3.8-3.9 R2:3.5
9-10	Consistency limit and indices of soil	CO1	R2:3.6

11	I.S. classification of soils,	CO1	T4: 5.7
12	Permeability - soil water –capillary rise, Darcy's law	CO2	T4: 8.1-8.4
13.14	Flow of water through soil	CO2	T4: 8.9-8.10
15-16	Permeability and factors effecting, laboratory determination of coefficient of permeability	CO 2	T4: 8.6-8.7
17-18	Permeability of layered systems	CO2	T4: 8.9-8.10, R3:3.7
19-20	Seepage through soils –total, neutral and effective stresses quick sand conditions	CO2	T4: 9.11-9.12
21-22	Seepage through soils.	CO2	T4: 9.11-9.12
23-24	Flow nets, characteristics and uses	CO2	T4: 9.4-9.5
25	Stress distribution in soils – Boussinesq's theory for point loads and areas of different shapes	CO3	T4:11.3-11.9
26	Westergaard's theory for point loads and area of different shapes	CO3	T4:11.15-11.1
27-28	Newmark's influences chart	CO3	T4:11.3-11.9
29-30	Compaction- mechanism of compaction	CO4	T4:14.1-14.4
31-32	Factors effecting compaction of soils properties	CO4	T4:14.8-14.9
33-34	Effect of compaction on soil properties	CO4	T4:14.8-14.9
35-36	Field compaction equipment, Compaction control	CO4	T4:14.13-14.1
37-38	Consolidation –stress history of clay, e-p and e- log pcurves	CO5	T4:12.1-12.2
39-40	Magnitude and rates of 1-d consolidation	CO5	T4:12.4-12.5
41-42	Terzaghi's theory, shear strength of soils –Mohr and Coulomb failure theories	CO6	T4:13.1-13.2
43-44	Types of laboratory strength test, Shear strength of sands	CO6	T4:13.23-13.24, R2:5.2
45	Strength test based on drainage conditions, Critical void ratio of clay, Liquefaction and shear strength of clay	CO6	T4:13.22-13.23
PROBLEM SOLVING/ CASE STUDIES			
1	Problems of soil 3-phase relationships	CO1	T1,2 and R1
2	Problems on weight-volume relationships	CO1	T1,2 and R1
3	Problems on density-volume relationships	CO1	T1,2 and R1

4	Problems on Grain size analysis	CO1	T1,2 and R1
5	Problems on Capillary rise	CO2	T1,2 and R1
6	Problems on flow of water through soils	CO2	T1,2 and R1
7	Problems on permeability	CO2	T1,2 and R1
8	Problems on permeability of layered soils	CO2	T1,2 and R1
9	Problems on Total, neutral and effective stress	CO2	T1,2 and R1
10	Problems on Boussinesq's and Westergard's theories	CO3	T1,2 and R1
11	Problems on variation of vertical stress under point load along vertical and horizontal plane	CO3	T1,2 and R1
12	Problems on compaction	CO4	T1,2 and R1
13	Problems on primary consolidation and secondary consolidation	CO5	T1,2 and R1
14	Problems on shear strength of soils based on drainage conditions	CO6	T1,2 and R1
15	Problems on shear strength of sands, dilatancy and critical void ratio	CO6	T1,2 and R1
DISCUSSION OF DEFINITION AND TERMINOLOGY			
1	Module I (Void rstio and porosity)	CO 1	R1
2	Module II (Permeability and Darcy's Law)	CO2	R1
3	Module III(pressure bulb and compaction)	CO3 & CO4	R1
4	Module IV (consolidation)	CO5	T 1&2, R1
5	Module V (critical void ratio and liquefaction)	CO6	R1
DISCUSSION OF QUESTION BANK			
1	Module I (clay mineralogy and soil structure)	CO1	R1
2	Module II (permeability, Total, neutral and effective stress)	CO2	T 1&2, R1
3	Module III (variation of vertical stress under point load along vertical and horizontal plane and Mechanism of compaction)	CO 3 & CO4	T 1&2, R1
4	Module IV (Types of compressibility, immediate settlement, primary consolidation and secondary consolidation)	CO 5	T 1&2, R1
5	Module V (Mohr and coulomb failure theories and types of laboratory tests for determination of strength parameters)	CO 6	T 1&2, R1

Signature of Course Coordinator **HOD**

INSTITUTE OF AERONAUTICAL ENGINEERING
(Autonomous)
Dundigal, Hyderabad - 500 043

COURSE DESCRIPTION

Department	**Civil Engineering**				
Course Title	**Building Materials Construction and Planning**				
Course Code	ACE007				
Program	B.Tech				
Semester	IV				
Course Type	CORE				
Regulation	R16				
Course Structure	Theory			Practical	
	Lecture	Tutorials	Credits	Laboratory	Credits
	3	-	3	-	-
Course Coordinator	Mr. K. Lokesh , Assistant Professor				

I COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites
B.Tech	AHS005	I	Engineering Chemistry

II COURSE OVERVIEW:

The construction materials course introduces students to materials used in different construction projects from building materials to ground and foundation make-up. Specific materials studied include soil, metals, concrete and wood. This course also covers finishes and materials for the exterior and interior of buildings. Skills are developed to assess the effect materials have on a building projects related to structure, fire safety, building codes as well as market demand. A large part of construction management has to do with overseeing entire building projects or multiple construction projects. This course helps to develop students' skills in managing projects and people. This course may be taken at different times in a construction management program with an emphasis on residential or commercial construction.

III MARKS DISTRIBUTION:

Subject	SEE Examination	CIE Examination	Total Marks
Building Materials, Construction and Planning	70 Marks	30 Marks	100

IV CONTENT DELIVERY / INSTRUCTIONAL METHODOLOGIES:

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

V EVALUATION METHODOLOGY:

The course will be evaluated for a total of 100 marks, with 30 marks for Continuous Internal Assessment (CIA) and 70 marks for Semester End Examination (SEE). Out of 30 marks allotted for CIA during the semester, marks are awarded by taking average of two CIA examinations or the marks scored in the make-up examination.

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 14 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
16.7%	Remember
33.3 %	Understand
33.3 %	Apply
16.7 %	Analyze
0 %	Evaluate
0 %	Create

Continuous Internal Assessment (CIA):
CIA is conducted for a total of 30 marks, with 25 marks for Continuous Internal Examination (CIE) and 05 marks for Quiz \Alternative Assessment Tool (AAT).

Component	Theory		Total Marks
Type of Assessment	CIE Exam	Quiz \AAT	
CIA Marks	25	05	30

Continuous Internal Examination (CIE):
Two CIE exams shall be conducted at the end of the 8^{th} and 17^{th} week of the semester respectively. The CIE exam is conducted for 25 marks of 2 hours duration consisting of two parts. Part–A shall have five compulsory questions of one mark each. In part–B, four out of five questions have to be answered where, each question carries 5 marks. Marks are awarded by taking average of marks scored in two CIE exams.

Quiz - Online Examination
Two Quiz exams shall be online examination consisting of 25 multiple choice questions and are to be answered by choosing the correct answer from a given set of choices (commonly four). Such a question paper shall be useful in testing of knowledge, skills, application, analysis, evaluation and understanding of the students. Marks shall be awarded considering the average of two quiz examinations for every course.

Alternative Assessment Tool (AAT)
This AAT enables faculty to design own assessment patterns during the CIA. The AAT converts the classroom into an effective learning center. The AAT may include tutorial hours/classes, seminars, assignments, term paper, open ended experiments, METE (Modeling and Experimental Tools in Engineering), five minutes video, MOOCs etc. The AAT chosen for this course is given in table

Concept Video	Tech-talk	Complex Problem Solving
40%	40%	20%

VI COURSE OBJECTIVES:

The students will try to learn:

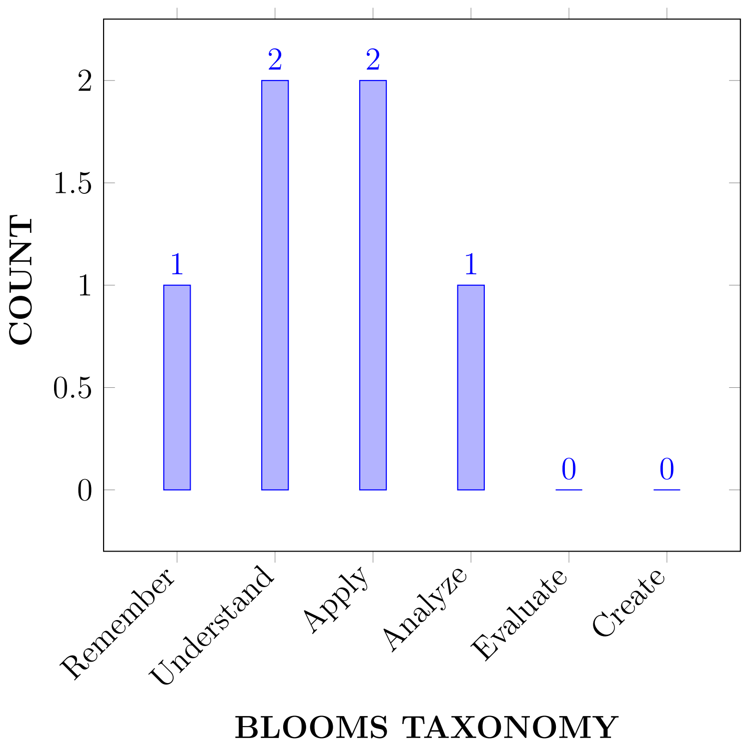
I	Develop knowledge of material science and behavior of various building materials used in construction
II	Identify the construction materials required for the assigned work.
III	Provide procedural knowledge of the simple testing methods of cement, lime and concrete etc.
IV	List the requirements and different types of stairs.

VII COURSE OUTCOMES:

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

CO 1	**Explain** various physical and mechanical properties of building materials used in construction of structures to compute their strength and durability.	Understand
CO 2	**Identify** the mineral and chemical admixtures for enhancing the strength and durability of concrete mixtures.	Apply
CO 3	**Choose** suitable floors in buildings like mosaic flooring, terrazzo flooring, rubber flooring, asphalt flooring used in modern construction to enhance the elegance and performance..	Remember
CO 4	**Select** appropriate building walls and foundations capable of bearing and transferring applied loads successfully to the foundation of the building	Apply
CO 5	**Distinguish** the difference of use among Galvanized iron, fiber-reinforcement plastics, steel, wood and aluminum in construction as doors and windows.	Analyze
CO 6	**Explain** various types of stair cases used in modern construction scenario to improve the accessibility of building floors.	Understand

COURSE KNOWLEDGE COMPETENCY LEVEL



VIII PROGRAM 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.
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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 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

IX 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.	1	CIE / Quiz / AAT
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	CIE / Quiz / AAT

X HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

PROGRAM OUTCOMES		Strength	Proficiency Assessed by
PSO 1	Design and Supervise Sub-Structures and Super Structures for Residential and Public Buildings, Industrial Structures, Irrigation Structures, Power Houses, Highways, Railways, Airways, Docs and Harbours.	1	CIA / SEE

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

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	✓	✓	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 2	✓	-	-	-	-	-	-	-	-	-	-	-	✓	-	-
CO 3	✓	✓	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 4	✓	✓	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 5	✓	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 6	✓	-	✓	-	-	-	-	-	-	-	-	-	✓	-	-

XII 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 matched.
CO 1	PO 1	Describe (knowledge) the process to identify the rocks based on geological, physical chemical classification, define the rocks their importance by using principles of science, and engineering fundamentals.	2
	PO 2	Comprehend and write effective reports on rock properties and its chemical and mechanical behavior in the construction by develop using principles of science, and engineering fundamentals.	2
CO 2	PO 1	Identify (knowledge) the different trusses and roofs used in construction and its stability with the science, and engineering fundamentals.	2
	PSO 1	Identify various building materials used in the construction process and its suitability for the building components based on NBC	1
CO 3	PO 1	Outline the building bylaws and standards of building materials and its components by using basic fundamentals of mathematics, science and engineering.	3

Course Outcomes	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key competencies matched.
	PO 2	Extend the focus to understand the innovative and dynamic challenges involve planning of modern buildings.	1
CO 4	PO 1	Explain the suitability of floors in building like mosaic floor terrazzo floors with basic engineering fundamentals.	2
	PO 2	Examine chemical composition of different materials and basic composition of materials with basics of mathematics and engineering sciences.	2
CO 5	PO 1	Explain building wall and foundations based on the soil strength using the principles of mathematics and engineering fundamentals.	2
CO 6	PO 1	Acquire knowledge on the modern construction. Select the basic materials which are used in construction to achieve better environment by using knowledge of principals of science and engineering fundamentals.	3
	PO 3	Recognize the need of materials those are used in construction avoid the failure of the structures by identify problems by using science and engineering fundamentals.	2
	PSO 1	Identify various building materials used in the construction process and its suitability for the building components based on NBC	1

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

XIV 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	20	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 2	66.6	-	-	-	-	-	-	-	-	-	-	-	10	-	-
CO 3	66.6	20	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 4	66.6	20	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 5	100	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 6	100	-	33.3	-	-	-	-	-	-	-	-	-	10	-	-

XV 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
1-5 <C≤ 40% – Low/ Slight
2 - 40 % <C < 60% –Moderate
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	1	-	-	-	-	-	-	-	-	-	-	1	-	-
CO 3	3	1	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 4	3	1	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 5	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 6	3	-	1	-	-	-	-	-	-	-	-	-	1	-	-
TOTAL	18	3	1	-	-	-	-	-	-	-	-	-	2	-	-
AVERAGE	3	1	1	-	-	-	-	-	-	-	-	-	1	-	-

XVI ASSESSMENT METHODOLOGY-DIRECT:

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

XVII ASSESSMENT METHODOLOGY-INDIRECT:

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

XVIII SYLLABUS:

MODULE I	STONES, BRICKS AND AGGREGATES
	Properties of building stones, relation to their structural requirements. Classification of stones, stone quarrying, precautions in blasting, dressing of stone, composition of good brick earth, various methods of manufacture of bricks, Comparison between clamp burning and kiln burning; Fine aggregate: Natural and manufactured: Sieve analysis, zoning, specify gravity, bulking, moisture content, deleterious materials; Coarse aggregate: Natural and manufactured: Importance of size, shape and texture.
MODULE II	CEMENT AND ADMIXTURES
	Various types of cement and their properties; Various file and laboratory tests for cement; Various ingredients of cement concrete and their importance, various tests for concrete; Field and tests admixtures, mineral and chemical admixture
MODULE III	BUILDING COMPONENTS AND FOUNDATIONS
	Lintels, arches, different types of floors-concrete, mosaic, terrazzo floors, pitched, flat and curved roofs, lean-to-roof, coupled roofs, trussed roofs, king and queen post. Trusses; RCC roofs, madras terrace/shell roofs; Foundations: Shallow foundations, spread, combined, strap and mat footings
MODULE IV	WOOD, ALUMINUM AND GLASS
	Structure, properties, seasoning of timber; Classification of various types of woods used in buildings, defects in timber; Alternative materials for wood, galvanized iron, fiber-reinforced plastics, steel, aluminum; Types of masonry, English and Flemish bonds, rubble and ashlars masonry, cavity and partition walls.
MODULE V	STAIRS AND BUILDING PLANNING
	Stairs: Definitions, technical terms and types of stairs, requirements of good stairs; Geometrical design of RCC doglegged and open-well stairs; Principles of building planning, classification building and planning and building by laws.

TEXTBOOKS

1. Sushil Kumar "Building Materials and construction", Standard Publishers, 20th edition, reprint, 2015.

2. Dr. B.C.Punmia, Ashok kumar Jain, Arun Kumar Jain, "Building Construction, Laxmi Publications (P) ltd., New Delhi.

3. Rangawala S. C. "Engineering Materials", Charter Publishing House, Anand, India.

REFERENCE BOOKS:

1. S. K. Duggal, "Building Materials", New Age International (P) Limited, 4th Edition,2016

2. National Building Code (NBC) of India

3. P C Vergese, "Building Materials", PHI Learning Pvt. Ltd, 2nd Edition, 2015.

4. Building Materials and Components, CBRI, India, 1990.

WEB REFERENCES:

1. http://nptel.ac.in/courses/105102088/
2. http://nptel.ac.in/courses/105101088/

XIX COURSE PLAN:

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

S.No	Topics to be covered	CO's	Reference T1: 4.1
OBE DISCUSSION			
	Discussion on Outcome Based Education and Course Outcomes		
CONTENT DELIVERY (THEORY)			
1-2	Understand the types, properties of stones, manufacturing process of bricks, types of bricks and aggregates.	CO 1	T1: 3.1-3.16, T1: 2.1-2.16
3-4	Predict the properties of building stones and its classifications.	CO 1	T2: 3.1-3.5.
5-6	Understand the concept of various methods of manufacture of bricks.	CO 1	T2: 2.8-2.9
7-8	Identify rock using basic geological classification Systems	CO 1	T2: 3.2-3.4
9-10	Differentiate the fine aggregates and coarse aggregates under various views.	CO 1	T2: 6.8-6.9
11	Describe the different types of cements, admixtures, manufacturing process, properties of cement ingredients of cement concrete and tests conducted on concrete	CO 1	T2: 3.4, R1: 4.1
12	Explain various types of cements and them applications in construction. Various field and laboratory tests on cement.	CO 2	T2: 3.4
13-14	Analyze the importance of mineral and chemical admixtures, requirements of the concrete in construction.	CO 2	T2: 10.17
15-16	Identify the components of building, types of foundations and differentiate types of materials depending on its function.	CO 3	T2: 4.2
17-18	Understand the different types of trusses, RCC roofs, madras terrace/shell roofs.	CO 3	T2: 5.1
19-20	Explain the foundations and uses of different types of foundations.	CO 3	T2: 5.2
21-22	Develop the building walls and foundations how they will help for buildings and details to precise the type of Footings.	CO 3	T2: 5.3
23-24	Explain the classification of various types of woods. State the properties, seasoning of Timber.	CO 3	T1: 4.1-4.16

25	Identify the components of building, types of foundations and differentiate types of materials depending on its function.	CO 4	T1: 4.1
26	Understand the different types of trusses, RCC roofs, madras terrace/shell roofs.	CO 4	T1: 4.2
27-28	Explain the foundations and uses of different types of foundations.	CO 4	T1: 4.3
29-30	Develop the building walls and foundations how they will help for buildings and details to precise the type of Footings.	CO 4	T2: 5.2
31-32	Explain the classification of various types of woods. State the properties, seasoning of Timber.	CO 4	T2: 5.2
33-34	Describe the properties of wood, aluminum, glass and different types of wood, masonry used in buildings.	CO 4	T2: 5.3
35-36	Understand the Types of properties of wood, aluminum and manufacture of glass.	CO 5	T1: 4.1-4.12
37-38	Differentiate the uses of Galvanized iron, fiber reinforcement plastics, steel and aluminum Construction.	CO 5	T1: 4.15
39-40	Understand masonry, English and Flemish bonds. Finishing plastering painting and know about building services.	CO 5	T1: 6.3
41-42	Explain Geometrical design of RCC doglegged and open-well stairs. Classification of staircase and technical terms and types of stairs.	CO 6	T1: 6.6
43-44	Explain principles of building planning, building by laws, classification of buildings and stairs.	CO 6	T1: 6.6
45-46	Principle of building planning and by laws and standards of building material Components and orientation of the building.	CO 6	T1: 7.2
47	Understand the requirements of good stairs.	CO6	T1: 7.3
48-49	Design RCC doglegged and open-well stairs.	CO 6	T1: 7.4,
PROBLEM SOLVING/ CASE STUDIES			
1	Calculate the moisture content in stones	CO 1	R2:7.5
2	Determine the specific gravity of aggregate	CO 1	T2:3
3	Determining the flakyness index of coarse aggregate	CO 1	R2:7.5
4	Calculate the consistency limit of cement	CO 1	R2:7.5
5	Calculate the initial and final setting time of cement	CO 2	T1: 4.1
6	Determine the soundness of cement	CO 2	T3:4.5
7	Design the stair case for 2m head room.	CO 5	R4:5.2
8	Design the stair case for 3m head room.	CO 5	T2:5.2
9	Calculate the number of rises for stair case of height 3.2m	CO 5	R2:7.5
10	Calculate the number of treads for stair cases of 3.2m length	CO 5	R2:7.5
11	Determine the specific gravity of fine aggregates	CO 2	R2:7.5
12	Dram the grain size distribution curve for fine aggregate	CO 2	R2:7.5

13	Calculate D_{30}, D_{10}, D_{60} for given fine aggregate	CO 2	R2:7.5
14	Determine the grade of fine aggregate using sieve analysis for given sample.	CO 2	R2:7.5
15	Determine the specific gravity of given cement using density bottle.	CO 3	R2:7.5
DISCUSSION OF DEFINITION AND TERMINOLOGY			
1	stones, stone quarrying, dressing of stone, Fine aggregate,specify gravity, Coarse aggregate	CO 1	R4:2.1
2	Cement, concrete mineral and chemical admixture	CO 2	T4:7.3
3	Lintels, arches, pitched, flat and curved roofs, lean-to-roof, coupled roofs, trussed roofs, king and queen post, spread, combined, strap and mat footings	CO 3, CO 4	R4:5.1
4	seasoning of timber, English and Flemish bonds, rubble and ashlars masonry	CO 5	T1:7.5
5	Tread, rise, Landing, Offsets, Orientation.	CO 6	T1: 4.1
DISCUSSION OF QUESTION BANK			
1	stones, stone quarrying, dressing of stone, Fine aggregate,specify gravity, Coarse aggregate	CO 1	R4:2.1
2	Cement, concrete mineral and chemical admixture	CO 2	T4:7.3
3	Lintels, arches, pitched, flat and curved roofs, lean-to-roof, coupled roofs, trussed roofs, king and queen post, spread, combined, strap and mat footings	CO 3, CO 4	R4:5.1
4	seasoning of timber, English and Flemish bonds, rubble and ashlars masonry	CO 5	T1:7.5
5	Tread, rise, Landing, Offsets, Orientation.	CO 6	T1: 4.1

Signature of Course Coordinator **HOD,CE**
Mr. K. Lokesh , Assistant Professor

INSTITUTE OF AERONAUTICAL ENGINEERING
(Autonomous)
Dundigal, Hyderabad - 500 043
COURSE DESCRIPTION

Department	CIVIL ENGINEERING				
Course Title	STRENGTH OF MATERIALS LABORATORY				
Course Code	ACE104				
Program	B.Tech				
Semester	IV	CE			
Course Type	Foundation				
Regulation	R16				
Course Structure	Theory			Practical	
	Lecture	Tutorials	Credits	Laboratory	Credits
	-	-	-	3	2
Course Coordinator	Mr S. SivaRamaKrishna, Assistant Professor				

I COURSE OVERVIEW:

The Civil Engineers are required to design structures like residential , public and comeercial buildings etc. The loads coming onto these structures, along with the self-weight, have to be safely transmitted. A structural engineer must be able to design a structure in such a way that none of its members fail during load transfer process. This foundational laboratory course in civil is to comprehend and study the mechanical behavior of engineering materials such as tensile strength, rigidity modulus, hardness, impact strength and compressive strength through a set of experimentations. The students shall verify the experimental results through analytical calculations.

II COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites
B.Tech	AME002	II	Engineering Mechanics

III MARKS DISTRIBUTION:

Subject	SEE Examination	CIE Examination	Total Marks
Strength of Materials Laboratory	70 Marks	30 Marks	100

IV DELIVERY / INSTRUCTIONAL METHODOLOGIES:

✓	Demo Video	✓	Lab Worksheets	✓	Viva Questions	✓	Probing further Questions

V EVALUATION METHODOLOGY:

Each laboratory will be evaluated for a total of 100 marks consisting of 30 marks for b internal assessment and 70 marks for semester end lab examination. Out of 30 marks ofinternal assessment, continuous lab assessment will be done for 20 marks for the day today performance and 10 marks for the final internal lab assessment.

Semester End Examination (SEE): The semester end labexamination for 70 marks shall be conducted by two examiners, one of them beingInternal Examiner and the other being External Examiner, both nominated by thePrincipal from the panel of experts recommended by Chairman, BOS. The emphasis on the experiments is broadly based on the following criteria given in Table: 1

	Experiment Based	Programming based
20 %	Objective	Purpose
20 %	Analysis	Algorithm
20 %	Design	Programme
20 %	Conclusion	Conclusion
20 %	Viva	Viva

Continuous Internal Assessment (CIA):

CIA is conducted for a total of 30 marks (Table 1), with 20 marks for continuous lab assessment during day to day performance, 10 marks for final internal lab assessment.

Component			Total Marks
Type of Assessment	**Day to day performance**	**Final internal lab assessment**	
CIA Marks	20	10	30

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.

1. **Experiment Based**

Objective	Analysis	Design	Conclusion	Viva	Total
2	2	2	2	2	10

2. **Programming Based**

Objective	Analysis	Design	Conclusion	Viva	Total
-	-	-	-	-	10

VI COURSE OBJECTIVES:

The students will try to learn:

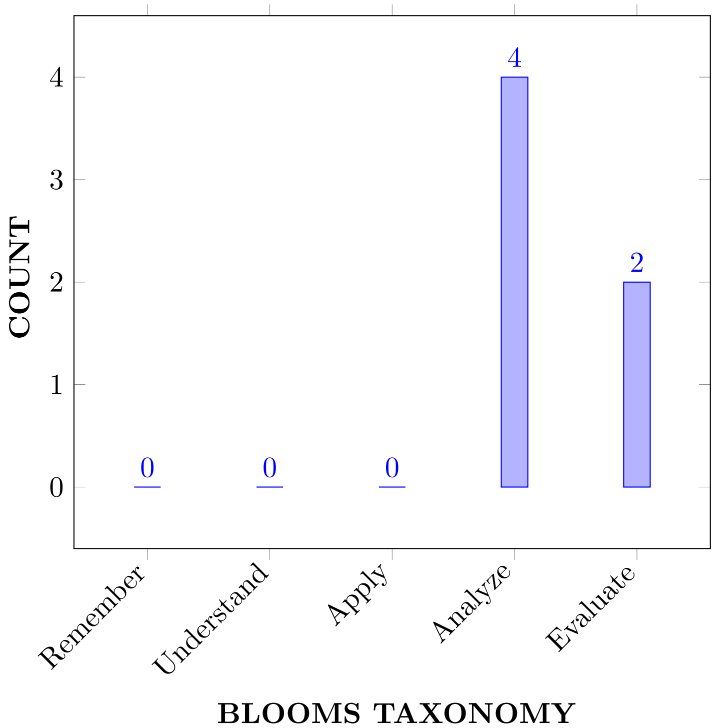
I	The different mechanical properties of different solid engineering materials used in civil engineering applications.
II	The behavior of various material samples under different loads and equilibrium conditions
III	The characterization of materials subjected to tension, compression, shear, torsion, bending and impact.
IV	The analyzation of material testing data for selection of construction materials

VII COURSE OUTCOMES:

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

CO 1	**Analyze** young's modulus of a mild steel bar for the calculation of tension using Universal testing machine	Analyze
CO 2	**Analyze** the beams under point loads for computing shear force, bending moment, slope and deflection in designing structures	Analyze
CO 3	**Determine** the modulus of rigidity of a given shaft for calculating the angle of twist under torsional loading.	Evaluate
CO 4	**Analyze** the impact strength of steel specimen using Izod and Charpy test for the characterization under suddenly applied load acting on a specimen.	Analyze
CO 5	**Determine** the compressive strenth of concrete and grade of concrete for designing structures.	Analyze
CO 6	**Analyze** stiffness and modulus of rigidity of the spring wire for designing shock absorbers in aerospace and automobile industries.	Evaluate

COURSE KNOWLEDGE COMPETENCY LEVEL



VIII HOW PROGRAM OUTCOMES ARE ASSESSED:

Program		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.	2	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 modelling to complex Engineering activities with an understanding of the limitations	1	Lab Exercises

3 = High; 2 = Medium; 1 = Low

IX HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

Program		Strength	Proficiency Assessed by
PSO 2	Focus on Improving Performance of Structures with reference to Safety, Serviceability and Sustainable Green Building Technology..	1	Lab Exercises

3 = High; 2 = Medium; 1 = Low

X JUSTIFICATIONS FOR CO – (PO, PSO) MAPPING -DIRECT:

COURSE OUTCOMES	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key Competencies
CO 1	PO 1	Recall (knowledge) the different beam generally come across in design, and calculate tension by applying the principles of **mathematics and engineering fundamentals.**	2
	PO 2	Understand the given **problem statement** of structural members related to young's modulus from the provided **information and data** in reaching substantiated solutions by the **interpretation of results.**	3
	PO 5	Make use of **modern engineering tools** for calculation of tension in members.	1

	PSO 2	Select the appropriate method for the analysis of structures using **Safety** and **serviceability of structure** for different loads for the design purpose.	2
CO 2	PO 1	Understand the different components in the engineering structures (multistoried structures and bridges) and its behavior by **using mathematics and engineering fundamentals.**	2
	PO 2	Analyze cantilever beam for calculation of stress and strain using strain gauge test by **formulate** and **state a problem,** and **develop solution** and **document the results.**	4
	PO 5	Use of **Modern tools** in the design of cantilever beam by the concept of stress strain in a specimen.	1
CO 3	PO 1	Recall (knowledge) different shaft generally come across in design, and calculate angle of twist under torsional load by applying the principles of **mathematics and engineering fundamentals.**	2
	PO 2	Analyze the shaft to Calculate angle of twist under torsional loading for determining the rigidity using the structural analysis concepts, **formulate** and **state a problem,** and **develop solution** and **document the results.**	4
	PSO 2	Understand the design of shafts based on Indian standards using **Performance improvement** and **Safety and serviceability** of shaft.	3
CO 4	PO 1	Understand the different components in the engineering structures (structures and bridges) and its behavior by **using mathematics and engineering fundamentals.**	2
	PO 2	Analyze steel specimen for the concept of sudden load acting on a specimen using Izod and Charpy test by **formulate** and **state a problem,** and **develop solution** and **document the results.**	4
	PO 5	Use of **Modern tools** in the design of steel by the concept of sudden loading in steel specimen.	1
CO 5	PO 1	Understand the concept of comcrete in the engineering structures (multistoried structures and bridges) to determine the compresive strength of concrete by **using mathematics and engineering fundamentals.**	2
	PO 5	Design of concrete grade by the Use of modern engineering modeling to complex engineering activities with **understanding of the limitations**	1
CO 6	PO 1	Make use of advanced methods of analysis for solving engineering problems related to structures by applying the principles of **engineering fundamentals** and their **integration and support with other engineering disciplines, mathematics.**	2

	PO 2	Analyze the spring wire for critical load combinations to know the design forces using the structural analysis concepts **formulate** and **state a problem,** and **develop solution** and **document the results.**	4

XI MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

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

XII ASSESSMENT METHODOLOGY DIRECT:

CIE Exams	✓	SEE Exams	✓	Seminars	-
Laboratory Practices	✓	Student Viva	✓	Certification	-
Assignments	-				

XIII ASSESSMENT METHODOLOGY INDIRECT:

	Assessment of Mini Projects by Experts	✓	End Semester OBE Feedback

XIV SYLLABUS:

WEEK I	**DIRECT TENSION TEST**
	Study the behaviour of mild steel and various materials under different loads. To determine a) Tensile b) Yield strength c) Elongation d) Young‘s modulus
WEEK II	**BENDING TEST ON CANTILEVER BEAM**
	(a) To evaluate the deflections of the beam made ofsteel. and (b) To evaluate the modulus of elasticity of the beam made of steel
WEEK III	**BENDING TEST ON SIMPLY SUPPORTED BEAM**
	(a) To evaluate the deflections of the beam made ofsteel. and (b) To evaluate the modulus of elasticity of the beam made of steel.
WEEK IV	**TORSION TEST**
	Determine of Modulus of rigidity of various specimens.
WEEK V	**HARDNESS TEST**
	To conduct hardness test on mild steel, carbon steel, brass and aluminium specimens using (a) Brinell's Hardness Test. (b) Rockwell's Hardness Test.

WEEK VI	**SPRING TEST**
	Determine the stiffness of the spring and the Modulus of rigidity of wire material.
WEEK VII	**COMPRESSION TEST**
	To perform compression test on CTM/UTM for Concrete block
WEEK VIII	**IMPACT TEST**
	To evaluate the impact strength of steel specimen using (a) Izod test. (b) Charpy Test.
WEEK IX	**SHEAR TEST**
	Batch- To evaluate the shear strength of the given specimens using universal testing machine.
WEEK X	**VERIFICATION OF MAXWELL'SRECIPROCAL THEOREM ON BEAMS**
	Batch-I : To verify the Maxwell's reciprocal theorem for beam deflections.
WEEK XI	**STRAIN MEASUREMENTS**
	Use of electrical resistance strain gauges .
WEEK XII	**DEFLECTIN OF CONTINUOUS BEAMS**
	To evaluate deflections on a continuous beam. .
WEEK XIII	**REVIEW - I**
	Spare session for additional repetitions and review.

TEXTBOOKS

1. R. S Kurmi, Gupta, "Strength of Materials", S. Chand, 24th Edition, 2005.
2. Gere, Timoshenko, "Mechanics of Materials", McGraw Hill, 3rd Edition, 1993.
3. William Nash, "Strength of Materials", Tata McGraw Hill, 4th Edition, 2004.

REFERENCE BOOKS:

1. Strength of Materials by R. Subramanian, Oxford University Press, New Delhi.
2. Mechanics of Materials - Ferdinand P. Beer, E. RusselJhonston Jr., John T. DEwolf – TMH 2002.

XV 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	Study the behavior of mild steel and various materials under different loads. To determine: a) Tensile b) Yield strength c) Elongation d) Youngs modulus	CO 1	T2:2.3
2	Determine the Youngs modulus of the given material with the help of deflection of Cantilever beam.	CO 2	R1:2.6
3	Determine the Youngs modulus of the given material with the help of deflection of Simple Supported Beam	CO 2	T1:2.6
4	Determine of Modulus of rigidity of various specimens.	CO 3	T2:2.7 R1:2.18

5	Determination of hardness number of different specimens such as steel, brass, copper and aluminum.	CO 4	T2:2.22
6	Determine the stiffness of the spring and the Modulus of rigidity of wire material	CO 4	T2:2.25
7	Determine the compressive stress of concrete cube.	CO 5	T2:2.26 R1:2.55
8	Determine the toughness of the materials like steel, copper, brass and other alloys using Charpy test.	CO 4	T2:2.3
9	Determine Youngs modulus of the given specimen.	CO 6	R1:2.6
10	To verify the Maxwell's reciprocal theorem for beam deflections.	CO 2, CO 6	T1:2.6
11	Use of electrical resistance strain gauges for measurement of strain.	CO 6	R1:7.2
12	Determine the Youngs modulus and deflection for the given material with the help of continious Beam.	CO 2, CO 6	R1:7.2
13	Spare session for additional repetitions and review.	CO 1 to CO 6	R1:7.3

XVI EXPERIMENTS FOR ENHANCED LEARNING (EEL):

S.No	Design Oriented Experiments
1	Demonstration the hardness number of different alloys
2	Demonstrate the behavior of composite materials subjected to different loading conditions.
3	Encourage students to design and analyze of different beams and columns

Signature of Course Coordinator **HOD,CE**
Mr. S SivaRamaKrishna, Assistant Professor

INSTITUTE OF AERONAUTICAL ENGINEERING
(Autonomous)
Dundigal, Hyderabad - 500 043
CIVIL ENGINEERING
COURSE DESCRIPTION

Course Title	**Geotechnical Engineering Laboratory**				
Course Code	ACE105				
Program	B.Tech				
Semester	IV	CE			
Course Type	Core				
Regulation	R-16				
Course Structure	Theory			Practical	
	Lecture	Tutorials	Credits	Laboratory	Credits
	-	-	-	3	2
Course Coordinator	Mr. M. Madhusudhan Reddy, Assistant Professor				

I COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites
B.Tech	ACE006	IV	Geotechnical Engineering

II COURSE OVERVIEW:

The Geotechnical Engineering Laboratory intends to train the students in the field of testing of soils to determine their physical, index and engineering properties. This course enables the students to perform the most important tests including: soil classification, compaction, permeability, direct shear testing and cyclical triaxial testing; each experiment of soil testing is presented with brief introduction covering the important details of the experiment, the theory and the purpose for which it is to be performed, followed by the detailed explanation of apparatus required, procedure and specimen calculations.

III MARKS DISTRIBUTION:

Subject	SEE Examination	CIE Examination	Total Marks
Geotechnical Engineering Laboratory	70 Marks	30 Marks	100

IV DELIVERY / INSTRUCTIONAL METHODOLOGIES:

✓	Demo Video	✓	Lab Worksheets	✓	Viva Questions	✓	Probing further Questions

V EVALUATION METHODOLOGY:

Each laboratory will be evaluated for a total of 100 marks consisting of 30 marks forinternal assessment and 70 marks for semester end lab examination. Out of 30 marks ofinternal assessment, continuous lab assessment will be done for 20 marks for the day today performance and 10 marks for the final internal lab assessment.

Semester End Examination (SEE): The semester end labexamination for 70 marks shall be conducted by two examiners, one of them beingInternal Examiner and the other being External Examiner, both nominated by thePrincipal from the panel of experts recommended by Chairman, BOS. The emphasis on the experiments is broadly based on the following criteria given in Table: 1

	Experiment Based	Programming based
20 %	Objective	Purpose
20 %	Analysis	Algorithm
20 %	Design	Programme
20 %	Conclusion	Conclusion
20 %	Viva	Viva

Continuous Internal Assessment (CIA):

CIA is conducted for a total of 30 marks (Table 2), with 20 marks for continuous lab assessment during day to day performance, 10 marks for final internal lab assessment.

Component			Total Marks
Type of Assessment	**Day to day performance**	**Final internal lab assessment**	
CIA Marks	20	10	30

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.

1. **Experiment Based**

Objective	Analysis	Design	Conclusion	Viva	Total
2	2	2	2	2	10

2. **Programming Based**

Objective	Analysis	Design	Conclusion	Viva	Total
-	-	-	-	-	-

VI COURSE OBJECTIVES:

The students will try to learn:

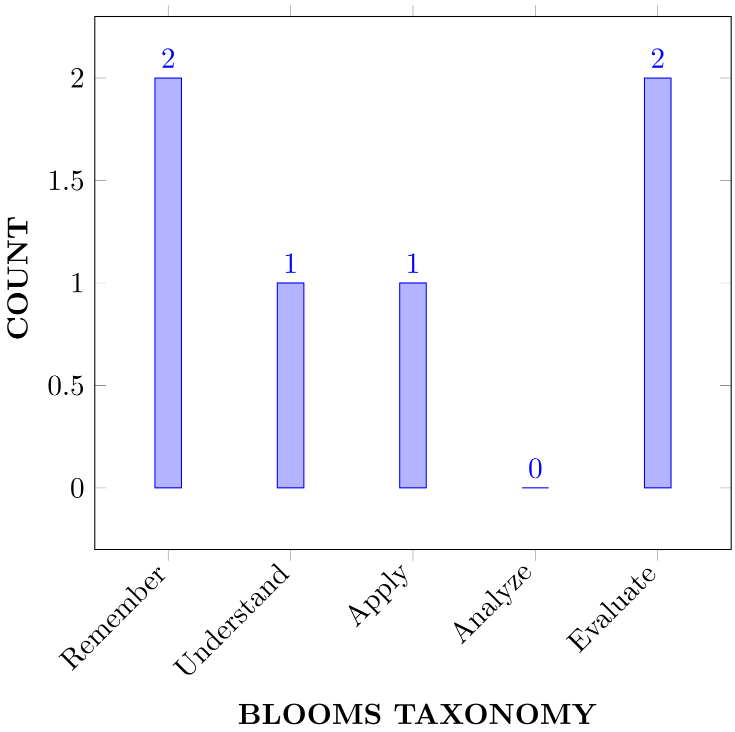
I	The concept behind the soil formation, type soil and the relationships between the soil mass and volume of voids and enables the students to perform moisture content, specific gravity and atterberg limits.
II	The procedure for soil classification through grain size distribution and classification of soil according to IS code.
III	The importance of determining the permeability and enables the students to perform permeability (constant head and variable head) test; so that students can estimate ground water flow, seepage through dams, rate of consolidation and settlement of structures.
IV	The behaviour of soil under different loading condition and enable the students derive the bearing capacity, design retaining walls, evaluate the stability of slopes and embankments, etc.

VII COURSE OUTCOMES:

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

CO 1	**Recall** the behaviour of soil with respect to water content (moisture content) for characterizing the permeability, compressibility and shear strength of soil.	Remember
CO 2	**Classify** the soils according to their grain size for determining the coefficient of uniformity and coefficient curvature upon to classify the soil according to IS code.	Understand
CO 3	**Select** the appropriate method to estimate the permeability of the layered soil for assessing drainage characteristics of soil, rate of consolidation and to predict rate of settlement of soil bed.	Apply
CO 4	**Determine** the maximum dry density through compaction and consolidation to increase the bearing capacity and stiffness of in-situ soil medium.	Evaluate
CO 5	**Recall** the importance of compressibility of the soil medium concept for taking necessary action to prevent the settlement of soil and foundation failures.	Remember
CO 6	**Evaluate** the strength of soil sub-grades and base course materials and enable appropriate selection of suitable pavement thickness for the anticipated traffic density.	Evaluate

COURSE KNOWLEDGE COMPETENCY LEVEL



VIII HOW PROGRAM OUTCOMES ARE ASSESSED:

Program		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	Lab Exercises
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	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	2.5	Lab Exercises
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.	1.8	Lab Exercises
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	Lab Exercises

3 = High; 2 = Medium; 1 = Low

IX HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

Program		Strength	Proficiency Assessed by
PSO 1	Design and supervise sub-structures and superstructures for residential and public buildings, industrial structures, irrigation structures, powerhouses, highways, railways, airways, docks and harbours.	2	Lab Exercises
PSO 2	Focus on Improving Performance of Structures with reference to Safety, Serviceability and Sustainable Green Building Technology.	3	Lab Exercises

3 = High; 2 = Medium; 1 = Low

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

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	✓	✓	-	✓	-	-	-	-	-	-	-	-	-	-	-
CO 2	✓	✓	✓	✓	-	-	-	-	-	-	-	-	-	-	-
CO 3	✓	✓	-	✓	-	-	-	-	-	-	-	-	✓	-	-
CO 4	✓	✓	✓	✓	-	✓	-	-	-	-	-	-	✓	✓	-
CO 5	✓	-	✓	-	-	✓	-	-	-	-	-	-	✓	-	-
CO 6	✓	✓	✓	✓	-	✓	-	-	-	-	-	-	✓	✓	-

XI 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	**Utilize** the knowledge of moisture content and understand how it **affects** shear strength, permeability and compressibility of soil using **scientific principles** and methodology.	3
	PO 2	**Identify** the problem regarding moisture content, collect required **information** (data collection) and **validate** the results using **experimental design**.	4
	PO 4	**Apply** the knowledge of **moisture content** and **specific gravity** in finding **engineering properties of soil**	4
CO 2	PO 1	**Apply** the knowledge of **engineering fundamentals** in **understanding** and **classifying** the soil using grain size distribution.	3
	PO 2	**Understand** the importance of **grain size distribution** in data collection and to **classify the soil** accordingly particle size distribution. The obtained results are also used for the **design of drainage filters**. It is also used for selecting **filling materials** for embankment, earthen dams, road sub-base etc. Particle size distribution is also used to estimate performance of grouting chemical injection.	5
	PO 3	**Recall** the procedure to **divide the soil** according to their grain size for finding soil classification and to find **index properties**, **shear strength**, **compressibility and consolidation** of soil	6
	PO 4	**Understand** the importance of **texture** and how it affects many soil properties, such as **infiltration, structure, porosity, water holding capacity, and chemical composition** of soil solids.	7
CO 3	PO 1	**Understand** the rate at which water flows through soil (for example, the **determination** of rate of **leakage** through an earth dam) (b) Compres sion (for example, the determination of the rate of settlement of a foundation and (c) Strength (for example, the evaluation of factors of safety of an embankment).	3

	PO 2	**Understand** the soil formation because soil being a **particulate material**, has many void spaces between the grains because of the irregular shape of the individual particles; thus, soil deposits are porous media. In general, all voids in soils are connected to **neighboring voids**.	3
	PO 4	**Understand** the flow of **water through soil** and path of flow from one point to another is considered to be a straight one, on a macroscopic scale and the velocity of flow is considered **uniform** at an effective value ; this path, in a **microscopic scale**, is invariably a tortuous and erratic one because of the **random arrangement** of soil particles, and the velocity of flow may vary considerably from point to point depending upon the size of the **pore and other factors**.	6
	PSO 1	**Understand** the concept of flow nets because it provide a general knowledge of the **regional groundwater** flow **patterns** that the hydrologist can use to determine such information as **areas of recharge and discharge**. Construction of a flow net is often used for solving groundwater flow problems where the geometry makes **analytical** solutions impractical.	6
CO 4	PO 1	The **deformation**, especially the vertical deformation, called **'settlement'** of the soil, should not be excessive and must be within tolerable or permissible limits and, The **shear strength** of the foundation soil should be adequate to withstand the stresses induced.	3
	PO 2	**Understand** the behaviour of soil under the loads usually encountered in geotechnical engineering practice, the **solid grains** as well as **pore water** may be considered to be **incompressible**. Thus, **compression** of pore air and expulsion of pore water are the primary sources of volume decrease of a soil mass subjected to stresses.	5
	PO 3	**Understand** the compressibility of a soil depends on the structural arrangement of the soil particles, and in **fine-grained soils**, the degree to which adjacent particles are bonded together. A structure which is more porous, such as a honey-combed structure, is more compressible than a dense structure.	5
	PO 4	**Recall** the concept of compressibility characteristics because these are usually found by performing an **oedometer test** in the laboratory on a "so-called" **undisturbed sample** of clay or on a **remoulded sample** of the same clay. The **pressure-void ratio** diagrams for these will be invariably different. This difference is attributed to the inevitable disturbance caused during remoulding.	5
	PO 6	**Understand** the relationship between the compressibility of a clay, as indicated by its **compression index**, and the liquid limit, by conducting experiments with **clays** from various parts of the world.	3

	PSO 1	**Understand** the **one-dimensional consolidation** concept, subject to the condition of constant **initial hydrostatic** excess pressure, is the type of consolidation that is of **major interest**. It applies in the **laboratory consolidation tests** and is usually assumed, although it generally is not strictly applicable, in the cases of consolidation in the field.	5
	PSO 2	**Understand** the process of applying one of the **fitting methods** may be repeated for different increments of **pressure** using the time-compression curves obtained in each case. The values of the coefficient of consolidation thus obtained will be found to be essentially decreasing with increasing effective stress	3
CO 5	PO 1	**Understand** the procedure for the computation of anticipated settlements is called **Settlement analysis'**. This analysis may be divided into three parts. The first part consists of obtaining the soil profile, which gives an idea of the depths of various characteristic zones of soil at the site of the structure, as also the relevant properties of soil such as **initial void ratio**, grain specific gravity, water content, and the consolidation and compressibility characteristics.	3
	PO 3	**Recall** the importance of **foundations** because all structures have to be placed on soil. The structure may undergo **settlement** depending upon the characteristics such as **compressibility** of the strata of soil on which it is founded.	4
	PO 6	**Understand** the concept of elastic as well as the **primary compression** effects occur more or less together in the case of **cohesionless soils** because of their high permeabilities. The resulting settlement is termed 'immediate settlement'	3
	PSO 1	**Understand** the importance of **California bearing ratio** (CBR) test because **strength** of the strata can be determined with CBR and it is defined as the rate of the **force per unit area** required to penetrate a soil mass with a standard circular plunger of 50 mm diameter at the rate of 1.25 mm/min to that required for the corresponding **penetration** of a standard material.	5
CO 6	PO 1	**Understand** the **shearing strength** of a soils because the soil is governed by the total **normal stress** on the failure plane. However, according to Terzaghi, it is the effective stress on the failure plane that governs the shearing strength and not the total stress.	3
	PO 2	**Understand** the importance of triaxial testing is a method used to determine the **stress-strain properties** of soils by subjecting soil samples to constant **lateral pressure** while increasing **vertical pressure**. This test measures stresses in three mutually **perpendicular directions**.Normally Triaxial test is the best method to evaluate the **shear strength** of soil. It gives reliable results but accuracy of the results depends mainly on initial moisture content, **confining pressure** and drainage conditions.	7

	PO 3	**Understand** the special case of a **triaxial compression test**; the **confining pressure** being zero. A **cylindrical soil** specimen, usually of the same standard size as that for the triaxial compression, is **loaded axially** by a compressive force until failure takes place. Since the specimen is laterally unconfined, the test is known as '**unconfined compression test**'.	6
	PO 4	**Understand** the importance of unconfined compression test because it is the most popular method of soil **shear** testing because it is one of the fastest and least **expensive** methods of measuring shear strength. It is used primarily for saturated, cohesive soils which is recovered from **thin-walled sampling tubes**.	4
	PO 6	**Understand** the behaviour of **undisturbed soils** because remoulded samples cannot be got for conducting triaxial or **unconfined compression tests**, the shear strength is determined by a device called the Shear Vane. The vane shear test may also conducted in the laboratory. The laboratory shear vane will be usually smaller in size as compared to the **field vane**.	4
	PSO 1	**Understand** the importance of **Pore water pressures** because it play an important role in determining the **strength of soil**. The change in pore water pressure due to change in applied stress is characterised by **dimensionless coefficients**, called 'Pore pressure coefficients' or 'Pore pressure parameters'	4
	PSO 2	**Understand** the **strength behaviour** of a soil becasue the strength depends of its **resistance** to shearing stresses. It is made up of basically the components; frictional due to friction between individual particles. Cohesive - due to adhesion between the soil particles	3

XII 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	-	4		-	-	-	-	-	-	-	-	-	-
CO 2	3	5	6	7	-	-	-	-	-	-	-	-	-	-	-
CO 3	3	3	-	6	-	-	-	-	-	-	-	-	6	-	-
CO 4	3	5	5	5	-	3	-	-	-	-	-	-	5	3	-
CO 5	3	-	4	-	-	3	-	-	-	-	-	-	5	-	-
CO 6	3	7	6	4	-	4	-	-	-	-	-	-	4	3	-

XIII 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	-	36.6	-	-	-	-	-	-	-	-	-	-	-
CO 2	100	50	60	63.6	-	-	-	-	-	-	-	-	-	-	-
CO 3	100	30	-	54.5	-	-	-	-	-	-	-	-	60	-	-
CO 4	100	50	50	45.5	-	60	-	-	-	-	-	-	50	100	-
CO 5	100	-	40	-	-	60	-	-	-	-	-	-	50	-	-
CO 6	100	70	60	36.3	-	80	-	-	-	-	-	-	40	100	-

XIV COURSE ARTICULATION MATRIX (PO / PSO MAPPING):

CO'S and PO'S and CO'S and PSO'S on the scale of 0 to 3, 0 being no correlation, 1 being the low correlation, 2 being medium correlation and 3 being high correlation.
0 - $0 \leq C \leq 5\%$ – No correlation
1 -$5 < C \leq 40\%$ – Low/ Slight
2 - $40\% < C < 60\%$ –Moderate
3 - $60\% \leq C < 100\%$ – Substantial /High

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	3	2	-	1	-	-	-	-	-	-	-	-	-	-	-
CO 2	3	2	3	3	-	-	-	-	-	-	-	-	-	-	-
CO 3	3	1	-	2	-	-	-	-	-	-	-	-	2	-	-
CO 4	3	2	2	2	-	3	-	-	-	-	-	-	2	3	-
CO 5	3	-	2	-	-	3	-	-	-	-	-	-	2	-	-
CO 6	3	3	3	1	-	3	-	-	-	-	-	-	2	3	-
TOTAL	18	10	10	9	-	9	-	-	-	-	-	-	8	6	-
AVERAGE	3	2	2.5	1.8	-	3	-	-	-	-	-	-	2	3	-

XV ASSESSMENT METHODOLOGY DIRECT:

CIE Exams	✓	SEE Exams	✓	Seminars	-
Laboratory Practices	✓	Student Viva	✓	Certification	-
Assignments	-				

XVI ASSESSMENT METHODOLOGY INDIRECT:

✓	Early Semester Feedback	✓	End Semester OBE Feedback
X	Assessment of Mini Projects by Experts		

XVII SYLLABUS:

WEEK I	**MOISTURE CONTENT**
	To determine the natural moisture content of the given soil sample.
WEEK II	**SPECIFIC GRAVITY**
	Determine the specific gravity of soil fraction passing 4.75 mm I.S sieve by density bottle
WEEK III	**ATTERBERGS LIMITS**
	To determine liquid limit, plastic limit, shrinkage limit, classify the soil and to find flow index and toughness index
WEEK IV	**RELATIVE DENSITY**
	To determine the relative density of given coarse grained material
WEEK V	**FIELD DENSITY- CORE CUTTER AND SAND REPLACEMENT METHOD**
	To determine the mass density of soils by core cutter method and replacement method
WEEK VI	**GRAIN SIZE ANALYSIS**
	To classify the coarse grained soils based on sieve analysis
WEEK VII	**PERMEABILITY OF SOIL: CONSTANT AND VARIABLE HEAD TEST**
	To determine coefficient of permeability of given soil sample at desired density by a suitable method.
WEEK VIII	**COMPACTION TEST**
	To determine the optimum moisture content and maximum dry density of a soil by proctor test.
WEEK IX	**CBR TEST**
	To determine the California bearing ratio by conducting a load penetration test in the laboratory.
WEEK X	**CONSOLIDATION TEST**
	To determine the settlements due to primary consolidation of soil by conducting one dimensional test.
WEEK XI	**UNCONFINED COMPRESSION TEST**
	To determine the unconfined compressive strength of cohesive soil sample and its sensitivity.
WEEK XII	**TRIAXIAL COMPRESSION TEST**
	To determine shear strength parameter i.e. angle of shearing resistance and cohesion of a given soil sample.
WEEK XIII	**DIRECT SHEAR TEST**
	To determine shear strength parameters of the given soil sample at known density and moisture content by direct shear test.
WEEK XIV	**VANE SHEAR TEST**
	To determine the shear strength of clay specimen.
WEEK XV	**STANDARD PENETRATION TEST**
	To measure the resistance to penetration of a sampling spoon in soil under dynamic loading.

TEXTBOOKS

1. Braja M. Das, "Principles of geotechnical engineering" Cengage learning publishers,2002.
2. VNS Murthy, "Soil mechanics and foundation engineering", CBS publishers and distributors,2003.
3. Gopal Ranjan and ASR Rao, "Basic and Applied Soil Mechanics", New age international Pvt. Ltd, New Delhi,2000.
4. K.R. Arora, " Soil mechanics and foundation engineering" Standard Publishers Distributors" 2004.

REFERENCE BOOKS:

1. C. Venkataramiah, "Geotechnical engineering", New Age International Pvt. Ltd,2002.
2. Manojdutta and Gulati, "Geotechnical engineering", Tata Mc Graw hill publishers New Delhi,2005.
3. K.R .Arora, "Soil mechanics and foundation engineering", standard publishers and distributors, New Delhi,2005.
4. B.C. Punmia, Ashok Kumar Jain and Arun Kumar Jain, "Soil mechanics and foundation", Laxmi publications Pvt. Ltd, New Delhi,2005.

XVIII 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	Introduction to Geotechnical Engineering.	CO 1	R4: 788-816
2	Determination of Specific gravity of soil solids by Pycnometer and Density bottle method	CO 1	R4: 788-816
3	Determination of water content of soil solids oven drying and Pycnometer method.	CO 1	R4: 788-816
4	Determination of in-situ density by core cutter and sand replacement method	CO 2	R4: 788-816
5	Grain size analysis	CO 2	R4: 788-816
6	Determination of liquid limit of fine soil by Casagrande apparatus	CO 2	R4: 788-816
7	Determination of maximum dry density and optimum moisture content by Standard Proctor compaction method	CO 4	R4: 788-816
8	Determination of co-efficient of permeability by Constant head	CO 3	R4: 788-816
9	Determination of co-efficient of permeability by variable head method	CO 3	R4: 788-816
10	Determination of liquid limit of fine soil by Cone Penetration Method	CO 3	R4: 788-816
11	Determination of shear parameters by Direct shear test of soil	CO 5	R4: 788-816
12	Determination of unconfined compressive strength of soil	CO 6	R4: 788-816
13	Vane Shear Test	CO 6	R4: 788-816

XIX EXPERIMENTS FOR ENHANCED LEARNING (EEL):

S.No	Design Oriented Experiments
1	Demonstration of miscellaneous equipments such as Augers, Samplers, Rapid Moisture meter, Proctor's needle
2	Demonstration of Hydrometer Test
3	Demonstration of Free Swell Index and Swell Pressure Test
4	Demonstration of determination of relative density of sands

Signature of Course Coordinator **HOD,CE**
Mr. M. Madhusudhan Reddy, Assistant Professor

INSTITUTE OF AERONAUTICAL ENGINEERING
(Autonomous)
Dundigal, Hyderabad - 500 043

CIVIL ENGINEERING
COURSE DESCRIPTION

Department	**CIVIL ENGINEERING**				
Course Title	**ADVANCED SURVEYING LABORATORY**				
Course Code	ACE106				
Program	B.Tech				
Semester	VI	CE			
Course Type	CORE				
Regulation	R16				
Course Structure	Theory			Practical	
	Lecture	Tutorials	Credits	Laboratory	Credits
	-	-	-	3	2
Course Coordinator	Mr. B Suresh , Assistant Professor				

I COURSE OVERVIEW:

Advanced Surveying is the application of technology and scientific principles for tracing, design, operation and management of facilities.Surveying refers to tracing points on ground or field. This course gives an overview on surveying with respect to tracing of points locating inaccessible points, curve and path, contours etc., This course also focuses on advanced surveying techniques, including EDM, photogrammetry and Remote sensing. Further the course is useful to solve the complex problems related to the inaccessible distances, remote elevation and remote distances by collecting and evaluating the data such as horizontal distances, vertical distances,slopes and elevations

II COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites
B.Tech	ACE101	III	Surveying Laboratory

III MARKS DISTRIBUTION:

Subject	SEE Examination	CIE Examination	Total Marks
Advanced Surveying Laboratory	70 Marks	30 Marks	100

IV DELIVERY / INSTRUCTIONAL METHODOLOGIES:

✓	Demo Video	✓	Lab Worksheets	✓	Viva Questions	✓	Probing further Questions

V EVALUATION METHODOLOGY:

Each laboratory will be evaluated for a total of 100 marks consisting of 30 marks forinternal assessment and 70 marks for semester end lab examination. Out of 30 marks ofinternal assessment, continuous lab assessment will be done for 20 marks for the day today performance and 10 marks for the final internal lab assessment.

Semester End Examination (SEE): The semester end labexamination for 70 marks shall be conducted by two examiners, one of them beingInternal Examiner and the other being External Examiner, both nominated by thePrincipal from the panel of experts recommended by Chairman, BOS. The emphasis on the experiments is broadly based on the following criteria given in Table: 1

	Experiment Based	Programming based
20 %	Objective	Purpose
20 %	Analysis	Algorithm
20 %	Design	Programme
20 %	Conclusion	Conclusion
20 %	Viva	Viva

Continuous Internal Assessment (CIA):

CIA is conducted for a total of 30 marks (Table 1), with 20 marks for continuous lab assessment during day to day performance, 10 marks for final internal lab assessment.

Component			Total Marks
Type of Assessment	**Day to day performance**	**Final internal lab assessment**	
CIA Marks	25	5	30

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.

1. **Experiment Based**

Objective	Analysis	Design	Conclusion	Viva	Total
2	2	2	2	2	10

2. **Programming Based**

Objective	Analysis	Design	Conclusion	Viva	Total
-	-	-	-	-	-

VI COURSE OBJECTIVES:

The students will try to learn:

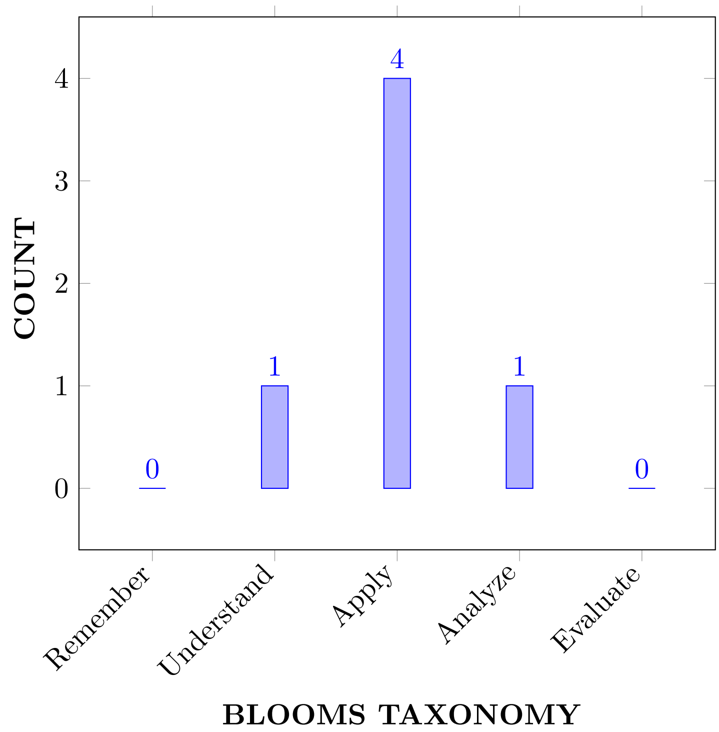
I	The types of surveys, methods and technology involved in measuring field parameters using traditional and modern instruments.
II	The operating principles of various levelling instruments and analyze their performance characteristics under various terrains.
III	The measurement of alteration works, detecting land use and land cover, creating base maps for visual reference.

VII COURSE OUTCOMES:

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

CO 1	**Utilize** the concept of traversing in theodolite to measure horizontal and vertical angles	Apply
CO 2	**Make use of** trigonometric leveling to measure inaccessible heights and distances.	Apply
CO 3	**Demonstrate** the repetition and reiteration methods in theodolite surveying for tracing out the Centring point or station point.	Understand
CO 4	**Identify** the reduced levels using leveling apparatus for illustrating longitudinal section and cross section and plotting.	Apply
CO 5	**Make use of** contours for investigating the suitable path along the alignment and conflict points.	Apply
CO 6	**Distinguish** remote elevation and remote distance in total station at various operating conditions and data record keeping.	Analyze

COURSE KNOWLEDGE COMPETENCY LEVEL



VIII HOW PROGRAM OUTCOMES ARE ASSESSED:

Program		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	Lab Exercises/CIA/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	1	Lab Exercises/CIA/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 Exercises/CIA/SEE
PO 9	**Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.	1	Lab Exercises/CIA/SEE

3 = High; 2 = Medium; 1 = Low

IX HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

Program		Strength	Proficiency Assessed by
PSO 1	Design and Supervise Sub-Structures and Super Structures for Residential and Public Buildings, Industrial Structures, Irrigation Structures, Power Houses, Highways, Railways, Airways, Docs and Harbours.	1	Lab Exercises

3 = High; 2 = Medium; 1 = Low

X 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	Utilize the concept of bearing system to a considerable extent appreciate (understanding) their importance and applicability (apply) in solving (complex) bearing angle measurement problems by applying the **principles of Mathematics and Engineering**	3

	PO 2	Understand the calibration procedure of compass for (**information and data**) reaching substantiated conclusions by the interpretation of results	1
CO 2	PO 1	Explain (understanding) various parts of theodolite in detail and apply the principle of traversing, in calculating horizontal and vertical angles by applying **principles of Mathematics, Science and Engineering**	3
CO 3	PO 2	Understand the given **problem statement** and formulate (complex) two point and three point problems in plane table surveying (understanding)and their importance, applicability (apply) in solving complex engineering problems from the provided information and substantiate with the interpretation of variations results.	1
	PO 9	Recall the fundamental of plane table surveying and understand the concept of orientation resection and radiation which helps the **Ability to work with all levels of people in an organization .**	1
CO 4	PO 1	Recognize (knowledge) the importance and application (apply) of leveling, in solving (complex) problems associated with leveling by applying the **principles of Mathematics, Science and Engineering**	3
	PO 5	Understand the given problem statement and apply the **simulation packages** for the analysis of longitudinal and cross sectional analysis and similarity parameters for predicting physical parameters that govern the plotting on ground	1
	PO 9	Recall the fundamental of EDM and understand the concept of RDM and REM which helps the **Ability to work with all levels of people in an organization.**	1
	PSO 1	Apply (knowledge) Design and Supervise Sub-Structures and Super Structures for Residential and Public Buildings, (apply) for illustrating longitudinal section and cross section by applying the **Quantitative building survey and quality assurance**	1
CO 5	PO 1	Apply the basic conservation laws of science for various curves setting in surveying and use **mathematical principles** for investigating the suitable path along the alignment and conflict points. (complex) engineering equations by understanding the appropriate parametric assumptions and limitations based on **engineering fundamentals** of surveying	3
	PSO 1	Apply (knowledge) Design and Supervise Sub-Structures and Super Structures for Residential and Public Buildings, (apply) for illustrating longitudinal section and cross section by applying the **Quantitative building survey and quality assurance**	1
CO 6	PO 2	Using standard stadia diaphragm derive the Tacheometric equation to analyze complex surveying problems with help of **Problem or opportunity identification.**	1

	PO 5	Understand the given problem statement and apply the appropriate techniques of advances **Computer software simulation packages** for the analysis of electronic distance measurements and similarity parameters for predicting physical parameters that govern the plotting on ground **technically**	3

XI MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

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

XII ASSESSMENT METHODOLOGY DIRECT:

CIE Exams		SEE Exams		Seminars	-
Laboratory Practices		Student Viva		Certification	-
Assignments	-				

XIII ASSESSMENT METHODOLOGY INDIRECT:

✓	Early Semester Feedback	✓	End Semester OBE Feedback
X	Assessment of Mini Projects by Experts		

XIV SYLLABUS:

WEEK I	**INTRODUCTION TO ADVANCED SURVEYING LABORATORY**
	INTRODUCTION TO ADVANCED SURVEYING LABORATORY .
WEEK II	**STUDY OF THEODOLITE IN DETAIL-PRACTICE FOR MEASUREMENT OF HORIZONTAL AND VERTICAL ANGLES.**
	STUDY OF THEODOLITE IN DETAIL-PRACTICE FOR MEASUREMENT OF HORIZONTAL AND VERTICAL ANGLES.
WEEK III	**MEASUREMENT OF HORIZONTAL ANGLES BY METHOD OF REPETITION AND REITERATION.**
	MEASUREMENT OF HORIZONTAL ANGLES BY METHOD OF REPETITION AND REITERATION.
WEEK IV	**TRIGONOMETRIC LEVELING- HEIGHTS AND DISTANCE PROBLEMS**
	TRIGONOMETRIC LEVELING- HEIGHTS AND DISTANCE PROBLEMS.
WEEK V	**CURVE SETTING –DIFFERENT METHODS**
	CURVE SETTING –DIFFERENT METHODS
WEEK VI	**SETTING OUT WORKS FOR BUILDINGS AND PIPE LINES**
	SETTING OUT WORKS FOR BUILDINGS AND PIPE LINES .
WEEK VII	**DETERMINATION OF AN AREA USING TOTAL STATION**
	DETERMINATION OF AN AREA USING TOTAL STATION
WEEK VIII	**TRAVERSING USING TOTAL STATION.**
	TRAVERSING USING TOTAL STATION
WEEK IX	**HEIGHTS AND DISTANCES USING PRINCIPLES OF TACHEOMETRIC SURVEY.**
	HEIGHTS AND DISTANCES USING PRINCIPLES OF TACHEOMETRIC SURVEY.
WEEK X	**CONTOURING USING TOTAL STATION.**
	CONTOURING USING TOTAL STATION.
WEEK XI	**DETERMINATION OF REMOTE HEIGHT USING TOTAL STATION**
	DETERMINATION OF REMOTE HEIGHT USING TOTAL STATION
WEEK XII	**STATE-OUT USING TOTAL STATION).**
	STATE-OUT USING TOTAL STATION
WEEK XIII	**CALCULATING DISTANCE, GRADIENT AND DIFFERENT HEIGHTS BETWEEN TWO INACCESSIBLE POINTS USING TOTAL STATION.**
	CALCULATING DISTANCE, GRADIENT AND DIFFERENT HEIGHTS BETWEEN TWO INACCESSIBLE POINTS USING TOTAL STATION

TEXTBOOKS

1. James M. Anderson, Edward M. Mikhail, "Surveying: Theory and Practice", Tata Mc Graw Hill Education, 2012.
2. S. S. Bhavikatti, "Surveying Theory and Practice", IK Books, New Delhi, 2010
3. H. S. Moondra, Rajiv Gupta, "Laboratory Manual for Civil Engineering", CBS Publishers Pvt .Ltd., New Delhi, 2^{nd} Edition, 2013

REFERENCE BOOKS:

1. P. Venugopala Rao, Vijayalakshmi Akella, —Textbook on surveying‖, PHI Learning, New Delhi, 1^{st} Edition, 2015.

XV 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	INTRODUCTION TO ADVANCED SURVEYING LABORATORY	CO 1, CO 2,CO 3, CO 4,CO 5, CO 6	T1: 1.1
2	STUDY OF THEODOLITE IN DETAIL-PRACTICE FOR MEASUREMENT OF HORIZONTAL AND VERTICAL ANGLES.	CO 1, CO 2,CO 3, CO 4,CO 5, CO 6	T1: 2.1
3	MEASUREMENT OF HORIZONTAL ANGLES BY METHOD OF REPETITION AND REITERATION.	CO 1, CO 2,CO 3, CO 4,CO 5, CO 6	T2: 3.9
4	TRIGONOMETRIC LEVELING- HEIGHTS AND DISTANCE PROBLEMS .	CO 1, CO 2,CO 3, CO 4,CO 5, CO 6	R1: 1.4
5	CURVE SETTING –DIFFERENT METHODS	CO 1, CO 2,CO 3, CO 4,CO 5, CO 6	T1: 5.4
6	SETTING OUT WORKS FOR BUILDINGS AND PIPE LINES	CO 1, CO 2,CO 3, CO 4,CO 5, CO 6	T1: 6.6
7	DETERMINATION OF AN AREA USING TOTAL STATION.	CO 1, CO 2,CO 3, CO 4,CO 5, CO 6	R1: 5.4
8	TRAVERSING USING TOTAL STATION.	CO 1, CO 2,CO 3, CO 4,CO 5, CO 6	T1: 8.8
9	HEIGHTS AND DISTANCES USING PRINCIPLES OF TACHEOMETRIC SURVEY.	CO 1, CO 2,CO 3, CO 4,CO 5, CO 6	R1: 9.2
10	CONTOURING USING TOTAL STATION.	CO 1, CO 2,CO 3, CO 4,CO 5, CO 6	T1: 10.6
11	DETERMINATION OF REMOTE HEIGHT USING TOTAL STATION	CO 1, CO 2,CO 3, CO 4,CO 5, CO 6	R1:7.2
12	STATE-OUT USING TOTAL STATION	CO 1, CO 2,CO 3, CO 4,CO 5, CO 6	R1:11.4

13	CALCULATING DISTANCE, GRADIENT AND DIFFERENT HEIGHTS BETWEEN TWO INACCESSIBLE POINTS USING TOTAL STATION	CO 1, CO 2,CO 3, CO 4,CO 5, CO 6	T1:12.3

XVI EXPERIMENTS FOR ENHANCED LEARNING (EEL):

S.No	Design Oriented Experiments
1	**SURFER 13:** Surfer is a Contouring and surface modelling software used for Graphical representation of drawing.
2	**ArcGIS:** Encourage students to Collect and manage data, create professional maps, perform traditional and advanced spatial analysis, and solve real problems .

Signature of Course Coordinator **HOD,CE**
Mr. B Suresh, Assistant Professor

INSTITUTE OF AERONAUTICAL ENGINEERING
(Autonomous)
Dundigal, Hyderabad - 500 043

CIVIL ENGINEERING

COURSE DESCRIPTION

Course Title	STRUCTURAL ANALYSIS				
Course Code	ACE008				
Program	B.Tech				
Semester	V	CE			
Course Type	Core				
Regulation	IARE - R16				
Course Structure	Theory			Practical	
	Lecture	Tutorials	Credits	Laboratory	Credits
	3	1	4	-	-
Course Coordinator	Mr Suraj Baraik, Assistant Professor				

I COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites
B.Tech	ACE004	IV	Strength of Materials - II

II COURSE OVERVIEW:

The course of Structural Analysis comprises a set of fundamental theorems of mechanics that obey physical laws required to study and predict the behavior of structures for computation of deformations, internal forces and stresses. This course mainly discusses the energy, force and displacement methods for the analysis of arches, determinate and indeterminate beams and trusses. This course also includes the effects of rolling loads on bridge girders and truss girders. Through this course content engineers can analyze the response of various structural members under different loading conditions for design, safety and serviceability.

III MARKS DISTRIBUTION:

Subject	SEE Examination	CIE Examination	Total Marks
STRUCTURAL ANALYSIS	70 Marks	30 Marks	100

IV CONTENT DELIVERY / INSTRUCTIONAL METHODOLOGIES:

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

V EVALUATION METHODOLOGY:

The course will be evaluated for a total of 100 marks, with 30 marks for Continuous Internal Assessment (CIA) and 70 marks for Semester End Examination (SEE). Out of 30 marks allotted for CIA during the semester, marks are awarded by taking average of two CIA examinations or the marks scored in the make-up examination.

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 14 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 Table: 1.

Percentage of Cognitive Level	Blooms Taxonomy Level
10%	Remember
25 %	Understand
30%	Apply
35 %	Analyze

Continuous Internal Assessment (CIA):

CIA is conducted for a total of 30 marks, with 25 marks for Continuous Internal Examination (CIE) and 05 marks for Quiz \Alternative Assessment Tool (AAT).

Component	Theory		Total Marks
Type of Assessment	CIE Exam	Quiz \AAT	
CIA Marks	25	05	30

Continuous Internal Examination (CIE):

Two CIE exams shall be conducted at the end of the 8^{th} and 17^{th} week of the semester respectively. The CIE exam is conducted for 25 marks of 2 hours duration consisting of two parts. Part–A shall have five compulsory questions of one mark each. In part–B, four out of five questions have to be answered where, each question carries 5 marks. Marks are awarded by taking average of marks scored in two CIE exams.

Quiz - Online Examination

Two Quiz exams shall be online examination consisting of 25 multiple choice questions and are to be answered by choosing the correct answer from a given set of choices (commonly four). Such a question paper shall be useful in testing of knowledge, skills, application, analysis, evaluation and understanding of the students. Marks shall be awarded considering the average of two quiz examinations for every course.

Alternative Assessment Tool (AAT)

This AAT enables faculty to design own assessment patterns during the CIA. The AAT converts the classroom into an effective learning center. The AAT may include tutorial hours/classes, seminars, assignments, term paper, open ended experiments, METE (Modeling and Experimental Tools in Engineering), five minutes video, MOOCs etc. The AAT chosen for this course is given in table

Concept Video	Tech-talk	Complex Problem Solving

40%	40%	20%

VI COURSE OBJECTIVES:

The students will try to learn:

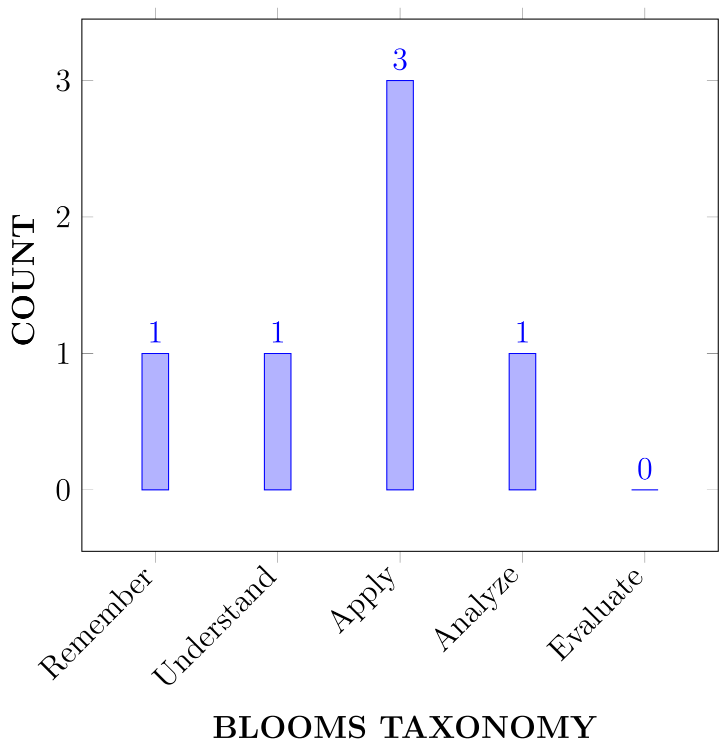
I	The analysis of pin-jointed frames for various load conditions for designing industrial structures.
II	The behavior of arches under the action of uniformly distributed loads and concentrated loads.
III	The analysis of indeterminate beams and rigid frames by displacement methods for designing framed structures.
IV	The concept of rolling loads and influence lines for analyzing the bridge girders and truss girders in complex structures.

VII COURSE OUTCOMES:

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

CO 1	**Explain** various types of pin-jointed frames for selecting suitable truss for use in industrial structures.	Remember
CO 2	**Recall** various types of arches for selecting appropriate arch in field applications.	Understand
CO 3	**Make use of** energy principles in the analysis of two hinged arches for computing resultant thrust and evaluating secondary stresses due to thermal and rib shortening effects.	Apply
CO 4	**Analyze** propped cantilever, fixed beam and continuous beam by appropriate methods for computing support moments and reactions.	Analyse
CO 5	**Apply** the concepts of slope-deflection and moment distribution methods for analysing continuous beam with and without support settlement and frames with and without side sway.	Apply
CO 6	**Apply** the concept of rolling loads and influence line diagrams for analyzing beams, bridge girders and trusses in real time problems.	Apply

COURSE KNOWLEDGE COMPETENCY LEVEL



VIII PROGRAM OUTCOMES:

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

Program Outcomes	
PO 7	**Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO 8	**Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO 9	**Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO 10	**Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO 11	**Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO 12	**Life-Long Learning:** Recognize the need for and having the preparation and ability to engage in independent and life-long learning in the broadest context of technological change

IX HOW PROGRAM OUTCOMES ARE ASSESSED:

Program		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
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	CIE/SEE/AAT
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.	1	CIE/SEE/AAT

3 = High; 2 = Medium; 1 = Low

X HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

Program		Strength	Proficiency Assessed by
PSO 1	Synthesize and analyze aircraft structures, propulsion, production technologies and computer aided engineering in aeronautical systems including air traffic controls standards	2	CIE/AAT

3 = High; 2 = Medium; 1 = Low

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

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	✓	-	-	-	-	-	-	-	-	-	-	-	✓	-	-
CO 2	✓	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 3	✓	✓	-	-	-	-	-	-	-	-	-	-	✓	-	-
CO 4	-	✓	-	-	-	-	-	-	-	-	-		✓	-	-
CO 5	✓	✓	✓	-	-	-	-	-	-	-	-		✓	-	-
CO 6	✓	✓	✓	-	-	-	-	-	-	-	-	✓	✓	-	-

XII 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 mathematical principles and engineering fundamentals** for **identifying the structures** based on static and kinematic indeterminacies and choose appropriate method of analysis.	3
	PSO 1	Understand various methods of analysis of determinate and indeterminate structures by using **engineering fundamentals.**	1
CO 2	PO 1	Distinguish between arches and **selects appropriate arch** in various engineering applications using the knowledge of **mathematics and engineering fundamentals**	3
CO 3	PO 1	**Apply the knowledge of Mathematics, Sciences and Engineering fundamentals principles** for **estimating the horizontal thrust** in arches subjected to various load combinations.	3
	PO 2	Determine the secondary stresses in two hinged arches, by analysing the **complex engineering problems**using the principles of **mathematics and engineering sciences**.	2

	PSO 1	Understand the behaviour of arches under various loads and apply energy principles in analysing the arch for horizontal thrust at the supports, with the help of the **mathematical principles and engineering fundamentals**	2
CO 4	PO 2	Determine the end moments in fixed beams, by analysing the **complex engineering problems**using the principles of **mathematics and engineering sciences**.	2
	PSO 1	Understand the behaviour of propped cantilevers and fixed beams under various loads and apply energy principles in analysing the same for end moments and support reactions, with the help of the **mathematical principles and engineering fundamentals**	2
CO 5	PO 1	**Apply the mathematical principles and engineering fundamentals** for understanding the behavior of continuous beams and **choose appropriate method** of analysis.	3
	PO 2	Analyse rigid frames for finding support moments using the **principles of mathematics and engineering sciences.**	2
	PO 3	Analyse the framed structures using the **principles of mathematics and engineering sciences** .	1
	PSO 1	Understand various methods of analysis of determinate and indeterminate structures by using **engineering fundamentals**	1
CO 6	PO 1	Make use of concepts of influence lines, for **solving engineering problems related to moving loads** on beams and girders applying the principles of **mathematics and engineering fundamentals.**	3
	PO 2	Find the solution for complex engineering structures such as bridge girders and truss girders using the **principles of mathematics and engineering sciences**	2
	PO 3	**Analyse the complex engineering structures** such as bridge girders using the concepts of moving loads and influence line diagrams	1
	PO 12	Recognize the importance of influence line concept in the design of bridge girders and trusses, and have sufficient preparation to design bridges independently, according to varying field conditions and tries to **enhance design skill towards future advancement and lifelong learning.**	1
	PSO 1	Understand the behaviour of bridge girders under various moving loads and apply principles in analysing the girder for bending moments and shear forces, with the help of the **mathematical principles and engineering fundamentals**	2

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

XIV 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	-	-	-	-	-	-	-	-	-	-	-	25	-	-
CO 2	100	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 3	100	20	-	-	-	-	-	-	-	-	-	-	50	-	-
CO 4	-	20	-	-	-	-	-	-	-	-	-		50	-	-
CO 5	100	20	10	-	-	-	-	-	-	-	-	-	25	-	-
CO 6	100	20	10	-	-	-	-	-	-	-	-	12.5	50	-	-

XV COURSE ARTICULATION MATRIX (PO / PSO MAPPING):

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

0 - $0 \leq$ C$\leq$ 5% – No correlation
1 - 5% <C$\leq$ 40% – Low/ Slight
2 - 40 % <C < 60% –Moderate
3 - 60% $\leq$ C < 100% – Substantial /High

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

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
TOTAL	15	4	2	-	-	-	-	-	-	-	-	1	8	-	-
AVERAGE	3	1	1	-	-	-	-	-	-	-	-	1	2	-	-

XVI ASSESSMENT METHODOLOGY DIRECT:

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

XVII ASSESSMENT METHODOLOGY INDIRECT:

✓	Early Semester Feedback	✓	End Semester OBE Feedback
X	Assessment of Mini Projects by Experts		

XVIII SYLLABUS:

MODULE I	**ANALYSIS OF PIN-JOINTED FRAMES (TRUSSES)**
	Types of frames, perfect, imperfect and redundant. Pin jointed frames (trusses), analysis of determinate pin jointed frames , analysis of determinate pin jointed frames using method of joints, method of sections and tension coefficient method for vertical loads, horizontal loads and inclined loads.
MODULE II	**ARCHES**
	Introduction, types of arches, comparison between three hinged and two hinged arches; Normal thrust and radial shear in an arch; Geometrical properties of parabolic and circular arch; Three hinged circular arch at different levels; Absolute maximum bending moment diagram for a three hinged arch; Two hinged arches: Introduction, classification of two hinged arches, analysis of two hinged parabolic arches, secondary stresses in two hinged arches due to temperature and elastic shortening of rib.

MODULE III	**FORCE METHOD OF ANALYSIS OF INDETERMINATE BEAMS**
	Analysis of propped cantilever and fixed beams using the method of consistent deformation, including the beams with varying moments of inertia, subjected to uniformly distributed load, central point load, eccentric point load, number of point loads, uniformly varying load, couple and combination of loads, shear force and bending moment diagrams for propped cantilever and fixed beams, deflection of propped cantilever and fixed beams; effect of rotation of a support. Continuous beams. Clapeyron's theorem of three moments, analysis of continuous beams with constant and variable moments of inertia with one or both ends fixed, continuous beams with overhang. Effects of sinking of supports.
MODULE IV	**DISPLACEMENT METHOD OF ANALYSIS: SLOPE DEFLECTION AND MOMENT DISTRIBUTION**
	Derivation of slope, deflection equation, concept of moment distribution method, application of the methods to continuous beams with and without settlement of supports. Shear force and bending moment diagrams, elastic curve, application of the methods to single bay, single storey frames with and without sway.
MODULE V	**MOVING LOADS AND INFLUENCE LINES**
	Introduction, maximum shear force, and bending moment; At a given section and absolute maximum shear force and bending moment due to various load cases, focal length; Definition of influence line for shear force, influence line for bending moment, load position for maximum SF at a section, load position for maximum BM at a section, for various loads.

TEXTBOOKS:

1. B.C. Punmia, A.K JainA, K.Jain, "Theory of Structures", Laxmi Publications 12th Edition, 2004.

2. C.S.Reddy, "Basic Structural Analysis", Tata Mc. Graw Hill, 3rd Edition, 2010

REFERENCE BOOKS:

1. Bhavikatti, "Analysis of Structures - Vol. 1 and 2",Vikas Publications.

2. VaziraniandRatwani, "Analysis of Structures–Vol.II", Khanna Publishers, 16th Edition, 2015.

3. Ramamrutham, "Theory of Structures", Dhanpat Rai Publications, 9thEdition, 2014.

4. C.K.Wang, "Intermediate Structural Analysis", Standard Publication, 1stEdition, 2010.

XIX COURSE PLAN:

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

S.No	Topics to be covered	CO's	Reference T1: 4.1
OBE DISCUSSION			
0	Discussion on Program outcomes, Course objectives and Course outcomes		
CONTENT DELIVERY (THEORY)			
1-2	Introduction to pin-jointed frames. Difference between determinate and indeterminate structures. Degree of static indeterminacy or degree of redundancy. Degree of kinematic indeterminacy	CO 1	T1:14.1
3-4	Analysis of pin jointed plane frames by method of joints.	CO 1	T1: 14.1
5-6	Analysis of pin jointed plane frames by method of sections.	CO 1	T1:Ex.14.1, 14.2
7-8	Analysis of pin jointed plane frames by method of tension coefficients.	CO 1	T1: 14.3, R1: 10.3
9-10	Introduction to arches, types of arches, comparison between three hinged and two hinged arches, Linear arch, Eddy's theorem	CO 2	T1: 16.1, R1: 7.1
11	Geometrical properties of parabolic and circular arch. Equation of parabolic arch.	CO 2	T1: 16.4, R1: 7.2
12-13	Analysis of three hinged parabolic arches. Determination of normal thrust and radial shear. Numerical Examples.	CO 3	T1: 16.4, R1: 7.3
14	Analysis of three hinged circular arch. Numerical examples	CO 3	T1: 16.5
15	Introduction to two hinged arches.	CO 3	T1:16.6, R1: 7.1
16	Analysis of two hinged parabolic arches. Analysis of two hinged circular arches.	CO 3	T1:16.7, R1: 7.1
17	Analysis of two hinged circular arches.	CO 3	T1:16.7, R1: 7.1
18	Analysis of two hinged parabolic arches. Problems on secondary stresses in two hinged arches.	CO 3	T1:16.10
19	Problems on secondary stresses in two hinged arches due to temperature and elastic shortening of rib.	CO 3	T1:16.10-16.13

20	Introduction to propped cantilever and fixed beams. Analysis of propped cantilever and fixed beam by consistant deformation method.	CO 4	T1:9.1, R 1:7.6.3
21	Fixed end moments due to symmetric point load and eccentric point load. Numerical Examples	CO 4	R2:1.3-11
22	Fixed end moments due to UDL , UVL and a couple. Numerical Examples	CO 4	R2:1.4-14
23	Fixed end moments due to rotation and sinking of supports. Numerical Examples	CO 4	R2:1.7-20
24	Introduction to slope-deflection method. Slope-deflection equations, and procedure.	CO 5	R2:1.7-20
25-26	Analysis of continuous beams with and without sinking of supports by slope-deflection method. Numerical Examples.	CO 5	T1: 9.3
27	Introduction to Moment distribution method. Carry over factor, absolute stiffness and relative stiffness, distribution factor.	CO 5	T1: 10.2
28-29	Analysis of continuous beams with and without sinking of supports by moment distribution method. Procedure. Numerical Examples	CO 5	T1: 10.1
30	Analysis of rigid frames by slope deflection method	CO 5	T1: 28.1
31	Analysis of rigid frames by moment distribution method	CO 5	T1: 28.1
32	Analysis of rigid frames numerical example	CO 5	T1: 28.1
33	Introduction to moving or rolling loads and influence lines. Effect of moving loads on Shear force and bending moment at a given section.	CO 6	T1: 1.1-03
34	Maximum SF and BM at a given section and absolute maximum S.F. and B.M due to single concentrated load UDL longer than the span.	CO 6	T1: 1.2
35	Maximum SF and BM at a given section and absolute maximum S.F. and B.M UDL load shorter than the span, two-point loads with fixed distance between them and several point loads. Numerical Examples	CO 6	T1: 1.4
36	Equivalent uniformly distributed load – Focal length.- Numerical Examples.	CO 6	T1: 1.8-47
37-38	Definition of influence line for SF, Influence line for BM – load position for maximum SF at a section – Point loads, UDL longer than the span, UDL shorter than the span.	CO 6	T1: 2.3, R1: 5.2
39	Load position for maximum BM at a section- Point loads, UDL longer than the span, UDL shorter than the span. – Numerical Examples.	CO 6	T1: 2.4, R1: 5.10
40	Numerical Examples on Rolling loads and Influence lines.	CO 6	T1: 63, R1: 5.5

PROBLEM SOLVING/ CASE STUDIES			
1	Numerical Examples on truss analysis by method of joints	CO 1	T1:3.4 R1: 20.4
2	Numerical Examples on truss analysis by method of sections	CO 1	T1:2.7 R1: 20.7
3	Numerical Examples on truss analysis method of tension coefficients method	CO 1	T1:6.8 R1: 12.4 – 12.6
4	Numerical Examples on three hinged arches	CO 2	T1:6.8 R1: 12.4 – 12.6
5	Numerical Examples on two hinged arches	CO 3	T1:6.9 R1: 13.1 – 13.6
6	Numerical Examples on two hinged arches-temperature effects.	CO 3	T1:5.1,5.2 R1: 14.1 – 14.3
7	Numerical Examples on propped cantilevers	CO 4	T1:5.1,5.2 R1: 14.1 – 14.3
8	Numerical Examples onfixed beams	CO 4	T1:5.1,5.2 R1: 14.1 – 14.3
9	Analysis of continuous beam for shear forces and bending moments using theorem of three moments with different end conditions.	CO 4	T1:4.14 R1: 17.4 – 17.6
10	Analysis of continuous beam for shear forces and bending moments using theorem of three moments with different moment of inertias.	CO 4	T2:11
11	Numerical Examples on analysis of continuous beams by Slope-deflection method	CO 5	T1:10.17
12	Numerical Examples on analysis of rigid portal frame by Slope-deflection method	CO 5	T2:9.1 R1: 15.3 – 15.6
13	Numerical Examples on analysis of continuous beams by Moment distribution method	CO 5	T2:9.1 R1: 15.3 – 15.6
14	Numerical Examples on analysis of rigid portal frame by Moment distribution method	CO 5	T2:12
15	Numerical Examples on Rolling loads and Influence lines.	CO 6	T1: 63, R1: 5.5
DISCUSSION OF DEFINITION AND TERMINOLOGY			
1	Definitions and Terminology from Analysis of Trusses	CO 1	T1: 3.1 – 3.10 R1: 20.1 – 20.7
2	Definitions and Terminology from Arches	CO 2,3	T1:6.1 – 6.8 R1: 12.1 – 12.6
3	Definitions and Terminology from Propped cantilever, Fixed beam and Clapeyron's theorem	CO 4	T2:9.1 R1: 15.3 – 15.6
4	Definitions and Terminology from Slope deflection and moment distribution methods	CO 5	T2:13
5	Definitions and Terminology from Moving loads and Influence lines	CO 6	T1:4.8 – 4.10 R1: 17.1 – 17.6

DISCUSSION OF QUESTION BANK			
1	Questions bank problems from Analysis of Trusses	CO 1	T1: 3.1 – 3.10 R1: 20.1 – 20.7
2	Questions bank problems from Arches	CO 2,3	T1:6.1 – 6.8 R1: 12.1 – 12.6
3	Questions bank problems from Propped cantilever, Fixed beam and Clapeyron's theorem	CO 4	T2:9.1 R1: 15.3 – 15.6
4	Questions bank problems from Slope deflection and moment distribution methods	CO 5	T2:13
5	Questions bank problems from Moving loads and Influence lines	CO 6	T1:4.8 – 4.10 R1: 17.1 – 17.6

Signature of Course Coordinator **HOD,CE**
Mr.Suraj Baraik,Assistant Professor

INSTITUTE OF AERONAUTICAL ENGINEERING
(Autonomous)
Dundigal, Hyderabad - 500 043

COURSE DESCRIPTION

Department	**CIVIL ENGINEERING**				
Course Title	**Reinforced Concrete Structures Design and Drawing**				
Course Code	ACE009				
Program	B.Tech				
Semester	V				
Course Type	CORE				
Regulation	R16				
Course Structure	Theory			Practical	
	Lecture	Tutorials	Credits	Laboratory	Credits
	3	-	3	-	-
Course Coordinator	Mr. Gude Ramakrishna , Associate Professor				

I COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites
B.Tech	AME002	III	Engineering Mechanics
B.Tech	ACE001	IV	Strength of Materials

II COURSE OVERVIEW:

Reinforced Concrete Structures Design and Drawings an introductory design course in civil engineering. This course covers the structural design of reinforced concrete beams like singly reinforced, doubly reinforced, T and L beam sections, columns like short and long columns with biaxial bending, slabs likeone way, two way, continuous and cantilever and footings like isolated, combined, strip, etc. Different methods of design will be briefly described before introducing the limit state of design. The design will be done as per IS 456:2000. In this course, basic elements governed by bending, shear, axial forces or combination of them are identified and are considered for structural analysis of the whole structure.

III MARKS DISTRIBUTION:

Subject	SEE Examination	CIE Examination	Total Marks
Reinforced Concrete Structures Design and Drawing	70 Marks	30 Marks	100

IV CONTENT DELIVERY / INSTRUCTIONAL METHODOLOGIES:

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

V EVALUATION METHODOLOGY:

The course will be evaluated for a total of 100 marks, with 30 marks for Continuous Internal Assessment (CIA) and 70 marks for Semester End Examination (SEE). Out of 30 marks allotted for CIA during the semester, marks are awarded by taking average of two CIA examinations or the marks scored in the make-up examination.

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 14 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
18%	Remember
45 %	Understand
20 %	Apply
17 %	Analyze
0 %	Evaluate
0 %	Create

Continuous Internal Assessment (CIA):
CIA is conducted for a total of 30 marks, with 25 marks for Continuous Internal Examination (CIE) and 05 marks for Quiz \Alternative Assessment Tool (AAT).

Component	Theory		Total Marks
Type of Assessment	CIE Exam	Quiz \AAT	
CIA Marks	25	05	30

Continuous Internal Examination (CIE):
Two CIE exams shall be conducted at the end of the 8^{th} and 17^{th} week of the semester respectively. The CIE exam is conducted for 25 marks of 2 hours duration consisting of two parts. Part–A shall have five compulsory questions of one mark each. In part–B, four out of five questions have to be answered where, each question carries 5 marks. Marks are awarded by taking average of marks scored in two CIE exams.

Quiz - Online Examination
Two Quiz exams shall be online examination consisting of 25 multiple choice questions and are to be answered by choosing the correct answer from a given set of choices (commonly four). Such a question paper shall be useful in testing of knowledge, skills, application, analysis, evaluation and understanding of the students. Marks shall be awarded considering the average of two quiz examinations for every course.

Alternative Assessment Tool (AAT)
This AAT enables faculty to design own assessment patterns during the CIA. The AAT converts the classroom into an effective learning center. The AAT may include tutorial hours/classes, seminars, assignments, term paper, open ended experiments, METE (Modeling and Experimental Tools in Engineering), five minutes video, MOOCs etc. The AAT chosen for this course is given in table

Concept Video	Tech-talk	Complex Problem Solving
40%	40%	20%

VI COURSE OBJECTIVES:

The students will try to learn:

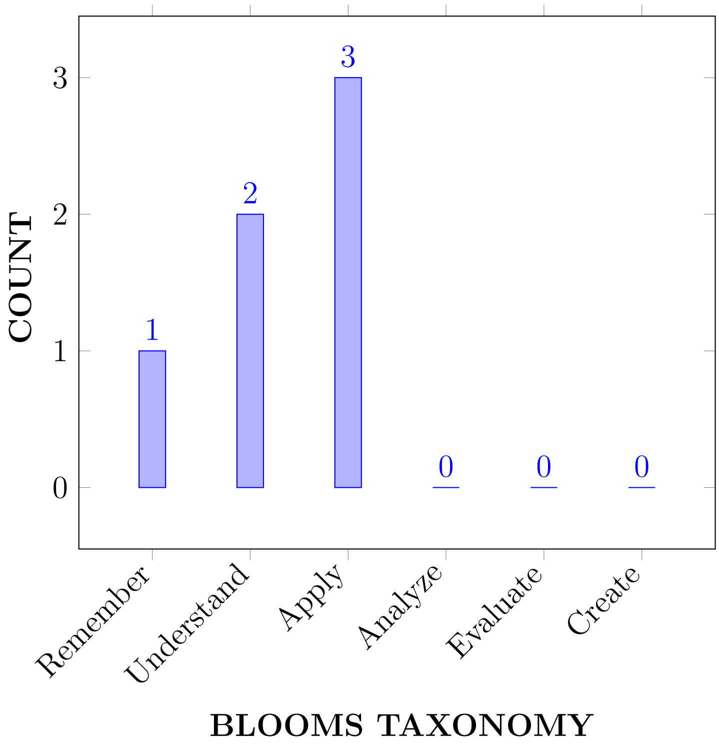
I	The basic design concepts for reinforced concrete structures starting with historical development to the latest limit state theory.
II	The Indian Standard codal provisions and refreshing the bending and shear theory.
III	The behavior of reinforced concrete components and systems subjected to gravity as well as lateral loads, designing of different structural members like beam, slab, column and footing.
IV	The utilization of advanced computer software packages for the analysis and design of structural components.

VII COURSE OUTCOMES:

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

CO 1	**Recall** basic concepts of reinforced concrete design, material stress–strain curves, and safety factors to know the properties of concrete structure..	Remember
CO 2	**Explain** the concept of Stress block parameters and use the design concept of working stress method, limit state method for designing different structural components .	Understand
CO 3	**Explain** the concept of bond, anchorage and development length and section for shear and torsion for safe designing of residential, commercial and industrial structures.	Understand
CO 4	**Design** reinforcement structural sections for shear,torsion and bond for obtaining the reinforcement details	Apply
CO 5	**Solve** singly reinforced, doubly reinforced, T, L beam and slabs sections as per IS: 456–2000 for obtaining the reinforcement details in load bearing members.	Apply
CO 6	**Develop** the concept of Axial loading uni-axial and bi-axial bending of vertically loaded members, isolated and Combined footing to obtain reinforcement details.	Apply

COURSE KNOWLEDGE COMPETENCY LEVEL



VIII PROGRAM 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.

Program Outcomes	
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

IX 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 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.	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 modelling to complex Engineering activities with an understanding of the limitations	1	CIE / Quiz / AAT

X HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

PROGRAM OUTCOMES		Strength	Proficiency Assessed by
PSO 1	**Design** and **Supervise** Sub-Structures and Super Structures for Residential and Public Buildings, Industrial Structures, Irrigation Structures, Power Houses, Highways, Railways, Airways, Docs and Harbours.	1	CIA / SEE

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

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	✓	✓	✓	-	-	-	-	-	-	-	-	-	-	-	-
CO 2	-	✓	✓	-	-	-	-	-	-	-	-	-	-	-	-
CO 3	-	✓	✓	-	-	-	-	-	-	-	-	-	-	-	-
CO 4	✓	✓	✓	-	-	-	-	-	-	-	-	-	✓	-	-
CO 5	✓	✓	✓	-	✓	-	-	-	-	-	-	-	✓	-	-
CO 6	✓	✓	✓	-	✓	-	-	-	-	-	-	-	✓	-	-

XII 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 engineering fundamentals, **scientific principles** of reinforced concrete design and analysis of structural members by applying **mathematical principles**.	2
	PO 2	**Identify** material stress–strain curves, safety factors **information and validation data** collection of member by using experimental design and **Interpretation of results.**	3
	PO 3	**Understand** the Stress–Strain curves relation, Safety factors, **evaluate** Stress block parameters and **manage the design process** for individual structural members of a structure.	1
CO 2	PO 2	**Information and data collected** from Stress block parameters for given member are checked for **validation** with respect to codal provisions.	2
	PO 3	Analyse various types of design concept of Working Stress Method problems and **identify solutions** for the effective design and develop solution in real world problems.	1

CO 3	PO 2	Describe the importance of limit state analysis and design of section to obtain reinforcement details from **given Information and data collection** from **problem statement and system definition.**	2
	PO 3	**Understand** limit state analysis and **manage the design process**, to obtain the **design section for torsion** and apply them to determine the behaviour of elements of a structure.	1
CO 4	PO 1	Relate the principles of using **mathematical principles** and **scientific methodology** and apply those results to determine the allowable stresses in the member.	2
	PO 2	**Information and data collection** from given source to obtain anchorage and development length for **solution development.**	2
	PO 3	Understand the design concept of one-way slabs, **engineering principles** and the **ability** to apply them to analyse in conducting and **solve engineering problems Use creativity to establish innovative solutions.**	1
	PSO 1	Examine the limit state method, **design** of section for shear and torsion for determining the allowable stresses in the member by following **codal** provisions	2
CO 5	PO 1	Explain the concept of bond, anchorage and development length, by using **mathematical, Scientific principles** for safe design of structure.	2
	PO 2	**Information and data collection** from given source to obtain anchorage and development length for **solution development.**	2
	PO 3	Design solutions for structural members to determine and **understand** development length, for safe design of structure to **manage the design process.**	2
	PO 5	Students also are responsible for **evaluating** the values as per **codal** provisions and which is then reflected in the final grade.	1
	PSO 1	Explain the concept of bond, anchorage and development length, for safe **designing** of residential, commercial and industrial structures following **codal** provisions	2
CO 6	PO 1	Apply the knowledge of **mathematics, scientific principles,** Engineering fundamentals to understand the deflection limits as per IS: 456–2000.	2
	PO 2	**Information and data collection** from given source to obtain anchorage and development length for **solution development.**	2
	PO 3	Design solutions for structural members to determine and **understand** development length, for safe design of structure to **manage the design process.**	2

	PO 5	Students also are responsible for **evaluating** the values as per **codal** provisions and which is then reflected in the final grade.	1
	PSO 1	Illustrate the deflection limits as per IS: 456–2000 for **designing** conceptual structural members in different applications following **codal** provisions.	2

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

XIV 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	30	10	-	-	-	-	-	-	-	-	-	-	-	-
CO 2	-	20	10	-	-	-	-	-	-	-	-	-	-	-	-
CO 3	-	20	10	-	-	-	-	-	-	-	-	-	-	-	-
CO 4	66.6	20	10	-	-	-	-	-	-	-	-	-	100	-	-
CO 5	66.6	20	20	-	100	-	-	-	-	-	-	-	100	-	-
CO 6	66.6	20	20	-	100	-	-	-	-	-	-	-	100	-	-

XV COURSE ARTICULATION MATRIX (PO / PSO MAPPING):

CO'S and PO'S and CO'S and PSO'S on the scale of 0 to 3, 0 being no correlation, 1 being the low correlation, 2 being medium correlation and 3 being high correlation.
0 - 0$\leq$ C$\leq$ 5% – No correlation
1-5 <C$\leq$ 40% – Low/ Slight
2 - 40 % <C < 60% –Moderate
3 - 60% $\leq$ C < 100% – Substantial /High

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

XVI ASSESSMENT METHODOLOGY-DIRECT:

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

XVII ASSESSMENT METHODOLOGY-INDIRECT:

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

XVIII SYLLABUS:

MODULE I	DESIGN OF BEAMS
	Concepts of RC Design –Limit state method, Material Stress–Strain curves, Safety factors, Characteristic values, Stress block parameter, IS-456:2000 - Working Stress Method. BEAMS: Limit state analysis and design of singly reinforced, doubly reinforced, T, and L beam sections.
MODULE II	**SHEAR TORSION AND BOND**
	Limit state analysis and design of section for shear and torsion – concept of bond, anchorage and development length, I.S. code provisions. Design examples in simply supported and continuous beams, detailing Limit state design for serviceability for deflection, cracking and codal provision.
MODULE III	**DESIGN OF SLABS**
	Design of One-way Slabs and Two-way slabs. Continuous slabs using I.S. coefficients, Cantilever slab or Canopy slab.
MODULE IV	**DESIGN OF COLUMNS**
	Design of short columns for axial loads, uni-axial and bi-axial bending. I.S. Code provisions.
MODULE V	**DESIGN OF FOOTINGS**
	Design of isolated square and rectangular footings for axially and eccentrically loaded columns, Design of combined footing.

TEXTBOOKS

1. Dr. B. C. Punmia, "Limit state design of reinforced concrete", Laxmi Publications, NewDelhi.
2. S. Unnikrishna Pillai and DevdasMenon, "Reinforced concrete design", Tata Mc. Graw Hill, New Delhi.
3. N. Krishna Raju and R. N. Pranesh, "Reinforced Concrete Design", New Age International Publishers, New Delhi
4. P. C. Varghese, "Limit state design of reinforced concrete", Prentice Hall of India, New Delhi

REFERENCE BOOKS:

1. M. L. Gambhir, "Fundamentals of reinforced concrete design", Prince Hall of India Pvt. Ltd, New Delhi.
2. P. Purushotham, "Reinforced concrete structural elements – behavior, Analysis and design", Tata McGraw Hill, 1994.

WEB REFERENCES:

1. http://nptel.ac.in/courses/105102088/
2. http://nptel.ac.in/courses/105101088/

COURSE WEB PAGE:

XIX COURSE PLAN:

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

S.No	Topics to be covered	CO's	Reference T1: 4.1
OBE DISCUSSION			
1	Course Objectives(CO),Course Outcomes(CO),Program Outcomes(PO)		
CONTENT DELIVERY (THEORY)			
1-2	Explanation about loading, working stress method, limit state method	CO 1	T1: 2.1 R1:3.9
3-4	Material stress strain curves, safety factors,Philosophy of characteristic strength values.	CO 1	T2: 3.1-3.5.
5-6	Stress block parameters for reinforced concrete rectangular section	CO 1	T2: 2.8-2.9
7-8	The failure modes of reinforced structures under different load conditions	CO 1	T2: 3.2-3.4
9-10	Summarize working stress method, Limit state method in design, design of singly reinforced beams	CO 1	T2: 6.8-6.9
11-16	Design of doubly reinforced beams, design of T beam sections and L beam sections	CO 1	T2: 3.4, R1: 4.1
17-19	Design of doubly reinforced beams, design of T beam sections and L beam sections	CO 1	T2: 3.4, R1: 4.1

20-22	Design of doubly reinforced beams, design of T beam sections and L beam sections	CO 1	T2: 3.4, R1: 4.1
23-25	Design of doubly reinforced beams, design of T beam sections and L beam sections	CO 1	T2: 3.4, R1: 4.1
17	Analysis and Design of section for shear and torsion	CO 2	T2: 3.4
26-27	Concept of bond, anchorage and development length	CO 2	T2: 10.17
28	Problems on development length	CO 2	T2: 4.2
22	Understand deflection limits in IS: 456–2000	CO 2	T2: 5.1
29-30	Problems on one-way slabs, design and concept of two-way slabs.	CO 3	T2: 5.2
31-32	Problems on Two-way slabs	CO 3	T2: 5.2
33-34	Design concept of continuous slabs	CO 4	T2: 5.3
35-36	Calculate the I.S. coefficients for Cantilever slab	CO 4	T1: 4.1-4.12
37-38	Problems on Cantilever and Canopy slab.	CO 4	T1: 4.15
39-40	Design of Short columns	CO 4	T1: 6.3
41-42	Problems on columns.	CO 5	T1: 6.6
43-44	Design of Short columns under axial loads	CO 5	T1: 6.6
45-46	Problems on Short columns under axial loading	CO 5	T1: 7.2
47	Understand the requirements of codal provisions for footings	CO 6	T1: 7.3
48-50	Design and concept of footings	CO 6	T1: 7.3
51-54	Design of isolated (square, rectangular) and combined footings	CO 6	T1: 7.4,
PROBLEM SOLVING/ CASE STUDIES			
1	Design reinforcement of a reinforced concrete beam a of 300 mm wide and 400 mm deep of grade M 20 to resist an ultimate moment of 150 kN-m. using mild steel bars of grade Fe 250.	CO 1	R2:7.5
2	Determine the moment of resistance of a T- beam having a web width of 240 mm, effective depth of 400 m, flange width of 740 mmand flange thickness equal to 100 mm. The beam is reinforced with 5-16 mm diameter, Fe 415 bars. Use M 20 concrete.	CO 1	T2:3
3	A reinforced concrete beam of a rectangular section 300 mm wide by 600 mm deep is reinforced with 4 bars of 25 mm diameter at an effective depth of 550 mm. the effective span of the beam is 7m, fy = 415 N/mm2 and fck = 20 N/mm2, find the uniformly distributed ultimate load on the beam.	CO 2	R2:7.5
4	Design shear reinforcement for a tapered cantilever beam of span 3 m, having a section of 250 mm effective depth and 300 mm width at the free end, and 550 mm effective depth and 300 mm width at the support (see Fig.). The beam has to support a factored uniform load of 80 kN/m, including its self-weight. Assume an effective cover of 50 mm, Fe 415 steel, and M25 concrete.	CO 2	R2:7.5

5	A simply supported rectangular beam of 12m span has a effective depth of 800mm. The area of tension reinforcement required to support the loads is designed as 1.6deflection control of the beam by empirical method if a) Fe 415 grade steel is used and b) Fe 500 grade steel is used	CO 2	T1: 4.1
6	A rectangular beam section 200 mm wide and 450 mm overall depth is reinforced with 3 bars of 16 mm diameter at an effective depth of 420 mm. Two hanger bars of 12 mm diameter are provided at the compression face. The effective span of the beam is 5 m. The beam supports a service load of 10 kN/m. If f ck = 20 N/mm 2 and f y = 415 N/mm 2. Compute short term deflection.	CO 3	T3:4.5
7	A simply supported reinforced concrete beam is 250 mm wide and 500mm effective depth and is reinforced with 4-20 mm diameter as tensile steel. If the beam is subjected to a factored shear of 65 KN at the support. Find the nominal shear stress at the support. Use M20 concrete and Fe 250 steel.	CO 3	R4:5.2
8	Design the torsional reinforcement in a rectangular beam section, 350 mm wide and 750 mm deep, subjected to an ultimate twisting moment of 140 kNm, combined with an ultimate (hogging) bending moment of 200 kNm and an ultimate shear force of 110kN. Assume M 25 concrete, Fe 415 steel and mild exposure conditions.	CO 4	T2:5.2
9	An R.C.C beam 300 mm x 600 mm in section reinforce with 5-25 mm dia. bars (effective) it is subjected to a design shear force of 200 kN. Comment on its shear design. Use M 20 concrete Fe415 steel.	CO 4	R2:7.5
10	Design a one way slab, with a clear span of 4.0 m, simply supported on 230 mm thick masonry walls, and subjected to a live load of 4 kN/m2 and a surface finish of 1 kN/m2. Assume Fe 415 steel. Assume the beam is subjected to moderate exposure conditions.	CO 5	R2:7.5
11	Design a symmetrically reinforced short column 450 x 450mm under bi axial bending with a load of 1000 KN and Mx = 75 KN-m and My =60 KN-m use M20 grade concrete and fe 415 grade steel.	CO 5	R2:7.5
12	Design a column having an effective length of 4.75 m to support factored load of 1600kN. Consider the reinforcement ratio to be in the range 1.5 to 2.0 percent and the effective cover to longitudinal steel of 55mm. The materials to be used are M25 grade of concrete and HYSD steel bars of grade Fe415.	CO 5	R2:7.5

13	A braced reinforced concrete column of circular cross-section of 500mm diameter is to support a factored axial load of 2300 kN along with a factored moment of 165 kNm. The unsupported length of the column is 6.3m effective length of 5.5m. Design the column when it is to be provided with: i. Lateral ties and ii. Spiral reinforcement. The M25 grade of concrete and HYSD steel bars of grade Fe415.	CO 6	R2:7.5
14	Design an isolated footing for a square column, 450 mm by 450 mm, reinforced with 8–25 bars, and carrying a service load of 2300 kN. Assume soil with a safe bearing capacity of 300 kN/m2 at a depth of 1.5 m below ground. Assume M 20 grade concrete and Fe 415 grade steel for the footing, and M 25 concrete and Fe 415 steel for the column.	CO 6	R2:7.5
15	Design a rectangular isolated sloped footing for a column of size 250 mm x 750 mm carrying an axial load of 2600 kN. The S.B.C. of the soil is 300 kN/m2. Use M 25 grade concrete and Fe 415 grade steel	CO 6	R2:7.5
DISCUSSION OF DEFINITION AND TERMINOLOGY			
1	Objectives of the design of reinforced concrete structure.	CO 1	R4:2.1
2	Types of reinforcements used to resist shear? Explain the action of different types of shear steel.	CO 2	T4:7.3
3	Considerations that govern thickness of one way and two way slabs.	CO 3,4	R4:5.1
4	Role of transverse steel ties in reinforced concrete columns	CO 5	T1:7.5
5	Provision of dowel bars as per IS: 456-2000 code of practice.	CO 6	T1: 4.1
DISCUSSION OF QUESTION BANK			
1	Design of Beams	CO 1	R4:2.1
2	Shear Torsion and Bond	CO 2	T4:7.3
3	Design of Slabs	CO 3,4	R4:5.1
4	Design of Columns	CO 5	T1:7.5
5	Design of Footings	CO 6	T1: 4.1

Signature of Course Coordinator **HOD,CE**
Mr. Gude Ramakrishna , Associate Professor

INSTITUTE OF AERONAUTICAL ENGINEERING
(Autonomous)
Dundigal, Hyderabad - 500 043

COURSE DESCRIPTION

Department	**CIVIL ENGINEERING**				
Course Title	**CONCRETE TECHNOLOGY**				
Course Code	ACE010				
Program	B.Tech				
Semester	V				
Course Type	Core				
Regulation	R16				
Course Structure	Theory			Practical	
	Lecture	Tutorials	Credits	Laboratory	Credits
	3	0	3	-	-
Course Coordinator	Mr. K. Anand Goud , Assistant Professor				

I COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites
-	-	-	-

II COURSE OVERVIEW:

Concrete is the most versatile construction material used all around the world. The study of concrete has become indispensable to the Civil engineering graduates to learn fundamental properties of fresh concrete, hardened concrete, strength and durability. Concrete technology provides a comprehensive coverage of the theoretical and practical aspects of the subject and includes the latest developments in the field of concrete construction. It incorporates the latest Indian standard specifications and codes of practices for regulating concrete construction. The properties of concrete and its constituent materials, the role of various admixtures in modifying these properties to suit specific requirements and situations are also be studied. The course also provides the knowledge on mix design for producing most economical and durable concrete, it also enable the students to acquire knowledge on special and new generation concrete with their applications.

III MARKS DISTRIBUTION:

Subject	SEE Examination	CIE Examination	Total Marks
Concrete Technology	70 Marks	30 Marks	100

IV CONTENT DELIVERY / INSTRUCTIONAL METHODOLOGIES:

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

V EVALUATION METHODOLOGY:

The course will be evaluated for a total of 100 marks, with 30 marks for Continuous Internal Assessment (CIA) and 70 marks for Semester End Examination (SEE). CIA is conducted for a total of 30 marks, with 20 marks for Continuous Internal Examination (CIE), and 10 marks for Alternative Assessment Tool (AAT).

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 14 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
16.6%	Remember
50%	Understand
0%	Apply
33.3 %	Analyze

Continuous Internal Assessment (CIA):
CIA is conducted for a total of 30 marks, with 25 marks for Continuous Internal Examination (CIE) and 05 marks for Quiz \Alternative Assessment Tool (AAT).

Component	Theory		Total Marks
Type of Assessment	CIE Exam	Quiz \AAT	
CIA Marks	25	05	30

Continuous Internal Examination (CIE):
Two CIE exams shall be conducted at the end of the 8^{th} and 17^{th} week of the semester respectively. The CIE exam is conducted for 25 marks of 2 hours duration consisting of two parts. Part–A shall have five compulsory questions of one mark each. In part–B, four out of five questions have to be answered where, each question carries 5 marks. Marks are awarded by taking average of marks scored in two CIE exams.

Quiz - Online Examination
Two Quiz exams shall be online examination consisting of 25 multiple choice questions and are to be answered by choosing the correct answer from a given set of choices (commonly four). Such a question paper shall be useful in testing of knowledge, skills, application, analysis, evaluation and understanding of the students. Marks shall be awarded considering the average of two quiz examinations for every course.

Alternative Assessment Tool (AAT)
This AAT enables faculty to design own assessment patterns during the CIA. The AAT converts the classroom into an effective learning center. The AAT may include tutorial hours/classes, seminars, assignments, term paper, open ended experiments, METE (Modeling and Experimental Tools in Engineering), five minutes video, MOOCs etc. The AAT chosen for this course is given in table

Concept Video	Tech-talk	Complex Problem Solving
40%	40%	20%

VI COURSE OBJECTIVES:

The students will try to learn:

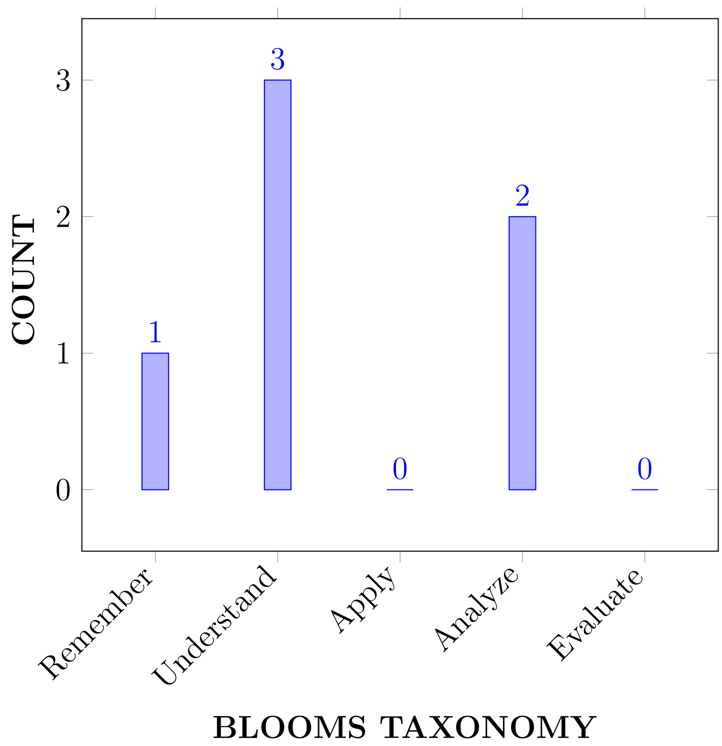
I	The fundamental properties of construction materials such as cement, aggregates and admixtures based on laboratory and filed tests for identifying material quality
II	The factors influencing workability and methods involved in measuring workability of fresh concrete.
III	The importance of water/cement ratio and its influence on compressive tensile and flexural strengths of hardened concrete.
IV	The concept of quality control and design of concrete mix for ensuring quality of concrete.

VII COURSE OUTCOMES:

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

CO 1	**Choose** the basic physical and chemical properties of construction materials for determining quality of concrete.	Remember
CO 2	**Explain** the workability and manufacturing process of concrete for obtaining economical and durable concrete.	Understand
CO 3	**Inspect** the impact of water/cement ratio on strength and durability of concrete by measuring its hardened strength	Analyze
CO 4	**Apply** destructive and Non-destructive tests of hardened concrete for calculating compressive, tensile and flexural strengths	Apply
CO 5	**Develop** the most economical and eco-friendly concrete mix based on standard methods for producing quality of concrete.	Understand
CO 6	**Examine** special concretes and new generation concrete for satisfying the future needs of industry in real time.	Analyze

COURSE KNOWLEDGE COMPETENCY LEVEL



VIII PROGRAM 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

IX 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.	1	CIE/Quiz/AAT
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	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 limitation	3	CIE / SEE/ AAT
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	3	CIE / SEE/ AAT

3 = High; 2 = Medium; 1 = Low

X HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

PROGRAM SPECIFIC OUTCOMES		Strength	Proficiency Assessed by
PSO 1	Design and supervise sub-structures and superstructures for residential and public buildings, industrial structures, irrigation structures, powerhouses, highways, railways, airways, docks and harbours.	1	Quiz / AAT
PSO 2	Focus on improving performance of structures with reference to safety and serviceability and sustainable green building technology	2	Quiz / AAT

3 = High; 2 = Medium; 1 = Low

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

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	✓	✓	-	-	-	-	-	-	-	-	-		✓	-	-
CO 2	-	✓	✓	-	-	-	-	-	-	-	-	-	✓	-	-
CO 3	✓	✓	-	-	-	-	-	-	-	-	-	-	✓	✓	-
CO 4	✓	-	-	-	✓	-	-	-	-	-	-	-	✓	-	-
CO 5	✓	-	-	-	-	-	✓	-	-	-	-		-	✓	-
CO 6	✓	-	✓	-	-	-	✓	-	-	-	-	-	-	✓	-

XII 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 matched.
CO 1	PO 1	Apply the knowledge and **principals of mathematics** to engineering problems for testing the quality of materials using the knowledge of **science and engineering fundamentals.**	2
	PO 2	Analyze and **formulate** the engineering problems todetermine the quality of cement, aggregates and admixtures to produce goodquality of concrete by **identify the problem statement,** formulation **and abstraction** forthe **development of solution.**	4
	PSO 1	Explainthe properties of material sused in sub structures and super structures ofresidential and public buildings with **materialsknowledge** and ensure **qualityassurance.**	2
CO 2	PO 2	Understand the given **problem statement and identifyto formulate**complex engineering problems related to workability of concrete **translatethe information** in to the model and prototype systemfrom the providedinformation and data, **develop solutions**based on the functionality of the concrete, **validate** the condition of concrete in reaching substantiated conclusions by **interpretation** of results.	6
	PO 3	Determine the suitability of concrete after thorough**investigation** and ensure its **fitness for the purpose of all aspectsof the problem including production, operation and maintenance** of concrete.	2
	PSO 1	Identify the condition of fresh concrete basedon workability (slump) for **assessingstrength** with standard **quality**with the help of different **codes ofpractices.**	3

Course Outcomes	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key competencies matched.
CO 3	PO 1	Determinevarious engineering properties like compressive strength, tensile strength andflexural strength of concrete by applying different **own and interdisciplinary engineering practices.**	2
	PO 2	Understandthe given **problem statement andformulate** complex engineering problem related to mechanical properties ofmaterials from the provided **informationand data** in reaching substantiated conclusions by the **interpretation of results.**	4
	PSO 1	Select appropriate water cement ratio forobtaining desired **quality** withdesigned **strength**by adoptingdifferent **codes of practices**.	3
	PSO 2	Identify suitable water cement ratio for **improving the performance** of structuralcomponents.	1
CO 4	PO 1	Identifythe phenomena of creep, shrinkage and elasticity of concrete and use of **science, mathematical** principles forderiving complex engineering equations by understanding appropriate parametricassumptions limitations based on **engineeringfundamentals** of materials.	3
	PO 5	Selectand apply appropriate non-destructive **diagnosticequipment's** (modern tool) to determine the strength of hardened concrete	1
	PSO 1	Make use of appropriate destructive , non-destructive testing methods fordetermining **strength** with the helpof different **codes of practices**.	2
CO 5	PO 1	Choosethe designing procedure to develop a new generation concrete for solvingcomplex engineering problems related toreal world applications along with enhanced performance with minimumaffordability by applying principles of **engineering fundamentals and** their **integration and support with otherengineering disciplines. Mathematics and scientific methodologies.**	3
	PO 7	Understandthe impact of professional engineering solutions in societal and environmentalcontext and develop a special concrete to promote **environmental safety** for sustainable **socio economic development**	2
	PSO 2	Develop most economical and eco friendlyconcrete for **improving the performanceof structures**with reference to **safety and serviceability, and sustainable green building technology.**	3

Course Outcomes	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key competencies matched.
CO 6	PO 1	Choosethe designing procedure to develop a new generation concrete for solvingcomplex engineering problems related toreal world applications along with enhanced performance with minimumaffordability by applying principles of **engineering fundamentals and** their **integration and support with otherengineering disciplines. Mathematics and scientific methodologies.**	3
	PO 3	Investigate and identify special concretes and new generation concrete for satisfying the future needs of industry including **environmental and sustainability** and production, operation, maintenance	2
	PO 7	Understand the impact of professional engineering solutions in societal and environmental context and develop a special concrete and new generation concrete for satisfying the future needs of industry to promote **environmental safety** for sustainable **socio economic development.**	2
	PSO 2	Classify new generation concrete for **improving structural performance** and promoting **green building technology** for enhanced **safety and serviceability** ofstructures.	3

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

XIV 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	66.7	40.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	20.0	0.0	0.0
CO 2	00.0	70.0	20.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	30.0	0.0	0.0
CO 3	66.7	40.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	30.0	33.3	0.0
CO 4	100	00.0	0.0	0.0	100	0.0	0.0	0.0	0.0	0.0	0.0	0.0	20.0	0.0	0.0
CO 5	30.0	0.0	0.0	0.0	0.0	0.0	66.7	0.0	0.0	0.0	0.0	0.0	0.0	100	0.0

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 6	66.7	0.0	20.0	0.0	0.0	0.0	66.7	0.0	0.0	0.0	0.0	0.0	0.0	33.3	0.0

XV COURSE ARTICULATION MATRIX (PO / PSO MAPPING):

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

0 - $0 \leq C \leq 5\%$ – No correlation
1 -5 $< C \leq 40\%$ – Low/ Slight
2 - 40 % $< C < 60\%$ –Moderate
3 - $60\% \leq C < 100\%$ – Substantial /High

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	3	1	-	-	-	-	-	-	-	-	-		1	-	-
CO 2	-	3	1	-	-	-	-	-	-	-	-	-	1	-	-
CO 3	3	1	-	-	-	-	-	-	-	-	-	-	1	1	-
CO 4	3	-	-	-	3	-	-	-	-	-	-		1	-	-
CO 5	1	-	-	-	-	-	3	-	-	-	-	-	-	3	-
CO 6	3	-	1	-	-	-	3	-	-	-	-	-	-	1	-
TOTAL	28	16	2	4	-	-	-	-	-	-	-	-	3	9	6
AVERAGE	2.9	1.6	2	2	-	-	-	-	-	-	-	-	3	3	3

XVI ASSESSMENT METHODOLOGY-DIRECT:

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

XVII ASSESSMENT METHODOLOGY-INDIRECT:

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

XVIII SYLLABUS:

MODULE I	**CEMENT ADMIXTURES AND AGGREGATES**
	Portland cement :chemical composition , hydration, setting of cement , structure of hydrate cement , test on physical properties , different grades of cement Admixtures: Mineral and chemical admixtures, properties, dosage, effects usage. Aggregates: Classification of aggregate, particle shape & texture bond, strength & other mechanical properties of aggregate, specific gravity, bulk density, porosity, adsorption & moisture content of aggregate, bulking of sand, deleterious substance in aggregate, soundness of aggregate , alkali aggregate reaction, thermal properties, sieve analysis, fineness modulus, grading curves, grading of fine & coarse aggregates, gap graded aggregate, maximum aggregate size.
MODULE II	**FRESH CONCRETE**
	Workability :factors affecting workability , measurement of workability by different tests, setting times of concrete, effect of time and temperature on workability, segregation & bleeding, mixing and vibration of concrete, steps in manufacture of concrete, quality of mixing water.
MODULE III	**HARDENED CONCRETE AND ITS TESTING**
	Water / Cement ratio: Abram's Law, Gel space ratio, Nature of strength of concrete, Maturity concept, Strength in tension & compression, factors affecting strength, relation between compression & tensile strength curing.Testing of hardened concrete: compression tests, tension tests, factors affecting strength, flexure tests, splitting tests, Non-destructive testing methods, codal provisions for NDT. elasticity, creep & shrinkage, modulus of elasticity, dynamic modulus of elasticity, Poisson's ratio, creep of concrete, factors influencing creep, relation between creep & time, nature of creep, effects of creep, shrinkage, types of shrinkage.
MODULE IV	**MIX DESIGN**
	Factors in the choice of mix proportions, Durability of concrete, Quality Control of concrete, Statistical methods, Acceptance criteria, Proportioning of concrete mixes by various methods,BISmethod of mix design
MODULE V	**SPECIAL CONCRETE**
	Light weight aggregates, light weight aggregate concrete, cellular concrete , no fines concrete, high density concrete, fiber reinforced concrete, different types of fibers , factors affecting properties of F.R.C, applications, polymer concrete, types of polymer concrete, properties of polymerconcrete applications, high performance concrete, self-consolidating concrete, SIFCON

TEXTBOOKS

1. Shetty, M.S., "Concrete Technology, Theory & Practice", S. Chand and Co,2004
2. Gambhir, M.L., "Concrete Technology", Tata McGraw Hill,2004.

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1. V.N.Vazirani&S.P.Chandola, Ed. by Vineet Kumar," Concrete technology", 6th edition reprint.
2. Santakumar A.R., "Concrete Technology", Oxford University Press, New Delhi,2007.

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1. https://nptel.ac.in/courses/112105171/1

COURSE WEB PAGE:

XIX COURSE PLAN:

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

S.No	Topics to be covered	CO's	Reference T1: 4.1
OBE DISCUSSION			
1	Course objectives, Course outcomes, Program Outcomes and CO-PO Mapping		
CONTENT DELIVERY (THEORY)			
2	Portland cement :chemical composition Hydration, setting of cement.	CO 1	T1: 1.8-1.9, T1: 2.28-2.28.2
3	structure of hydrate cement, Test on physical properties	CO 1	T1: 1.13-1.1
4	Different grades of cement	CO 1	T1:2.1-2.6, T1: 2.18, R2:5.1
5	Admixtures: Mineral and chemical admixtures.	CO 1	T1: 5.1-5.3
6	Admixtures-properties, dosage, effects usage.	CO 1	T1: 5.4-5.5
7	Aggregates: Classification of aggregate, particle shape & texture bond	CO 1	T1: 3.2-3.4, R2:6.3
8	strength and other mechanical properties of aggregate	CO 1	T1: 3.7-3.9
9	specific gravity, bulk density, porosity, adsorption & moisture content of aggregate	CO 1	T1: 3.15-3.18, R2:6.5
10	Bulking of sand,Deleterious substance in aggregate, Soundness of aggregate	CO 1	T1:3.26-3.27, T1:3.19-3.20, T2 :3.50
11	Alkali aggregate reaction, thermal properties	CO 1	T2 :3.6-3.7, R1:7.1
12	Sieve analysis, fineness modulus,Grading curves	CO 1	T2:3.8-3.9
13	grading of fine & coarse aggregates, gap graded aggregate, maximum aggregate size	CO 2	T2:3.9-3.11, R1:7.5

14	Workability :factors affecting workability , measurement of workability by different tests	C02	T2: 6.1-6.4, R2:7.2
15	setting times of concrete, effect of time and temperature on workability	CO 2	T1:6.3-6.36
16	segregation & bleeding, mixing and vibration of concrete	CO 2	T1:6.6, R1:3.5
17	steps in manufacture of concrete, quality of mixing water.	CO 2	T1: 6.6, R1:8.4
18	Water / Cement ratio: Abram's Law, Gel space ratio	CO 2	T1: 6.4-6.5, R1:8.5
19	Nature of strength of concrete, Maturity concept	CO 3	T1: 6.7.1-6.7.7.15
20	Strength in tension & compression, factors affecting strength, relation between compression & tensile strength curing	CO 3	T1: 6.7-6.8
21	Testing of hardened concrete: compression tests, tension tests	CO 3	T1: 4.2-4.3
22	Factors affecting strength, flexure tests, splitting tests	CO 3	T1: 7.2, R1:8.6
23	Non-destructive testing methods, codal provisions for NDT	CO 3	T1: 7.3, R1:8.8
24	Elasticity, creep & shrinkage, modulus of elasticity, dynamic modulus of elasticity, Poisson's ratio	CO 3	T1: 7.4
25	creep of concrete, factors influencing creep, relation between creep & time, nature of creep, effects of creep	CO 3	T1: 7.6, R1:9.1.4
26	shrinkage, types of shrinkage	CO5	T1: 7.8
27	Factors in the choice of mix proportions	CO 5	T1: 7.7 R2:9.2.1
28	Durability of concrete & tensile strength, curing	CO 5	T1: 7.8 R1: 6.8-6.9
29	Quality Control of concrete	CO 5	T1: 10.1-10.2, R1:4.2.3
30	Statistical methods, Acceptance criteria	CO 5	T1:10.7-10.9
31	Proportioning of concrete mixes by various methods	CO5	T1:10.8-10.11, R1: 10.1-10.2
32	Proportioning of concrete mixes by various methods	CO 5	T1:8.1-8.3
33	BIS method of mix design	CO 5	T1:8.1.1-8.1.4
34	BIS method of mix design	CO 5	T1:8.2
35	Light weight aggregates, polymer concrete	CO 6	T1:8.3

36	cellular concrete , no fines concrete, high density concrete	CO 5	T1:11.3
37	fiber reinforced concrete, different types of fibers	CO 6	R1:9.2
38	factors affecting properties of F.R.C, applications	CO 6	R1:11.5
39	high performance concrete	CO 6	R1:11.5-11.7
40	high performance concrete	CO 6	T1:11.9
41	self-consolidating concrete, SIFCON	CO 6	T1:11.13
	PROBLEM SOLVING/ CASE STUDIES		
1	Design the concrete mix for grade M30 with suitable conditions	CO 4	T1:11.13-11.14
2	Design the concrete mix for grade M35 with suitable conditions	CO 4	R2:14.2-14.3
3	Design the concrete mix for grade M 40 with suitable conditions	CO 4	R2:14.15
4	Design the concrete mix for grade M45 with suitable conditions	CO 4	R1:12.8
5	Design the concrete mix for grade M50 with suitable conditions	CO 4	T1:12.10
6	Design of concrete mix for grade M20 with suitable conditions.	CO 4	R1:12.10.2
7	Design the concrete mix for grade M55 with suitable conditions.	CO 4	R1:12.13
8	Design the concrete mix for grade M60 with suitable conditions.	CO 4	R1:12.13.2
9	Fineness modulus of aggregates	CO 1	R2:16.1-16.9
10	Setting time of cement	CO 1	T1:13.1-13.4
11	Affect of gel space ratio on properties of hardened concrete	CO 5	R2:14.2
12	relationship between time and creep	CO 5	R2:14.2-14.3
13	Compressive strength of hardened concrete.	CO 6	R2:14.15
14	creep affect on hardened concrete	CO 6	R1:12.8
15	Effect of water cement ratio on the properties of hardened concrete	CO 6	T1:12.10
	DISCUSSION OF DEFINITION AND TERMINOLOGY		
1	Cement admixtures and aggregates	CO 1	R1:12.10.2
2	Fresh concrete	CO 2	R2:14.2-14.3
3	Hardened concrete and its testing	CO 3	R2:14.15
4	Mix design	CO 4	R2:14.2-14.3

5	Special concrete	CO 5	R2:14.15
DISCUSSION OF QUESTION BANK			
1	Cement admixtures and aggregates	CO 1	R1:12.8
2	Fresh concrete	CO 2	T1:12.10
3	Hardened concrete and its testing	CO 3	R1:12.10.2
4	Mix dsesign	CO 4	R2:14.2-14.3
5	Special concrete	CO 5	R2:14.2-14.3

Signature of Course Coordinator **HOD,CE**

Mr. K. Anand Goud, Assistant Professor

INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

Dundigal, Hyderabad - 500 043

COURSE DESCRIPTION

Department	**CIVIL ENGINEERING**				
Course Title	**HYDRAULICS AND HYDRAULIC MACHINERY**				
Course Code	ACE011				
Program	B.Tech				
Semester	V	CE			
Course Type	Core				
Regulation	R16				
Course Structure	Theory			Practical	
	Lecture	Tutorials	Credits	Laboratory	Credits
	3	1	4	1	-
Course Coordinator	Mrs. N Sri Ramya, Assistant Professor				

I COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites
B.Tech	ACEC03	III	Fluid Mechanics

II COURSE OVERVIEW:

This course is intended to introduce basic principles of fluid mechanics. It is further extended to cover the application of fluid mechanics by the inclusion of fluid machinery especially water turbine and water pumps. Now days the principles of fluid mechanics find wide applications in many situations directly or indirectly. The use of fluid machinery, turbines pumps in general and in power stations in getting as accelerated fill up. Thus, there is a great relevance for this course for mechanical technicians. The Mechanical technicians have to deal with large variety of fluids like water, air, steam, ammonia and even plastics. The major emphasis is given for the study of water. However, the principle dealt with in this course will be applicable to all incompressible fluids.

III MARKS DISTRIBUTION:

Subject	SEE Examination	CIE Examination	Total Marks
Hydraulics and hydraulic machinery	70 Marks	30 Marks	100

IV CONTENT DELIVERY / INSTRUCTIONAL METHODOLOGIES:

✓	PPT	✓	Chalk & Talk	x	Assignments	x	MOOC
✓	Open Ended Experiments	x	Seminars	x	Mini Project	✓	Videos
x	Others						

V EVALUATION METHODOLOGY:

The course will be evaluated for a total of 100 marks, with 30 marks for Continuous Internal Assessment (CIA) and 70 marks for Semester End Examination (SEE). Out of 30 marks allotted for CIA during the semester, marks are awarded by taking average of two CIA examinations or the marks scored in the make-up examination.

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 14 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
16.7%	Remember
33.3 %	Understand
50 %	Apply
10 %	Analyze
0 %	Evaluate
0 %	Create

Continuous Internal Assessment (CIA):
CIA is conducted for a total of 30 marks, with 20 marks for Continuous Internal Examination (CIE), 05 marks for Quiz and 05 marks for Alternative Assessment Tool (AAT).

Component	Theory		Total Marks
Type of Assessment	CIE Exam	Quiz \AAT	
CIA Marks	25	05	30

Continuous Internal Examination (CIE):
Two CIE exams shall be conducted at the end of the 8^{th} and 16^{th} week of the semester respectively. The CIE exam is conducted for 20 marks of 2 hours duration consisting of five descriptive type questions out of which four questions have to be answered where, each question carries 5 marks. Marks are awarded by taking average of marks scored in two CIE exams.

Quiz - Online Examination
Two Quiz exams shall be online examination consisting of 50 multiple choice questions and are to be answered by choosing the correct answer from a given set of choices (commonly four). Such a question paper shall be useful in testing of knowledge, skills, application, analysis, evaluation and understanding of the students. Marks shall be awarded considering the average of two quiz examinations for every course.

Alternative Assessment Tool (AAT)
This AAT enables faculty to design own assessment patterns during the CIA. The AAT converts the classroom into an effective learning center. The AAT may include tutorial hours/classes, seminars, assignments, term paper, open ended experiments, METE (Modeling and Experimental Tools in Engineering), five minutes video, MOOCs etc. The AAT chosen for this course is given in table

Concept Video	Tech-talk	Complex Problem Solving
40%	40%	20%

VI COURSE OBJECTIVES:

The students will try to learn:

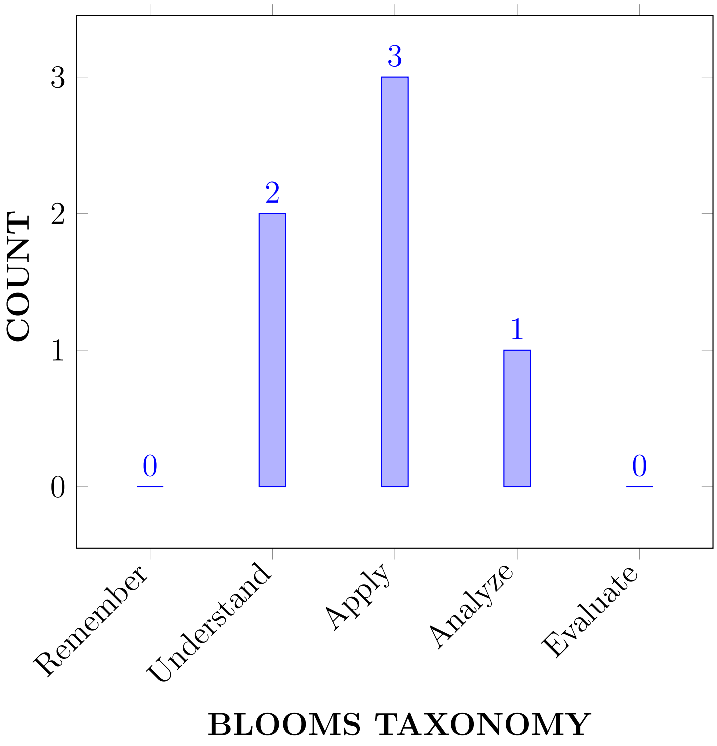
I	The importance of study of open channel flow, to give brief description on different types of flows and channels and hydraulic design principles of channels
II	The fundamentals of Uniform and Non-Uniform flow in open channels and importance of specific energy, critical flow and their applications.
III	The gradually varied flow and rapidly varied flow and their equations and computations and the concepts of momentum principles.
IV	The working principles, functions and applications of pumps and turbines.

VII COURSE OUTCOMES:

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

CO 1	**Summarize** the types and geometrical properties of the open channels and establish the relationships among them for the designing of the most economical sections.	Understand
CO 2	**Apply** the methods of dimensional analysis using Buckingham's pi-Theorem and concept of similitude for dimensional, model and prototype analysis.	Apply
CO 3	**Apply** the concept of Hydrodynamic force of jets on stationary and moving flat inclined and curved vanes, for jet striking centrally and at tip.	Apply
CO 4	**Make use of** angular momentum Principal for jet striking on series vanes to determine the effect of hydrodynamic force of jets.	Apply
CO 5	**Choose** the different types of turbines and its working principle for designing a efficient hydro power plant.	Understand
CO 6	**Analyze** the various types of pumps and performance for determining minimum starting speed, losses and efficiency of pumps.	Analyze

COURSE KNOWLEDGE COMPETENCY LEVEL



VIII PROGRAM 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.

Program Outcomes	
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

IX 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.	1	CIE/Quiz/AAT
PO 4	**Conduct Investigations of Complex Problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.	1	Assignments/ SEE /CIE, AAT, QUIZ
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. e.	3	SEE/ CIE, AAT, QUIZ

3 = High; 2 = Medium; 1 = Low

X HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

PROGRAM SPECIFIC OUTCOMES		Strength	Proficiency Assessed by
PSO 1	Understand, analyze, design, and supervise sub-structures and superstructures for residential and public buildings, industrial structures, irrigation structures, powerhouses, highways, railways, airways, docks, and harbors.	2	Quiz

3 = High; 2 = Medium; 1 = Low

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

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	✓	✓	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 2	✓	✓	-	✓	-	-	-	-	-	✓	-	-	-	-	-
CO 3	✓	✓	-	✓	-	-	-	-	-	-	-	-	✓	-	-
CO 4	✓	✓	-	✓	-	-	-	-	-	-	-	-	✓	-	-
CO 5	✓	✓		-	-	-	-	-	-	-	-		-	-	-
CO 6	✓	✓	-	-	-	-	-	-	-	✓	-	-	✓	-	-

XII 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 matched.
CO 1	PO 1	Recognize (knowledge) the importance and application (apply)of dimensions, units and dimensional homogeneity in solving(complex) engineering problems with specific emphasis to fluid mechanics by applying **the principles of mathematics, knowledge of science and engineering fundamentals.**	3
	PO 2	Understand the given **problem statement and formulate** the problems related to viscous forces from the provided **information and data in to interpret the results.**	2
CO 2	PO 1	Apply the knowledge of **mathematical and science principles** for branching pipe analysis.	2
	PO 2	**Analyze the complex engineering problems** for pipe network analysis using Hardy Cross method to **develop solutions** for pipe network analysis.	2
	PO 4	**Understand** the principles of engineering and **apply**them in finding equivalent pipe for the pipes arranged in series and parallel. .	2

Course Outcomes	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key competencies matched.
	PO 10	Communicate clearly in form of **writing** assignments, preparing **subject matter** in form of Tech Talk and 5 Minute video, and maintain a profound **speaking style.**	3
CO 3	PO 1	Use the **engineering and scientific principles** to understand the conservation laws in differential forms to determine velocities, pressures and acceleration in a moving liquid.	2
	PO 2	Analyze the given **information and data** from the conservation laws in differential forms and **implementing** them for determination of various hydraulic parameters in fluid flows.	2
	PO 4	**Understanding** of differential forms of conservation laws and **apply** them to determine the solutions of **engineering problems.**	3
	PSO 1	Recall the concept of law of conservation of mass and energy in design and analysis of **water conveyance systems with environmental impact and remediation measures.**	2
CO 4	PO 1	Use the **engineering and scientific principles** to understand the conservation laws in differential forms to determine velocities, pressures and acceleration in a moving liquid.	2
	PO 2	Analyze the given **information and data** from the conservation laws in differential forms and **implementing** them for determination of various hydraulic parameters in fluid flows.	2
	PO 4	**Understanding** of differential forms of conservation laws and **apply** them to determine the solutions of **engineering problems.**	3
	PSO 1	Recall the concept of law of conservation of mass and energy in design and analysis of **water conveyance systems with environmental impact and remediation measures.**	2
CO 5	PO 1	Use the **fundamentals of engineering and science** in determining the possibility of flow with the help of velocity potential and stream functions.	2
	PO 2	Understand the concepts of velocity potential, stream function to **develop solutions** using **principles of mathematical and Engineering science**.	3
CO 6	PO 1	Use the **fundamentals of engineering and science** in the determination of total energy of various geometrical cross sections for discharge with applications of Bernoulli's theorem.	2
	PO 2	**Analyze the complex engineering problems** for real flows using Bernoulli's theorem to **develop solutions** for various geometrical cross sections and **validate** with the **experimental design.**	4

Course Outcomes	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key competencies matched.
	PO 10	Communicate clearly in form of **writing** assignments, preparing **subject matter** in form of Tech Talk and 5 Minute video, and maintain a profound **speaking style**	3
	PSO 1	Analyze the **procurement and construction**Techniques confining to **codes of practice** to design the geometrical cross sections for various types of open channels.	3

XIII 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	2	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 2	3	2	-	2	-	-	-	-	-	3	-	-	2	-	-
CO 3	2	2	-	3	-	-	-	-	-	-	-	-	2	-	-
CO 4	2	2	-	3	-	-	-	-	-	-	-		2	-	-
CO 5	2	2	-	-	-	-	-	-	-	-	-	-	-		-
CO 6	2	4	-	-	-	-	-	-	-	3	-	-	3	-	-

XIV 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	20	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 2	67	20	-	18	-	-	-	-	-	60	-	-	50	-	-
CO 3	67	20	-	27	-	-	-	-	-	-	-	-	50	-	-
CO 4	67	20	-	27	-	-	-	-	-	-	-		50	-	-
CO 5	67	20	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 6	67	40	-	-	-	-	-	-	-	60	-	-	67	-	-

XV COURSE ARTICULATION MATRIX (PO / PSO MAPPING):

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

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

1 -$5 < C \leq 40\%$ – Low/ Slight

2 - $40\% < C < 60\%$ –Moderate

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

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	3	1	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 2	3	1	-	1	-	-	-	-	-	3	-	-	2	-	-
CO 3	3	1	-	1	-	-	-	-	-	-	-	-	2	-	-
CO 4	3	1	-	1	-	-	-	-	-	-	-	-	2	-	-
CO 5	3	1	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 6	2	2	-	-	-	-	-	-	-	3	-	-	3	-	-
TOTAL	17	7	-	3	-	-	-	-	-	6	-	-	9	-	-
AVERAGE	3	1	-	1	-	-	-	-	-	3	-	-	2	-	-

XVI ASSESSMENT METHODOLOGY-DIRECT:

CIE Exams	✓	SEE Exams	✓	Seminars	-
Laboratory Practices	-	Student Viva	-	Certification	-
Term Paper	-	Concept Video	✓	Open Ended Experiments	-
Techtalk	✓				

XVII ASSESSMENT METHODOLOGY-INDIRECT:

	Assessment of mini projects by experts	✓	End Semester OBE Feedback

XVIII SYLLABUS:

MODULE I	**OPEN CHANNEL FLOW**
	Types of flows, types of channels, channel characteristics, velocity distribution, determination of velocity using empherical methods, economical sections, critical flow, critical depth, specific energy, hydraulic jump.
MODULE II	**BOUNDARY LAYER THEORY**
	Viscous fluid flow – Boundary conditions – Development of boundary layer – Estimation of boundary layer thickness – Displacement thickness, momentum and energy thickness Characteristics of boundary layer along a thin flat plate, Vonkarmon momentum integral equation, laminar and turbulent Boundary layers separation of BL, control of BL, flow around submerged objects.
MODULE III	**IMPACT OF JETS AND HYDRAULIC TURBINES**
	IMPACT OF JETS: Hydrodynamic force of jets on stationary, moving plates, jet striking centrally and at tip of symmetrical and unsymmetrical vanes, jet striking on series of straight and curved vanes. Velocity triangles at inlet and outlet, principle of angular momentum. HYDRAULIC TURBINES: Classification of hydraulic turbines, selection of hydraulic turbines, working, design principles of impulse and reaction turbines, draft tube, theory and function efficiency, layout of hydropower plant, types of heads and efficiencies.
MODULE IV	**CENTRIFUGAL PUMPS**

	Classification of pumps, work done, manometric head, minimum starting speed, losses and efficiency, specific speed, multistage pump, pumps in parallel, performance of pumps, design of centrifugal pumps, NPSH, cavitation in pumps
MODULE V	**DIMENSIONAL ANALYSIS**
	Dimensional Analysis, dimensionless numbers, methods of dimensional analysis (Buckingham's pi-Theorem). Concept of similitude – model and prototype.

TEXTBOOKS

1. Subramanya K. "Open Channel Flow", Tata McGraw Hill Publications, New Delhi, 2008
2. S. Ramamrutham, "Hydraulic Fluid Mechanics and Fluid Machines", Dhanpat Rai Publishing Company Private Limited, 9th Edition, 2014.
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2. K. Subramanya, "Theory and Applications of Fluid Mechanics", Tata McGraw Hill.
3. 2. R.L. Daugherty, J.B. Franzini and E.J. Finnemore, "Fluid Mechanics with Engineering Applications", International Student Edition, Tata Mc Graw Hill.
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2. http://nptel.ac.in/courses/105103096/
3. http://nptel.ac.in/courses/Webcourse-contents/IIT-KANPUR/machine/ui/TOC.htm

XIX COURSE PLAN:

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

S.No	Topics to be covered	CO's	Reference T1: 4.1
OBE DISCUSSION			
1	Couse objective, course outcomes, program outcomes and CO-PO mapping		
CONTENT DELIVERY (THEORY)			

2	Types of flows, types of channels, channel characteristics, velocity distribution	CO 1	T1: 1.1-3 R2:1-1.7
3	Energy and Momentum correction factors.	CO 1	T1: 2.4 R2:1-1.7
4	Chezy‘s, Manning‘s, Basin‘s formulae for uniform flow.	CO 2	T1: 2.6-14 R2:1-1.7
5	economical sections, critical flow	CO 2	T1: 2.15-20 R1:1-1.7
6	Critical depth, specific energy channel transitions	CO 2	T1: 3.1-.3 R1:2-2.8
7-8	Viscous fluid flow – Boundary conditions – Development of boundary layer .	CO3	T1 – T3 R1 - R3
9-10	Estimation of boundary layer thickness– Displacement thickness, momentum and energy thickness	CO 3	T2: 6.1-5 R1:2-2.8
11-12	Characteristics of boundary layer along a thin flat plate,Vonkarmon momentum integral equation	CO3, CO4	T1: 9.1-5 R2:2-2.8
13-15	Laminar and Turbulent Boundary layers separation of BL, control of BL,flow around submerged objects.	CO 4	T1 – T3 R1 - R3
16-17	Hydrodynamic force of jets on stationary, moving plates,jet striking centrally and at tip of symmetrical and unsymmetrical vanes.	CO 5 CO 6	T2: 9.6-7 R2: 3-3.8
18-19	Jet striking on series of straight and curved vanes.	CO 5, CO6	T2: 4.5
20	Practical applications of Bernoulli’s equation – Venturimeter, orifice meter, pitot tube.	CO 6	T1 – T3 R1 - R3
21	Velocity triangles at inlet and outlet, Principle of angular momentum.	CO 6	T1: 10.1-5 R2: 4-4.8
22-23	Classification of hydraulic turbines, Selection of hydraulic turbines	CO 6	T1: 10.5-7 R2: 4-4.8
24	Working, design principles of impulse and reaction turbines	CO6	T1: 10.7 R2: 4-4.8
25	Draft tube, theory and function efficiency.	CO 6	T1: 11.1-7 R2: 11-11.10
26	Layout of hydropower plant.	CO 6	T4: 2.1 -2.2 R2: 13-13.7
27	Types of heads and efficiencies.	CO 6	T4: 2.3 -2.6 R2: 13-13.7
28-29	Classification of pumps,work done.	CO 6	T4: 2.7 - 2.9 R2: 13-13.7
30	Manometric head.	CO 6	T4: 3.8 -3.10 R2: 19&20
31-33	Minimum starting speed, losses and efficiency,multistage pump,pumps in parallel,performance of pumps	CO 6	T4: 4.1 - 4.6 R2: 19&20
34-35	Design of centrifugal pumps, NPSH, cavitation in pumps	CO 6	T1: 11.1-7 R2: 11-11.10

36	Dimensional Analysis,dimensionless numbers	CO 6	T4: 2.1 -2.2 R2: 13-13.7
37-38	Methods of dimensional analysis (Buckingham's pi-Theorem).	CO 6	T4: 2.3 -2.6 R2: 13-13.7
39-40	Concept of similitude – model and prototype	CO 6	T4: 2.7 - 2.9 R2: 13-13.7
PROBLEM SOLVING/ CASE STUDIES			
1-3	Problems on Open channel flow	CO 1	T2: 4.2-4.13
4-6	Problems on Boundary Layer theory	CO 2	T2: 4.2-4.13
7-9	Problem on Impact of jets and Hydraulic Turbines	CO 3, CO 4	T2: 4.2-4.13
10-12	Problem on Centrifugal Pumps	CO 5	T1.4.2-4.10
13-15	Problems on Dimensional Analysis	CO 6	T1.4.2-4.10
DISCUSSION OF DEFINITION AND TERMINOLOGY			
1	Types of flows, types of channels, channel characteristics, velocity distribution, determination of velocity using empherical methods, economical sections, critical flow, critical depth, specific energy, hydraulic jump.	CO 1	T2: 4.2-4.13
2	Viscous fluid flow – Boundary conditions – Development of boundary layer – Estimation of boundary layer thickness – Displacement thickness, momentum and energy thickness Characteristics of boundary layer along a thin flat plate, Vonkarmon momentum integral equation, laminar and turbulent Boundary layers separation of BL, control of BL, flow around submerged objects.	CO 2	T1.4.2-4.10
3	IMPACT OF JETS: Hydrodynamic force of jets on stationary, moving plates, jet striking centrally and at tip of symmetrical and unsymmetrical vanes, jet striking on series of straight and curved vanes. Velocity triangles at inlet and outlet, principle of angular momentum. HYDRAULIC TURBINES: Classification of hydraulic turbines, selection of hydraulic turbines, working, design principles of impulse and reaction turbines, draft tube, theory and function efficiency, layout of hydropower plant, types of heads and efficiencies.	CO 3, CO 4	T2:5.2-5.7
4	Classification of pumps, work done, manometric head, minimum starting speed, losses and efficiency, specific speed, multistage pump, pumps in parallel, performance of pumps, design of centrifugal pumps, NPSH, cavitation in pumps	CO 5	T2:9.1-9.7
5	Dimensional Analysis, dimensionless numbers, methods of dimensional analysis (Buckingham's pi-Theorem). Concept of similitude – model and prototype..	CO 6	T2:11.1-11.4 R3:12.34-12.36
DISCUSSION OF QUESTION BANK			

1	Types of flows, types of channels, channel characteristics, velocity distribution, determination of velocity using empherical methods, economical sections, critical flow, critical depth, specific energy, hydraulic jump.	CO 1	T2: 4.2-4.13
2	Viscous fluid flow – Boundary conditions – Development of boundary layer – Estimation of boundary layer thickness – Displacement thickness, momentum and energy thickness Characteristics of boundary layer along a thin flat plate, Vonkarmon momentum integral equation, laminar and turbulent Boundary layers separation of BL, control of BL, flow around submerged objects.	CO 2	T1.4.2-4.10
3	IMPACT OF JETS: Hydrodynamic force of jets on stationary, moving plates, jet striking centrally and at tip of symmetrical and unsymmetrical vanes, jet striking on series of straight and curved vanes. Velocity triangles at inlet and outlet, principle of angular momentum. HYDRAULIC TURBINES: Classification of hydraulic turbines, selection of hydraulic turbines, working, design principles of impulse and reaction turbines, draft tube, theory and function efficiency, layout of hydropower plant, types of heads and efficiencies.	CO 3, CO 4	T2:5.2-5.7
4	Classification of pumps, work done, manometric head, minimum starting speed, losses and efficiency, specific speed, multistage pump, pumps in parallel, performance of pumps, design of centrifugal pumps, NPSH, cavitation in pumps	CO 5	T2:9.1-9.7
5	Dimensional Analysis, dimensionless numbers, methods of dimensional analysis (Buckingham's pi-Theorem). Concept of similitude – model and prototype..	CO 6	T2:11.1-11.4 R3:12.34-12.36

Signature of Course Coordinator **HOD,CE**
Ms. N Sri Ramya, Assistant Professor

INSTITUTE OF AERONAUTICAL ENGINEERING
(Autonomous)
Dundigal, Hyderabad - 500 043

COURSE DESCRIPTION

Department	**CIVIL ENGINEERING**				
Course Title	**BUSINESS ECONOMICS AND FINANCIAL ANALYSIS**				
Course Code	AHS015				
Program	B.Tech				
Semester	V				
Course Type	SKILL				
Regulation	R-16				
Course Structure	Theory			Practical	
	Lecture	Tutorials	Credits	Laboratory	Credits
	3	-	3	-	-
Course Coordinator	Dr. S. Sivasankara Rao, Associate Professor				

I COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites
-	-	-	-

II COURSE OVERVIEW:

The present course is designed in such a way that it gives an overview of concepts of Economics. Managerial Economics enables students to understand micro environment in which markets operate how price determination is done under different kinds of competitions. Financial Analysis gives clear idea about concepts, conventions and accounting procedures along with introducing students to fundamentals of ratio analysis and interpretation of financial statements. Break Even Analysis is very helpful to the Business Concern for Decision Making, controlling and forward Strategic Planning. Ratio analysis gives an idea about financial forecasting, financial planning, controlling the business and decision making.

III MARKS DISTRIBUTION:

Subject	SEE Examination	CIE Examination	Total Marks
BEFA	70 Marks	30 Marks	100

IV CONTENT DELIVERY / INSTRUCTIONAL METHODOLOGIES:

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

V EVALUATION METHODOLOGY:

The course will be evaluated for a total of 100 marks, with 30 marks for Continuous Internal Assessment (CIA) and 70 marks for Semester End Examination (SEE). Out of 30 marks allotted for CIA during the semester, marks are awarded by taking average of two CIA examinations or the marks scored in the make-up examination.

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 14 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
16%	Remember
17%	Understand
17%	Apply
50%	Analyze
0%	Evaluate
0%	Create

Continuous Internal Assessment (CIA):
CIA is conducted for a total of 30 marks, with 20 marks for Continuous Internal Examination (CIE), 05 marks for Quiz and 05 marks for Alternative Assessment Tool (AAT).

Component	Theory			Total Marks
Type of Assessment	CIE Exam	Quiz	AAT	
CIA Marks	25	05	-	30

Continuous Internal Examination (CIE):
Two CIE exams shall be conducted at the end of the 8^{th} and 16^{th} week of the semester respectively. The CIE exam is conducted for 20 marks of 2 hours duration consisting of five descriptive type questions out of which four questions have to be answered where, each question carries 5 marks. Marks are awarded by taking average of marks scored in two CIE exams.

Quiz - Online Examination
Two Quiz exams shall be online examination consisting of 50 multiple choice questions and are to be answered by choosing the correct answer from a given set of choices (commonly four). Such a question paper shall be useful in testing of knowledge, skills, application, analysis, evaluation and understanding of the students. Marks shall be awarded considering the average of two quiz examinations for every course.

Alternative Assessment Tool (AAT)
This AAT enables faculty to design own assessment patterns during the CIA. The AAT converts the classroom into an effective learning center. The AAT may include tutorial hours/classes, seminars, assignments, term paper, open ended experiments, METE (Modeling and Experimental Tools in Engineering), five minutes video, MOOCs etc. The AAT chosen for this course is given in table

Concept Video	Tech-talk	Complex Problem Solving
40%	40%	20%

VI COURSE OBJECTIVES:

The students will try to learn:

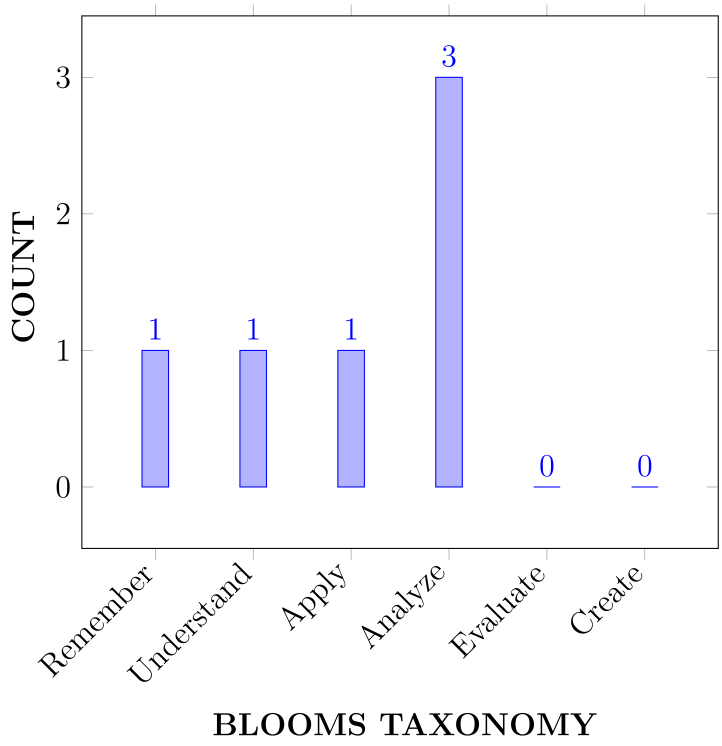
I	The concepts of business economics and demand analysis helps in optimal decision making in business environment
II	The functional relationship between Production and factors of production and able to compute breakeven point to illustrate the various uses of breakeven analysis.
III	The features, merits and demerits of different forms of business organizations existing in the modern business environment and market structures.
IV	The concept of capital budgeting and allocations of the resources through capital budgeting methods and compute simple problems for project management.
V	Various accounting concepts and different types of financial ratios for knowing financial positions of business concern.

VII COURSE OUTCOMES:

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

CO 1	**List** the basic concepts of managerial economics and analysis, measurement of demand and its forecasting to know the current status of goods and services.	Remember
CO 2	**Examine** to know the current status of goods and services. to know the economies and diseconomies of scale in manufacturing sector.	Analyze
CO 3	**Summarize** the four basic market models like perfect competition, monopoly, monopolistic competition, and oligopoly to know the price and quantity are determined in each model.	Understand
CO 4	**Compare** various types of business organizations and discuss their implications for resource allocation to strengthen the market environment.	Analyze
CO 5	**Analyze** different project proposals by applying capital budgeting techniques to interpret the solutions for real time problems in various business projects.	Analyze
CO 6	**Develop** the ability to use a basic accounting system along with the application of ratios to create (record, classify, and summarize) the data needed to know the financial position of the organization.	Apply

COURSE KNOWLEDGE COMPETENCY LEVEL



VIII PROGRAM 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.

Program Outcomes	
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

IX HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

PROGRAM SPECIFIC OUTCOMES		Strength	Proficiency Assessed by
PSO 1	Design and Supervise Sub-Structures and Super Structures for Residential and Public Buildings, Industrial Structures, Irrigation Structures, Power Houses, Highways, Railways, Airways, Docs and Harbours.	-	-
PSO 2	Focus on Improving Performance of Structures with reference to Safety, Serviceability and Sustainable Green Building Technology.	-	-
PSO 3	Make use of Advanced Structural Analysis and Project Management Software for creating Modern Avenues to succeed as an Entrepreneur, Pursue Higher Studies and Career Paths.	-	-

3 = High; 2 = Medium; 1 = Low

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

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	✓	✓	-	-	-	-	-	✓	✓	-	✓	-	-	-	-
CO 2	✓	✓	-	-	-	-	-	✓	✓	-	✓	-	-	-	-
CO 3	-	-	-	-	-	-	-	✓	✓	-	-	-	-	-	-
CO 4	-	-	-	-	-	-	-	✓	✓	-	-	-	-	-	-
CO 5	✓	-	-	-	-	-	-	-	-	-	✓	-	-	-	-
CO 6	-	✓	-	-	-	-	-	-	-	-	✓	-	-	-	-

XI 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 matched.
CO 1	PO 1	**Recall** (knowledge) the scientific fundamentals of economic activities performed by the businessmen in the business for profit earning.	2
	PO 2	**Interpret** and identify the demand and its analysis with the mathematical and natural principles of demand forecasting methods.	6
	PO 8	**Define** (knowledge) the responsibilities of the engineering practices by knowing the best economical practices.	1
	PO 9	**Match** (knowledge) the economical implication to effectively function as a team member, and as a member or leader in diverse teams.	5
	PO 11	**Relate** (knowledge) the knowledge and understanding of the economic principles 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.	6
CO 2	PO 1	**Recall** (Knowledge) the knowledge of mathematics, science in the production function through Different Combination of variable inputs with Economies of Scale.	2
	PO 2	**Demonstrate** the different cost concepts and determine the significance of Break Even Analysis.	5
	PO 8	**Relate** (Knowledge) (Knowledge) the ethical principles and commit to professional ethics and responsibilities and norms of the production management	2
	PO 9	**Show** (Fundamentals) the production function implications for effective implementation of gang compositions in a team work and in multidisciplinary settings.	6
	PO 11	**Define** the economies of scale in production function and Break Even Analysis knowledge applied in one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.	5
CO 3	PO 8	**List** (Knowledge) (Knowledge) different structures of market and how price is determined under different market structures commit to professional ethics and responsibilities and norms of the engineering practice.	2
	PO 9	**Match** the market structures and the market entry strategies as an individual, and as a member in diverse teams.	6
CO 4	PO 8	**Categorize** the ethical principles and commit to professional ethics and responsibilities belongs to different forms of business organizations existing in the modern business.	2

Course Outcomes	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key competencies matched.
	PO 9	**Classify** various business organizations and their functioning as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.	6
CO 5	PO 1	**Explain** the ethical issues involved in the allocation of funds under the concept of capital budgeting.	1
	PO 11	**Summarize** the concept of capital budgeting and allocations of the resources through capital budgeting methods of the 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.	8
CO 6	PO 2	**Explain** the GAAP principles and ratios to analyse complex engineering problems reaching substantiated conclusions using first principles of accounts and profitability and efficiency of the organization.	6
	PO 11	**Illustrate**the accounting methods and procedures and accounting principles to manage the financial aspects in a project.	8

XII 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	2	6	-	-	-	-	-	1	5	-	6	-	-	-	-
CO 2	2	5	-	-	-	-	-	2	6	-	5	-	-	-	-
CO 3	-	-	-	-	-	-	-	2	6	-	-	-	-	-	-
CO 4	-	-	-	-	-	-	-	2	6	-	-	-	-	-	-
CO 5	1	-	-	-	-	-	-	-	-	-	8	-	-	-	-
CO 6	-	2	-	-	-	-	-	-	-	-	8	-	-	-	-

XIII 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	66.7	60.0	-	-	-	-	-	33.3	41.6	-	50.0	-	-	-	-
CO 2	66.7	50.0	-	-	-	-	-	66.7	50.0	-	41.6	-	-	-	-
CO 3	-	-	-	-	-	-	-	66.7	50.0	-	-	-	-	-	-
CO 4	-	-	-	-	-	-	-	66.7	50.0	-	-	-	-	-	-
CO 5	33.3	-	-	-	-	-	-	-	-	-	75.0	-	-	-	-
CO 6	-	20.0	-	-	-	-	-	-	-	-	75.0	-	-	-	-

XIV COURSE ARTICULATION MATRIX (PO / PSO MAPPING):

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

0 - $0 \leq C \leq 5\%$ – No correlation
1 -$5 < C \leq 40\%$ – Low/ Slight
2 - $40\ \% < C < 60\%$ –Moderate
3 - $60\% \leq C < 100\%$ – Substantial /High

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	3	3	-	-	-	-	-	1	2	-	2	-	-	-	-
CO 2	3	2	-	-	-	-	-	3	2	-	2	-	-	-	-
CO 3	-	-	-	-	-	-	-	3	2	-	-	-	-	-	-
CO 4	-	-	-	-	-	-	-	3	2	-	-	-	-	-	-
CO 5	1	-	-	-	-	-	-	-	-	-	3	-	-	-	-
CO 6	-	1	-	-	-	-	-	-	-	-	3	-	-	-	-
TOTAL	7	7	-	-	-	-	-	10	8	-	-	-	-	-	-
AVERAGE	2.3	2.3	-	-	-	-	-	2.5	2	-	2.5	-	-	-	-

XV ASSESSMENT METHODOLOGY-DIRECT:

CIE Exams	PO 1, PO 2, PO 8,PO 9 PO 11	SEE Exams	PO 1, PO 2, PO 8,PO 9 PO 11	Seminars	PO8
Laboratory Practices	-	Student Viva	-	Certification	-
Term Paper	-	5 Minutes Video	PO 1, PO 2, PO 8,PO 9 PO 11	Open Ended Experiments	-
Assignments	PO 9				

XVI ASSESSMENT METHODOLOGY-INDIRECT:

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

XVII SYLLABUS:

MODULE I	**INTRODUCTION&DEMAND ANALYSIS**
	Introduction to Business Economics: Definition, Nature and Scope of Managerial Economics – Demand Analysis: Demand Determinants, Law of Demand and its exceptions. Elasticity of Demand: Definition, Types, Measurement and Significance of Elasticity of Demand. Demand Forecasting, Factors governing demand forecasting, methods of demand forecasting

MODULE II	**PRODUCTION & COST ANALYSIS**
	Theory of Production and Cost Analysis: Production Function – Iso-quants and Iso-costs, MRTS, Least Cost Combination of Inputs, Cobb-Douglas Production function, Laws of Returns, Internal and External Economies of Scale. Cost Analysis: Cost concepts; Break-even analysis, Determination of Break – Even point (Simple Problems) , Managerial Significance of BEA.
MODULE III	**MARKETS & NEW ECONOMIC ENVIRONMENT**
	LMarket structures: Types of competition, Features of perfect competition, Monopoly and monopolistic competition. Price determination & Price Statistics: Price Output determination in case of perfect competition and monopoly. Features and evaluation of different forms of Business organization: Sole proprietorship, partnership, Joint Stock Company, public enterprises and their types.
MODULE IV	**CAPITAL BUDGETING**
	Capital and its significance, types of capital, estimation of fixed and working capital requirements, methods and sources of raising capital- Trading Forecast, Capital budget, Cash Budget. Features of capital budgeting proposals, methods of capital budgeting – payback method, Accounting rate of return(ARR), Net Present Value Method (simple problems).
MODULE V	**INTRODUCTION TO FINANCIAL ACCOUNTING AND FINANCIAL ANALYSIS**
	Financial accounting objectives, functions, importance; Accounting concepts and accounting conventions - double-entry book keeping, journal, ledger, trial balance; Final accounts: Trading account, profit and loss account and balance sheet with simple adjustments; Financial analysis: Analysis and interpretation of liquidity ratios, activity ratios, capital structure ratios and profitability ratios (simple problems), Du Pont chart.

TEXTBOOKS

1. Aryasri, "Managerial Economics and Financial Analysis", TMH publications, 4thEdition,2012.
2. M. KasiReddy, Saraswathi, "Managerial Economics and Financial Analysis", PHI Publications, New Delhi, 2ndEdition,2012.
3. Varshney, Maheswari, "Managerial Economics", Sultan Chand Publications, 11thEdition,2009.

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1. D.N. Dwivedi, "Managerial Economics", Vikas Publication House Pvt.Ltd, 2ndEdition,2012.
2. S.N. Maheshwari & S.K.Maheshwari, "Financial Accounting", Vikas Publication House Pvt.Ltd,4thEdition, 2012.
3. R.NarayanaSwamy, "Financial Accounting- A managerial Perspective", Pearson publications, 1stIndian Reprint Edition,2012.

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3. https://corporatefinanceinstitute.com/resources/knowledge/modeling/break-even-analysis/
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6. https://courses.lumenlearning.com/boundless-finance/chapter/introduction-to-capital-budgeting/
7. https://jkbhardwaj.com/20-transactions-with-their-journal-entries-ledger-and-trial-balance/
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10. https://caknowledge.com/how-to-prepare-final-accounts/
11. https://corporatefinanceinstitute.com/resources/knowledge/finance/ratio-analysis/

COURSE WEB PAGE:

https://lms.iare.ac.in/index?route=publicprofile&id=5201

XVIII 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	Discussion on Course Outcomes and how these COs mapped with POs and PSOs.		
	CONTENT DELIVERY (THEORY)		
2-3	Explain about managerial economics according to the business	CO 1	T1- 1.3-1.8 R1-1.5-1.7
4-5	Describe about demand analysis, the Law of Demand and Demand Function.	CO 1	T1-2.2-2.11 R1-3.3-3.20
6-7	Understand elasticity of the demand of the product, different types, Measurement of Elasticity of Demand and Factors influencing on Elasticity of Demand.	CO 1	T1-3.3-3.20 R1- 5.29-6.8
8	State different methods of Demand Forecasting and the factors governing Demand Forecasting.	CO 1	T1-4.6-4.19
9-10	Demonstrate the Production function, features of Iso-Quants and Iso-Costs, different types of Internal Economies, External Economies and Law of Returns.	CO 2	T1- 5.3-5.18 R1- 5.29-6.8
11-13	Different types of Internal Economies, External Economies ad Law of Returns with appropriate examples.	CO 2	T1- 5.3-5.18
14-15	Illustrate different types of costs	CO 2	T1- 5.29-6.8
16-17	Explain the Significance and Limitations of Break-Even Analysis	CO 2	T1- 7.13-7.14
18-19	Calculate Break-Even Point (Simple Problems)	CO 2	T1- 7.1-7.12

20-21	Illustrate the features, price-output determination under Perfect Competition, Monopoly and Monopolistic competition Markets.	CO 3	T1- 8.4-8.16 R2- 5.29-6.8
22-24	Demonstrate the Objectives, Policies and Methods of Pricing Strategies and Price Methods.	CO 3	T1- 8.21-8.25
25-26	Describe Features of business, Definitions of Various forms of Business Units.	CO 4	T1-9.3-9.15
27-30	State the Merits & Demerits of Different types of Public Enterprises and Changing Business Environment to Post Liberalization Scenario.	CO 4	T1-9.2-10.23 R1- 8.21-8.25
31-32	Explain the significance and classification of capital, Methods and Sources of Raising Finance.	CO 6	T1-9.2-10.23
33-34	Demonstrate the concept of capital budgeting and allocations of the resources through capital budgeting methods and compute simple problems.	CO 6	T1-11.3-11.5 R2-12.3-12.5
35-37	Illustrate the Significance of Financial Accounting, Double Entry, Accounts, Accounting Concepts and Conventions	CO 6	T1-12.1-12.26
38-40	Explain the meaning, advantages and Limitations of the Journal, Ledger and Trial Balance and Final Accounts and Solve simple Problems.	CO 6	T1-13.4-13.15 R2-11.3-11.5
41-42	Describe Meaning, Definitions and Limitations of Ratio Analysis	CO 6	T1-13.4-13.15 R2-11.7-11.8
43-45	Compute different types of Financial Ratios (Problems)	CO 6	T1-13.5-13.68
PROBLEM SOLVING/ CASE STUDIES			
46	Problems relating to Demand elasticty measurement and Forecasting	CO 1	T1: 1.1 - 2.8, R1:2.1
47	Problems relation to Break Even Point	CO 2	T2: 3.0 to 3.6, 5.0 to5.5 , R2:4.4
48	Problems in determining the price in different types of markets	CO 3,4	T3: 6.0 to 6.4, R1:5.1
49	Problems relating to Capital Budgeting Decisions	CO 5	R2:7.5
50	Problems relating to Final Accounts and Calculation of Ratios	CO 6	R3: 4.1
DISCUSSION OF DEFINITION AND TERMINOLOGY			
51	Introduction and Demand Analysis	CO 1	T1: 1.1 - 2.8, R1:2.1
52	Production and Cost Analysis	CO 2	T2: 3.0 to 3.6, 5.0 to5.5 , R2:4.4
53	Markets and New Environment	CO 3,4	T3: 6.0 to 6.4, R1:5.1
54	Capital Budgeting	CO 5	R2:7.5
55	Introduciton to Financial Accounting and Financial Analysis	CO 6	R3: 4.1

DISCUSSION OF QUESTION BANK			
56	Introduction and Demand Analysis	CO 1	T1: 1.1 - 2.8, R1:2.1
57	Production and Cost Analysis	CO 2	T2: 3.0 to 3.6, 5.0 to5.5 , R2:4.4
58	Markets and New Environment	CO 3,4	T3: 6.0 to 6.4, R1:5.1
59	Capital Budgeting	CO 5	R2:7.5
60	Introduciton to Financial Accounting and Financial Analysis	CO 6	R3: 4.1

Signature of Course Coordinator **HOD,CE**
Dr. S. Sivasankara Rao, Associate Professor

INSTITUTE OF AERONAUTICAL ENGINEERING
(Autonomous)
Dundigal, Hyderabad - 500 043
COURSE DESCRIPTION

Course Title	**CIVIL ENGINEERING**				
Course Title	**DISASTER MANAGEMENT AND MITIGATION**				
Course Code	ACE533				
Program	B.Tech				
Semester	VI	CE			
Course Type	Open Elective				
Regulation	IARE - R16				
Course Structure	Theory			Practical	
	Lecture	Tutorials	Credits	Laboratory	Credits
	3	-	3	-	-
Course Coordinator	Mr S. SivaRamaKrishna, Assistant Professor				

I COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites
-	-	-	-

II COURSE OVERVIEW:

This course Disaster Management and Mitigation is intended to provide fundamental understanding of different aspects of Disaster Management. It will expose the students to the concept and functions of Disaster Management and to build competencies of Disaster Management professionals and development practitioners for effective supporting environment as put by the government in legislative manner. It would also provide basic knowledge, skills pertaining to Planning, Organizing and Decision-making process for Disaster Risk Reduction.

III MARKS DISTRIBUTION:

Subject	SEE Examination	CIE Examination	Total Marks
Disaster Management	70 Marks	30 Marks	100

IV CONTENT DELIVERY / INSTRUCTIONAL METHODOLOGIES:

✓	PPT	✓	Chalk & Talk	✓	Assignments	x	MOOC
x	Open Ended Experiments	x	Seminars	x	Mini Project	x	Videos
x	Others						

V EVALUATION METHODOLOGY:

The course will be evaluated for a total of 100 marks, with 30 marks for Continuous Internal Assessment (CIA) and 70 marks for Semester End Examination (SEE). Out of 30 marks allotted for CIA during the semester, marks are awarded by taking average of two CIA examinations or the marks scored in the make-up examination.

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 14 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 Table: 1.

Percentage of Cognitive Level	Blooms Taxonomy Level
22%	Remember
66 %	Understand
22 %	Apply
0 %	Analyze
0 %	Evaluate
0 %	Create

Continuous Internal Assessment (CIA):
CIA is conducted for a total of 30 marks, with 25 marks for Continuous Internal Examination (CIE) and 05 marks for Quiz \Alternative Assessment Tool (AAT).

Component	Theory		Total Marks
Type of Assessment	CIE Exam	Quiz \AAT	
CIA Marks	25	05	30

Continuous Internal Examination (CIE):
Two CIE exams shall be conducted at the end of the 8th and 16th week of the semester respectively. The CIE exam is conducted for 20 marks of 2 hours duration consisting of five descriptive type questions out of which four questions have to be answered where, each question carries 5 marks. Marks are awarded by taking average of marks scored in two CIE exams

Quiz - Online Examination
Two Quiz exams shall be online examination consisting of 25 multiple choice questions and are to be answered by choosing the correct answer from a given set of choices (commonly four). Such a question paper shall be useful in testing of knowledge, skills, application, analysis, evaluation and understanding of the students. Marks shall be awarded considering the average of two quiz examinations for every course.

Alternative Assessment Tool (AAT)
This AAT enables faculty to design own assessment patterns during the CIA. The AAT converts the classroom into an effective learning center. The AAT may include tutorial hours/classes, seminars, assignments, term paper, open ended experiments, METE (Modeling and Experimental Tools in Engineering), five minutes video, MOOCs etc. The AAT chosen for this course is given in table

Concept Video	**Tech-talk**	**Open Ended Experiment**
40%	40%	20%

VI COURSE OBJECTIVES:

The students will try to learn:

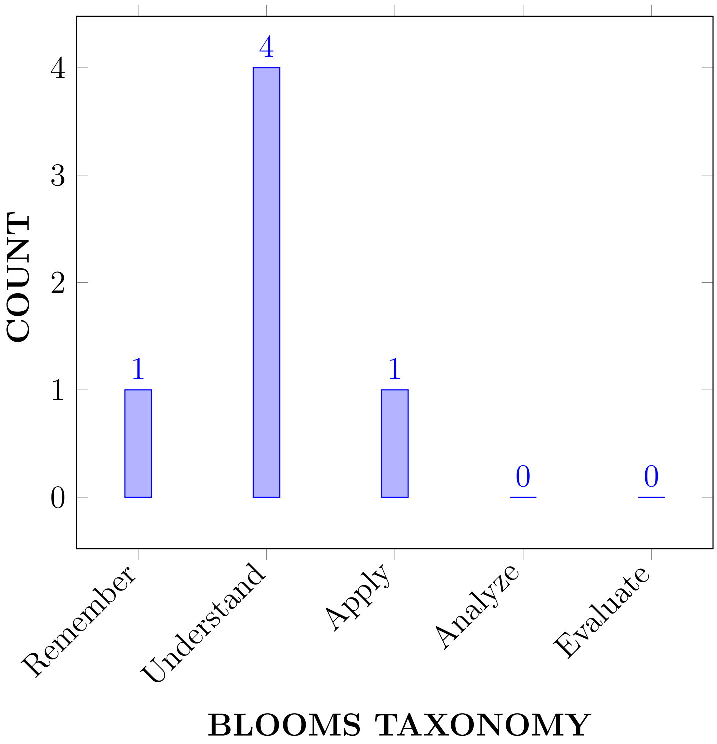
I	Identify the major disaster types and develop an understanding of modern disastermanagement.
II	Recognize and develop awareness of the chronological phases of natural disaster response and refugee relief operations.
III	Understand the key concepts of disaster management related to development and the relationship of different disaster management activities.
IV	Categorize the organizations that are involved in natural disaster assistance and reliefsystem.

VII COURSE OUTCOMES:

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

CO 1	**Classify** Environmental hazards for developing modern disaster management system.	Understand
CO 2	**Explain** various approaches for reducing the level of risk associated with Disasters.	Understand
CO 3	**Compare** natural and manmade disasters for finding out intensity of damage loss occurred by them.	Understand
CO 4	**List** various hazards and their effects for evaluating their impact on society and Environment.	Remember
CO 5	**Identify** Post Disaster stages and Rehabilitation for disaster mitigation towards the restoration of human-centered services.	Apply
CO 6	**Summarize** disaster phenomenon and its different contextual aspects for implementing the Disaster Risk Reduction Strategy.	Understand

COURSE KNOWLEDGE COMPETENCY LEVEL



VIII PROGRAM 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 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

IX HOW PROGRAM OUTCOMES ARE ASSESSED:

Program Outcome		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.	2	CIE/SEE/AAT

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	CIE/SEE/AAT
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.	3	CIE/SEE/AAT

3 = High; 2 = Medium; 1 = Low

X HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

Program Outcome		Strength	Proficiency Assessed by
PSO 1	Design and Supervise Sub-Structures and Super Structures for Residential and Public Buildings, Industrial Structures, Irrigation Structures, Power Houses, Highways, Railways, Airways, Docs and Harbours.	-	-
PSO 2	Focus on Improving Performance of Structures with reference to Safety, Serviceability and Sustainable Green Building Technology.	-	-
PSO 3	Make use of Advanced Structural Analysis and Project Management Software for creating Modern Avenues to succeed as an Entrepreneur, Pursue Higher Studies and Career Paths.	-	-

3 = High; 2 = Medium; 1 = Low

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

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	✓	-	-	-	-	-	✓	-	-	-	-	-	-	-	-
CO 2	✓	-	-	-	-	✓	-	-	-	-	-	-	-	-	-
CO 3	-	-	-	-	-	✓	✓	-	-	-	-	-	-	-	-
CO 4	-	-	-	-	-	✓	✓	-	-	-	-	-	-	-	-
CO 5	✓	-	-	-	-	✓	-	-	-	-	-	-	-	-	-
CO 6	✓	-	-	-	-	✓	-	-	-	-	-	-	-	-	-

XII 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 **science** and **Engineering fundamentals** to differentiate hazards and disasters and to develop a modern disaster management system	2
	PO 7	Understand the disaster management by considering **Environmental** impacts on the livelihood and their effect on **Socio economic** issues for sustainable development.	2
CO 2	PO 1	Apply the knowledge on various disaster mitigation approaches in **engineering disciplines** and use their application in geographical researches.	1
	PO 6	Apply the engineering knowledge in disaster management to **promote sustainable development** and build **Awareness on health**, safety, and risk issues associated with Disasters.	2
CO 3	PO 6	Identify **engineering activities including personnel, health, safety, and risk and effective disaster management strategies** for implementing, analyzing disaster impacts on human life and environment.	2
	PO 7	Understand intensity of disasters and their impact on **environment** and influence on **socio economic** parameter for assessment of intensity of risk.	2
CO 4	PO 6	Identify **engineering activities including personnel, health, safety, and risk** for analyzing hazard impacts on environment.	1
	PO 7	Identify the impact of various hazards in **socio economic and environmental** aspects for developing modern disaster management system.	2
CO 5	PO 1	Understand the **methodology and scientific principal** in Post Disaster stages and Rehabilitation for disaster mitigation.	1
	PO 6	Understanding of the need for a **high level of professional and ethical conduct in engineering** for human adjustments, perception with effective **management strategies** for disaster mitigation.	2
CO 6	PO 1	Understand the **knowledge of scientific principal and methodology** in disaster phenomenon for minimizing impact by implementing the Disaster Risk Reduction Strategy.	1
	PO 6	**Appropriate management strategies** are to be applied to reduce the level of risk in disaster mitigation.	1

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

XIV 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	-	-	-	-	-	66.6	-	-	-	-	-	-	-	-
CO 2	33.3	-	-	-	-	40	-	-	-	-	-	-	-	-	-
CO 3	-	-	-	-	-	40	66.6	-	-	-	-	-	-	-	-
CO 4	-	-	-	-	-	20	66.6	-	-	-	-		-	-	-
CO 5	33.3	-	-	-	-	20	-	-	-	-	-	-	-	-	-
CO 6	33.3	-	-	-	-	20	-	-	-	-	-	-	-	-	-

XV COURSE ARTICULATION MATRIX (PO – PSO MAPPING):

CO'S and PO'S and CO'S and PSO'S on the scale of 0 to 3, 0 being no correlation, 1 being the low correlation, 2 being medium correlation and 3 being high correlation.
0 - $0 \leq$ C$\leq$ 5% – No correlation
1 -5 <C$\leq$ 40% – Low/ Slight
2 - 40 % <C < 60% –Moderate
3 - 60% $\leq$ C < 100% – Substantial /High

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

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	2	-	-	-	-	1	3	-	-	-	-	-	-	-	-

XVI ASSESSMENT METHODOLOGY DIRECT:

CIE Exams	✓	SEE Exams	✓	Seminars	-
Laboratory Practices	-	Student Viva	-	Certification	-
Term Paper	-	Concept Video	-	Open Ended Experiments	-
Assignments	✓				

XVII ASSESSMENT METHODOLOGY-INDIRECT:

	Assessment of mini projects by experts	✓	End Semester OBE Feedback

XVIII SYLLABUS:

UNIT I	**ENVIRONMENTAL HAZARDS AND DISASTERS**
	Environmental hazards and disasters: meaning of environmental hazards, environmental disasters and environmental stress; concept of environmental hazards, environmental stress and environmental disasters, different approaches and relation with human ecology, landscape approach, ecosystem approach, perception approach, human ecology and its application in geographical researches.
UNIT II	**TYPES OF ENVIRONMENTAL HAZARDS AND DISASTERS**
	Types of environmental hazards and disasters: Natural hazards and disasters, man induced hazards and disasters, natural hazards, planetary hazards/ disasters, extra planetary hazards/ disasters, planetary hazards, endogenous hazards, exogenous hazards.

UNIT III	**ENDOGENOUS HAZARDS AND EXOGENOUS HAZARDS**
	Endogenous hazards, volcanic eruption, earthquakes, landslides, volcanic hazards/ disasters, causes and distribution of volcanoes, hazardous effects of volcanic eruptions, environmental impacts of volcanic eruptions, earthquake hazards/disasters, causes of earthquakes, distribution of earthquakes, hazardous effects of earthquakes, earthquake hazards in India, human adjustment, perception and mitigation of earthquake. Exogenous hazards/ disasters, infrequent events, cumulative atmospheric hazards/ disasters, infrequent events: Cyclones, lightning, hailstorms; Cyclones: Tropical cyclones and local storms (causes, distribution human adjustment, perception and mitigation), cumulative atmospheric hazards/ disasters: Floods, droughts. cold waves; heat waves floods: Causes of floods, flood hazards India, flood control measures (human adjustment, perception and mitigation), droughts, impacts of droughts, drought hazards in India- drought control measures, extra planetary hazards/ disasters, man induced hazards /disasters, physical hazards/ disasters, soil erosion.
UNIT IV	**EMERGING APPROACHES IN DISASTER MANAGEMENT**
	Emerging approaches in Disaster Management. Three Stages 1. Pre, disaster stage (preparedness) 2. Emergency Stage 3. Post Disaster stage, Rehabilitation.
UNIT V	**DISASTER MANAGEMENT- AN INTEGRATED APPROACH**
	Disaster Management: An integrated approach for disaster preparedness, mitigation and awareness; mitigation: Institutions, discuss the work of following Institution: Meteorological observatory, seismological observatory, volcanology institution, hydrology laboratory, institution of urban and regional planners, engineering council, world meteorological organizations (WMO), geographical information system (GIS), world federation of engineering organizations (WFED).

TEXTBOOKS:

1. PardeepSahni, “Disaster Mitigation: Experiences and Reflections”, PHI Learning Pvt. Ltd., 1 st Edition, 2001.

2. J.Glynn, GaryW.HeinKe, “Environmental Science and Engineering”,Prentice Hall Publishers, 2 nd Edition, 1996.

REFERENCE BOOKS:

1. R.B.Singh (Ed), “Environmental Geography”, 2nd Edition, 1990.

2. R.B. Singh (Ed), “Disaster Management”, 2nd Edition, 2006.

3. Donald Hyndman “Natural Hazards and Disasters” - 5th edition, 2017.

COURSE WEB PAGE:

XIX COURSE PLAN:

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

S.No	Topics to be covered	CO's	Reference T1: 4.1
OBE DISCUSSION			
1	Course Objectives, Course Outcomes, Program Outcomes, CO-PO Mapping		
CONTENT DELIVERY (THEORY)			
2	Classify Environmental Hazards & Disasters	CO 1	T2:26.3, R2: 3.1
3	Understand the Meaning of Environmental Hazards	CO 1	T2:2.2.2
4	Understand Environmental Stress	CO 1	T2:2.2.2, R3:3.7
5	Understand Environmental stress.	CO 2	T2:2.2.2
6	Obtain knowledge on Concept of Environmental Hazards	CO 2	T1:8.1
7	Capacity to analyze Environmental stress & Environmental Disasters	CO 2	T1:7.1, R2: 1.2
8	Capacity to analyze Ecology concept	CO 2	T2:3.2.3, R2: 1.3
9	Understand Different Approaches	CO 3	T2:4.2.3
10	Understand Landscape Approach -.	CO 3	T2:4.5.2
11	Explain Ecosystem approach -Perception approach.	CO 3	T2:4.7.9
12-13	Understand Human ecology & its application in geographical researches	CO 4	T2:5.2.1, R2: 6.4
14	Understand Types of Environmental hazards & Disasters	CO 4	T2:5.4
15-16	Capacity to analyze and evaluate Natural hazards and Disasters	CO 3	T2:5.5.3
17-18	Understand Man induced hazards & Disasters	CO 3	T2:6.2.2
19-20	Obtain knowledge on Natural Hazards- Planetary Hazards/ Disasters	CO 4	R1:2.5, R2: 8.2
21-22	Analyze the Planetary Hazards-Endogenous Hazards - Exogenous Hazards	CO 4	R2:2.2.5, R2: 9.2
23-24	Understand Volcanic Eruption – Earthquakes – Landslides	CO 4	R3:5.4.8, R2: 9.6
25-26	Volcanic Hazards/Disasters- Causes and distribution of Volcanoes	CO 4	T2:8.1.2
27-28	Explain the Hazardous effects of volcanic eruptions	CO 4	T2:8.3.5, R2: 5.3
29-30	Understand Environmental impacts of volcanic eruptions - Earthquake Hazards/ disasters - Causes of Earthquakes	CO 4	T2:8.5
31	Distribution of earthquakes - Hazardous effects of - earthquakes - Earthquake Hazards in India	CO 4	T2:8.9.2
32-33	Explain the Droughts: Impacts of droughts, Drought hazards in India	CO 5	T2:9.2, R3: 4.6

34-35	Understand Extra Planetary Hazards/ Disasters- Man induced Hazards /Disasters	CO 5	T2:9.2, R3: 4.7
36-37	Understand the Infrequent events: Cyclones, Lightning, Hailstorms, Cyclones: Earthquake Hazards in India	CO 5	T2:9.5.3
38	Analyze the Tropical cyclones and Local storms	CO 5	T2:9.6.2, R3: 8.5
39-40	Understand the Destruction by tropical cyclones and local storms (causes, distribution human adjustment, perception and mitigation)	CO 5	T2:9.7.5, R3: 8.12
41-42	Analyze the Cumulative atmospheric hazards/ disasters : Floods, Droughts, Cold waves, Heat waves Floods	CO 5	T2:9.5.4
43-44	Identification of Flood control measures (Human adjustment, perception and mitigation),	CO 6	T2:9.5.4
45	Analyze the Exogenous hazards/ disasters - Infrequent events- Cumulative atmospheric hazards/ disasters	CO 6	T2:9.5.6
PROBLEM SOLVING/ CASE STUDIES			
1	Case study on Latur earthquake	CO 4	T2:2.2.2
2	Case study on Fukushima Nuclear disaster	CO 4	T2:2.2.2, R3:3.7
3	Case study on tsunami occurred in Japan	CO 5	T2:2.2.2
4	Case study on Hiroshima and Nagasaki	CO 4	T1:8.1
5	Case study on Russian Siberia oil spill	CO 4	T1:7.1, R2: 1.2
6	Case study on Hudhud Cyclone 2014	CO 5	T2:3.2.3, R2: 1.3
7	Case study on South India Floods 2015	CO 5	T2:4.2.3
8	Case study on Bihar Heat Wave 2019	CO 5	T2:4.5.2
9	Case study on Bihar Floods 2019	CO 5	T2:4.7.9
10	Case study on Oil Spillage in Russia 2020	CO 4	T2:5.4
11	Case study on Yellow River Flood in china	CO 4	T2:5.5.3
12	Case study on Bhola Cyclone Bangladesh	CO 5	T2:6.2.2
13	Causes of wildfires and effects	CO 4	T2:9.5.4
14	pre-disaster activities to reduce the impact of cyclones	CO 5	T2:9.5.4
15	Tectonic plate theory	CO 4	T2:9.5.6
DISCUSSION OF DEFINITION AND TERMINOLOGY			
1	different approaches and relation with human ecology, landscape approach, ecosystem approach, perception approach	CO 1	T2:2.2.2
2	natural hazards, planetary hazards/ disasters, extra planetary hazards/ disasters, planetary hazards, endogenous hazards, exogenous hazards	CO 2	T2:2.2.2, R3:3.7
3	effects of volcanic eruptions, environmental impacts of volcanic eruptions	CO 3, CO 4	T2:2.2.2
4	lightning , hailstorms; Cyclones: Tropical cyclones and local storms, destruction by tropical cyclones and local storms (causes, distribution human adjustment, perception and mitigation); Cumulative atmospheric hazards/ disasters:	CO 5	T1:8.1

5	Emerging approaches in Disaster Management, Three Stages 1. Pre, disaster stage(preparedness), 2. Emergency Stage ,3. Post Disaster stage, Rehabilitation.	CO 6	T1:7.1, R2: 1.2
DISCUSSION OF QUESTION BANK			
1	Questions from Environmental Hazards AND DISASTERS	CO 1	R1:2.1
2	Questions from TYPES Of Environmental Hazards and Disasters	CO 2	T4:7.3
3	Questions from Endogenous Hazards	CO 3, CO 4	R2:5.1
4	Questions from Exogenous Hazards	CO 5	T1:7.5
5	Questions from Emerging Approaches in Disaster Management	CO 6	T1: 4.1

Signature of Course Coordinator **HOD,CE**
Mr S. SivaRamaKrishna, Assistant Professor

INSTITUTE OF AERONAUTICAL ENGINEERING
(Autonomous)
Dundigal, Hyderabad - 500 043

CIVIL ENGINEERING
COURSE DESCRIPTION

Course Title	**Fluid Mechanics and Hydraulic Machinery Laboratory**				
Course Code	ACE107				
Program	B.Tech				
Semester	V	CE			
Course Type	Core				
Regulation	IARE - R16				
Course Structure	Theory			Practical	
	Lecture	Tutorials	Credits	Laboratory	Credits
	-	-	-	3	2
Course Coordinator	Ms. Durga Sharma, Assistant Professor				

I COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites
B.Tech	ACE005	III	Fluid Mechanics

II COURSE OVERVIEW:

The primary objective of Fluid Mechanics Laboratory is to develop the analytical ability of the students by better understanding the concepts of flow studies. The experiments carried out like Calibration of flow measuring devices, determination of Co-efficient of discharge, Co-efficient of velocity for flow measuring devices, estimation of both major and minor losses, verification of Bernoulli's equation, determination of impact of jet on vanes for the blades of the turbine, determination of efficiencies of various types of turbines etc.

III MARKS DISTRIBUTION:

Subject	SEE Examination	CIE Examination	Total Marks
Fluid Mechanics and Hydraulic Machinery Laboratory	70 Marks	30 Marks	100

IV DELIVERY / INSTRUCTIONAL METHODOLOGIES:

✓	Demo Video	✓	Lab Worksheets	✓	Viva Questions	✓	Probing further Questions

V EVALUATION METHODOLOGY:

Each laboratory will be evaluated for a total of 100 marks consisting of 30 marks forinternal assessment and 70 marks for semester end lab examination. Out of 30 marks ofinternal assessment, continuous lab assessment will be done for 20 marks for the day today performance and 10 marks for the final internal lab assessment.

Semester End Examination (SEE): The semester end labexamination for 70 marks shall be conducted by two examiners, one of them beingInternal Examiner and the other being External Examiner, both nominated by thePrincipal from the panel of experts recommended by Chairman, BOS. The emphasis on the experiments is broadly based on the following criteria given in Table: 1

	Experiment Based	Programming based
20 %	Objective	Purpose
20 %	Analysis	Algorithm
20 %	Design	Programme
20 %	Conclusion	Conclusion
20 %	Viva	Viva

Continuous Internal Assessment (CIA):

CIA is conducted for a total of 30 marks (Table 1), with 20 marks for continuous lab assessment during day to day performance, 10 marks for final internal lab assessment.

Component			Total Marks
Type of Assessment	**Day to day performance**	**Final internal lab assessment**	
CIA Marks	20	10	30

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.

1. **Experiment Based**

Objective	Analysis	Design	Conclusion	Viva	Total
2	2	2	2	2	10

2. **Programming Based**

Objective	Analysis	Design	Conclusion	Viva	Total
-	-	-	-	-	-

VI COURSE OBJECTIVES:

The students will try to learn:

I	Enrich the concept of fluid mechanics and hydraulic machines.
II	Demonstrate the classical experiments in fluid mechanics and hydraulic machinery.

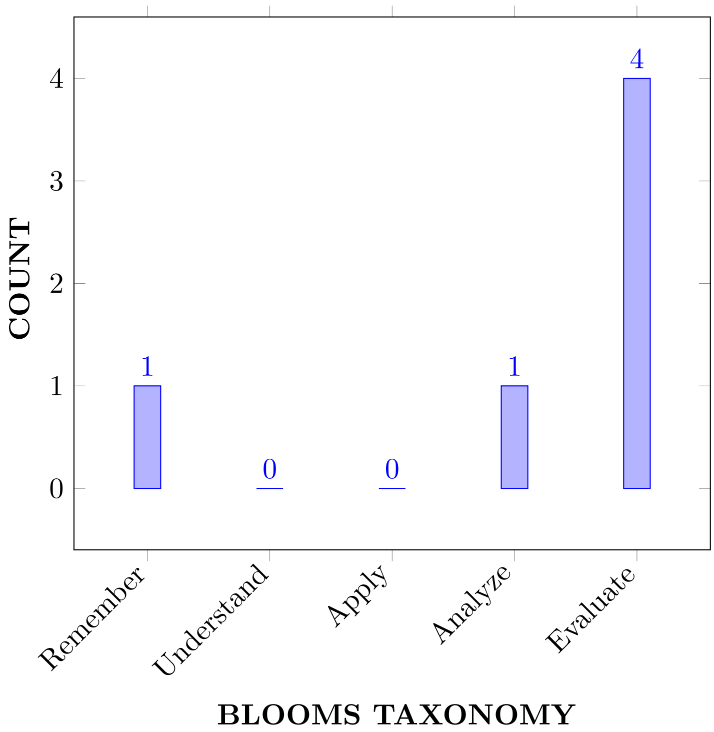
III	Correlate various flow measuring devices such as Venturimeter, orifice meter and notches etc.
IV	Discuss the performance characteristics of turbines and pumps.

VII COURSE OUTCOMES:

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

CO 1	**Recall** the basic principle of fluid mechanics for determining their properties through various laboratory tests.	Remember
CO 2	**Determine** coefficient of discharge for measuring actual discharge using different discharge measuring device.	Evaluate
CO 3	**Measure** friction factor of pipe for calibration of losses in pipes.	Evaluate
CO 4	**Examine** coefficient of minor losses for verifying Bernoulli's equation.	Analyze
CO 5	**Determine** impact of jet on vanes and study of hydraulic jump for finding the impact on both flat and curved surfaces and analysing hydraulic jump in open channel flow.	Evaluate
CO 6	**Determine** performance test of various turbines and pumps for evaluating the speed and energy required in running any hydro-electric scheme.	Evaluate

COURSE KNOWLEDGE COMPETENCY LEVEL



VIII HOW PROGRAM OUTCOMES ARE ASSESSED:

Program		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	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	2	Lab Exercises
PO 4	**Conduct Investigations of Complex Problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.	2	Lab Exercises
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	2	Videos

3 = High; 2 = Medium; 1 = Low

IX HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

Program		Strength	Proficiency Assessed by
PSO 1	Design and supervise sub-structures and superstructures for residential and public buildings, industrial structures, irrigation structures, powerhouses, highways, railways, airways, docks and harbours.	2	Lab Exercises
PSO 3	Self-Learning and Service: Graduates will be motivated for continuous self-learning in engineering practice and/ or pursue research in advanced areas of civil engineering in order to offer engineering services to the society, ethically and responsibly.	1	Lab Exercises

3 = High; 2 = Medium; 1 = Low

X 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 and **principals of mathematics** to engineering problems for testing the quality of materials using the knowledge of **science and engineering fundamentals.**	2
	PO 7	Understand the impact of professional engineering solutions in societal and environmental context and develop a special concrete to promote **environmental safety** for sustainable **socio economic development**	2
	PSO 1	Explain the properties of fluid and **principle of fluid mechanics** to understand the fluid flow in irrigation practices and hydraulic schemes .	2
CO 2	PO 1	Apply the knowledge and **principals of mechanics** to understand water resources engineering using the knowledge of **science and engineering fundamentals**.	2
	PO 4	**Select and apply appropriate techniques** for determining coefficient of discharge **understanding the limitations of each measuring device**.	2
	PSO 1	Select suitable discharge measuring device based on **suitability of methods and equipment for measurements** for **analysing water flow problems**.	2
CO 3	PO 1	Apply the knowledge and **principals of mechanics** to understand water resources engineering using the knowledge of **science and engineering fundamentals**.	2
	PO 4	**Select and apply appropriate techniques** for determining friction factor of pipe and **understanding the limitations** to determine frictional losses in pipes.	2
	PSO 3	**Determine different conditions** of pressure changes in pipe network for determining friction factor of pipe in the branching pipes and **understanding the methods** to reduce the head loss due to frictional losses in pipes.	2
CO 4	PO 1	Apply the knowledge and **principals of mathematics** to engineering problems for **determining** coefficient of minor losses using concept of Bernoulli's theorem.	2
	PO 3	Determine the coefficient of minor losses after thorough **investigation** of different types of pipe fitting material and ensure its **applicability in pipe network analysis**.	3
	PSO 1	Explain the properties of fluid and **principle of fluid mechanics** to **understand** the fluid flow in irrigation practices and hydraulic schemes .	2
CO 5	PO 1	Apply the knowledge and **principals of mechanics** to understand water resources engineering using the knowledge of **science and engineering fundamentals**.	2

	PO 3	**Determine the impact of jet** on vanes for finding the impact of both flat and curved surfaces to **understand** the amount of torque required to generate electricity.	2
	PSO 1	**Analyse** different value of depth before a hydraulic jump to that **calculated from theory and calculate energy loss** in a hydraulic jump for **understanding a energy distribution** of fluid flow in hydraulic schemes.	3
CO 6	PO 1	Apply the knowledge and **principals of mechanics** to understand water resources engineering using the knowledge of **science and engineering fundamentals**.	2
	PO 3	**Determine the performance characteristics** of Turbine and pumps constant head, constant speed and constant efficiency to **understand working principle of** turbines and pumps in hydroelectric power generation process.	2
	PSO 1	**Analyse** different types of turbo machinery, **to understand the essential difference** between turbines and pumps clearly to know the amount of energy created using fluid movement and to **determine** the fluid movement created using energy.	3

XI MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

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

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

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO 1	66.6	0	0	0	0	0	66.6	0	0	0	0	0	20	0	0
CO 2	66.6	0	0	20	0	0	0	0	0	0	0	0	20	0	66.6
CO 3	66.6	0	0	20	0	0	0	0	0	0	0	0		0	0
CO 4	66.6	0	30	0	0	0	0	0	0	0	0	0	20	0	0
CO 5	66.6	0	20	0	0	0	0	0	0	0	0	0	20	0	0
CO 6	66.6	0	20	0	0	0	0	0	0	0	0	0	30	0	0

XIII 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
1-5 <C≤ 40% – Low/ Slight
2 - 40 % <C < 60% –Moderate
3 - 60% ≤ C < 100% – Substantial /High

COURSE OUTCOMES	**PROGRAM OUTCOMES**												**PSO'S**		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO 1	3	0	0	0	0	0	3	0	0	0	0	0	2	0	0
CO 2	3	0	0	2	0	0	0	0	0	0	0	0	2	0	3
CO 3	3	0	0	2	0	0	0	0	0	0	0	0	0	0	0
CO 4	3	0	2	0	0	0	0	0	0	0	0	0	2	0	0
CO 5	3	0	2	0	0	0	0	0	0	0	0	0	2	0	0
CO 6	3	0	2	0	0	0	0	0	0	0	0	0	2	0	0
TOTAL	18	-	6	4	-	-	3	-	-	-	-	-	10	-	3
TOTAL	3	-	2	2	-	-	3	-	-	-	-	-	2	-	3

XIV ASSESSMENT METHODOLOGY DIRECT:

CIE Exams	✓	SEE Exams	✓	Seminars	-
Laboratory Practices	✓	Student Viva	✓	Certification	-
Assignments	-				

XV ASSESSMENT METHODOLOGY INDIRECT:

✓	Early Semester Feedback	✓	End Semester OBE Feedback
X	Assessment of Mini Projects by Experts		

XVI SYLLABUS:

WEEK I	**INTRODUCTION TO FLUID MECHANICS**
	Introduction to Fluid Mechanics, Do's and Don'ts in Fluid Mechanics Laboratory
WEEK II	**CALIBRATION OF VENTURIMETER and ORFICEMETER**
Orifice meter	Calibration of Venturimeter
WEEK III	**CALIBRATION OF VENTURIMETER and ORFICEMETER**
Orifice meter.	Calibration of Venturimeter
WEEK IV	**DETERMINATION OF COEFFICIENT OF DISCHARGE FOR A SMALL ORIFICE / MOUTH PIECE BY CONSTANT HEAD METHOD**
	Calibration of small orifice by constant head method.
WEEK V	**DETERMINATION OF COEFFICIENT OF DISCHARGE FOR A SMALL ORIFICE / MOUTH PIECE BY CONSTANT HEAD METHOD**
	Calibration of mouth piece by constant head method
WEEK VI	**CALIBRATION OF CONTRACTED RECTANGULAR NOTCH / TRIANGULAR NOTCH AND DETERMINATION OF FRICTION FACTOR OF PIPE**
	Calibration of contracted rectangular and triangular notch.
WEEK VII	**CALIBRATION OF CONTRACTED RECTANGULAR NOTCH / TRIANGULAR NOTCH AND DETERMINATION OF FRICTION FACTOR OF PIPE**
	Determination of friction factor for given pipe
WEEK VIII	**DETERMINATION OF COEFFICIENT FOR MINOR LOSSES AND VERIFICATION OF BERNOULLI'S EQUATION**
	Calibration of minor losses in pipes.
WEEK IX	**DETERMINATION OF COEFFICIENT FOR MINOR LOSSES AND VERIFICATION OF BERNOULLIS EQUATION**
	Verification of Bernoulli's equation.
WEEK X	**IMPACT OF JET ON VANES AND STUDY OF HYDRAULIC JUMP**
	Determination of impact of jet on both flat and curved vanes.
WEEK XI	**IMPACT OF JET ON VANES AND STUDY OF HYDRAULIC JUMP**
	Study of hydraulic jump in the given open channel.
WEEK XII	**PERFORMANCE TEST ON PELTON WHEEL TURBINE AND PERFORMANCE TEST ON FRANCIS TURBINE**
	Performance test on Pelton wheel turbine and Francis turbine

TEXTBOOKS

1. Frank M. White, "Fluid Mechanics ", McGraw Hill Education Private Limited, 8th Edition, 2017 .
2. Modi and Seth, "Fluid Mechanics‖", Standard book house, 2011.
3. R.K. Rajput, "A text of Fluid mechanics and hydraulic machines", S. Chand and company Pvt. Ltd, Sixth Edition, 2015.
4. S.K. Som and G. Biswas, —Introduction to Fluid Machines‖, Tata Mc Grawhill publishers Pvt. Ltd, 2010.
5. Ramdurgaia, — Fluid Mechanics and Machinery‖, New Age Publications, 2007.

REFERENCE BOOKS:

1. Yuan S W, "Foundations of fluid Mechanics", Prentice-Hall, 2nd Edition, 1987.
2. Shiv Kumar, "Fluid Mechanics Basic Concepts and Principles", Ane Books Pvt Ltd., 2010.
3. R.K. Bansal ,A text of Fluid mechanics and hydraulic machines- Laxmi Publications (P) ltd., New Delhi, 2011.

XVII 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	Introduction to Hydraulics and Hydraulic Machinery Laboratory Laboratory	CO 1	R1: 2.4
2	Calibration of Venturimeter and Orifice meter	CO1	R1: 2.4
3	Coefficient of discharge for a small orifice / Mouth piece by constant head method	CO2	R1: 2.4
4	Calibration of contracted rectangular notch / triangular Notch	CO2	R1: 2.4
5	Calibration of friction factor of pipe / minor losses in different types of pipes	CO2	R1: 2.4
6	Verification of Bernoulli's Equation	CO3	R1: 2.4
7	Impact of jet on vanes	CO 4	R1: 2.4
8	Performance test on Pelton wheel turbine	CO 4	R1: 2.4
9	Performance test on Francis turbines	CO 5	R1: 2.4
10	Performance characteristics of a single stage Centrifugal pump	CO 5	R1: 2.4
11	Performance characteristics of multi- stage Centrifugal pump	CO 6	R1: 2.4
12	Performance characteristics of a Reciprocating pump	CO 6	R1: 2.4
13	Study of hydraulic jump	CO 6	R1: 2.4

Signature of Course Coordinator **HOD,CE**

INSTITUTE OF AERONAUTICAL ENGINEERING
(Autonomous)
Dundigal, Hyderabad - 500 043
CIVIL ENGINEERING
COURSE DESCRIPTION

Course Title	**CONCRETE TECHNOLOGY LABORATORY**				
Course Code	ACE108				
Program	B.Tech				
Semester	V	CE			
Course Type	Core				
Regulation	IARE - R16				
Course Structure	Theory			Practical	
	Lecture	Tutorials	Credits	Laboratory	Credits
	-	-	-	3	2
Course Coordinator	Mr. K. Anand Goud, Assistant Professor				

I COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites
B.Tech	ACE010	V	Concrete Technology

II COURSE OVERVIEW:

Concrete technology laboratory course emphasizes the practical aspects of the latest developments in the field of concrete construction. It focuses the latest Indian standard specifications and codes, which regulates the concrete construction. The laboratory course covers the properties of concrete and its constituent materials, the role of various admixtures in modifying these properties to suit specific requirements, such as ready mix concrete, reinforcement detailing, disaster-resistant construction, concrete machinery and it also enable the students to acquire knowledge on special and new generation concrete with their applications.

III MARKS DISTRIBUTION:

Subject	SEE Examination	CIE Examination	Total Marks
Concrete Technology Laboratory	70 Marks	30 Marks	100

IV DELIVERY / INSTRUCTIONAL METHODOLOGIES:

✓	Demo Video	✓	Lab Worksheets	✓	Viva Questions	✓	Probing further Questions

V EVALUATION METHODOLOGY:

Each laboratory will be evaluated for a total of 100 marks consisting of 30 marks forinternal assessment and 70 marks for semester end lab examination. Out of 30 marks ofinternal assessment, continuous lab assessment will be done for 20 marks for the day today performance and 10 marks for the final internal lab assessment.

Semester End Examination (SEE): The semester end labexamination for 70 marks shall be conducted by two examiners, one of them beingInternal Examiner and the other being External Examiner, both nominated by thePrincipal from the panel of experts recommended by Chairman, BOS. The emphasis on the experiments is broadly based on the following criteria given in Table: 1

	Experiment Based	Programming based
20 %	Objective	Purpose
20 %	Analysis	Algorithm
20 %	Design	Programme
20 %	Conclusion	Conclusion
20 %	Viva	Viva

Continuous Internal Assessment (CIA):

CIA is conducted for a total of 30 marks (Table 1), with 20 marks for continuous lab assessment during day to day performance, 10 marks for final internal lab assessment.

Component			Total Marks
Type of Assessment	**Day to day performance**	**Final internal lab assessment**	
CIA Marks	20	10	30

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.

1. **Experiment Based**

Objective	Analysis	Design	Conclusion	Viva	Total
2	2	2	2	2	10

2. **Programming Based**

Objective	Analysis	Design	Conclusion	Viva	Total
-	-	-	-	-	-

VI COURSE OBJECTIVES:

The students will try to learn:

I	The fundamental properties of construction materials like cement, aggregates and admixtures based on laboratory and field tests for identifying material quality.

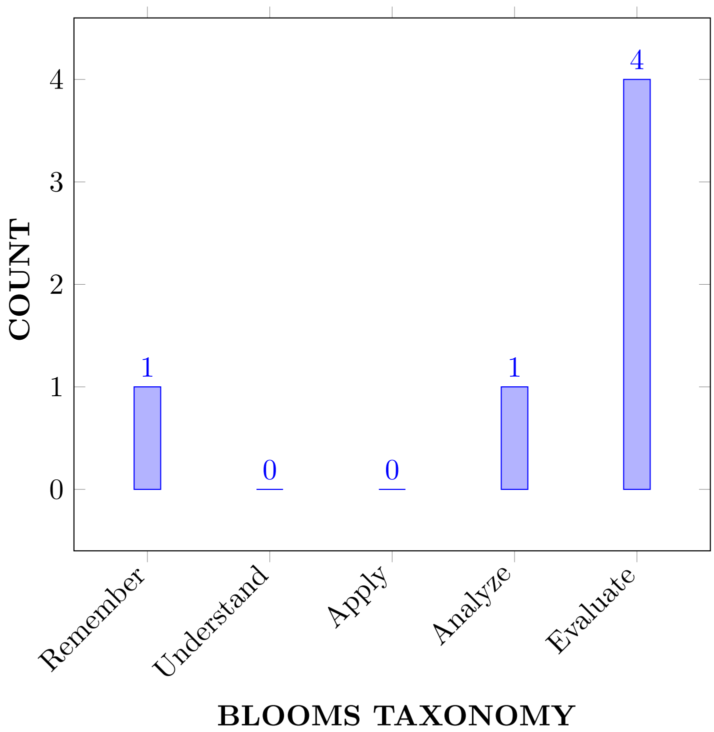
II	The factors influencing workability and methods involved in measuring workability of fresh concrete.
III	The importance of water/cement ratio and its influence on compressive strengths of hardened concrete.
IV	The concept of quality control and design of concrete mix for ensuring quality of concrete.

VII COURSE OUTCOMES:

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

CO 1	**Recall** the basic properties of cement and aggregates for determining their suitability through various laboratory tests.	Remember
CO 2	**Determine** physical and chemical properties of cement in laboratory for deciding its suitability in construction practice.	Evaluate
CO 3	**Determine** the specific gravity of cement for estimating quantity in mix design.	Evaluate
CO 4	**Examine** the fineness modulus of aggregates and bulking of sand for producing good quality concrete.	Analyze
CO 5	**Measure** the workability of fresh concrete for identifying the condition of plastic concrete.	Evaluate
CO 6	**Determine** Compressive strength of cement concrete for accepting in construction practice.	Evaluate

COURSE KNOWLEDGE COMPETENCY LEVEL



VIII HOW PROGRAM OUTCOMES ARE ASSESSED:

Program		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.	2	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	3	Lab Exercises
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	1	Lab Exercises
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	1	Videos

3 = High; 2 = Medium; 1 = Low

IX HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

Program		Strength	Proficiency Assessed by
PSO 1	Design and supervise sub-structures and superstructures for residential and public buildings, industrial structures, irrigation structures, powerhouses, highways, railways, airways, docks and harbours.	3	Lab Exercises
PSO 2	Focus on Improving Performance of Structures with reference to Safety, Serviceability and Sustainable Green Building Technology.	1	Lab Exercises

3 = High; 2 = Medium; 1 = Low

X 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 and **principals of mathematics** to engineering problems for testing the quality of materials using the knowledge of **science and engineering fundamentals.**	2

	PO 7	Understand the impact of professional engineering solutions in societal and environmental context and develop a special concrete to promote **environmental safety** for sustainable **socio economic development**	2
	PSO 1	Explain the properties of materials used in sub structures and super structures of residential and public buildings with **materials knowledge** and ensure **quality assurance**.	2
CO 2	PO 1	Apply the knowledge and **principals of mathematics** to engineering problems for testing the quality of materials using the knowledge of **science and engineering fundamentals**.	2
	PO 3	Determine the fineness of cement after thorough **investigation** and ensure its **fitness for the purpose of all aspects of the problem including production, operation and maintenance** of concrete.	2
	PO 5	**Select and apply appropriate techniques** for determining the properties of construction materials by **understanding the limitations**.	1
	PSO 1	Select suitable cement by testing their fineness based on **structural design and material knowledge** for **strength assessment**.	2
CO 3	PO 5	**Select and apply appropriate techniques** for determining the properties of construction materials by **understanding the limitations**.	1
	PSO 1	Explain the properties of materials used in **construction** of residential and public buildings with **material knowledge, codes of practices** and ensure **quality assurance** for **assessing strength**.	5
CO 4	PO 1	Apply the knowledge and **principals of mathematics** to engineering problems for testing the quality of materials using the knowledge of **science and engineering fundamentals**.	2
	PO 3	Determine the specific gravity of cement after thorough **investigation** and ensure its **fitness for the purpose of all aspects of the problem including production, operation and maintenance** of concrete.	3
	PO 5	**Select and apply appropriate testing method** to know the specific gravity of cement by understanding the limitations.	1
	PSO 1	Explain the properties of materials used in **construction** of residential and public buildings with **material knowledge, codes of practices** and ensure **quality assurance** for **assessing strength**.	5
CO 5	PO 3	Determine the suitability of concrete after thorough investigation and ensure its fitness for the purpose of all aspects of the problem including production, operation and maintenance of concrete for innovative solutions.	3

	PSO 1	Identify the condition of fresh concrete based on workability (slump) for assessing strength with standard quality with the help of different codes of practices.	3
CO 6	PO 1	Apply the knowledge and principals of mathematics to engineering problems for testing the quality of materials using the knowledge of science and engineering fundamentals.	2
	PO 3	Determine the compressive strength of cement after thorough investigation and ensure its fitness for the purpose of all aspects of the problem including production, operation and maintenance of concrete.	2
	PSO 1	Make use of appropriate destructive , non-destructive testing methods for determining strength and quality by applying the scientific, engineering and experimental knowledge, different codes of practices.	2

XI MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

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

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

COURSE OUTCOMES	**PROGRAM OUTCOMES**												**PSO'S**		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO 1	66.7	0.0	0.0	0.0	0.0	0.0	66.0	0.0	0.0	0.0	0.0	0.0	20.0	0.0	0.0
CO 2	66.0	0.0	30.0	0.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	20.0	0.0	0.0
CO 3	0	0.0	10.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	50.0	0	0.0
CO 4	66	00.0	30.0	0.0	100	0.0	0.0	0.0	0.0	0.0	0.0	0.0	50.0	0.0	0.0
CO 5	0.0	0.0	30.0	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0.0	30.0	0	0.0
CO 6	66.0	0.0	20.0	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0.0	20.0	0	0.0

XIII COURSE ARTICULATION MATRIX (PO – PSO MAPPING):

CO'S and PO'S and CO'S and PSO'S on the scale of 0 to 3, 0 being no correlation, 1 being the low correlation, 2 being medium correlation and 3 being high correlation.
0 - 0$\leq$ C$\leq$ 5% – No correlation
1-5 <C$\leq$ 40% – Low/ Slight
2 - 40 % <C < 60% –Moderate
3 - 60% $\leq$ C < 100% – Substantial /High

COURSE	**PROGRAM OUTCOMES**												**PSO'S**		
OUTCOMES	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO 1	3	0	0	0	0	0	3	0	0	0	0	0.0	1	0	0
CO 2	3	0.0	1	0	3	0	0	0	0	0	0	0.0	1	0	0
CO 3	0	0	1	0	0	0	0	0	0	0	0	0.0	2	0	0
CO 4	3	0	1	0	2	0	0	0	0	0	0	0.0	2	0	0
CO 5	0	0	1	0	0.0	0.0	0	0	0	0	0.0	0.0	1	0	0
CO 6	3	0	1	0	0	0.0	0	0	0	0	0	0.0	1	0	0.0
TOTAL	13	5	2	-	3	-	6	-	-	-	-	-	4	5	-
AVERAGE	3	1	1	-	3	-	3	-	-	-	-	-	1	2	-

XIV ASSESSMENT METHODOLOGY DIRECT:

CIE Exams	✓	SEE Exams	✓	Seminars	-
Laboratory Practices	✓	Student Viva	✓	Certification	-
Assignments	-				

XV ASSESSMENT METHODOLOGY INDIRECT:

	Assessment of Mini Projects by Experts	✓	End Semester OBE Feedback

XVI SYLLABUS:

WEEK I	**INTRODUCTION TO CONCRETE TECHNOLOGY**
	Introduction to concrete technology laboratory. Do's and Don'ts in concrete lab
WEEK II	**FINENESS OF CEMENT**
	Fineness of cement
WEEK III	**NORMAL CONSISTENCY OF CEMENT**
	Normal consistency of cement.
WEEK IV	**INITIAL AND FINAL SETTING TIMES OF CEMENT**
	Initial and final setting times of cement.
WEEK V	**SPECIFIC GRAVITY OF CEMENT**
	Specific gravity of cement

WEEK VI	**COMPRESSIVE STRENGTH OF CEMENT**
	Compressive strength of cement.
WEEK VII	**SOUNDNESS OF CEMENT**
	Soundness of cement
WEEK VIII	**FINENESS MODULUS OF FINE AND COARSE AGGREGATE**
	Fineness modulus of fine and coarse aggregate.
WEEK IX	**BULKING OF SAND**
	Bulking of sand.
WEEK X	**WORKABILITY TESTS ON FRESH CONCRETE**
	Workability tests on fresh concrete.
WEEK XI	**TEST FOR COMPRESSIVE STRENGTH OF CEMENT CONCRETE**
	Test for compressive strength of cement concrete.
WEEK XII	**REVISION**
	Revision
WEEK XIII	**REVISION**
	Revision
WEEK XIV	**REVISION**
	Revision

TEXTBOOKS

1. Shetty, M.S., "Concrete Technology, Theory & Practice", S. Chand and Co,2004.

2. Gambhir, M.L., "Concrete Technology", Tata McGraw Hill,2004.

REFERENCE BOOKS:

1. 1. Hemanth sood and LN Mittal, —Laboratory Manual on concrete technology‖, CBS Publishers Pvt. Ltd., New Delhi, 2nd Edition, 2013.

2. 2. Khanna S.K & Justo C.E.G. —Pavement materials and testing‖, Tata McGraw Hill Education, 2012.

XVII 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	Introduction to concrete technology.	CO 1	R1: 2.4
2	Fineness of cement.	CO 2	R2: 4 2
3	Normal consistency of cement.	CO 2	R1: 4.3
4	Initial and final setting times of cement.	CO 2	R1: 3.2
5	Specific gravity of cement.	CO 2	R1: 5.4
6	Compressive strength of cement.	CO 3	R3: 6.2
7	Soundness of cement.	CO 3	R3: 7.1
8	Fineness modulus of fine and coarse aggregate.	CO 4	R2: 6.6
9	Bulking of sand.	CO 4	R2: 7.2

10	Workability tests on fresh concrete.	CO 5	R1: 8.1
11	Test for compressive strength of cement concrete.	CO 6	R1:8.4
12	Revision	CO 6	R1:7.3, R2: 8.1
13	Revision	CO 6	R1:7.3, R2: 8.1
14	Revision	CO 6	R1:7.3, R2: 8.1

XVIII EXPERIMENTS FOR ENHANCED LEARNING (EEL):

S.No	Design Oriented Experiments
1	Strength of concrete made of silica fume and fly-ash.
2	Strength of concrete made of steel fibres.
3	Light weight concrete using light weight aggregates.
4	Investigation on characteristics properties of high performance Self-compacting concrete for m40 and m50.
5	Measurement of Workability of Concrete Mix.

Signature of Course Coordinator **HOD,CE**
Mr. K. Anand Goud, Assistant Professor

INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

Dundigal, Hyderabad -500 043

CIVIL ENGINEERING

COURSE DESCRIPTION

Course Title	**BUILDING INFORMATON MODELLING LABORTARY**				
Course Code	ACE111				
Programme	B.Tech				
Semester	V	CE			
Course Type	Core				
Regulation	IARE - R16				
Course Structure	**Theory**			**Practical**	
	Lectures	**Tutorials**	**Credits**	**Laboratory**	**Credits**
	-	-	-	3	2
Chief Coordinator	Mr. S.Selvaprakash				

I. COURSE OVERVIEW:

Autodesk Revit Architecture is a powerful BIM tool used by architects throughout the globe to accomplish their projects. This course is designed to make the students familiar with the functionality of Autodesk Revit. The students will begin by learning about the user interface and then about Autodesk Revit commands used for design development followed by those for construction documentation. The objective of this course is to enable the students to create 2D and 3D architectural project models and extract their working drawings.

II. COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites	Credits
-	-	-	-	-

III. MARKSDISTRIBUTION:

Subject	SEE Examination	CIAExamination	Total Marks
Advanced Structural DesignLaboratory	70 Marks	30 Marks	100

IV. DELIVERY / INSTRUCTIONAL METHODOLOGIES:

✔	Demo Video	✔	Lab Worksheets	✔	Viva Questions	✔	Probing further question

V. EVALUATION METHODOLOGY:

Each laboratory will be evaluated for a total of 100 marks consisting of 30 marks forinternal assessment and 70 marks for semester end lab examination. Out of 30 marks ofinternal assessment, continuous lab assessment will be done for 20 marks for the day today performance and 10 marks for the final internal lab assessment.

Semester End Examination (SEE): The semester end labexamination for 70 marks shall be conducted by two examiners, one of them beingInternal Examiner and the other being External Examiner, both nominated by thePrincipal from the panel of experts recommended by Chairman, BOS.

The emphasis on the experiments is broadly based on the following criteria:

	Experiment Based	**Programming based**
20 %	Objective	Purpose
20 %	Analysis	Algorithm
20 %	Design	Programme
20 %	Conclusion	Conclusion
20 %	Viva	Viva

Continuous Internal Assessment (CIA):

CIA is conducted for a total of 30 marks (Table 1), with 20 marks for continuous lab assessment during day to day performance, 10 marks for final internal lab assessment.

Table 1: Assessment pattern for CIA

Component	**Laboratory**		**Total Marks**
Type of Assessment	**Day to day performance**	**Final internal lab assessment**	
CIA Marks	20	10	30

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.

A. Experiment Based

Objective	**Analysis**	**Design**	**Conclusion**	**Viva**	**Total**
0	0	0	0	0	0

B. Programming Based

Purpose	Algorithm	Program	Conclusion	Viva	Total
2	2	2	2	2	10

VI. 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.	2	Lab Exercise /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 Exercise /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 Exercise /CIE/SEE
PO 9	**Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.	2	Lab Exercise /CIE/SEE
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	Lab Exercise /CIE/SEE

3 = High; 2 = Medium; 1 = Low

VII. HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

Program Specific Outcomes		Strength	Proficiency assessed by
PSO 1	Design and Supervise Sub-Structures and Super Structures for Residential and Public Buildings, Industrial Structures, Irrigation Structures, Power Houses, Highways, Railways, Airways, Docs and Harbours.	2	Lab Exercise /CIE/SEE
PSO 2	Focus on Improving Performance of Structures with reference to Safety, Serviceability and Sustainable Green Building Technology.	1	Lab Exercise /CIE/SEE
PSO 3	Make use of Advanced Structural Analysis and Project Management Software for creating Modern Avenues to succeed as an Entrepreneur, Pursue Higher Studies and Career Paths.	2	Lab Exercise /CIE/SEE

3 = High; 2 = Medium; 1 = Low

VIII. COURSE OBJECTIVES:

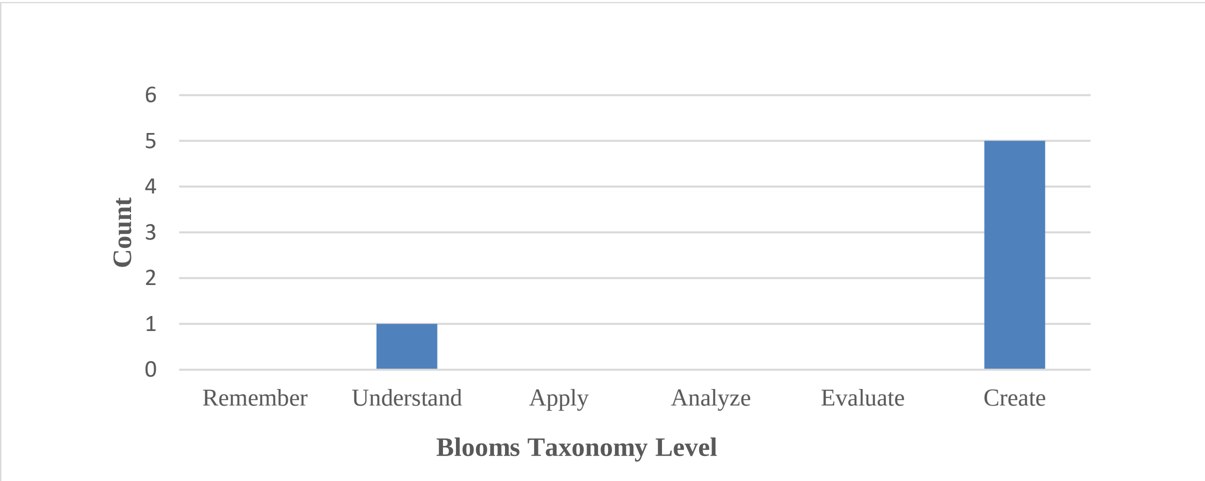
students will try to learn:	
I	Provide familiarity with current BIM technologies.
II	Understand the shift from 2D representation to 3D simulation.
III	Synthesize, link and maintain continuity of existing and designed BIM information and other vital information into the model.
IV	Explore new project delivery systems and technologies for integrated practice.

IX. COURSE OUTCOMES:

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

CO No	Course Outcomes	Knowledge Level (Bloom's Taxonomy)
CO 1	**Understand** the basics of BIM and Autodesk Revit for drawing and editing tools available in Revit architecture.	Understand
CO 2	**Design** the beams, slabs and column for draw the setting up levels and grids in building using Revit software.	Create
CO 3	**Design** the walls, doors and windows for draw a different types of modeling walls , doors and windows in building using Revit software.	Create
CO 4	**Design** the curtain walls and type of views for draw a different types curtain walls and views in building using Revit software.	Create
CO 5	**Design** the adding and modifying components for draw a adding and modifying components in building using Revit software.	Create
CO 6	**Design** the modelling floors, ceiling and stairs for draw a modeling floors, celiling and stairs in building using Revit software.	Create

COURSE KNOWLEDGE COMPETENCY LEVELS



X. JUSTIFICATIONS FOR CO – (PO, PSO) MAPPING

Course Outcomes	POs / PSOs	Justification for mapping (Students will be able to)	No. of key competencies
CO 1	PO 1	Apply the knowledge of **engineering fundamentals, and an engineering specialization** to the basics Revit software.	2
	PO 3	Design solutions for **design system components for beam, slabs, columns, walls, doors, windows, curtain walls, stairs & views** that meet the specified needs with appropriate consideration for the Revit software.	10
	PO 5	Select and using **modern engineering modeling** to complex engineering activities with an understanding of the Revit software.	1
	PO 9	Design **Function effectively as an individual**, **adding components, modifying components** and in multidisciplinary settings for learning basics Revit software.	3
	PO 12	**Recognize the need** for **basics tools software** and **life-long learning** in the basics Revit software.	3
	PSO 1	Design and **Supervise Sub-Structures and Super Structures** for learning the Revit software.	2
CO 2	PO 1	Apply the knowledge of **engineering fundamentals, and an engineering specialization** to the basics Revit software.	2
	PO 3	Design solutions for **design system the beams, slabs & columns components** that meet the specified needs with appropriate consideration for the Revit software.	3
	PO 5	Select and using **modern engineering modeling** the beams, slabs & columns to complex engineering activities with an understanding of the Revit software.	1
	PSO 3	Make use of Revit software for creating Modern **the beams, slabs & columns** and Career Paths.	3
CO 3	PO 1	Apply the knowledge of **engineering fundamentals, and an engineering specialization** to the basics Revit software.	2
	PO 3	Design solutions for **design system the walls, doors & windows components** that meet the specified needs with appropriate consideration for the Revit software.	3
	PO 5	Select and using **modern engineering modeling** the walls, doors & windows to complex engineering activities with an understanding of the Revit software.	1
	PSO 3	Make use of Revit software for creating Modern **walls, doors & windows** and Career Paths.	3
CO 4	PO 1	Apply the knowledge of **engineering fundamentals, and an engineering specialization** to the basics Revit software.	2
	PO 3	Design solutions for **design system the curtain walls & type of views** that meet the specified needs with appropriate consideration for the Revit software.	2
	PO 5	Select and using **modern engineering modeling** the curtain walls & type of views to complex engineering activities with an understanding of the Revit software.	1
	PSO 2	Focus on Improving **Performance of Structures** with reference to **Sustainable Green Building Technology** in the **curtain walls & type of views** using Revit software.	4
CO 5	PO 1	Apply the knowledge of **engineering fundamentals, and an engineering specialization** to the basics Revit software.	2
	PO 3	Design solutions for **design system the adding & modifying components** that meet the specified needs with appropriate consideration for the Revit software.	2
	PO 5	Select and using **modern engineering modeling** the adding & modifying components to complex engineering activities with an understanding of the Revit software.	1
	PSO 1	Design and Supervise Sub-Structures and Super Structures for **Residential and Public Buildings, Industrial Structures** in modeling the the adding & modifying components using Revit software.	**3**

CO 6	**PO 1**	Apply the knowledge of **engineering fundamentals, and an engineering specialization** to the basics Revit software.	2
	PO 3	Design solutions for **design system the modeling floors, ceiling & stairs** that meet the specified needs with appropriate consideration for the Revit software.	3
	PO 5	Select and using **modern engineering modeling** the modeling floors, ceiling & stairs to complex engineering activities with an understanding of the Revit software.	1
	PO 9	Design **Function effectively as an individual**, and as and in multidisciplinary settings for learning basics Revit software	1
	PSO 1	Design and Supervise for **Residential and Public Buildings, Industrial Structures** in modeling the modeling floors, ceiling & stairs using Revit software	3

3 = High; 2 = Medium; 1 = Low

XI. MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:

Course Learning Outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	√	-	√	-	√	-	-	-	√	-	-	√	√	-	-
CO 2	√	-	√	-	√	-	-	-	-	-	-	-	-	-	√
CO 3	√	-	√	-	√	-	-	-	-	-	-	-	-	-	√
CO 4	√	-	√	-	√	-	-	-	-	-	-	-	-	√	-
CO 5	√	-	√	-	√	-	-	-	-	-	-	-	√	-	-
CO 6	√	-	√	-	√	-	-	-	√	-	-	-	√	-	-

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

Course Outcomes (COs)	Program Outcomes (POs) / No. of Key Competencies Matched												Program Specific Outcomes (PSOs) / No. of Key Competencies		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO 1	2	-	10	-	1	-	-	-	3	-	-	3	2	-	-
CO 2	2	-	3	-	1	-	-	-	-	-	-	-	-	-	3
CO 3	2	-	3	-	1	-	-	-	-	-	-	-	-	-	3
CO 4	2	-	2	-	1	-	-	-	-	-	-	-	-	4	-
CO 5	2	-	2	-	1	-	-	-	-	-	-	-	3	-	-
CO 6	2	-	3	-	1	-	-	-	1	-	-	-	3	-	-

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

Course Outcomes (COs)	Program Outcomes (POs) / No. of Key Competencies												Program Specific Outcomes (PSOs) / No. of Key Competencies		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO 1	66.7	0.0	100.0	0.0	100.0	0.0	0.0	0.0	25.0	0.0	0.0	25.0	66.7	0.0	0.0
CO 2	66.7	0.0	30.0	0.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	30.0
CO 3	66.7	0.0	30.0	0.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	30.0
CO 4	66.7	0.0	20.0	0.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	40.0	0.0
CO 5	66.7	0.0	20.0	0.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	100.0	0.0	0.0
CO 6	66.7	0.0	30.0	0.0	100.0	0.0	0.0	0.0	10.0	0.0	0.0	0.0	100.0	0.0	0.0

XIV. COURSE ARTICULATION MATRIX (PO – PSAPPING)

COs and POs and COs and PSOs 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% –Nocorrelation;**2** – 40 % <C< 60% –Moderate.
1 – 5 <C≤ 40% – Low/ Slight; **3** – 60% ≤ C< 100% – Substantial /High

Course Outcomes (COs)	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO 1	3	-	3	-	3	-	-	-	1	-	-	1	3	-	-
CO 2	3	-	1	-	3	-	-	-	-	-	-	-	-	-	1
CO 3	3	-	1	-	3	-	-	-	-	-	-	-	-	-	1
CO 4	3	-	1	-	3	-	-	-	-	-	-	-	-	2	-
CO 5	3	-	1	-	3	-	-	-	-	-	-	-	3	-	-
CO 6	3	-	1	-	3	-	-	-	1	-	-	-	3	-	-
TOTAL	12		8		18				2			1	9	2	2
AVERAGE	**3.0**		**1.0**		**3.0**				**2.0**			**1.0**	**3.0**	**2.0**	**1.0**

XV. ASSESSMENT METHODOLOGIES–DIRECT

CIE Exams	PO1,PO3,PO5, PO9,PO12, PSO1,PSO2, PSO3	SEE Exams	PO1,PO3,PO5, PO9,PO12, PSO1,PSO2, PSO3	Assignments	-	Seminars	-
Laboratory Practices	PO1,PO3,PO5, PO9,PO12, PSO1,PSO2, PSO3	Student Viva	PO1,PO3,PO5, PO9,PO12, PSO1,PSO2, PSO3	Mini Project	PO5	Certification	-

XVI. ASSESSMENT METHODOLOGIES–INDIRECT

✔	Early Semester Feedback	✔	End Semester OBE Feedback
✘	Assessment of Mini Projects by Experts		

XVII. SYLLABUS

Week-1	**INTRODUCTION TO BIM & AUTODESK REVIT**
About Autodesk and Autocad, workflow and BIM, Revit terms, overview of the interface, starting projects, viewing commands.	
Week-2	**BASIC DRAWING AND EDITING TOOLS**
Using general drawing tools, editing elements, working with modify tools.	
Week-3	**SETTING UP LEVELS AND GRIDS**
Setting up levels and grids, creating structural grids, adding columns, linking and importing CAD files.	
Week-4	**MODELING WALLS**
Modelling walls, modifying walls, model exterior shell, add interior walls.	
Week-5	**WORKING WITH DOORS AND WINDOWS**
Inserting doors and windows, loading door and window types from library, creating additional door and window sizes.	
Week-6	**WORKING WITH CURTAIN WALLS**
Creating curtain walls, adding curtain grids, working with curtain wall panels, attaching mullions to curtain grids.	
Week-7	**WORKING WITH VIEWS**
Setting the view display, duplicating views, adding callout views, elevations and sections.	
Week-8	**ADDING COMPONENTS**
Adding component, modifying component, working with elements.	
Week-9	**MODELING FLOORS**
Modelling & modifying floors, joining geometry, creating shaft openings, creating sloped floors	
Week-10	**MODELING CEILINGS & ROOFS**
Modelling ceilings, adding ceiling fixtures, creating ceiling soffits, modelling roofs	
Week-11	**MODELING STAIRS AND RAILING**
Creating component stairs, modifying component stairs, working with railings, sketching custom stairs, creating ramps	
Text Books:	
1. Ascent , —Audodesk Revit for 2015 BIM handbook ‖, SDC publication , 1st Edition August 2014.	
Reference Books:	
1. Chuck Eastman, Paul Teicholz, Rafael Sacks, Kathleen Liston —BIM HANDBOOK‖, Wiley, 2 nd Edition, 2011.	
Web References:	
1. http://auvsp.edu.in/datastore/auwebsite/documents/libraryebookspdf/building-information-modeling.pdf	

XVIII. COURSE PLAN:

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

Week No.	Topics to be covered	Course Outcomes	Reference
1	Introduction to BIM & AUTODESK REVIT	CO 1	
2	Basic Drawing And Editing Tools	CO 1	
3	Setting Up Levels And Grids	CO 2	
4	Modeling Walls	CO 3	
5	Working With Doors And Windows	CO 3	
6	Working With Curtain Walls	CO4	
7	Working With Views	CO 4	
8	Adding Components	CO 5	
9	Modeling Floors	CO 6	
10	Modeling Ceilings & Roofs	CO 6	
11	Modeling Stairs And Railing	CO 6	

XIX. EXPERIMENTS FOR ENHANCED LEARNING (EEL):

S. No.	Design Oriented Experiments
1	Design of Grid & levels
2	Design of Beams, Column & slab
3	Design of walls & curtain walls
4	Design of doors & windows
5	Design of ceilings, floors, roofs & stairs

Prepared by:
Mr. S Selvaprakash
Assistant Professor

HOD, CE

INSTITUTE OF AERONAUTICAL ENGINEERING
(Autonomous)
Dundigal, Hyderabad - 500 043

COURSE DESCRIPTION

Department	**CIVIL ENGINEERING**				
Course Title	**DESIGN OF STEEL STRUCTURES AND DRAWING**				
Course Code	ACE012				
Program	B.Tech				
Semester	VI				
Course Type	CORE				
Regulation	IARE-16				
Course Structure	Theory			Practical	
	Lecture	Tutorials	Credits	Laboratory	Credits
	3	1	4	-	-
Course Coordinator	Dr Venu M, Professor				

I COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites
B.Tech	ACE001	III	Strength of Materials - I
B.Tech	ACE004	IV	Strength of Materials - II
B.Tech	ACE008	V	Structural Analysis

II COURSE OVERVIEW:

Design of steel structures and drawing deals with the analysis and design of steel structural elements like tension members, compression members, beams and girders etc. This course will focus on mechanical properties of structural steel, concepts of elasticity and plasticity and limit state design. The course will help to enrich the knowledge of design in multi storeyed and industrial structures including bridges. The course will also enhance the knowledge or skill sets of the student for designing efficient, economic and durable steel structures.

III MARKS DISTRIBUTION:

Subject	SEE Examination	CIE Examination	Total Marks
Design of Steel Structures and Drawing	70 Marks	30 Marks	100

IV CONTENT DELIVERY / INSTRUCTIONAL METHODOLOGIES:

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

V EVALUATION METHODOLOGY:

The course will be evaluated for a total of 100 marks, with 30 marks for Continuous Internal Assessment (CIA) and 70 marks for Semester End Examination (SEE). Out of 30 marks allotted for CIA during the semester, marks are awarded by taking average of two CIE examinations or the marks scored in the make-up examination.

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 14 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
15%	Remember
15%	Understand
60%	Apply
10%	Analyze
0%	Evaluate
0%	Create

Continuous Internal Assessment (CIA):
CIA is conducted for a total of 30 marks, with 25 marks for Continuous Internal Examination (CIE) and 05 marks for Quiz \Alternative Assessment Tool (AAT).

Component	Theory		Total Marks
Type of Assessment	CIE Exam	Quiz \AAT	
CIA Marks	25	05	30

Continuous Internal Examination (CIE):
Two CIE exams shall be conducted at the end of the 8^{th} and 17^{th} week of the semester respectively. The CIE exam is conducted for 25 marks of 2 hours duration consisting of two parts. Part–A shall have five compulsory questions of one mark each. In part–B, four out of five questions have to be answered where, each question carries 5 marks. Marks are awarded by taking average of marks scored in two CIE exams.
Quiz - Online Examination
Two Quiz exams shall be online examination consisting of 25 multiple choice questions and are to be answered by choosing the correct answer from a given set of choices (commonly four). Such a question paper shall be useful in testing of knowledge, skills, application, analysis, evaluation and understanding of the students. Marks shall be awarded considering the average of two quiz examinations for every course.
Alternative Assessment Tool (AAT)
This AAT enables faculty to design own assessment patterns during the CIA. The AAT converts the classroom into an effective learning center. The AAT may include tutorial hours/classes, seminars, assignments, term paper, open ended experiments, METE (Modeling and Experimental Tools in Engineering), five minutes video, MOOCs etc. The AAT chosen for this course is given in table

Concept Video	Tech-talk	Complex Problem Solving
40%	40%	20%

VI COURSE OBJECTIVES:

The students will try to learn:

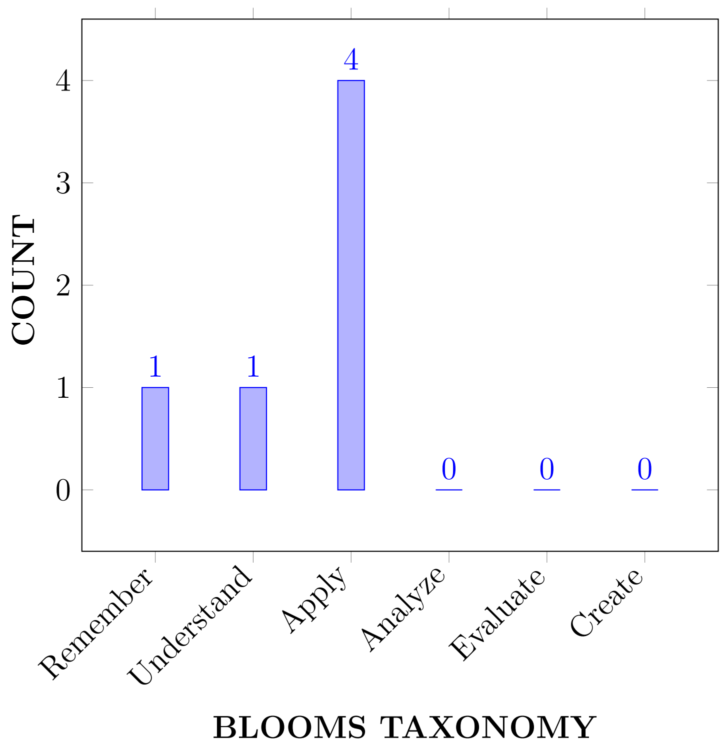
I	The concepts of limit state design and the behaviour of structural steel used in design and its properties.
II	The design of structural elements necessary for creating efficient and economic steel structures.
III	The design and drawing of multi storeyed industrial and residential structures including bridges for creating high performance and durable structures.

VII COURSE OUTCOMES:

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

CO 1	**Recall** the concepts of structural steel properties, different loads and their combinations for understanding the behavior of steel structures.	Remember
CO 2	**Explain** the concept of limit state design, different limit states, design strengths, deflection limits and serviceability requirements forthe designing of steel structural elements.	Understand
CO 3	**Design** bolted and welded connections for joining two or more steel structural elements for the transfer of loads.	Apply
CO 4	**Design** tension members, compression member / column, beams and girders using Indian standard code method.	Apply
CO 5	**Design** eccentric connections with brackets, beam end connections, web angle and truss joints for large crane movement in industries.	Apply
CO 6	**Design** of plate girders with and without stiffeners for designing bridge structures and large span beams.	Apply

COURSE KNOWLEDGE COMPETENCY LEVEL



VIII PROGRAM OUTCOMES:

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

Program Outcomes	
PO 7	**Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO 8	**Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO 9	**Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO 10	**Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO 11	**Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO 12	**Life-Long Learning:** Recognize the need for and having the preparation and ability to engage in independent and life-long learning in the broadest context of technological change

IX 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
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	CIE / SEE / AAT
PO 4	**Conduct Investigations of Complex Problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.	2	Assignments/ AAT

3 = High; 2 = Medium; 1 = Low

X HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

PROGRAM OUTCOMES		Strength	Proficiency Assessed by
PSO 1	Design and supervise sub-structures and superstructures for residential and public buildings, industrial structures, irrigation structures, powerhouses, highways, railways, airways, docks and harbours.	2	CIE / SEE / AAT

3 = High; 2 = Medium; 1 = Low

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

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	✓	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 2	✓	-	-	-	-	-	-	-	-	-	-	-	✓	-	-
CO 3	✓	✓	✓	✓	-	-	-	-	-	-	-	-	✓	-	-
CO 4	✓	✓	✓	✓	-	-	-	-	-	-	-	-	✓	-	-
CO 5	✓	✓	✓	✓	-	-	-	-	-	-	-	-	✓	-	-
CO 6	✓	✓	✓	✓	-	-	-	-	-	-	-	-	✓	-	-

XII 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 matched
CO 1	PO 1	Identify different material generally used in steel structures, different loads acting in the members and know their behavior by applying the principles of **mathematics and engineering fundamentals**.	2
CO 2	PO 1	Recall (knowledge) the different limit state design and different limit states in design, and formulate the design parameters by applying the principles of **mathematics, and engineering fundamentals**.	2
	PSO 1	Understand the basic concepts of limit state design and load combinations using **structural design** concepts for the design purpose.	1
CO 3	PO 1	Understand the different loads to be considered and design process of bolted connections by applying the principles of **mathematics and engineering fundamentals**.	2

Course Outcomes	PO'S PSO'S	Justification for mapping (Students will be able to	No. of Key competencies matched
	PO 2	Analyse the joints for critical loads to know the design forces using the structural analysis concepts, , **formulate and state a problem, and develop solution and document the results**.	4
	PO 3	**Design** the bolted and welded joints for the factored forces for safety and serviceability.	1
	PO 4	Understand the appropriate IS codes and **engineering knowledge** for the design of bolted connections by **Identifying problem, classify problem** and **describe problem** and **quality issues** associated with the given problem in different conditions.	4
	PSO 1	Understand the design of bolted connections based on Indian standards using **structural design; strength assessment; materials knowledge their applications in engineering construction** of steel structures.	4
CO 4	PO 1	Understand the different loads to be considered and design process of tension, compression and beam by applying the principles of **mathematics and engineering fundamentals**.	2
	PO 2	Analyse the joints for critical loads to know the design forces using the structural analysis concepts, **formulate and state a problem, and develop solution and document the results**.	4
	PO 3	**Design** the tension, compression and beam for the factored forces for safety and serviceability.	1
	PO 4	Understand the appropriate is codes and **engineering knowledge** for the design of tension, compression and beam by **Identifying problem, classify problem and describe problem and quality issues** associated with the given problem in different conditions.	5
	PSO 1	Understand the design of tension, compression and beam based on Indian standards for the **structural design; strength assessment; materials knowledge** their applications in **engineering construction** of tension, compression and beams.	4
CO 5	PO 1	Understand the different loads to be considered and design process of bracket connections, beam connections and truss joints by applying the principles of **mathematics and engineering fundamentals**.	2

Course Outcomes	PO'S PSO'S	Justification for mapping (Students will be able to	No. of Key competencies matched
	PO 2	Analyse the joints for critical loads to know the design forces using the structural analysis concepts, **formulate** and **state a problem**, and **develop solution** and **document the results**.	4
	PO 3	**Design** the bracket connections, beam connections and truss joints for the factored forces for safety and serviceability.	1
	PO 4	Understand the appropriate is codes and **engineering knowledge** for the design of bracket connections, beam connections and truss joints by **Identifying problem**,**classify problem** and **describe problem** and **quality issues** associated with the given problem in different conditions.	5
	PSO 1	Understand the design of bracket connections, beam connections and truss joints based on Indian standards for the **structural design; strength assessment; materials knowledge** their applications in **engineering construction** of steel structural elements.	4
CO 6	PO 1	Understand the different loads to be considered and design process of plate girders by applying the principles of **mathematics and engineering fundamentals.**	2
	PO 2	Analyse the joints for critical loads to know the design forces using the structural analysis concepts, **formulate** and **state a problem**, and **develop solution** and **document the results.**	4
	PO 3	**Design** the plate girders for the factored forces for safety and serviceability.	1
	PO 4	Understand the appropriate is codes and **engineering knowledge** for the design of plate girders by **Identifying problem, classify problem** and **describe problem** and **quality issues** associated with the given problem in different conditions.	5
	PSO 1	Understand the design of plate girders based on Indian standards for the **structural design; strength assessment; materials knowledge** their applications in **engineering construction** of very large girders in bridges.	3

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

XIV 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	66.7	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 2	66.7	-	-	-	-	-	-	-	-	-	-	-	10.0	-	-
CO 3	66.7	40.0	10.0	45.5	-	-	-	-	-	-	-	-	40.0	-	-
CO 4	66.7	40.0	10.0	45.5	-	-	-	-	-	-	-	-	40.0	-	-
CO 5	66.7	40.0	10.0	45.5	-	-	-	-	-	-	-	-	40.0	-	-
CO 6	66.7	40.0	10.0	45.5	-	-	-	-	-	-	-	-	40.0	-	-

XV COURSE ARTICULATION MATRIX (PO / PSO MAPPING):

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

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

1 - $5\% < C \leq 40\%$ – Low/ Slight

2 - $40\% < C < 60\%$ –Moderate

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

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

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 5	3	2	1	2	-	-	-	-	-	-	-	-	2	-	-
CO 6	3	2	1	2	-	-	-	-	-	-	-	-	2	-	-
TOTAL	18	8	4	8									9		
AVERAGE	3.0	2.0	1.0	2.0									2.0		

XVI ASSESSMENT METHODOLOGY-DIRECT:

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

XVII ASSESSMENT METHODOLOGY-INDIRECT:

	Assessment of mini projects by experts	✓	End Semester OBE Feedback

XVIII SYLLABUS:

UNIT I	**INTRODUCTION ON MECHANICAL BEHAVIOUR OF STEEL**
	Materials, making of iron and steel, types of structural steel, mechanical properties of steel, concepts of plasticity yield strength, loads and combinations, behavior of steel, local buckling. Concept of limit state design – different limit states as per IS 800:2007. Design strengths deflection limits, serviceability, bolted connections, welded connections, efficiency of joint, prying action, design of tension members, design strength of members.
UNIT II	**COMPRESSION MEMBERS**
	Design of compression members, buckling class, slenderness ratio, strength design, laced columns, battened columns, slab base.
UNIT III	**BEAMS**
	Design of beams and bending and shear strength laterally supported beams. Design of built-up sections, large plates web buckling, crippling and deflection of beams, design of purlin.
UNIT IV	**ECCENTRIC CONNECTIONS**
	Design of eccentric connections with brackets, beam end connections, web angle, unstiffened and stiffened seated connections (bolted and welded types), design of truss joints.
UNIT V	**WELDED PLATE GIRDERS**

	Design of welded plate girders, optimum depth, design of main section, design of end bearing stiffness and intermediate stiffness. Connection between web and flange and design of flange splice and web splices.

TEXTBOOKS

1. S. K. Duggal, "Limit state design of steel structures", Tata McGraw-Hill, 3rd Edition, 2019.
2. N. Subramanian, "Design of steel structures", Oxford University Press, 2nd Edition, 2018.
3. S.S. Bhavikatti, "Design of steel structures", 4th Edition, IK International Publication House, New Delhi, 2014.

REFERENCE BOOKS:

1. K. S. Sai Ram, "Design of steel structures", Pearson Education, 2nd Edition, 2015.
2. Ramachandra and Virendra Gehlot, "Design of steel structures Volumes 1 and 2, Standard Publications, 2nd Edition, 2010.
3. Edwin H. Gaylord, Jr. Charles N. Gaylord and James Stallmeyer, "Design of Steel Structures", Tata McGraw-Hill Education private Limited, 3rd Edition, 2010.

WEB REFERENCES:

1. https://nptel.ac.in/courses/105/105/105105162/
2. https://nptel.ac.in/courses/105/106/105106112/

COURSE WEB PAGE:

XIX COURSE PLAN:

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

S.No	Topics to be covered	CO's	Reference T1: 4.1
OBE DISCUSSION			
1	Course Objectives, Course Outcomes, Program Outcomes, CO-PO Mapping		
CONTENT DELIVERY (THEORY)			
2	Know the materials, making of iron and steel.	CO 1	T1:1.1 -1.8 R1: 1.1 – 1.2
3	Know the types of structural steel, mechanical properties of steel.	CO 1	T1:2.1-2.10 R1: 1.3 – 1.4
4	Know the concepts of plasticity yield strength.	CO 1	R4:3.1-3.10
5-6	Understand loads and combinations loading wind loads on roof trusses.	CO 1	T1:10.2 R1: 1.6
7	Understand behavior of steel, local buckling.	CO 1	T1:10.1

8	Concept of limit state design – different limit states as per IS 800:2007.	CO 2	T1: 10.4-10.5 T3: 2.1 – 2.7
9	Concept of design strengths deflection limits, serviceability.	CO 2	T1: 11.1-11.8
10-11	Evaluate the bolted and welded connections and efficiency of joint.	CO 3	T1: 11.10 -11.11
12	Analyze the prying action in bolted and welded joints.	CO 3	T1: 3.10-3.12
13-15	Understand the design of tension members and design strength of members.	CO 4	T1: 3.10 R1: 3.1 – 3.5
16-18	Understand the design of compression members, buckling class, slenderness ratio.	CO 4	T1: 5.1-5.3 T3: 6.1 – 6.5
19-20	Understand the strength design, laced and battened columns.	CO 4	T1: 5.4-5.9 R1: 4.1 – 4.8
21-22	Understand the design of column base, and slab base.	CO 4	T1: 5.11-5.13 R1: 9.3
23-24	Understand the design of beams, plastic moment.	CO 4	T1: 6.1-6.4 R1: 5.1 – 5.4
25-26	Analyse the bending and shear strength laterally supported beams.	CO 4	T1: 6.5-6.12 T2: 6.1 – 6.4
27-29	Understand the design, built up sections, large plates web buckling.	CO 4	T1: 6.12 R1: 5.5 – 5.8
30-31	Analyse the crippling and deflection of beams, design of purlin.	CO 4	T1: 12.6 T3: 7.12 – 7.15
32-33	Understand the design of eccentric connections with brackets.	CO 5	T1: 11.3-11.4 T2: 10.1 – 10.9
34-35	Analyse the beam end connections, web angle and design of truss joints.	CO 5	T1: 7.1-7.3
36-39	Understand the design of plate girders, optimum depth, and design of main section.	CO 6	T1: 7.4-7.8 R1: 7.1 – 7.3
40-42	Understand the design of end bearing stiffness and intermediate stiffness.	CO 6	T1: 7.6 R1: 7.4 – 7.6
43-45	Analyze the Connection between web and flange.	CO 6	T1: 7.6-7.8
PROBLEM SOLVING/ CASE STUDIES			
1	Calculate the strength of a bolt and strength of different bolted joints.	CO 3	T1: 11.10 -11.11
2	Design of bolted and welded connections for different joints.	CO 3	T1: 3.10-3.12
3	Calculate the strength of the given tension member in the steel structures.	CO 4, CO 5	T1: 3.10 R1: 3.1 – 3.5
4	Design of tension members subjected to tensile loads.	CO 4, CO 5	T1: 3.10 R1: 3.1 – 3.5
5	Calculate the strength of a given compression member of a rolled section and built-up section.	CO 4	T1: 5.1-5.3 T3: 6.1 – 6.5

6	Design of compression member for axial loads including built-up sections.	CO 4	T1: 5.4-5.9 R1: 4.1 – 4.8
7	Design built-up columns sections using lacings.	CO 4	T1: 5.4-5.9 R1: 4.1 – 4.8
8	Design built-up columns sections using battens.	CO 4	T1: 5.4-5.9 R1: 4.1 – 4.8
9	Design slab base as the foundation for the columns	CO 4	T1: 5.11-5.13 R1: 9.3
10	Calculate the strength of a given rolled beam section and built-up section.	CO 4	T1: 6.5-6.12 T2: 6.1 – 6.4
11	Design of laterally supported beam sections.	CO 4, CO 5	T1: 6.12 R1: 5.5 – 5.8
12	Design of laterally un supported beam sections	CO 4, CO 5	T1: 6.5-6.12 T2: 6.1 – 6.4
13	Design of bracket connections type I and II for joining steel members.	CCO 5	T1: 11.3-11.4 T2: 10.1– 10.9
14	Calculate the strength of a given plate girder.	CO 6	T1: 7.4-7.8 R1: 7.1 – 7.3
15	Design of plate girder with and without stiffeners,	CO 6	T1: 7.6 R1: 7.4 – 7.6
DISCUSSION OF DEFINITION AND TERMINOLOGY			
1	Concept of limit state design – different limit states as per IS 800:2007. Design strengths deflection limits, serviceability, bolted connections, efficiency of joint, prying action, design of tension members, design strength of members.	CO 1,2,3	R1:1.1 - 1.6
2	Design of compression members, buckling class, slenderness ratio, strength design, laced columns, battened columns, slab base.	CO 3, CO 4	T1:5.1 - 5,13
3	Design of beams and bending and shear strength laterally supported beams. Design of built-up sections, large plates web buckling, crippling and deflection of beams, design of purlin.	CO 3, CO 4	T1 6.1-6.12
4	Design of eccentric connections with brackets, beam end connections, web angles, design of truss joints.	CO 5	T1:7.1 - 7.3
5	Design of plate girders, optimum depth, design of main section, design of end bearing stiffness and intermediate stiffness. Connection between web and flange.	CO 6	T1: 7.1 - 7.8
DISCUSSION OF QUESTION BANK			

1	Concept of limit state design – different limit states as per IS 800:2007. Design strengths deflection limits, serviceability, bolted connections, efficiency of joint, prying action, design of tension members, design strength of members.	CO 1,2,3	R1:1.1 - 1.6
2	Design of compression members, buckling class, slenderness ratio, strength design, laced columns, battened columns, slab base.	CO 3,4	T1:5.1 - 5.13
3	Design of beams and bending and shear strength laterally supported beams. Design of built-up sections, large plates web buckling, crippling and deflection of beams, design of purlin.	CO 3,4	T1 6.1-6.12
4	Design of eccentric connections with brackets, beam end connections, web angles, design of truss joints.	CO 5	T1:7.1 - 7.3
5	Design of plate girders, optimum depth, design of main section, design of end bearing stiffness and intermediate stiffness. Connection between web and flange.	CO 6	T1: 7.1 - 7.8

Signature of Course Coordinator **HOD, CE**
Dr. Venu M, Professor

INSTITUTE OF AERONAUTICAL ENGINEERING
(Autonomous)
Dundigal, Hyderabad - 500 043

COURSE DESCRIPTION

Department	CIVIL ENGINEERING				
Course Title	TRANSPORTATION ENGINEERING				
Course Code	ACE013				
Program	B.TECH				
Semester	VI				
Course Type	CORE				
Regulation	R-16				
Course Structure	Theory			Practical	
	Lecture	Tutorials	Credits	Laboratory	Credits
	3	1	4	-	-
Course Coordinator	Mr. B Suresh, Assistant Professor				

I COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites
B.Tech	AHS002	I	Linear Algebra and Ordinary Differential Equations
B.Tech	ACE002	III	Surveying

II COURSE OVERVIEW:

Transportation engineering is the application of technology and scientific principles to the planning, design, operation and management of facilities. Traffic control refers to the traffic engineering, regulation, management and safety with an integrated approach in traffic system. This course gives an overview on Transportation engineering with respect toconstruction and maintenance of highways as per IRC standards. This course also focuses on designing new transportation systems and infrastructures, including highways. Further the course is useful to solve the complex problems related to the traffic management by collecting and evaluating the data such as traffic flow, density, speed and volume.

III MARKS DISTRIBUTION:

Subject	SEE Examination	CIE Examination	Total Marks
Transportation Engineering	70 Marks	30 Marks	100

IV CONTENT DELIVERY / INSTRUCTIONAL METHODOLOGIES:

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

V EVALUATION METHODOLOGY:

The course will be evaluated for a total of 100 marks, with 30 marks for Continuous Internal Assessment (CIA) and 70 marks for Semester End Examination (SEE). Out of 30 marks allotted for CIA during the semester, marks are awarded by taking average of two CIA examinations or the marks scored in the make-up examination.

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 14 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
50%	Understand
25%	Apply
15%	Analyze
0 %	Evaluate
0 %	Create

Continuous Internal Assessment (CIA):
CIA is conducted for a total of 30 marks, with 25 marks for Continuous Internal Examination (CIE) and 05 marks for Quiz Alternative Assessment Tool (AAT).

Component	Theory			Total Marks
Type of Assessment	CIE Exam	Quiz AAT		
CIA Marks	25	05		30

Continuous Internal Examination (CIE):
Two CIE exams shall be conducted at the end of the 8^{th} and 16^{th} week of the semester respectively. The CIE exam is conducted for 20 marks of 2 hours duration consisting of five descriptive type questions out of which four questions have to be answered where, each question carries 5 marks. Marks are awarded by taking average of marks scored in two CIE exams.

Quiz - Online Examination
Two Quiz exams shall be online examination consisting of 50 multiple choice questions and are to be answered by choosing the correct answer from a given set of choices (commonly four). Such a question paper shall be useful in testing of knowledge, skills, application, analysis, evaluation and understanding of the students. Marks shall be awarded considering the average of two quiz examinations for every course.

Alternative Assessment Tool (AAT)
This AAT enables faculty to design own assessment patterns during the CIA. The AAT converts the classroom into an effective learning center. The AAT may include tutorial hours/classes, seminars, assignments, term paper, open ended experiments, METE (Modeling and Experimental Tools in Engineering), five minutes video, MOOCs etc. The AAT chosen for this course is given in table

Concept Video	Tech-talk	Complex Problem Solving
40%	40%	20%

VI COURSE OBJECTIVES:

The students will try to learn:

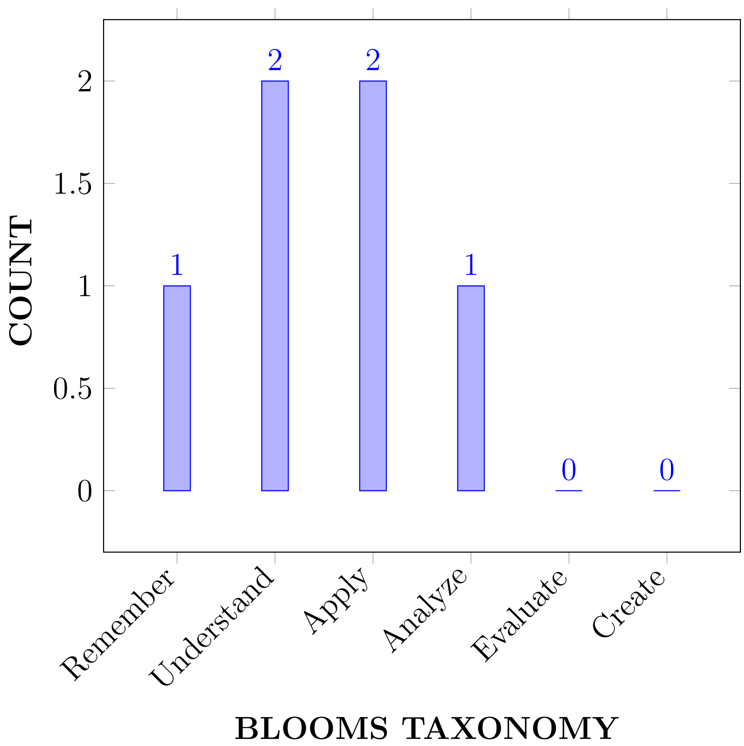
I	The highway planning process, surveys involved in planning and highway alignment.
II	The geometric design of highways and expressways based on different terrains.
III	The various traffic surveys to implement traffic regulation and control measures.
IV	The engineering properties of pavement materials used in construction of highway.

VII COURSE OUTCOMES:

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

CO 1	**Recall** the fundamentals of highway engineering for effective planning and development of highways based on the mission requirement.	Remember
CO 2	**Identify** highway intersection at urban areas for promoting continuous flow without congestions.	Apply
CO 3	**Identify** traffic signals at intersections for avoiding conflicts and promoting free flow of traffic.	Apply
CO 4	**Classify** the various traffic parameters considered in traffic study for regulating traffic at various controlled and uncontrolled intersections.	Analyze
CO 5	**Explain** the mechanical properties of pavement construction materials for enhancing serviceability and durability of highway pavements.	Understand
CO 6	**Explain** the stresses induced in rigid pavements considered for designing, CC pavements to improve their performance.	Understand

COURSE KNOWLEDGE COMPETENCY LEVEL



VIII PROGRAM 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

IX 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	CIE/SEE/AAT
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	CIE/SEE/AAT
PO 4	**Conduct Investigations of Complex Problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.	1	CIE/SEE/AAT
PO 5	**Modern Tool Usage:**M 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	3	CIE/SEE/AAT

3 = High; 2 = Medium; 1 = Low

X HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

PROGRAM SPECIFIC OUTCOMES		Strength	Proficiency Assessed by
PSO 1	Design and Supervise Sub-Structures and Super Structures for Residential and Public Buildings, Industrial Structures, Irrigation Structures, Power Houses, Highways, Railways, Airways, Docs and Harbours.	2	CIE/SEE/AAT
PSO 2	Focus on Improving Performance of Structures with reference to Safety, Serviceability and Sustainable Green Building Technology.	3	CIE/SEE/AAT

3 = High; 2 = Medium; 1 = Low

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

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	✓	-	-	-	✓	-	-	-	-	-	-	-	✓	-	-
CO 2	✓	-	-	✓	-	-	-	-	-	-	-		-	✓	-
CO 3	✓	-	✓	✓	-	-	-	-	-	-	-		-	-	-
CO 4	✓	-	✓	✓	-	-	-	-	-	-	-		-	-	-
CO 5	-	-	✓	✓	✓	-	-	-	-	-	-	-	✓	✓	-
CO 6	-	-	-	✓	✓	-	-	-	-	-	-	-	-	✓	-

XII 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 matched.
CO 1	PO 1	Explain the factors affecting highway alignment by using **Scientific principles and methodology.**	1
	PO 5	Select and apply appropriate techniques of traffic **simulation packages** for development of highways by understanding the limitations.	1
	PSO 1	Explain the classification of roads based on **structural design and material** knowledge by conducting various **traffic studies and design of pavement** using **Soil investigation and design of sub-structures** by **Engineering, procurement and construction** using **standard codes of practice.**	5
CO 2	PO 1	Understand importance of vertical and horizontal alignment by applying **scientific principles and methodology** to study the optimum speed of vehicles.	1
	PO 4	Understand contexts in which **engineering knowledge can be applied** for avoiding conflict on highways at intersections by using **appropriate codes of practice and industry standard.**	2
	PSO 2	Understand the fundamentals of intersections to **improve the performance of highways** in terms of **safety and serviceability of structure and research**	2
CO 3	PO 1	Understand the major causes and remedial measures to decrease the rate of accidents by applying **scientific principles and methodology**	1
	PO 3	Identify and Manage cost drivers designof parking facilities in urban areasto improve the free flow of traffic by applying **operation, maintenance and disposal techniques to Manage the design process and evaluate outcomes** of design	2

Course Outcomes	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key competencies matched.
	PO 4	Explain the contexts in which **engineering knowledge can be applied** for highway lightening on roads using **analytical methods and modeling techniques**	2
CO 4	PO 1	Understand the various traffic parameters for regulationg traffic flow by applying **scientific principles and methodology**	1
	PO 3	Identify and Manage traffic regulation and control in urban areas to improve the free flow of traffic at controlled intersections by applying **operation, maintenance and disposal techniques to Manage the design process and evaluate outcomes** of design	2
	PO 4	Explain the contexts in which **engineering knowledge can be applied** for regulatimng traffic flow on uncontrolled intersections using **analytical methods and modeling techniques**	2
CO 5	PO 3	Identify and Manage cost drivers in design and construction of highways to improve the free flow of traffic by applying **operation, maintenance and disposal techniques** to **Manage the design process and evaluate outcomes** of design	2
	PO 4	Identify, classify and describe the performance of pavement materials used in construction by **analytical methods and modeling techniquesto analyze engineering processes**	2
	PO 5	Select and apply appropriate techniques for construction of highways by understanding the requirements and limitations **simulation packages**	1
	PSO 1	Understand the various material testing procedures used for determining engineering properties of materials based on **structural design and material knowledge** and inputs from **Soil investigation and design of sub-structures** by **Engineering, procurement and construction** and Identify the factors causing traffic congestion in urban areas by conducting various **traffic studies and design of pavement** using standard **codes of practice**	5
	PSO 2	Focus on **improving performance of materials/structures** by testing with reference to **safety and serviceability of structures and research**	2
CO 6	PO 4	Understand **Knowledge of characteristics of particular materials** characteristics and **quality issues** of materials used in construction	2
	PO 5	Select and apply appropriate **Computer software** techniques for minimizing the stress developed in flexible and rigid pavements by understanding the requirements and limitations	1

Course Outcomes	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key competencies matched.
	PSO 2	Understand the factors affecting design and performance of rigid to **Improve the performance of structures** for increasing **safety and serviceability of structures and research**	2

XIII TOTAL COUNT OF KEY COMPETENCIES FOR CO – PO/ PSO MAPPING:

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

XIV PERCENTAGE OF KEY COMPETENCIES FOR CO – PO/ PSO

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	33.3	-	-	-	100	-	-	-	-	-	-	-	50	-	-
CO 2	33.3		-	18.1	-	-	-	-	-	-	-		-	66.6	- -
CO 3	33.3	-	20	18.1	-	-	-	-	-	-	-		-	-	-
CO 4	33.3	-	20	18.1	-	-	-	-	-	-	-		-	-	-
CO 5	-	-	20	18.1	100	-	-	-	-	-	-	-	50	66.6	-
CO 6	-	-	-	18.1	100	-	-	-	-	-	-	-	-	66.6	-

XV COURSE ARTICULATION MATRIX (PO / PSO MAPPING):

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

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

1 -$5 < C \leq 40\%$ – Low/ Slight

2 - $40\ \% < C < 60\%$ –Moderate

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

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

XVI ASSESSMENT METHODOLOGY-DIRECT:

CIE Exams	✓	SEE Exams	✓	Seminars	-
Term Paper	-	Concept Video	✓	Open Ended Experiments	-
Assignments	-	Mini project	-	Tech Talk	✓

XVII ASSESSMENT METHODOLOGY-INDIRECT:

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

XVIII SYLLABUS:

MODULE I	**HIGHWAY DEVELOPMENT AND PLANNING**
	Highway development in India, necessity for highway planning, different road development plans; Classification of roads, road network patterns, highway alignment, factors affecting alignment, engineering surveys, drawing and reports, highway project.
MODULE II	**HIGHWAY GEOMETRIC DESIGN**
	Importance of geometric design, factors affecting highway geometric design. Design controls and criteria, highway cross section elements, sight distance elements, stopping sight distance, overtaking sight distance and intermediate sight distance, design of horizontal alignment, design of super elevation and extra widening, design of transition curves, design of vertical alignment, gradients, vertical curves
MODULE III	**TRAFFIC ENGINEERING AND REGULATIONS**
	Basic parameters of traffic, volume, speed and density, traffic volume studies, data collection and presentation, speed studies, data collection and presentation, origin and destinations studies. Parking studies, onstreet and offstreet parking , road accidents , causes and preventive measures, accident data recording, condition diagram and collision diagrams, traffic signs, types and specifications, road markings, need for road markings, types of road markings, design of traffic signals, webster method.
MODULE IV	**INTERSECTION DESIGN**
	Types of Intersections, conflicts at intersections, requirements of at, grade intersection, types of at grade intersections, canalization ,traffic islands, types of grade separated intersections, rotary intersection, concept of rotary, design factors of rotary, advantages and limitations of rotary intersections

MODULE V	**HIGHWAY MATERIAL, CONSTRUCTION AND MAINTENANCE**
	Highway material characterization; subgrade soil, stone aggregate, bitumen materials, construction of gravel roads, construction of water bound macadam roads, construction of bituminous pavements: Surface dressing, bitumen bound macadam, bituminous concrete, construction of cement concrete pavements, construction of joints in cement concrete pavements joint filter and seal pavement failures, maintenance of highways, highway drainage.

TEXTBOOKS

1. S.K.Khanna, and , C.E.G Justo and Veeraragavan, A, 'Highway Engineering', Revised 10 th Edition, Nem Chand & Bros, 2017.

2. Dr.L.R.Kadyali, Traffic Engineering and Transportation Planning, Khanna publications, 6^{th} Edition, 1997.

REFERENCE BOOKS:

1. Garber and Hoel, "Principles of Traffic and Highway Engineering", Cengage Learning, 2014.

2. Dr.L.R.Kadyali, and Dr.N.B Lal, "Principles of Practices of Highway Engineering", Khanna publications, 2003.

3. S.P.Bindra, ", Dhanpat Rai and Sons., "Highway Engineering, 4^{th} Edition, 1981

WEB REFERENCES:

1. https://nptel.ac.in/courses/105/101/105101087/

COURSE WEB PAGE:

1. https://lms.iare.ac.in/index?route=course/detailscourseid=374

XIX COURSE PLAN:

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

S.No	Topics to be covered	CO's	Reference T1: 4.1
OBE DISCUSSION			
1.	Outcome Based Education, CO PO attainment and Blooms Taxonomy		
CONTENT DELIVERY (THEORY)			
1-2	Classification of roads	CO 1	T1:2.4 T2:11.2
3-4	Road development in India	CO 1	T1:2.10
6-7	Current road projects in India	CO 1	T1:3.10
8	Highway alignment	CO 1	T1:3.1
9	Factors affecting alignment	CO 1	T1:3.1.2
10	Engineering surveys	CO 1	T1:3.2
11	Drawing and reports, highway project	CO 1	T1:3.4.2

12	Introduction, highway cross section elements	CO 2	T1:16.6.2
13	Sight distance elements	CO 2	T1:4.3 R3:2.1
14	Stopping sight distance	CO 2	T1: 4.3.2
15	Overtaking sight distance and intermediate sight distance	CO 2	T1: 4.3.3 R3:2.3
16	Design of horizontal alignment	CO 2	T1: 4.4
17	Design of vertical alignment	CO 2	T1: 4.5
18	Design of intersections	CO 2	T1:5.4
19	Traffic characteristics	CO 3	T1:5.2 T3:16.5
20	Traffic engineering studies	CO 3	T1:5.2.3 T2:1.2
21	Traffic flow and capacity	CO 3	T1:5.2.3 R2:4.1
22	Traffic regulation and control	CO 4	T1:5.3.2 T3:17.1
23	Design of parking facilities	CO 4	T1:5.5 T2:6.3
24	Highway lighting	CO 4	T1:5.6
25	Accident studies: causes and measures	CO 4	T1:5.2.1
26	Materials used in Highway Construction- Soils	CO 5	T1:6.1.1
27	Stone aggregates	CO 5	T1:6.2
28	Bituminous binders, bituminous paving mixes	CO 5	T1:6.3
29-30	Portland cement and cement concrete	CO 5	T1:6.2
31	Desirable properties, tests	CO 5	T1:6.3
32-33	Requirements for different types of pavements	CO 6	T1:7.1.1
34	Introduction; flexible pavements	CO 6	T1:7.2
35	Factors affecting design and performance	CO 6	T1:6.3 R2:1.1
36	Stresses in flexible pavements	CO 6	T1:7.3
37-38	Design of flexible pavements as per IRC	CO 6	T1:7.3.1 R2:6.1
39-40	Rigid pavements- components and functions	CO 6	T1:4.1 R1:6.5
41-42	Factors affecting design and performance of CC pavements	CO 6	T1:7.4.2
43	Stresses in rigid pavements	CO 6	T1:7.4.3 R2:4.1
44-45	Design of concrete pavements as per IRC; problems	CO 6	T1:7.4.5 R1:6.10
PROBLEM SOLVING/ CASE STUDIES			
1	Classification of roads	CO 1	T1:2.4 T2:11.2
2	Highway alignment	CO 1	T1:3.1
3	Sight distance elements	CO 2	T1:4.3 R3:2.1

4	Stopping sight distance	CO 2	T1: 4.3.2
5	Overtaking sight distance and intermediate sight distance	CO 2	T1: 4.3.3 R3:2.3
6	Design of horizontal alignment	CO 2	T1: 4.4
7	Design of vertical alignment	CO 2	T1: 4.5
8	Design of intersections	CO 3	T1:5.4
9	Traffic characteristics	CO 3	T1:5.2 T3:16.5
10	Traffic regulation and control	CO 4	T1:5.3.2 T3:17.1
11	Design of parking facilities	CO 4	T1:5.5 T2:6.3
12	Portland cement and cement concrete	CO 5	T1:6.2
13	Design of flexible pavements as per IRC	CO 5	T1:7.3.1 R2:6.1
14	Design of concrete pavements as per IRC; problems	CO 6	T1:7.4.5 R1:6.10
15	Stresses in rigid pavements	CO 6	T1:7.4.3 R2:4.1
DISCUSSION OF DEFINITION AND TERMINOLOGY			
1	Classification of roads, Road development in India, Factors affecting alignment, Engineering surveys, Drawing and reports, highway project	CO 1,	T1:2.4-3.2 T2:11.2
2	Introduction, highway cross section elements Sight distance elements, Stopping sight distance, Overtaking sight distance and intermediate sight distance, Design of vertical alignment, Design of horizontal alignment	CO 2	T1:16.6.2-T1: 4.5
3	Traffic characteristics ,Traffic engineering studies, Traffic flow and capacity ,Traffic regulation and control, Accident studies: causes and measures, Highway lighting	CO 3, CO 4	T1:5.2 T3:16.5-T1:5.2.1
4	Materials used in Highway Construction- Soils, Stone aggregates, Portland cement and cement concrete	CO 5	T1:6.1.1-T1:6.2
5	Flexible pavements, Design of flexible pavements as per IRC, Stresses in rigid pavements	CO 6	T1:7.3-T1:7.4.3 R2:4.1
DISCUSSION OF QUESTION BANK			
1	Calculate the lengths of National and State highways required in a district with a total area of 2000 km^2 , Developed, Semi-developed Undeveloped areas being 22, 35,15 percent of the respective district. The no of towns with population over 1.1, 0.2- 1.1, 0.1-0.6 and 0.1-0.2 lakhs are 2,5, 16 and 18 respectively in a district using second twenty year plan?	CO 1	T1:2.4-3.2 T2:11.2
2	A two lane road with design speed 80kmph has horizontal curve of radius 480m. Design the rate of superelevationfor mixed traffic. By how much should the outer edges of the pavement be raised with respect to the centre line, if the pavement is rotated with respect to the centre line	CO 2	T1:16.6.2-T1: 4.5

3	A vehicle moving at 40kmph speed was stopped by applying breaks and length of the skid mark was 12.2 m. if average skid resistance of the pavement is known to be 0.70. Determine the break efficiency of the test vehicle	CO 3, CO 4	T1:5.2 T3:16.5- T1:5.2.1
4	Explain in detail about aggregate crushing strength test according to IS 2386 part-IV	CO 5	T1:6.1.1- T1:6.2
5	Design the pavement for construction of a new bypass with the following data: 1. Two lane carriage way 2. Initial traffic in the year of completion of construction = 400 CVPD (sum of both directions) 3. Traffic growth rate = 7.5 percentage 4. Design life = 15 years 5. Vehicle damage factor based on axle load survey = 2.5 standard axle per commercial vehicle 6. Design CBR of subgrade soil = 4 percentage.	CO 6	T1:7.3- T1:7.4.3 R2:4.1

Signature of Course Coordinator **HOD CE**
Mr. B Suresh Assistant Professor

INSTITUTE OF AERONAUTICAL ENGINEERING
(Autonomous)
Dundigal, Hyderabad - 500 043

COURSE DESCRIPTION

Department	CIVIL ENGINEERING				
Course Title	WATER RESOURCES ENGINEERING				
Course Code	ACE014				
Program	B.Tech				
Semester	VI				
Course Type	CORE				
Regulation	R-16				
Course Structure	Theory			Practical	
	Lecture	Tutorials	Credits	Laboratory	Credits
	3	1	4	-	-
Course Coordinator	Ms. B Bhavani, Assistant Professor				

I COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites
B.Tech	ACE011	V	Hydraulics and Hydraulic Machinery
B.Tech	ACE005	IV	Fluid Mechanics
B.Tech	AME002	II	Engineering Mechanics

II COURSE OVERVIEW:

This course addresses the concept of present science of the practice of irrigation engineering which comprising partially all the modern developments which occurs in irrigation purpose. In this mainly the units are taken as metric unit which covers the total area which need for irrigation. In this we can know about water requirement of crops by hydrology, ground water, reservoir water and rain water storing. By this water recourses engineering we can know about design of irrigation structures and planning of reservoir as for flood control.

III MARKS DISTRIBUTION:

Subject	SEE Examination	CIE Examination	Total Marks
Water Resources Engineering	70 Marks	30 Marks	100

IV CONTENT DELIVERY / INSTRUCTIONAL METHODOLOGIES:

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

V EVALUATION METHODOLOGY:

The course will be evaluated for a total of 100 marks, with 30 marks for Continuous Internal Assessment (CIA) and 70 marks for Semester End Examination (SEE). Out of 30 marks allotted for CIA during the semester, marks are awarded by taking average of two CIE examinations or the marks scored in the make-up examination.

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 units and each unit 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 unit. Each question carries 14 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
11%	Remember
44 %	Understand
34 %	Apply
11 %	Analyze
0 %	Evaluate
0 %	Create

Continuous Internal Assessment (CIA):

CIA is conducted for a total of 30 marks, with 25 marks for Continuous Internal Examination (CIE) and 05 marks for Quiz \Alternative Assessment Tool (AAT).

Component	Theory		Total Marks
Type of Assessment	CIE Exam	Quiz \AAT	
CIA Marks	25	05	30

Continuous Internal Examination (CIE):

Two CIE exams shall be conducted at the end of the 8^{th} and 17^{th} week of the semester respectively. The CIE exam is conducted for 25 marks of 2 hours duration consisting of two parts. Part–A shall have five compulsory questions of one mark each. In part–B, four out of five questions have to be answered where, each question carries 5 marks. Marks are awarded by taking average of marks scored in two CIE exams.

Quiz - Online Examination

Two Quiz exams shall be online examination consisting of 25 multiple choice questions and are to be answered by choosing the correct answer from a given set of choices (commonly four). Such a question paper shall be useful in testing of knowledge, skills, application, analysis, evaluation and understanding of the students. Marks shall be awarded considering the average of two quiz examinations for every course.

Alternative Assessment Tool (AAT)

This AAT enables faculty to design own assessment patterns during the CIA. The AAT converts the classroom into an effective learning center. The AAT may include tutorial hours/classes, seminars, assignments, term paper, open ended experiments, METE (Modeling and Experimental Tools in Engineering), five minutes video, MOOCs etc. The AAT chosen for this course is given in table

Concept Video	Tech-talk	Complex Problem Solving
40%	40%	20%

VI COURSE OBJECTIVES:

The students will try to learn:

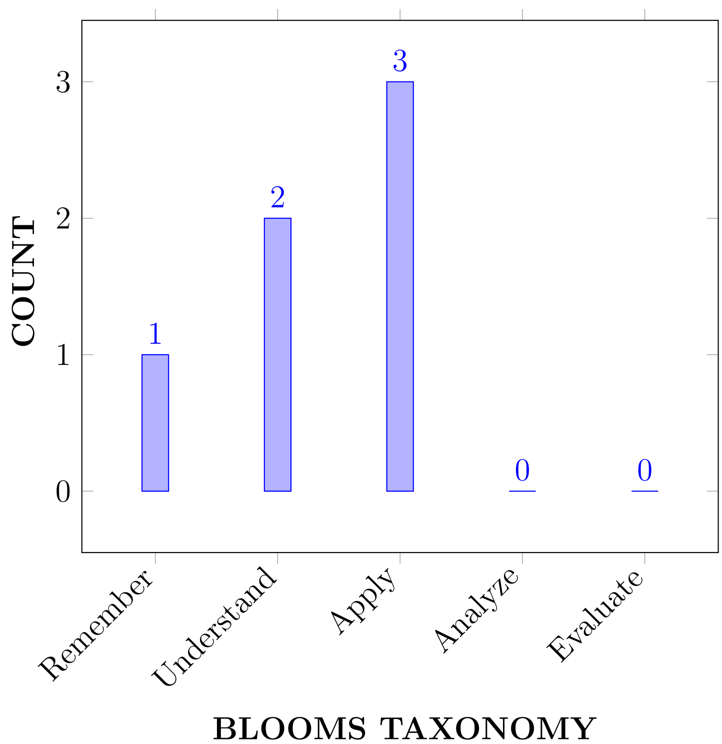
I	The fundamentals of hydrological cycle – on and below the surface of the earth.
II	The concept of ground water engineering and analytical techniques in ground water flow.
III	The principles of irrigation types, methods and design-discharge required based on canal networks.
IV	The construction of hydraulic structures based on data from design-flood flow.

VII COURSE OUTCOMES:

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

CO 1	**Interpret** the components of water cycle for evolving the effects of hydrology.	Understand
CO 2	**Develop** a unit hydrograph based on stream flow data for preventing hydraulic system flood problems.	Apply
CO 3	**Recall** the concepts of ground water flow in confined and unconfined aquifers for the measurement of the well yield.	Remember
CO 4	**Summarize** the different aquifer properties and their uses for construction of well.	Understand
CO 5	**Identify** the basic requirements of irrigation and various techniques to supply water for improving the production of crops.	Apply
CO 6	**Design** of irrigation canals by using kennedy's and lacey's theory.	Apply

COURSE KNOWLEDGE COMPETENCY LEVEL



VIII PROGRAM 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

IX 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 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	CIE/SEE/AAT
PO 4	**Conduct Investigations of Complex Problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.	1	CIE/SEE/AAT
PO 7	**Environment and sustainability:** 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/AAT

3 = High; 2 = Medium; 1 = Low

X HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

PROGRAM SPECIFIC OUTCOMES		Strength	Proficiency Assessed by
PSO 1	Design and supervise sub-structures and superstructures for residential and public buildings, industrial structures,irrigation structures,power houses, highways,railways,airways,docks and harbours.	2	CIE/SEE/ AAT
PSO 2	Focus on improving performance of structures with reference to safety and serviceability and sustainable green building technology.	3	CIE/SEE/ AAT

3 = High; 2 = Medium; 1 = Low

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

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	✓	-	-	-	-	-	✓	-	-	-	-	-	-	-	-
CO 2	-	✓	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 3	✓	✓	✓	-	-	-	-	-	-	-	-	-	✓	-	-
CO 4	✓	✓	✓	-	-	-	-	-	-	-	-	-	✓	-	-
CO 5	-	-	-	✓	-	-	-	-	-	-	-	-	-	-	-
CO 6	-	-	-	✓	-	-	-	-	-	-	-	-	-	-	-

XII 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 matched.
CO 1	PO 1	Recall the components and process of hydrological cycle based on **scientific and mathematical principles**	2
	PO 7	Understand the cycle of water, **environmental** effects on hydrological cycle with their **socio-economical effect**.	2
CO 2	PO 2	Understand the given **problem statement, formulation and model** for **developing the solution** of hydrographs to estimate flood flow.	4
CO 3	PO 1	Recognizing (knowledge) the various types of aquifer and their uses in construction of wells and its composition suitability (application) with **scientific and mathematical principles**.	2
	PO 2	Understand the given **problem statement, formulation and model** for **developing the solution** of ground water to estimate yield of the aquifer.	4
	PO 3	Understand and **Investigate** the ground water flow equations in confined and unconfined aquifer and their uses in **all aspects of the problems** including **operation and maintenance**.	3
	PSO 1	Identify various properties of an aquifer and suitability of soil stratum for building an (aquifer) **sub-structures** by using **code** of **practices based on engineering, soil investigation and environmental impact.**	5
CO 4	PO 1	Recognizing (knowledge) the various types of aquifer and their uses in construction of wells and its composition suitability (application) with **scientific and mathematical principles**.	2
	PO 2	Understand the given **problem statement, formulation and model** for **developing the solution** of ground water to estimate yield of the aquifer.	4

Course Outcomes	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key competencies matched.
	PO 3	Understand and **Investigate** the ground water flow equations in confined and unconfined aquifer and their uses in **all aspects of the problems** including **operation and maintenance**.	3
	PSO 1	Identify various properties of an aquifer and suitability of soil stratum for building an (aquifer) **sub-structures** by using **code** of **practices based on engineering, soil investigation and environmental impact.**	5
CO 5	PO 4	Understand and **investigate** the various irrigation techniques and its suitability for the **quality** crop production by using **codes of practices and standards** .	4
CO 6	PO 1	Classify the different types of canals,hydraulic structures and its suitability with the **scientific and mathematical principles**	2
	PO 2	Understand the given **problem statement, formulate,analyze and model** for developing the solution of canals to estimate flood flow.	4
	PO 4	Understand the **engineering principles** and ability to apply them to analyze the **design** of unlined/lined canal construction and the performance of structures/components by using **engineering,quality issues** .	3
	PSO 1	Identify various types of canals and its suitability for transporting water to the crop by using **engineering, soil investigation, sub-structures and distribution system**.	4
	PSO 2	Understand the use of canal and their types to **improve the performance of structural components of hydraulic structures** with increased **safety and serviceability**.	2

XIII 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	2	-	-	-	-	-	2	-	-	-	-	-	-	-	-
CO 2	-	4	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 3	2	4	3	-	-	-	-	-	-	-	-	-	5	-	-
CO 4	2	4	3	-	-	-	-	-	-	-	-	-	5	-	-
CO 5	-	-	-	4	-	-	-	-	-	-	-	-	-	-	-
CO 6	2	4	-	3	-	-	-	-	-	-	-	-	4	2	-

XIV 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	67	-	-	-	-	-	67	-	-	-	-	-	-	-	-
CO 2	-	40	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 3	67	40	30	-	-	-	-	-	-	-	-	-	50	-	-
CO 4	67	40	30	-	-	-	-	-	-	-	-	-	50	-	-
CO 5	-	-	-	36	-	-	-	-	-	-	-	-	-	-	-
CO 6	67	40	-	27	-	-	-	-	-	-	-	-	40	67	-

XV COURSE ARTICULATION MATRIX (PO / PSO MAPPING):

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

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

1 -5 <C$\leq$ 40% – Low/ Slight

2 - 40 % <C < 60% –Moderate

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

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

XVI ASSESSMENT METHODOLOGY-DIRECT:

CIE Exams	✓	SEE Exams	✓	Seminars	-
Laboratory Practices	-	Student Viva	-	Certification	-
Term Paper	-	Concept Video	✓	Open Ended Experiments	✓
Techtalk	✓				

XVII ASSESSMENT METHODOLOGY-INDIRECT:

	Assessment of mini projects by experts	✓	End Semester OBE Feedback

XVIII SYLLABUS:

UNIT I	INTRODUCTION TO ENGINEERING HYDROLOGY AND ITS APPLICATIONS
	Introduction to engineering hydrology and its applications, hydrologic cycle, types and forms of participation, rainfall measurement, types of rain gauges, computation of average rainfall over a basin, processing of rainfall data, adjustment of record, rainfall double mass curve runoff, factors affecting runoff, runoff over a catchment, empirical and rational formulae. Abstraction from rainfall, evaporation, factors affecting evaporation, measurement of evaporation, evapo-transpiration, penman and Blaney and Criddle methods, infiltration, factors affecting infiltration, measurement of infiltration, infiltration indices.
UNIT II	DISTRIBUTION OF RUNOFF
	Hydrograph analysis flood hydrograph, effective rainfall, base flow separation, direct runoff hydrograph, unit hydrograph, definition, and limitations applications of unit hydrograph, derivation of unit hydrograph from direct runoff hydrograph and vice versa, hydrograph, synthetic unit hydrograph.
UNIT III	GROUND WATER OCCURRENCE
	Ground water Occurrence, types of aquifers, aquifer parameters, porosity, specific yield, permeability, transmissivity and storage coefficient. Darcys law, radial flow to wells in confined and unconfined aquifers. Types of wells, well construction, well development.
UNIT IV	NECESSITY AND IMPORTANCE OF IRRIGATION
	Work necessity and importance of irrigation, advantages and ill effects of irrigation, types of irrigation, and methods of application of irrigation water, India agricultural soils, methods of improving soil fertility, crop rotation, and preparation of land for irrigation, standards of quality for irrigation water, soil, water, plant relationship, vertical distribution of soil moisture, soil moisture constants, soil moisture tension, consumptive use, duty and delta, factors affecting duty, design discharge for a water course. Depth and frequency of irrigation, irrigation efficiencies, water logging.
UNIT V	CLASSIFICATION OF CANALS
	Mechanical classification of canals, design of irrigation canals by Kennedy's and Lacey's theories, balancing depth of cutting, IS standards for a canal design canal lining. Design discharge over a catchment, computation of design discharge, rational formula, SCS curve number method, flood frequency analysis of stream flow.

TEXTBOOKS

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2. B.C. Punmia, Ashok Kumar Jain, Arun Kumar Jain, Pande Brij Basi Lal, "Irrigation and Water Power Engineering", Laxmi publications Pvt. Ltd., New Delhi, 16th Edition, 2016.

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3. D.K.Majundar, "Irrigation Water Management", Prentice Hall of India, 2002.

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COURSE WEB PAGE:

1. https://lms.iare.ac.in/index?route=course/details&course_id=117

XIX COURSE PLAN:

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

S.No	Topics to be covered	CO's	Reference T1: 4.1
OBE DISCUSSION			
1	Discussion on Out come based Education		
CONTENT DELIVERY (THEORY)			
2-3	Understand the hydrological cycle, their components and water budget equation	CO 1	T2: 4.2-4.5
4	Understand precipitation, types, forms and characteristic of precipitation	CO 1	T2: 4.6, R1:2.4-2.6
5-6	Explain the concept of various measurement methods of precipitation with neat sketch.	CO 1	T2: 4.7
7-8	Differentiate the recording rain gauge and non-recording rain gauge	CO 1	T2: 4.7
9-10	Rain gauge network, mean precipitation over a basin area.	CO 1	T2: 4.8,4.10

11	Describe Depth-Area-Duration (DAD) relationships, Probable Maximum Precipitation (PMP)	CO 1	T2: 4.13
12	Explain adjustment of rainfall data in India.	CO 1	T2: 4.9, R1:2.14
13-14	Understand the importance of evaporation process, evaporimeters and analytical methods	CO 1	T2: 4.5
15	Reservoir evaporation and methods of reduction.	CO 1	T1: 2.4-2.7
16	Understand the evapotranspiration, measurement of evapotranspiration and their equations.	CO 1	T1: 2.8-2.9
17	Explain the Potential evapotranspiration, actual evapotranspiration	CO 1	T1: 2.10
18-19	Infiltration, Infiltration capacity and factors affecting infiltration Measurement of infiltration	CO 1	T2: 4.16
20-21	Explain the Surface runoff and runoff volume, estimation of runoff volume by SCS-CN method	CO 2	T2:4.17-4.19
22	Flow-duration-curve, flow-mass curve, hydrograph and factors affecting hydrograph.	CO 2	T1: 3.4-3.5
23	Components of hydrograph, base flow separation, effective rainfall, and unit hydrograph.	CO 2	T2:4.20-4.22
24	Sub – surface runoff - forms of subsurface water, saturated formation	CO 2	T2: 5.2-5.3
25-26	Aquifer properties, geologic formations of aquifers, well hydraulics	CO 3	T2: 5.4
27-28	Steady state flow in wells, equilibrium equations for confined and unconfined aquifers, aquifer tests.	CO 4	T2: 5.6-5.7
29	Water requirement of crops and crop seasons in India, cropping pattern, duty and delta	CO 5	T2: 3,1.2-1.7, 3.8-3.9
30-31	Quality of irrigation water; Soil-water relationships, root zone soil water, consumptive use	CO 5	T2:3.2,3.13, R2:4.5-4.8
32-33	Irrigation requirement, frequency of irrigation; Methods of applying water to the fields	CO 5	T2: 3.7, 2.1-2.10
34	Surface, sub-surface, sprinkler and trickle / drip irrigation.	CO 5	T2:2.11-2.13
35-36	Canal systems – Design of channels – Kennedy's and Lacey's theory of regime channels.	CO 6	T2: 13.1, 14.3-14.9
37-38	Balancing depth of cutting ,IS Standard for canal design canal lining	CO 6	T2: 7.1-7.4, 8.2-8.21
39-40	Design discharge over a catchment, Computation of design discharge - rational formula.	CO 6	T2: 9.1-9.7
41-42	SCS Curve number method	CO 6	T2:11.1-11.4
43	Flood frequency analysis – introductory part only	CO 6	T2:6.1-6.2

44-45	Stream gauging measurement and estimation of stream flow	CO 6	T2:6.3-6.5 R3:12.34-12.36
PROBLEM SOLVING/ CASE STUDIES			
1	Calculate the depth of rainfall occurred, mean precipitation	CO 1	T2: 4.2-4.13
2	Calculate the mean depth precipitation using isohyetal method, arithmatic mean method and iso-polygon method	CO 1	T2: 4.2-4.13
3	Draw Depth Area Duration Curve, intensity Depth duration curve and their relationship.	CO 1	T2: 4.2-4.13
4	Calculate depth of evaporation using empirical methods	CO 1	T1.4.2-4.10
5	Calculate the evapotranspiration using empirical methods	CO 1	T1.4.2-4.10
6	Calculate an infiltration capacity and its indices	CO 1	T1.4.2-4.10
7	Draw Hydrographs using ordinates given with respective time duartion	CO 2	T1.4.2-4.10
8	Draw an Unit hydrograph from DRH ordinates using required formula	CO 2	T1.4.2-4.10
9	Calculate surface runoff using rational formula and other required formula r	CO 2	T2:5.2-5.7
10	Estimate an aquifer discharge using equilibrium equations for confined and unconfined aquifer	CO 3, CO 4	T2:5.2-5.7
11	Design the canal alignment methods using Kennedy's and Lacey's theory	CO 5, CO 6	T2:9.1-9.7
12	Calculate the Consumptive use and discharge applied for the irrigation using required formulas,	CO 5, CO 6	T2:9.1-9.7
13	Describe the different types of canal systems and there functions	CO 6	T2:11.1-11.4 R3:12.34-12.36
14	Calculate the the discharges by using different formula	CO 6	T2:11.1-11.4 R3:12.34-12.36
15	Calculate the discharge using the required SCS- CN method	CO 6	T2:11.1-11.4 R3:12.34-12.36

DISCUSSION OF DEFINITION AND TERMINOLOGY			
1	INTRODUCTION TO ENGINEERING HYDROLOGY AND ITS APPLICATIONS- Introduction to engineering hydrology and its applications, hydrological cycle, types and forms of precipitation, rainfall measurement, types of rain gauges, processing of rainfall data, adjustment of record, rainfall double mass curve runoff, Abstraction from rainfall, evaporation, factors affecting evaporation, measurement of evaporation, evapo-transpiration, penman and Blaney and Criddle methods, infiltration, factors affecting infiltration, measurement of infiltration, infiltration indices.	CO 1	T2: 4.2-4.13
2	DISTRIBUTION OF RUNOFF Hydrograph analysis flood hydrograph, effective rainfall, base flow separation, direct runoff hydrograph, unit hydrograph, definition, and limitations applications of unit hydrograph, derivation of unit hydrograph from direct runoff hydrograph and vice versa, hydrograph, synthetic unit hydrograph.	CO 2	T1.4.2-4.10
3	GROUND WATER OCCURRENCE Ground water Occurrence, types of aquifers, aquifer parameters, porosity, specific yield, permeability, transmissivity and storage coefficient. Darcy's law, radial flow to wells in confined and unconfined aquifers. Types of wells, well construction, well development.	CO 3, CO 4	T2:5.2-5.7
4	NECESSITY AND IMPORTANCE OF IRRIGATION- Work necessity and importance of irrigation, advantages and ill effects of irrigation, types of irrigation, and methods of application of irrigation water, India agricultural soils, methods of improving soil fertility, crop rotation, and preparation of land for irrigation, standards of quality for irrigation water, soil, water, plant relationship, consumptive use, duty and delta, factors affecting duty,Depth and frequency of irrigation, irrigation efficiencies.	CO 5	T2:9.1-9.7
5	CLASSIFICATION OF CANALS- Mechanical classification of canals, design of irrigation canals by Kennedy's and Lacey's theories, balancing depth of cutting, IS standards for a canal design canal lining. Design discharge over a catchment, computation of design discharge, rational formula, SCS curve number method, flood frequency analysis of stream flow.	CO 6	T2:11.1-11.4 R3:12.34-12.36
DISCUSSION OF QUESTION BANK			
1	Introduction to Engineering Hydrology and its Applications	CO 1	T2: 4.2-4.13
2	Distribution on RUNOFF	CO 2	T1.4.2-4.10
3	Ground Water Occurance	CO 3, CO 4	T2:5.2-5.7
4	Necessity and Importance of Irrigation	CO 5	T2:9.1-9.7

5	Classification of Canals	CO 6	T2:11.1-11.4 R3:12.34-12.36

Signature of Course Coordinator **HOD,CE**
Ms. B Bhavani, Assistant Professor

INSTITUTE OF AERONAUTICAL ENGINEERING
(Autonomous)
Dundigal, Hyderabad - 500 043
COURSE DESCRIPTION

Department	**CIVIL ENGINEERING**				
Course Title	**INDUSTRIAL WASTEWATER TREATMENT**				
Course Code	ACE526				
Program	B.Tech				
Semester	VI				
Course Type	Elective				
Regulation	IARE R-16				
Course Structure	Theory			Practical	
	Lecture	Tutorials	Credits	Laboratory	Credits
	3	-	3	-	-
Course Coordinator	Mr. Ch.Balakrishna, Assistant Professor				

I COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites
B.Tech	AHS005	I	Engineering Chemistry
B.Tech	AHS009	II	Environmental Studies

II COURSE OVERVIEW:

This course deals the mechanisms and processes used to treat Industrial waste water that have been contaminated by anthropogenic industrial or commercial activities prior to its release into the environment or its re-use. This course provides various terms used in industrial waste water treatment and to acquaint with different steps involved in treatment of industrial waste water. This course focuses on wastewater treatment technologies or advanced waste water treatment methods. This course provides about the wastewater treatment plants to eventually produce water that can be reused for various purposes or disposes in a more ecological and healthy way.

III MARKS DISTRIBUTION:

Subject	SEE Examination	CIE Examination	Total Marks
Industrial Waste Water Treatment	70 Marks	30 Marks	100

IV DELIVERY / INSTRUCTIONAL METHODOLOGIES:

✓	PPT	✓	Chalk & Talk	✓	Assignments	x	MOOC
x	Open Ended Experiments	x	Seminars	x	Mini Project	✓	Videos
x	Others						

V EVALUATION METHODOLOGY:

The course will be evaluated for a total of 100 marks, with 30 marks for Continuous Internal Assessment (CIA) and 70 marks for Semester End Examination (SEE). Out of 30 marks allotted for CIA during the semester, marks are awarded by taking average of two CIA examinations or the marks scored in the make-up examination.

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 14 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 Table: 1.

Percentage of Cognitive Level	Blooms Taxonomy Level
33%	Remember
50 %	Understand
17 %	Apply
0 %	Analyze
0 %	Evaluate
0 %	Create

Continuous Internal Assessment (CIA):

CIA is conducted for a total of 30 marks, with 25 marks for Continuous Internal Examination (CIE) and 05 marks for Quiz \Alternative Assessment Tool (AAT).

Component	Theory		Total Marks
Type of Assessment	CIE Exam	Quiz \AAT	
CIA Marks	25	05	30

Continuous Internal Examination (CIE):

Two CIE exams shall be conducted at the end of the 8^{th} and 17^{th} week of the semester respectively. The CIE exam is conducted for 25 marks of 2 hours duration consisting of two parts. Part–A shall have five compulsory questions of one mark each. In part–B, four out of five questions have to be answered where, each question carries 5 marks. Marks are awarded by taking average of marks scored in two CIE exams.

Quiz - Online Examination

Two Quiz exams shall be online examination consisting of 25 multiple choice questions and are to be answered by choosing the correct answer from a given set of choices (commonly four). Such a question paper shall be useful in testing of knowledge, skills, application, analysis, evaluation and understanding of the students. Marks shall be awarded considering the average of two quiz examinations for every course.

Alternative Assessment Tool (AAT)

This AAT enables faculty to design own assessment patterns during the CIA. The AAT converts the classroom into an effective learning center. The AAT may include tutorial hours/classes, seminars, assignments, term paper, open ended experiments, METE (Modeling and Experimental Tools in Engineering), five minutes video, MOOCs etc. The AAT chosen for this course is given in table

Concept Video	Tech-talk	Complex Problem Solving
40%	40%	20%

VI COURSE OBJECTIVES:

The students will try to learn:

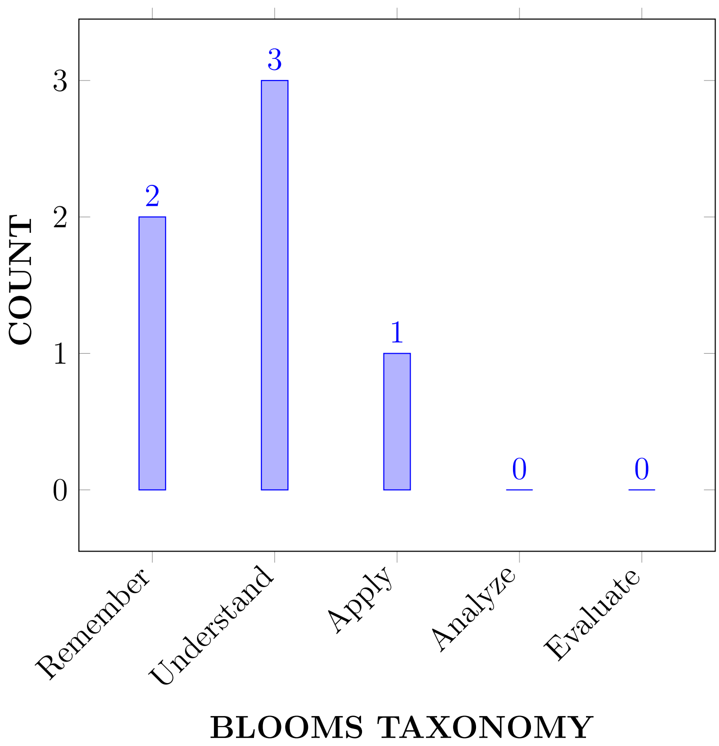
I	The knowledge on sources and characteristics of industrial wastewater.
II	The different methods of waste water treatment such as de-nitrification, membrane separation, air stripping, etc.
III	The characteristics and composition of wastewater generated from industrial processes.
IV	The Design and operate effluent treatment plants for joint treatment of raw industrial wastewater and domestic sewerage.

VII COURSE OUTCOMES:

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

CO 1	**List out** the Characteristics and composition of wastewater for the effective treatment of wastewater.	Remember
CO 2	**Explain** the different stages of pre and primary treatment of Industrial wastewater to minimize the effluent concentration.	Understand
CO 3	**Select** the strength Reduction and volume reduction processes for decreasing the quantity of wastewater.	Remember
CO 4	**Explain** the process involved in phosphorous removal, Nitrification and De-nitrification of wastewater for the removal of eutrophication process.	Understand
CO 5	**Demonstrate** the advanced wastewater treatment methods for the removal of all nutrients, suspended solids, dissolved solids and toxic substances	Understand
CO 6	**Identify** the advantages of common effluent treatment plants for efficient disposal of wastewater .	Apply

COURSE KNOWLEDGE COMPETENCY LEVEL



VIII PROGRAM 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.

Program 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

IX HOW PROGRAM OUTCOMES ARE ASSESSED:

Program		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 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.	1	CIE/SEE/AAT
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	CIE/SEE/AAT
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.	1	CIE/SEE/AAT

3 = High; 2 = Medium; 1 = Low

X HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

Program		Strength	Proficiency Assessed by
PSO 2	Focus on Improving Performance of Structures with reference to Safety, Serviceability and Sustainable Green Building Technology	2	CIE/SEE/AAT

3 = High; 2 = Medium; 1 = Low

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

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	✓	-	-	✓	-	✓	✓	-	-	-	-	-	-	✓	-
CO 2	✓	-	-	-	-	-	✓	-	-	-	-	-	-	-	-
CO 3	✓	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 4	-	-	-	✓	-	✓	✓	-	-	-	-	-	-	✓	-
CO 5	✓	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 6	-	-	-	-	-	✓	✓	-	-	-	-	-	-	✓	-

XII 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 matched.
CO 1	PO 1	Identify the characteristics and composition of wastewater by different methods and the Physical, chemical, organic and biological properties of wastewater by **mathematical principles** and **engineering fundamentals** by calculating the percentage of pollutants.	2
	PO 4	Identify the the Physical, chemical, organic and biological properties of wastewater by **Knowledge of particular equipment, processes** for the treatment to decrease the concentration and **Ability to identify** the best method for purifing the wastewater .	2
	PO6	The wastewater has different properties by applying **Knowledge and understanding** the correct method for the removal of toxic substances and creating awarness regarding the **health, safety, and risk (including environmental risk) issues** caused by the wastewater discharge without treatment	2
	PO7	Understand the impact of the wastewater that effect the **Environmental** and causes pollution which will effect the ecosystem .	1

	PSO 2	Identify the characteristics and composition of wastewater by different methods and maintain **Safety** measures to protect the environment and help in **Sustainable** development.	2
CO 2	PO 1	Explain the different stages of pre and primary treatment of industrial wastewater by **Scientific principles** and **engineering fundamentals**.	2
	PO 7	Explain the different stages of pre and primary treatment of industrial wastewater by advanced methods, dispose the water and protect the **Environment** which help in sustainable development.	1
CO 3	PO 1	Select the strength Reduction and volume reduction processes for decreasing the quantity of wastewaterwith **Engineering Knowledge** and by using **Mathematical Principles** to calculate the quantities and apply **Scientific methods** to estimate the amount of quantity of wastewater generated	3
CO 4	PO 4	Explain the process involved in Nitrification and De-nitrification stages of wastewater treatment by the **Knowledge of characteristics** and the effect of nitrogen cycle in wastewater and **Understand** the process involved in removal of nitrogen percent and **Ability to identify** the consequence of Nitrification and De-nitrification	3
	PO 6	Explain the process involved in phosphorous removal and heavy metal removal **mathematical principles** and **engineering fundamentals**.	2
	PO 7	Explain the process involved in Nitrification and De-nitrification and their effect on **Environment**for the prevention of groundwater pollution	1
	PSO 2	Explain the process involved in phosphorous and heavy metal removal which helps the public **Safety** and environment	1
CO 5	PO 1	Demonstrate the advanced wastewater treatment methods for the removal of all nutrients, suspended solids, dissolved solids and toxic substance and apply **Knowledge of processes** and maintain the **industry standards** by Ultrafiltration, Adsorption using activated carbon, Chemical precipitation and clarification	2
CO 6	PO 6	Identify the different operational problems of common effluent treatment plants and have the **Knowledge and understand** the benefits, effective disposal of wastewater which helps **health, safety, and risk (including environmental risk) issues**	2
	PO 7	Identify the different operational problems of common effluent treatment plants for the **Environment and Sustainable** development	1

	PSO 2	Identify the different operational problems of common effluent treatment plants for the **Safety** and protecting the environment	1

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

XIV 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	-	-	18	-	40	33.3	-	-	-	-	-	-	66.6	-
CO 2	66.6	-	-	-	-	-	33.3	-	-	-	-	-	-	-	-
CO 3	100	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 4	-	-	-	27	-	40	33.3	-	-	-	-	-	-	33.3	-
CO 5	66.6	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 6	-	-	-	-	-	40	33.3	-	-	-	-	-	-	33.3	-

XV COURSE ARTICULATION MATRIX (PO / PSO MAPPING):

CO'S and PO'S and CO'S and PSO'S on the scale of 0 to 3, 0 being no correlation, 1 being the low correlation, 2 being medium correlation and 3 being high correlation.
0 - $0 \leq C \leq 5\%$ – No correlation
1 -$5 < C \leq 40\%$ – Low/ Slight
2 - $40\ \% < C < 60\%$ –Moderate
3 - $60\% \leq C < 100\%$ – Substantial /High

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

CO 3	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 4	-	-	-	1	-	1	1	-	-	-	-	-	-	1	-
CO 5	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 6	-	-	-	-	-	1	1	-	-	-	-	-	-	1	-
TOTAL	12	-	-	2	-	3	4	-	-	-	-	-	-	5	-
AVERAGE	3.0	-	-	1.0	-	1.0	1.0	-	-	-	-	-	-	2.0	-

XVI ASSESSMENT METHODOLOGY DIRECT:

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

XVII ASSESSMENT METHODOLOGY INDIRECT:

	Assessment of mini projects by experts	✓	End Semester OBE Feedback

XVIII SYLLABUS:

UNIT - I	**CHARACTERISTICS OF INDUSTRIAL WASTE WATER**
	Sources of pollution, physical, chemical, organic and biological properties of industrial wastes, difference between industrial and municipal waste waters, effects of industrial effluents on sewers and natural water bodies
UNIT - II	**COMMMON TYPES OF TREATMENT PROCESS**
	Pre and primary treatment, equalization, proportioning, neutralization, oil separation by floatation, waste reduction, volume reduction, strength reduction.
UNIT -III	**DESCRIPTION OF MAIN TREATMENT METHODS**
	Waste treatment methods, nitrification and denitrification, phosphorous removal, heavy metal removal, Membrane separation process, air stripping and absorption processes, special treatment methods, disposal of treated waste water
UNIT - IV	**WASTE WATER FROM DIFFERENT INDUSTRIES**
	Characteristics and composition of waste water and manufacturing processes of industries like sugar, characteristics of industries like food processing industries, steel, petroleum refineries

UNIT - V	**COMPOSTION OF WASTE WATER AND COMMON EFFLUENT TREATMENT PLANTS**
	Characteristics and composition of industries like textiles, tanneries, atomic energy plants and other mineral processing industries, joint treatment of raw industrial waste water and domestic sewage, common effluent treatment plants location, design, operation and maintenance problems.

TEXTBOOKS

1. Metcalf and Eddy, "Wastewater engineering Treatment disposal reuse", Tata McGraw-Hill, 4th Edition, 2002.
2. Eckenfelder, W.W., "Industrial Water Pollution Control", McGraw-Hills, 3rd Edition, 1999.

REFERENCE BOOKS:

1. M.N. Rao and Dutta, "Waste Water treatment", Oxford and IBH publishing, 2009.
2. Mark J. Hammer, Mark J. Hammer, Jr., "Water & Wastewater Technology", Prentice Hall of India, 2013.
3. N.L. Nemerrow, "Theories and practices of Industrial Waste Engineering", B H Elsevier, 2007.
4. C.G. Gurnham, "Principles of Industrial Waste Engineering", Wiley, 1955.

WEB REFERENCES:

1. https://nptel.ac.in/courses/112105171/1

COURSE WEB PAGE:

1. https://akanksha.iare.ac.in

XIX COURSE PLAN:

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

S.No	Topics to be covered	CO's	Reference T1, R1
OBE DISCUSSION			
	Outcome Based Education, CO PO attainment and Blooms Taxonomy		
CONTENT DELIVERY (THEORY)			
1	Sources of water pollution	CO 1	T1: 1.1 -1.2, R1: 1.7
2	Physical properties of industrial waste	CO 1	T1: 1.2-1.3, R3:2.7,2.9

3	Chemical properties of industrial waste	CO 1	T1: 1.4 R1:1.2, R2: 4.8
4	Organic and biological properties of industrial waste	CO 1	T1:1.5-1.6, R2: 4.3
5	Difference between industrial and municipal waste waters	CO 1	T1:2.1-2.2
6	Effects of industrial effluents on sewers and natural water bodies	CO 1	T1:2.3-2.4
7	Pre and primary treatment of wastewater	CO 2	T1:2.5-2.6
8	Equalization and Proportioning processes of wastewater	CO 2	T1:2.6.1-2.6.3, R3: 3.4
9	Neutralization, oil separation by floatation method	CO 2	T1:2.7.1-2.7.2
10	Waste reduction, volume reduction and strength reduction.	CO 2	T1:2.7.3-2.7.4, R3: 5.1
11	Waste treatment methods	CO 2	T1: 7.1-7.3, R1:2.4
12	Nitrification and Denitrification process.	CO 3	T1: 7.4-7.6, R2: 2.2
13	Removal of phosphorous from waste water.	CO 3	T1: 7.7, R3: 10.4
14	Heavy metal removal from waste water.	CO 3	T1: 7.8
15	Membrane separation process.	CO 3	T1: 7.9
16	Air stripping and absorption processes,	CO 3	T1: 9.1-9
17	special treatment methods	CO 3	T1: 9.3
18	Disposal of treated waste water.	CO 4	T1: 9.4
19	Characteristics and composition of waste water	CO 4	T1:9.5-9.6, R1: 6.4
20	Characteristics and composition of wastewater from sugar industry	CO 4	T1:11.1-11.2, R2: 9.15
21	Characteristics and composition of wastewater from steel industry	CO 4	T1:11.7-11.8, R2: 7.10
22	Characteristics and composition of wastewater from petroleum refineries industry	CO 4	T1:11.9-11.9, R2: 10.11

23	Characteristics and composition of wastewater from food processing industries	CO 4	T2:13.1-13.2
24	Characteristics and composition of wastewater from petroleum refineries industry	CO 4	T2: 13.313.4
25	Characteristics and composition of wastewater from textiles industry	CO 4	T2:17.117.2
26	Characteristics and composition of wastewater from tanneries industry	CO 4	T2: 17.3
27	Characteristics and composition of wastewater from atomic energy plants industry	CO 5	T2: 17.4, R2:7.8
28	Characteristics and composition of wastewater from coal and iron industry	CO 5	T2: 17.5-17.
29	Characteristics and composition of wastewater from aluminium industry	CO 5	T1:15.5-15.6, R1:11.5
30	Characteristics and composition of wastewater from pharmacetical industry	CO 5	T1:15.5-15.6, R1:11.5
31	Characteristics and composition of wastewater from meat industry	CO 5	T1:15.7-15.8
32	Characteristics and composition of wastewater from dairy industry	CO 5	T1:15.7-15.9
33	Characteristics and composition of wastewater from mineral processing industries	CO 5	T1:15.7-15.10, R1:13.2
34	Joint treatment of raw industrial waste water	CO 5	T1:15.7-15.10
35	Advanced Wastewater Treatment Methods	CO 5	T1:15.7-15.10, R1:13.2
36	Common effluent treatment plants	CO 5	T1:15.7-15.10, R1:13.2
37	Location of common effluent treatment plants	CO 5	T1:15.5-15.6, R1:11.5
38	Operation of common effluent treatment plants	CO 5	T1:15.7-15.8
39	Maintenance problems of common effluent treatment plants	CO 6	T1:15.7-15.9
40	Advantages of joint treatment of raw industrial waste water	CO 6	T1:15.7-15.10, R1:13.2
41	Advantages of common effluent treatment plants	CO 6	T1: 1.1 -1.2, R1: 1.7

42	Case study of common effluent treatment plants in India	CO 6	T1: 1.2-1.3, R3:2.7,2.9
43	Case study of joint treatment plants in India	CO 6	T1: 1.4 R1:1.2, R2: 4.8
44	Advanced treatment methods	CO 6	T1:1.5-1.6, R2: 4.3
45	Effects of industrial effluents on sewers and natural water bodies	CO 6	T1:1.5-1.6, R2: 4.3
PROBLEM SOLVING/ CASE STUDIES			
1	The different sources of Industrial waste waters.	CO 1	T1:2.1-2.2
2	The Physical, chemical, organic and biological properties of industrial wastes.	CO 1	T1:2.3-2.4
3	Characteristics of waste water in detail of the following 1. pH, 2. Solids, 3. BOD, 4. COD, 5. Heavy Metals.	CO 2	T1:2.5-2.6
4	The various types of benefits of water pollution control by doing treatment of industrial waste.	CO 2	T1:2.7.3-2.7.4, R3: 5.1
5	Equalization and proportioning for industrial waste water treatment	CO 3	T1: 7.1-7.3, R1:2.4
6	The various methods of volume and strength reduction adopted for the industrial wast	CO 3	T1: 7.4-7.6, R2: 2.2
7	The process of Primary Treatment of industrial waste water	CO 4	T1: 9.3
8	The Applications of membrane Technologies in Wastewater treatment	CO 4	T1: 9.4
9	The process of removal of phosphorous in industrial waste water treatment	CO 4	T1:9.5-9.6, R1: 6.4
10	The process of removal of Heavy Metal in industrial waste water treatment	CO 4	T1:11.1-11.2, R2: 9.15
11	Characterize the various treatment processes for food and beverage industry waste water. What are the prospects of waste utilization from food industry	CO 5	T1:11.7-11.8, R2: 7.10
12	The impacts of petroleum exploration and its production on the environment	CO 5	T1: 1.1 -1.2, R1: 1.7
13	The characteristics and treatment of the wastes from sugar industry	CO 5	T1: 7.4-7.6, R2: 2.2

14	The process involved in Joint treatment of Raw Industrial wastewater and Domestic Sewage	CO 6	T2:13.1-13.2
15	The operation procedure of Common Effluent Treatment Plants (CEPT)	CO 6	T1:15.5-15.6, R1:11.5
DISCUSSION OF DEFINITION AND TERMINOLOGY			
1	Sources of pollution, physical, chemical, organic and biological properties of industrial wastes	CO 1	R4:2.1
2	Pre and primary treatment, equalization, proportioning, neutralization, oil separation by floatation, waste reduction, volume reduction, strength reduction.	CO 2	T4:7.3
3	Waste treatment methods, nitrification and denitrification, phosphorous removal, heavy metal removal, Membrane separation process	CO 3	R4:5.1
4	Characteristics and composition of waste water and manufacturing processes of industries like sugar, characteristics of industries like food processing industries, steel, petroleum refineries	CO 4	T1:7.5
5	Characteristics and composition of industries like textiles, tanneries, atomic energy plants and other mineral processing industries, joint treatment of raw industrial waste water	CO 5, CO 6	T1: 4.1
DISCUSSION OF QUESTION BANK			
1	Characteristics of Industrial Waste Water	CO 1	R4:2.1
2	Common Types of Treatment Process	CO 2	T4:7.3
3	Description of Main Treatment Methods	CO 3	R4:5.1
4	Waste Water from Different Industries	CO 4	T1:7.5
5	Composition of Waste Water and Common Effluent Treatment Plants	CO 5, CO 6	T1: 4.1

Signature of Course Coordinator **HOD, CE**
Mr. Ch. Balakrishna Assistant Professor

INSTITUTE OF AERONAUTICAL ENGINEERING
(Autonomous)
Dundigal, Hyderabad - 500 043

CIVIL ENGINEERING

COURSE DESCRIPTION

Course Title	**Advanced Material Testing Laboratory**				
Course Code	ACE109				
Program	B.Tech				
Semester	VI	CE			
Course Type	Core				
Regulation	IARE - R16				
Course Structure	Theory			Practical	
	Lecture	Tutorials	Credits	Laboratory	Credits
	-	-	-	3	2
Course Coordinator	Mr. K. Anand Goud, Assistant Professor				

I COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites
B.Tech	ACE010	V	Concrete Technology
B.Tech	ACE108	V	Concrete Technology Laboratory

II COURSE OVERVIEW:

Advanced Materials Testing laboratory course emphasizes the practical aspects of the latest developments in the field of concrete construction. It focuses the latest Indian standard specifications and codes, which regulates the concrete construction. The laboratory course covers the properties of concrete and its constituent materials, the role of various admixtures in modifying these properties to suit specific requirements, such as ready mix concrete, reinforcement detailing, disaster-resistant construction, concrete machinery and it also enable the students to acquire knowledge on special and new generation concrete with their applications.

III MARKS DISTRIBUTION:

Subject	SEE Examination	CIE Examination	Total Marks
Concrete Technology Laboratory	70 Marks	30 Marks	100

IV DELIVERY / INSTRUCTIONAL METHODOLOGIES:

✓	Demo Video	✓	Lab Worksheets	✓	Viva Questions	✓	Probing further Questions

V EVALUATION METHODOLOGY:

Each laboratory will be evaluated for a total of 100 marks consisting of 30 marks forinternal assessment and 70 marks for semester end lab examination. Out of 30 marks ofinternal assessment, continuous lab assessment will be done for 20 marks for the day today performance and 10 marks for the final internal lab assessment.

Semester End Examination (SEE): The semester end labexamination for 70 marks shall be conducted by two examiners, one of them beingInternal Examiner and the other being External Examiner, both nominated by thePrincipal from the panel of experts recommended by Chairman, BOS. The emphasis on the experiments is broadly based on the following criteria given in Table: 1

	Experiment Based	Programming based
20 %	Objective	Purpose
20 %	Analysis	Algorithm
20 %	Design	Programme
20 %	Conclusion	Conclusion
20 %	Viva	Viva

Continuous Internal Assessment (CIA):

CIA is conducted for a total of 30 marks (Table 1), with 20 marks for continuous lab assessment during day to day performance, 10 marks for final internal lab assessment.

Component			Total Marks
Type of Assessment	**Day to day performance**	**Final internal lab assessment**	
CIA Marks	20	10	30

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.

1. **Experiment Based**

Objective	Analysis	Design	Conclusion	Viva	Total
2	2	2	2	2	10

2. **Programming Based**

Objective	Analysis	Design	Conclusion	Viva	Total
-	-	-	-	-	-

VI COURSE OBJECTIVES:

The students will try to learn:

I	The fundamental properties of construction materials like cement, aggregates and admixtures based on laboratory and field tests for identifying material quality.

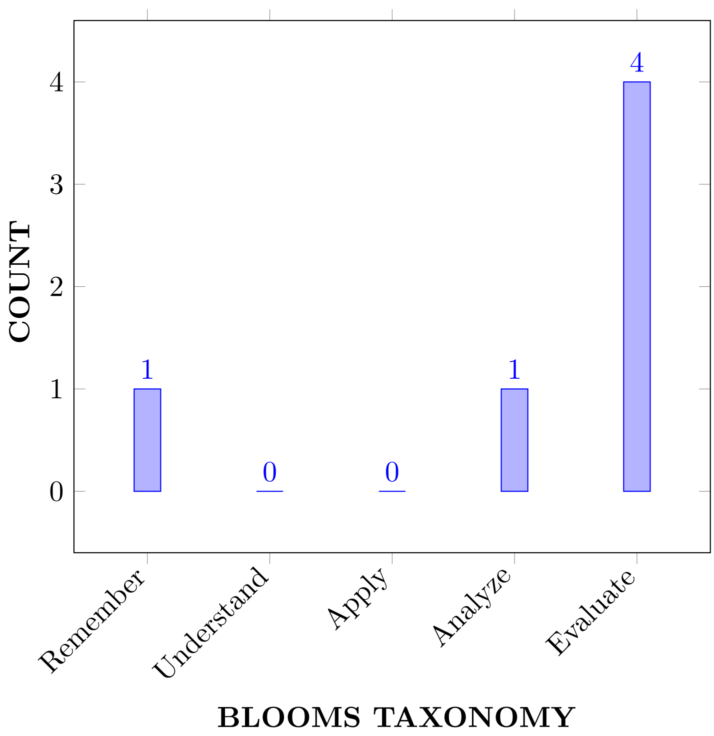
II	The factors influencing workability and methods involved in measuring workability of self compacting concrete.
III	The importance of water/cement ratio and its influence on compressive strengths of hardened concrete.
IV	The concept of quality control and design of concrete mix with various admixtures for ensuring quality of concrete.

VII COURSE OUTCOMES:

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

CO 1	**Recall** the basic properties of cement and aggregates for determining their suitability through various laboratory tests.	Remember
CO 2	**Determine** physical and chemical properties of cement in laboratory for deciding its suitability in construction practice.	Evaluate
CO 3	**Examine** the gradation, strength of aggregates and bulking of sand for producing good quality concrete.	Analyze
CO 4	**Measure** the workability of self compacting concrete and compressive strength of concrete by non destructive testing methods for accepting in construction practice.	Evaluate
CO 5	**Determine** the effect of air content and accelerated curing of concrete for producing durable concrete.	Evaluate
CO 6	**Determine** influence of water cement ratio and admixtures on Compressive strength of cement concrete for accepting in construction practice.	Evaluate

COURSE KNOWLEDGE COMPETENCY LEVEL



VIII HOW PROGRAM OUTCOMES ARE ASSESSED:

Program		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.	2	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	3	Lab Exercises
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	1	Lab Exercises
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	1	Videos

3 = High; 2 = Medium; 1 = Low

IX HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

Program		Strength	Proficiency Assessed by
PSO 1	Design and supervise sub-structures and superstructures for residential and public buildings, industrial structures, irrigation structures, powerhouses, highways, railways, airways, docks and harbours.	3	Lab Exercises
PSO 2	Focus on Improving Performance of Structures with reference to Safety, Serviceability and Sustainable Green Building Technology.	1	Lab Exercises

3 = High; 2 = Medium; 1 = Low

X 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 and **principals of mathematics** to engineering problems for testing the quality of materials using the knowledge of **science and engineering fundamentals.**	2

	PO 7	Understand the impact of professional engineering solutions in societal and environmental context and develop a special concrete to promote **environmental safety** for sustainable **socio economic development**	2
	PSO 1	Explain the properties of materials used in sub structures and super structures of residential and public buildings with **materials knowledge** and ensure **quality assurance**.	2
CO 2	PO 1	Apply the knowledge and **principals of mathematics** to engineering problems for testing the quality of materials using the knowledge of **science and engineering fundamentals**.	2
	PO 3	Determine the fineness of cement after thorough **investigation** and ensure its **fitness for the purpose of all aspects of the problem including production, operation and maintenance** of concrete.	2
	PO 5	**Select and apply appropriate techniques** for determining the properties of construction materials by **understanding the limitations**.	1
	PSO 1	Select suitable cement by testing their fineness based on **structural design and material knowledge** for **strength assessment**.	2
CO 3	PO 5	**Select and apply appropriate techniques** for determining the properties of construction materials by **understanding the limitations**.	1
	PSO 1	Explain the properties of materials used in **construction** of residential and public buildings with **material knowledge, codes of practices** and ensure **quality assurance** for **assessing strength**.	5
CO 4	PO 1	Apply the knowledge and **principals of mathematics** to engineering problems for testing the quality of materials using the knowledge of **science and engineering fundamentals**.	2
	PO 3	Determine the specific gravity of cement after thorough **investigation** and ensure its **fitness for the purpose of all aspects of the problem including production, operation and maintenance** of concrete.	3
	PO 5	**Select and apply appropriate testing method** to know the specific gravity of cement by understanding the limitations.	1
	PSO 1	Explain the properties of materials used in **construction** of residential and public buildings with **material knowledge, codes of practices** and ensure **quality assurance** for **assessing strength**.	5
CO 5	PO 3	Determine the suitability of concrete after thorough investigation and ensure its fitness for the purpose of all aspects of the problem including production, operation and maintenance of concrete for innovative solutions.	3

	PSO 1	Identify the condition of fresh concrete based on workability (slump) for assessing strength with standard quality with the help of different codes of practices.	3
CO 6	PO 1	Apply the knowledge and principals of mathematics to engineering problems for testing the quality of materials using the knowledge of science and engineering fundamentals.	2
	PO 3	Determine the compressive strength of cement after thorough investigation and ensure its fitness for the purpose of all aspects of the problem including production, operation and maintenance of concrete.	2
	PSO 1	Make use of appropriate destructive , non-destructive testing methods for determining strength and quality by applying the scientific, engineering and experimental knowledge, different codes of practices.	2

XI MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

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

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

COURSE OUTCOMES	**PROGRAM OUTCOMES**												**PSO'S**		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO 1	66.7	0.0	0.0	0.0	0.0	0.0	66.0	0.0	0.0	0.0	0.0	0.0	20.0	0.0	0.0
CO 2	66.0	0.0	30.0	0.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	20.0	0.0	0.0
CO 3	0	0.0	10.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	50.0	0	0.0
CO 4	66	00.0	30.0	0.0	100	0.0	0.0	0.0	0.0	0.0	0.0	0.0	50.0	0.0	0.0
CO 5	0.0	0.0	30.0	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0.0	30.0	0	0.0
CO 6	66.0	0.0	20.0	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0.0	20.0	0	0.0

XIII 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

1-5 <C≤ 40% – Low/ Slight

2 - 40 % <C < 60% –Moderate

3 - 60% ≤ C < 100% – Substantial /High

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO 1	3	0	0	0	0	0	3	0	0	0	0	0.0	1	0	0
CO 2	3	0.0	1	0	3	0	0	0	0	0	0	0.0	1	0	0
CO 3	0	0	1	0	0	0	0	0	0	0	0	0.0	2	0	0
CO 4	3	0	1	0	2	0	0	0	0	0	0	0.0	2	0	0
CO 5	0	0	1	0	0.0	0.0	0	0	0	0	0.0	0.0	1	0	0
CO 6	3	0	1	0	0	0.0	0	0	0	0	0	0.0	1	0	0.0
TOTAL	13	5	2	-	3	-	6	-	-	-	-	-	4	5	-
AVERAGE	3	1	1	-	3	-	3	-	-	-	-	-	1	2	-

XIV ASSESSMENT METHODOLOGY DIRECT:

CIE Exams	✓	SEE Exams	✓	Seminars	-
Laboratory Practices	✓	Student Viva	✓	Certification	-
Assignments	-				

XV ASSESSMENT METHODOLOGY INDIRECT:

	Assessment of Mini Projects by Experts	✓	End Semester OBE Feedback

XVI SYLLABUS:

WEEK I	**TESTS ON CEMENT - CONSISTENCY, SETTING TIMES, SOUNDNESS, COMPRESSIVE STRENGTH**
	tests on cment.
WEEK II	**GRADATION CHARTS OF AGGREGATES**
	Gradation charts of aggregates
WEEK III	**BULKING OF SAND**
	Bulking of sand
WEEK IV	**AGGREGATE CRUSHING AND IMPACT VALUE**
	Agregate crushing and Impact value

WEEK V	**WORKABILITY TESTS ON FRESH SELF-COMPACTING CONCRETE**
	workability tests on self compacting concrete
WEEK VI	**AIR ENTRAINMENT TEST ON FRESH CONCRETE**
	Air Entrainment test on concrete.
WEEK VII	**MARSH CONE TEST**
	Marsh cone test
WEEK VIII	**PERMEABILITY OF CONCRETE**
	permeability of concrete
WEEK IX	**NON DESTRUCTIVE TESTING OF CONCRETE.**
	Non-Destructive testing of concrete.
WEEK X	**ACCELERATED CURING OF CONCRETE**
	Accelerated curing of concrete.
WEEK XI	**INFLUENCE OF W/C RATIO ON STRENGTH AND AGGREGATE / CEMENT RATIO ON WORKABILITY AND STRENGTH**
	Influence of W/C ratio on strenth of concrete.
WEEK XII	**INFLUENCE OF W/C RATIO ON STRENGTH AND AGGREGATE / CEMENT RATIO ON WORKABILITY AND STRENGTH**
	Influence of admixtures on compressive strength of concrete

TEXTBOOKS

1. Shetty, M.S., "Concrete Technology, Theory & Practice", S. Chand and Co,2004.
2. Gambhir, M.L., "Concrete Technology", Tata McGraw Hill,2004.

REFERENCE BOOKS:

1. 1. Hemanth sood and LN Mittal, —Laboratory Manual on concrete technology‖, CBS Publishers Pvt. Ltd., New Delhi, 2nd Edition, 2013.
2. 2. Khanna S.K & Justo C.E.G. —Pavement materials and testing‖, Tata McGraw Hill Education, 2012.

XVII 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	Tests on cement - Consistency, setting times, soundness, compressive strength	CO 2	R1: 2.4
2	Study of gradation charts of aggregates.	CO 3	R2: 4 2
3	Study of bulking of sand.	CO 3	R1: 4.3
4	Measurement of aggregate crushing value and impact value.	CO 3	R1: 3.2
5	Measurement of workability on fresh self-compacting concrete	CO 3	R1: 5.4
6	Measurement of air entrainment of fresh concrete	CO 4	R3: 6.2
7	Performing marsh cone test on cement	CO 2	R3: 7.1

8	Performing permeability of concrete test on fresh concrete	CO 4	R2: 6.6
9	Performing non destructive test of concrete	CO 5	R2: 7.2
10	Performing accelerated curing test on concrete	CO 5	R1: 8.1
11	Influence of W/C ratio on strength of concrete Influence of aggregate / cement ratio on workability and strength.	CO 6	R1:8.4
12	Finding the influence of different chemical admixtures on concrete.	CO 6	R1:7.3, R2: 8.1

XVIII EXPERIMENTS FOR ENHANCED LEARNING (EEL):

S.No	Design Oriented Experiments
1	Strength of concrete made of silica fume and fly-ash.
2	Strength of concrete made of steel fibres.
3	Light weight concrete using light weight aggregates.
4	Investigation on characteristics properties of high performance Self-compacting concrete for m40 and m50.
5	Measurement of Workability of Concrete Mix.

Signature of Course Coordinator **HOD,CE**
Mr. K. Anand Goud, Assistant Professor

INSTITUTE OF AERONAUTICAL ENGINEERING
(Autonomous)
Dundigal, Hyderabad - 500 043

CIVIL ENGINEERING
COURSE DESCRIPTION

Course Title	**TRANSPORTATION MATERIALS LABORATORY**				
Course Code	ACE110				
Program	B.Tech				
Semester	VI	CE			
Course Type	Core				
Regulation	IARE - R16				
Course Structure	Theory			Practical	
	Lecture	Tutorials	Credits	Laboratory	Credits
	-	-	-	3	2
Course Coordinator	Mr.V.Surya Prakash Reddy, Assistant Professor				

I COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites
B.Tech	ACE007	IV	Building Materials Construction and Planning
B.Tech	ACE108	V	Concrete Technology Laboratory

II COURSE OVERVIEW:

The aim of this course is to conduct experiments on basic principles of Transportation materials laboratory and it is further extended to know the values and strengths of materials like bitumen, cement and aggregates. The experiments on Transportation materials testing is been done under different site conditions and environmental conditions. The course deals with equipment like Abrasion test, Specific gravity, fineness of cement, Impact crushing strength. This course includes experiments and practical studies with Cement, Aggregates, sand and Bitumen.

III MARKS DISTRIBUTION:

Subject	SEE Examination	CIE Examination	Total Marks
Transportation Materials Laboratory	70 Marks	30 Marks	100

IV DELIVERY / INSTRUCTIONAL METHODOLOGIES:

✓	Demo Video	✓	Lab Worksheets	✓	Viva Questions	✓	Probing further Questions

V EVALUATION METHODOLOGY:

Each laboratory will be evaluated for a total of 100 marks consisting of 30 marks forinternal assessment and 70 marks for semester end lab examination. Out of 30 marks ofinternal assessment, continuous lab assessment will be done for 20 marks for the day today performance and 10 marks for the final internal lab assessment.

Semester End Examination (SEE): The semester end labexamination for 70 marks shall be conducted by two examiners, one of them beingInternal Examiner and the other being External Examiner, both nominated by thePrincipal from the panel of experts recommended by Chairman, BOS. The emphasis on the experiments is broadly based on the following criteria given in Table: 1

	Experiment Based	Programming based
20 %	Objective	Purpose
20 %	Analysis	Algorithm
20 %	Design	Programme
20 %	Conclusion	Conclusion
20 %	Viva	Viva

Continuous Internal Assessment (CIA):

CIA is conducted for a total of 30 marks (Table 1), with 20 marks for continuous lab assessment during day to day performance, 10 marks for final internal lab assessment.

Component			Total Marks
Type of Assessment	**Day to day performance**	**Final internal lab assessment**	
CIA Marks	20	10	30

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.

1. **Experiment Based**

Objective	Analysis	Design	Conclusion	Viva	Total
2	2	2	2	2	10

2. **Programming Based**

Objective	Analysis	Design	Conclusion	Viva	Total
-	-	-	-	-	-

VI COURSE OBJECTIVES:

The students will try to learn:

I	Identify the properties and behavior of highway material for different loading patterns.

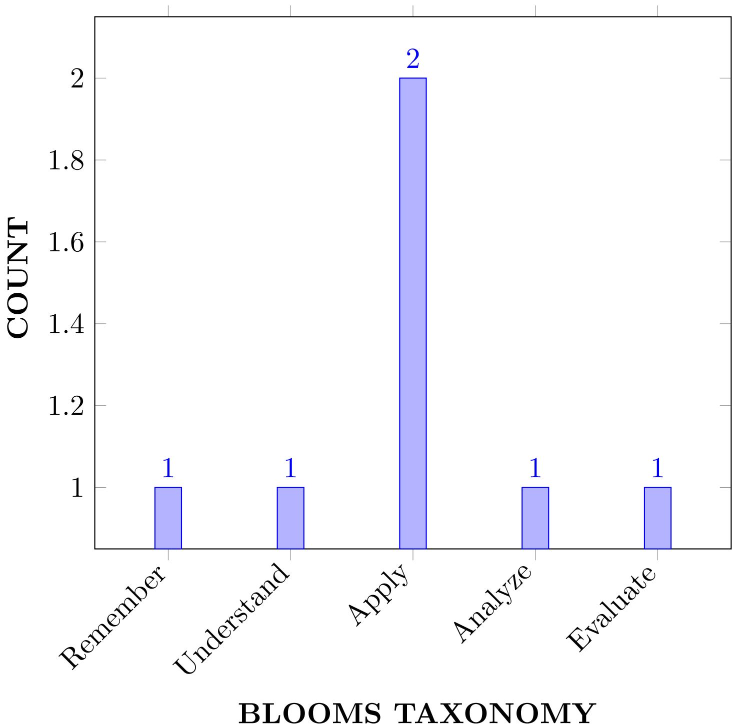
II	Demonstrate tests on transportation materials like aggregate, bitumen, sand etc. and check their Suitability.
III	Understand the properties of cement by conducting setting time, specific gravity and compressive strength tests.
IV	The concept of quality control and design of concrete mix for ensuring quality of concrete.

VII COURSE OUTCOMES:

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

CO 1	**Recall** the basic properties of cement and aggregates for determining their suitability through various laboratory tests.	Remember
CO 2	**Identify** the problems associated with roads based on the properties to suggest the appropriate remedy .	Apply
CO 3	**Determine** mechanical properties of aggregates in laboratory for deciding its suitability in construction practice.	Evaluate
CO 4	**Examine** the physical and chemical properties of cement for producing the good quality of concrete.	Analyze
CO 5	**Outline** the various properties of bitumen material to obtain the grade of bitumen.	Understand
CO 6	**Utilize** the concept on properties of aggreagates and binding materials for design of roads.	Apply

COURSE KNOWLEDGE COMPETENCY LEVEL



VIII HOW PROGRAM OUTCOMES ARE ASSESSED:

Program		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	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	Lab Exercises
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	1	Lab Exercises
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	3	Lab Exercises
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	3	Lab Exercises

3 = High; 2 = Medium; 1 = Low

IX HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

Program		Strength	Proficiency Assessed by
PSO 1	Design and supervise sub-structures and superstructures for residential and public buildings, industrial structures, irrigation structures, powerhouses, highways, railways, airways, docks and harbours.	2	Lab Exercises
PSO 2	Focus on Improving Performance of Structures with reference to Safety, Serviceability and Sustainable Green Building Technology.	3	Lab Exercises

3 = High; 2 = Medium; 1 = Low

X 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 and **principals of mathematics** to engineering problems for testing the quality of materials using the knowledge of **science and engineering fundamentals.**	3
	PO 7	Understand the impact of professional engineering solutions in societal and environmental context and develop a special concrete to promote **environmental safety** for sustainable **socio economic development**	2
	PSO 1	Explain the properties of materials used in layers of roads with **materials knowledge** and ensure **quality assurance**.	2
CO 2	PO 1	Apply the knowledge and **principals of mathematics** to engineering problems for testing the quality of materials using the knowledge of **science and engineering fundamentals**.	3
	PO 3	Determine the different properties of materials used for road construction after thorough **investigation** and ensure its **fitness for the purpose of all aspects of the problem including production, operation and maintenance** of concrete.	3
	PO 4	Recognize the properties of the aggregates by understanding the appropriate **code of practice and indian standards** to get **awareness of quality issues**	3
	PO 5	Select and apply **appropriate techniques** for determining the properties of construction materials by understanding the limitations.	1
	PSO 1	Select suitable material by testing their properties based on **structural design and material knowledge** for **strength assessment**.	3
CO 3	PO 1	Apply the knowledge and **principals of mathematics** to engineering problems for testing the quality of materials using the knowledge of **science and engineering fundamentals**.	3
	PO 5	Select and apply **appropriate techniques** for determining the properties of construction materials by understanding the limitations.	1
	PSO 1	Explain the properties of materials used in **construction** of roads with **material knowledge, codes of practices** and ensure **quality assurance** for **assessing strength**.	5

CO 4	PO 1	Apply the knowledge and **principals of mathematics** to engineering problems for testing the quality of materials using the knowledge of **science and engineering fundamentals**.	3
	PO 3	Determine the specific gravity of cement after thorough **investigation** and ensure its **fitness for the purpose of all aspects of the problem including production, operation and maintenance** of concrete.	3
	PO 5	Select and apply appropriate testing method to know the properties ofspecific gravity of cement by **understanding the limitations.**	1
	PSO 1	Explain the properties of materials used in **construction** of rigid pavements with **material knowledge, codes of practices** and ensure **quality assurance** for **assessing strength**.	5
CO 5	PO 1	Recognize the various properties of bitumen by applying the **principals of mathematics** to engineering problems for testing the quality of materials using the knowledge of **science and engineering fundamentals**.	3
	PO 4	Identify the grade of bitumen by understanding the appropriate **code of practice and indian standards** to get **awareness of quality issues**	3
	PSO 1	Identify the properties of bitumen used in **construction** of flexible pavements with **material knowledge, codes of practices** and ensure **quality assurance** for **assessing strength**.	5
CO 6	PO 1	Identify the properties of aggregates and binding materials by applying the knowledge and **principals of mathematics** to engineering problems for testing the quality of materials using the knowledge of **science and engineering fundamentals**.	3
	PO 7	Understand the impact of professional engineering solutions in societal and environmental context and develop a modified bitumen to promote **environmental safety** for sustainable **socio economic development**	2
	PSO 2	Understand the properties of materials by keeping the focus on performance of structures with reference to **safety, serviceability and sustainable roads.**	3

XI MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

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

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

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO 1	100	-	-	-	-	-	66.6	-	-	-	-	-	20	-	-
CO 2	100	-	30	27	100	-	-	-	-	-	-	-	30	-	-
CO 3	100	-	-	-	100	-	-	-	-	-	-	-	50	-	-
CO 4	100	-	30	-	100	-	-	-	-	-	-	-	50	-	-
CO 5	100	-	-	27	-	-	-	-	-	-	-	-	50	-	-
CO 6	100	-	-	-	-	-	66.6	-	-	-	-	-	-	100	-

XIII COURSE ARTICULATION MATRIX (PO – PSO MAPPING):

CO'S and PO'S and CO'S and PSO'S on the scale of 0 to 3, 0 being no correlation, 1 being the low correlation, 2 being medium correlation and 3 being high correlation.
0 - $0 \leq$ C$\leq$ 5% – No correlation
1-5 <C$\leq$ 40% – Low/ Slight
2 - 40 % <C < 60% –Moderate
3 - 60% $\leq$ C < 100% – Substantial /High

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

XIV ASSESSMENT METHODOLOGY DIRECT:

CIE Exams	✓	SEE Exams	✓	Seminars	-
Laboratory Practices	✓	Student Viva	✓	Certification	-
Assignments	-				

XV ASSESSMENT METHODOLOGY INDIRECT:

✓	Early Semester Feedback	✓	End Semester OBE Feedback
X	Assessment of Mini Projects by Experts		

XVI SYLLABUS:

Week-1	**INTRODUCTION TO TRANSPORTATION MATERIALS LABORATORY – I**
	Introduction to transportation material laboratory. Do's and Don'ts in materials lab.
Week-2	**AGGREGATE CRUSHING STRENGTH TEST**
	Batch I: Measurement of Aggregate crushing test. Batch II: Measurement of Aggregate crushing test.
Week-3	**AGGREGATE IMPACT TEST**
	Batch I: Measurement of Aggregate Impact test Batch II: Measurement of Aggregate Impact test
Week-4	**SPECIFIC GRAVITY AND WATER ABSORPTION TEST**
	Batch I: Calculation of specific gravity and water absorption test. Batch II: Calculation of specific gravity and water absorption test.
Week-5	**ATTRITION TEST OF COARSE AGGREGATES**
	Batch I: Perform Attrition test of coarse aggregates. Batch II: Perform Attrition test of coarse aggregates.
Week-6	**ABRASION TEST OF COARSE AGGREGATES**
	Batch I: Perform Abrasion test on coarse aggregates. Batch II: Perform Abrasion test on coarse aggregates.
Week-7	**SHAPE TESTS OF COARSE AGGREGATES**
	Batch I: Measurement of percentage of Flakiness in coarse aggregates. Batch II: Measurement of percentage of Elongation in coarse aggregates.
Week-8	**PENETRATION TEST OF BITUMINOUS MATERIALS**
	Batch I: Find the Penetration value of bitumen sample.
	Batch II: Find the Penetration value of bitumen sample.

Week-9	**DUCTILITY TEST OF BITUMINOUS MATERIALS**
	Batch I: Find the Ductility value of bituminous materials Batch II: Find the Ductility value of bituminous materials.
Week-10	**SOFTENING POINT OF BITUMEN MATERIALS**
	Batch I: Find the softening point value of bituminous materials. Batch II: Find the softening point value of bituminous materials
Week-11	**FLASH AND FIRE POINT TEST OF BITUMEN MATERIALS**
	Batch I: Find the flash point value of bitumen sample. Batch II: Find the flash point value of bitumen sample
Week-12	**NORMAL CONSISTENCY OF FINENESS OF CEMENT**
	Batch I: Perform test and find the normal consistency of fineness of cement. Batch II: Perform test and find the normal consistency of fineness of cement.
Week-13	**INITIAL SETTING TIME AND FINAL SETTING TIME OF CEMENT**
	Batch I: Find the Initial setting time of cement. Batch II: Find the Final setting time of cement.
Week-14	**SPECIFIC GRAVITY AND SOUNDNESS OF CEMENT**
	Batch I: Find the specific gravity of cement. Batch II: Find the soundness of cement.
Week-15	**COMPRESSIVE STRENGTH OF CEMENT**
	Batch I: Find the compressive strength of cement. Batch II: Find the compressive strength of cement.
Week-16	**COMPRESSIVE STRENGTH OF CONCRETE**
	Batch I: Find the compressive strength of concrete. Batch II: Find the compressive strength of concrete.
Week-17	**BULKING OF SAND**
	Batch I: Find the bulking of sand sample. Batch II: Find the bulking of sand sample.

TEXTBOOKS

1. Khanna S.K & Justo C.E.G. and Veeraragavan, A, "Highway Engineering", Nem Chand & Bros, Revised 10th Edition, 2017.

2. Kadiyalai, L.R., "Traffic Engineering and Transport Planning", Khanna Publishers, 2013.

REFERENCE BOOKS:

1. Fred L. Mannering, Scott S. Washburn, Walter P. Kilareski, "Principles of Highway Engineering and Traffic Analysis", John Wiley, 4 th Edition, 2007.

2. Srinivasa Kumar, R, "Textbook of Highway Engineering", Universities Press, 2011.

3. Paul H. Wright and Karen K. Dixon,Highway Engineering, Wiley Student Edition, 7th Edition, 2009.

XVII 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	Introduction to Transportation materials laboratory	CO1, CO 5	T1:2.1.5 T2:2.3
2	Measurement of aggregate crushing strength test.	CO2, CO 3	T2:2.1.5 R1:2.6
3	Measurement of aggregate impact test	CO2, CO 3	T1:2.6 R3:3.6.5
4	Calculation of specific gravity and water absorption test	CO2, CO 3	T2:2.7 R2:2.18
5	Perform attrition test of coarse aggregate	CO2, CO 3	T2:2.22 R3:3.1.1
6	Perform abrasion test on coarse aggregates	CO2, CO 3	T1:2.5.1 T2:2.25
7	Measurement of percentage of flakiness in coarse aggregates.	CO2, CO 3	T2:2.26 R3:2.55
8	Find the Penetration value of bitumen sample	CO 5, CO 6	T2:2.3
9	Find the ductility value of bituminous materials.	CO 5, CO 6	R3:2.6
10	Find the softening point value of bituminous materials.	CO 5, CO 6	T2:2.3
11	Find the flash point value of bitumen sample	CO 5, CO 6	R1:2.6
12	Perform test and find the normal consistency of fineness of cement	CO 2, CO 4	T1:2.6
13	Find the initial setting time of cement	CO 2, CO 4	T2:2.7 R1:2.18
14	Find the specific gravity of cement.	CO 2, CO 4	T2:2.7 R2:2.19
15	Find the compressive strength of cement.	CO 2, CO 4	T2:2.7 R2:2.20
16	Find the compressive strength of concrete.	CO 2, CO 4	T2:2.7 R1:2.21
17	Find the bulking of sand sample.	CO 2, CO 4	T2:2.7 R1:2.22

XVIII EXPERIMENTS FOR ENHANCED LEARNING (EEL):

S.No	Design Oriented Experiments
1	Design of Porous concrete pavement blocks for light weight traffic.
2	Design of Plastic roads using different lubrication oils and different speeds.
3	Design of crushing and impact strength for different loads and estimation of life.
4	Measurement of Workability of Concrete Mix.

Signature of Course Coordinator **HOD,CE**
Mr.V.Surya Prakash Reddy, Assistant Professor

INSTITUTEOFAERONAUTICALENGINEERING
(Autonomous)
Dundigal, Hyderabad-500043

COURSE DESCRIPTION

Department	**CIVILENGINEERING**				
Course Title	**ENVIRONMENTAL ENGINEERING**				
Course Code	ACE015				
Program	B. Tech				
Semester	VII				
Course Type	CORE				
Regulation	R-16				
Course Structure	Theory			Practical	
	Lecture	Tutorials	Credits	Laboratory	Credits
	3	0	3	3	1.5
Course Coordinator	Dr. JSR Prasad, Professor				

I COURSEPRE-REQUISITES:

Level	Course Code	Semester	Prerequisites
B. Tech	AHS005	I	Engineering Chemistry
B. Tech	ACE011	V	Hydraulics and Hydraulic Machinery

II COURSEOVERVIEW:

Environmental Engineering is a very popular discipline of engineering that deals with the issues related to the environment. The Environmental Engineers devote themselves finding out renewable sources of energy and solutions to curb pollution and other environmental issues. They work for the sustainable development of the earth and its living organisms. They also make devices for waste and water management in rural and urban areas, improved sanitation system, to stop the water-borne diseases. They study the effects of technological growth on environment such as: the effects of global warming, pollution, reason for shortage of rainfall, acid rain etc. In short, the Environmental Engineers are constantly engaged in maintaining the health of the earth and the living creatures on it; this course also cover the study of construction of oxidation pond, sludge digestion tank, skimming tanks, grit chambers, sedimentation tanks and designing of septic tanks and soak pits.

III MARKSDISTRIBUTION:

Subject	SEE Examination	CIE Examination	Total Marks
Environmental Engineering	70Marks	30Marks	100

IV CONTENTDELIVERY/INSTRUCTIONALMETHODOLOGIES:

✓	PowerPoint Presentations	✓	Chalk& Talk	✓	Assignments	x	MOOC
x	Open Ended Experiments	x	Seminars	x	Mini Project	✓	Videos
x	Others						

V EVALUATIONMETHODOLOGY:

The course will be evaluated for a total of 100marks, with 30 marks for Continuous Internal Assessment (CIA) and 70 marks for Semester End Examination (SEE). Out of 30 marks allotted for CIA during the semester, marks are awarded by taking average of two CIA examinations or the marks scored in the make-up examination.

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 14 marks. There could be a maximum of two subdivisions 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
20%	Remember
60%	Understand
20%	Apply
0%	Analyze
0%	Evaluate
0%	Create

Continuous Internal Assessment (CIA):

CIA is conducted for a total of 30 marks, with 25 marks for Continuous Internal Examination (CIE), 05 marks for Quiz and 05 marks for Alternative Assessment Tool (AAT).

Component	Theory		Total Marks
Type of Assessment	CIE Exam	Quiz\AAT	
CIA Marks	25	05	30

Continuous Internal Examination (CIE):

Two CIE exams shall be conducted at the end of the $8^{th}$and 17^{th}week of the semester respectively. The CIE exam is conducted for 25 marks of 2hours duration consisting of 5 descriptive type questions out of which 4 questions have to be answered where, each question carries 5marks. Marks are awarded by taking average of marks scored in two CIE exams.

Quiz-Online Examination

Two Quiz exams shall be online examination consisting of 25 multiple choice questions and are to be answered by choosing the correct answer from a given set of choices (commonly four). Such a question paper shall be useful infesting of knowledge, skills, application, analysis, evaluation and understanding of the students. Marks shall be awarded considering the average of two quiz examinations for every course.

Alternative Assessment Tool (AAT)

This AAT enables faculty to design own assessment patterns during the CIA. The AAT converts the classroom into an effective learning center. The AAT may include tutorial hours/classes, seminars, assignments, term paper, open ended experiments, METE (Modeling and Experimental Tools in Engineering), five minutes video, MOOCs etc. The AAT chosen for this course is given in table

Concept Video	Tech-talk	Complex Problem Solving
40%	40%	20%

VI COURSEOBJECTIVES:

The students will try to learn:

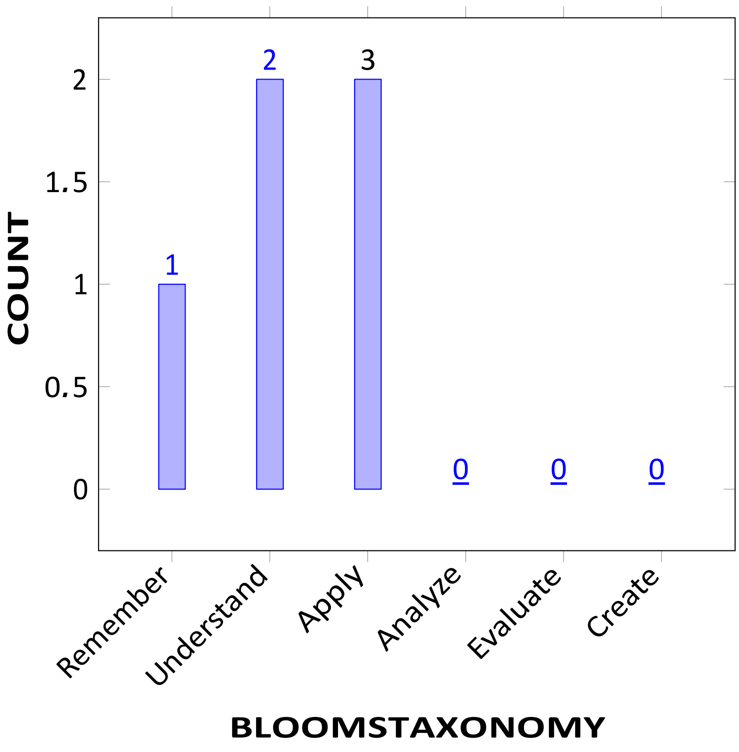
I	The quality and quantity of drinking water standards and know the demand of water for a particular community
II	The basic standards of water and study the procedure for determination
III	The conventional process of water and wastewater treatment methods, and know the distribution system
IV	Ultimate disposal methods of wastewater, self-purification of rivers, sewage farming.

VII COURSEOUTCOMES:

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

CO1	**Identify** the importance of water demand including types of demand according to population forecasts for supplying the water to meet the public needs.	Remember
CO2	**Understand** the general layout of various units in wastewater treatment plant (WWTP) and treatment process to remove the large suspended particles from wastewater and for reuse.	Apply
CO3	**Understand** the concept of conservancy and water carriage systems for arranging the pipeline system to transfer these wage and storm water to treatment plant.	Understand
CO4	**Discuss** the need for ultimate disposal of sewage, and dilution to allow human and industrial effluents to be disposed of without damage to the natural environment.	Apply
CO5	**Understand** the waste water treatment process via primary sedimentation and secondary sedimentation for removing the suspended particle from the collected wastewater.	Understand
CO6	**Choose** the design concept of oxidation ponds, sludge digestion tanks and septic tanks working principles for ultimate disposal of sludge.	Apply

COURSE KNOWLEDGE COMPETENCY LEVEL



VIII PROGRAMOUTCOMES:

Program Outcomes	
PO1	**Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2	**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.
PO3	**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.
PO4	**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.
PO5	**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
PO6	**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.
PO7	**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.
PO8	**Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO9	**Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO10	**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.
PO11	**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.
PO12	**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

IX HOWPROGRAMOUTCOMESAREASSESSED:

PROGRAMOUTCOMES		Strength	Proficiency Assessed by
PO1	**Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.	3	CIE,AAT,SEE
PO2	**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.	1	CIE,AAT,SEE
PO3	**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	CIE,AAT,SEE
PO4	**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.	1	CIE,AAT,SEE

3=High;2=Medium;1=Low

X HOWPROGRAMSPECIFICOUTCOMESAREASSESSED:

PROGRAMSPECIFICOUTCOMES		Strength	Proficiency Assessed by
PSO1	Design and Supervise Sub-Structures and Super Structures for Residential and Public Buildings, Industrial Structures, Irrigation Structures, Power Houses, Highways, Railways, Airways, Docs and Harbors.	1	Quiz
PSO2	Focus on Improving Performance of Structures with reference to Safety, Serviceability and Sustainable Green Building Technology.	2	Quiz

3=High;2=Medium;1= Low

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

COURSEO UTCOMES	PROGRAMOUTCOMES												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
CO1	✓	✓	✓		-	-	-	-	-	-	-	-	✓	✓	-
CO2	✓	-	✓	✓	-	-	-	-	-	-	-	-	✓	-	-
CO3	✓	✓	-	✓	-	-	-	-	-	-	-	-	-	✓	-
CO4	✓	-	✓	-	-	-	-	-	-	-	-	-	✓	-	-
CO5	✓	-	✓	✓	-	-	-	-	-	-	-	-	-	✓	-
CO6	✓	-	✓	✓	-	-	-	-	-	-	-	-	-	✓	-

XII 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 matched.
CO1	PO1	Identify (knowledge) the basic importance of water and water demand including types of water demand and design the water distribution patterns by applying the knowledge of **mathematics, science and Engineering fundamentals**	3
	PO2	Understand the water demand locations wise and type of demand then identify design the distribution pattern using concept of **structural design** for supplying the quality of water	1
	PO3	Investigate and define a problem (water demand) and choose a particular design pattern for distribution of quality water from intakes and infiltration galleries and design the distribution pattern by using fundamentals in **mathematics, engineering and structural engineering**	3
	PSO1	Identify the water source (In-takes, infiltration galleries, confined and unconfined aquifers) and provide the system (Pipe network) for water carriage to meet the public demand and design the network system using fundamentals in **construction technology**	1
	PSO2	Identify the type of water demand and design the pipe network system focusing on quality and durability using **Indian standard codes** and fundamentals in **Civil engineering** for design and construction of various structural elements.	2
CO2	PO1	Understand the necessity of water treatment including the various stages of treatment process using **engineering fundamentals and their integration and support with other engineering disciplines, mathematics, and science.**	3

CourseOu tcomes	PO'S PSO'S	Justification for mapping (Students will be able to)	No.ofKeycom petenciesmat ched.
	PO3	Understanding of the requirement for water treatment and investigate and define a problem and identify constraints (water demand based population forecasts techniques) using **basic mathematics and engineering fundamentals.**	2
	PO4	Understanding of appropriate codes (for design of various layouts in waste water treatment plants) of practice and industry standards using **engineering specializations and standard IS codes**	2
	PSO1	Understand the concept of various water distribution systems including the distribution patterns using **engineering fundamentals** for quality supply of water	1
CO3	PO1	Understand the necessity of water treatment and arrange the pipe network system (conservancy and water carriage systems) to transport the used domestic /industry water to treatment plant using basic **mathematical principles, engineering fundamentals and hydrology.**	3
	PO2	Characterizes the sewage water through physical, chemical and biological characteristics and understand the level of contaminate and estimate the required the dissolved through COD and BOD tests and apply the appropriate **chemical composition** to separate the suspended material from water using basic **mathematics, fundamentals in engineering and engineering chemistry.**	4
	PO4	Review the past existing survey records to understand the quantity of waste water that has been generating from domestic/industry in order to design the sedimentation tanks as per the **IS codes** using fundamental **mathematics and engineering principles.**	3
	PSO2	Understand the concept of one pipe and two pipe systems of plumbing for ultimate disposal of sewage using **pipe networking techniques, fundamentals of mathematics and engineering principles.**	3
CO4	PO1	Understand the necessity of wastewater treatment and importance of screenings. Screeners used to remove objects such as rags, paper, plastics, and metals to prevent damage and clogging of downstream equipment, piping, and appurtenances so that understand the design concept of screeners using **concept hydrology , basic mathematics and engineering fundamentals.**	3

Course Outcomes	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key competencies matched.
	PO3	Understand the necessity of wastewater treatment and design concept of sedimentation tanks using basic of **structural engineering concepts** since the sedimentation tank allows suspended particles to settle out of water or wastewater as it flows slowly through the tank, thereby providing some degree of purification.	1
	PSO1	Understand the necessity of wastewater treatment and importune of grit chamber including function of each type of grit chamber because grit chambers are long narrow tanks that are designed to slow down the flow so that solids such as sand, coffee ground sand egg shells will settle out of the waste. Therefore, understand the design concept of grit chamber using **engineering fundamentals and standard design codes.**	2
CO5	PO1	Understand the importance of oxidation ponds and sludge digestion tanks including design approaches using the **knowledge of mathematics, science and engineering fundamentals.**	3
	PO3	Understand the various requirements of engineering activities to design the oxidation pond and working principles and design-soak pits using **fundamentals in mathematics and basic engineering principles**	2
	PO4	Review sewage farming and make sure the water quality in appropriate way towards sewage farming using appropriate principles of **mathematics, science** and governing equations engineering **fundamentals** of sewage treatment.	3
	PSO2	Understand the importance of drying bed and concept of sludge disposal by drying using fundamental of **Engineering principles**	1
CO6	PO1	Understand the importance of oxidation ponds and sludge digestion tanks including design approaches using the **knowledge of mathematics, science and engineering fundamentals.**	3
	PO3	Understand the various requirements of engineering activities to design the oxidation pond and working principles and design-soak pits using **fundamentals in mathematics and basic engineering principles**	2
	PO4	Review sewage farming and make sure the water quality in appropriate way towards sewage farming using appropriate principles of **mathematics, science** and governing equations engineering **fundamentals** of sewage treatment.	3
	PSO2	Understand the importance of drying bed and concept of sludge disposal by drying using fundamental of **engineering principles**	1

XIII TOTALCOUNTOFKEYCOMPETENCIESFORCO–PO/PSOMAP-PING:

COURSEO UTCOMES	PROGRAMOUTCOMES												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
CO1	3	1	3	-	-	-	-	-	-	-	-	-	1	2	-
CO2	3	-	2	2	-	-	-	-	-	-	-	-	1	-	-
CO3	3	4	-	3	-	-	-	-	-	-	-	-	-	3	-
CO4	3	-	1	-	-	-	-	-	-	-	-	-	2	-	-
CO5	3	-	2	3	-	-	-	-	-	-	-	-	-	1	-
CO6	3	-	2	3	-	-	-	-	-	-	-	-	-	1	-

XIV PERCENTAGEOFKEYCOMPETENCIESFORCO–PO/PSO

COURSEO UTCOMES	PROGRAMOUTCOMES												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
CO1	100	10	30	-	-	-	-	-	-	-	-	-	10	66.6	-
CO2	100	-	20	18.1	-	-	-	-	-	-	-	-	10	-	-
CO3	100	40	-	27.7	-	-	-	-	-	-	-		-	100	-
CO4	100	-	10	-	-	-	-	-	-	-	-	-	20	-	-
CO5	100	-	20	27.7	-	-	-	-	-	-	-	-	-	33.3	-
CO6	100	-	20	27.7	-	-	-	-	-	-	-	-	-	33.3	-

XV COURSE ARTICULATION MATRIX (PO/PSOMAPPING):

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

0 0 ≤ C≤ 5%–No correlation
1 5<C ≤ 40%–Low/Slight
2 40 %<C<60%–Moderate
3 60%≤C<100%–Substantial/High

COURSEO UTCOMES	PROGRAMOUTCOMES												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
CO1	3	1	1	-	-	-	-	-	-	-	-	-	1	2	-
CO2	3	-	1	1	-	-	-	-	-	-	-	-	1	-	-
CO3	3	1	-	1	-	-	-	-	-	-	-	-	-	3	-
CO4	3	-	1	-	-	-	-	-	-	-	-	-	1	-	-
CO5	3	-	1	1	-	-	-	-	-	-	-	-	-	1	-
CO6	3	-	1	1	-	-	-	-	-	-	-	-	-	1	-
TOTAL	18	2	5	4	-	-	-	-	-	-	-	-	3	7	-
AVERAGE	3	1	1	1	-	-	-	-	-	-	-	-	1	2	-

XVI ASSESSMENTMETHODOLOGY-DIRECT:

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

XVII ASSESSMENTMETHODOLOGY-INDIRECT:

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

XVIII SYLLABUS:

MODULEI	WATERQUALITY,DEMANDANDSUPPLY
	Protected water supply, population forecasts, design period, water demand, types of demand, factors affecting fluctuations, fire demand, storage capacity, water quality and testing. Drinking water standards. Comparison from quality and quantity and other considerations, intakes, infiltration galleries, confined and unconfined aquifers, distribution systems, requirements, method sand layouts.
MODULEII	WATERTREATMENTANDDISTRIBUTION
	Layout and general outline of water treatment units, sedimentation, uniform settling velocity, principles, design factors, surface loading, jar test, optimum dosage of coagulant, coagulation, flocculation, clarifier design, coagulants, and feeding arrangements. filtration, theory, working of slow and rapid gravity filters, multimedia filters, design of filters, troubles in operation comparison of filters, disinfection, types of disinfection, theory of chlorination chlorine demand and other disinfection treatment methods. Distribution systems, types of layouts of distribution systems, design of distribution systems, Hardy Cross and equivalent pipe methods, service reservoirs, joints, valves such as sluice valves, air valves, scour valves and check valves water meters, laying and testing of pipelines, pump house.
MODULEIII	SEWAGETREATMENTANDDISPOSAL
	Conservancy and water carriage systems, sewage and storm water estimation, type of concentration, storm water over flows combined flow, characteristics of sewage, cycles of decay, decomposition of sewage, examination of sewage, B.O.D. and C.O.D. equations. Design of sewers, shapes and materials, sewer appurtenances manhole, inverted siphon, catch basins, flushing tanks, ejectors, pumps and pump houses, house drainage, components requirements, sanitary fittings, traps, one pipe and two pipe systems of plumbing, ultimate disposal of sewage, sewage farming, dilution.
MODULEIV	WASTEWATERTREATMENT
	Layout and general outline of various units in a wastewater treatment plant, primary treatment design of screens, grit chambers, skimming tanks - sedimentation tanks-principles and design of biological treatment, trickling filters, standard and high rate.
MODULEV	DESIGNANDWORKINGOFTREATMENTUNITS
	Construction and design of oxidation ponds, sludge digestion tanks, factors effecting, design of digestion tank, sludge disposal by drying, septic tanks working principles and design-soak pits. Ultimate disposal of wastewater, self-purification of rivers, sewage farming.

TEXT BOOKS

1. Peavy, Howard S., Donald R. Rowe, and George Tchobanoglous. Environmental engineering, Vol.2985, NewYork: McGraw-Hill,1985.

2. Davis, Mackenzie L., and David A. Cornwell. Introduction to environmental engineering, McGraw-Hill, 2008.

3. Duggal, K.N. “Elements of Environmental Engineering:” New Delhi; S. Chand and Company Ltd(2002).

4. PunmiaB.C, AshokJain ArunJain, “Water Supply Engineering”, Laxmi PublicationsPvt.Ltd NewDelhi,2004.

REFERENCE BOOKS:

1. Garg, Santosh Kumar. Water Supply Engineering: Environmental Engineering, Khanna, 1992.
2. Modi,P.N. Sewag Treatment & Disposal and Waste Water Engineering. Standard Book house, 2008.
3. Garg, Santosh Kumar. Sewage disposal and air pollution engineering. Khanna Publsihers, 2012.

WEB REFERENCES:

1. http://site.iugaza.edu.ps/afoul/files/2010/02/Environmentalbook.pdf
2. https://www.sanfoundry.com/best-reference-books-btech-environmental-engineering/

COURSE WEBPAGE:

1. http://site.iugaza.edu.ps/afoul/files/2010/02/Environmentalbook.pdf
2. https://libguides.rowan.edu/com

XIX COURSEPLAN:

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

S.No	Topics to be covered	CO’s	Reference T1:4.1
OBE DISCUSSION			
1	Discussion on OBE, CO’s and CLO’s of Environmental Engineering subject		
CONTENTDELIVERY(THEORY)			
2	Introduction to Environmental Engineering & water quality, demand and supply	CO1	T2,3
3	Importance and Necessity for Planned Water Supplies	CO1	T2,3& R1
4	Need for Protected Water Supply	CO1	T2,3& R1
5	Various Types of Water Demands	CO1	T2,3& R1
6	Per Capita Demand	CO1	T2,3& R1
7	Factors Affecting Per Capita Demand	CO1	T2,3& R1
8	Variations in Demand	CO1	T2,3& R1
9	Population forecasting Methods and Problems	CO1,2	T2,3& R1
10	Geometrical increase Method	CO1	T2,3& R1
11	Surface Source and Surface Source for Water	CO1	T2,3& R1

12	Intakes for collecting surface water	CO1	T2,3& R1
13	Introduction to water treatment and distribution	CO2	T2,3& R2,3
14	Treatment unit flow diagram	CO2	T2,3& R2,3
15	The Location of Treatment Plant	CO2	T2,3& R2,3
16	Screening	CO2	T2,3& R2,3
17	Sedimentation	CO2	T2,3& R2,3
18	Design aspects of sedimentation tanks	CO2	T2,3& R2,3
19	Sedimentation aided with coagulation	CO2	T2,3& R2,3
20	Distribution systems, types of layouts of distribution systems	CO2	T2,3& R2,3
21	Design of distribution systems, Hardy-Cross and equivalent pipe methods and service reservoirs	CO2	T2,3& R2,3
22	Introduction to sewage treatment and disposal	CO2	T1,2& R1,2
23	Direct discharge of sewage	CO2	T1,2& R1,2
24	Domestic water treatment	CO2	T1,2& R1,2
25	Methods of domestic waste water disposal	CO2	T1,2& R1,2
26	Sewerage Systems	CO3	T1,2& R1,2
27	Design of sewers, shapes and materials and sewer appurtenances manhole	CO4	T1,2& R1,2
28	Ultimate disposal of sewage, sewage farming, dilution.	CO5	T1,2& R1,2
29	Introduction Wastewater Treatment	CO4	T1,2& R1,3
30	Layout and general outline of various units in a wastewater treatment plant	CO2&4	T1,2& R1,3
31	Primary treatment process and design of screens	CO4	T1,2& R1,3
32	Grit chambers	CO4	T1,2& R1,3
33	Skimming tanks	CO4	T1,2& R1,3
34	Sedimentation tanks	CO2,4	T1,2& R1,3
35	Principles and design of biological treatment	CO4	T1,2& R1,3

36	Trickling filters	CO2,4	T1,2& R1,3
37	Introduction to design and working of treatment units	CO2,4	T1,2& R1,3
38	Construction and design of oxidation ponds	CO5	T1,2& R1,3
39	Sludge digestion tanks design	CO5	T1,2& R1,3
40	Factorseffectingthedesignofoxidationponds,designofdigestiontank,sludgedisposalbydrying	CO5	T1,2& R1,3
41	Septic tanks working principles and design-soak pits	CO5	T1,2& R1,3
42	Ultimate disposal of wastewater, self-purification of river sand sewage farming	CO5	T1,2& R1,3
PROBLEM SOLVING/CASE STUDIES			
1	Problems on population forecasts	CO1	T2,3& R1
2	Problems on domestic water demand	CO1	T2,3& R1
3	Problems based on per capita demand	CO1	T2,3& R1
4	Problems based variations in demand	CO1	T2,3& R1
5	Problems on sedimentation analysis	CO2	T2,3& R2,3
6	Problems on uniform settling velocity	CO2	T2,3& R2,3
7	Examples on coagulation, flocculation and clarifier design	CO2,4	T2,3& R2,3
8	Problems on design of filters	CO4	T2,3& R2,3
9	Types of layouts of distribution systems and Problems design of distribution systems	CO1,3	T2,3& R2,3
10	Problems on sewage and storm water estimation	CO3	T1,2& R1,2
11	Problems on B.O.D. and C.O.D. equations	CO3	T1,2& R1,2
12	Problems on design of sewers, appurtenances manhole and inverted siphon	CO4	T1,2& R1,2
13	Examples on catch basins, flushing tanks, ejectors, pumps and pump houses	CO4	T1,2& R1,2
14	Problems of on oxidation ponds design	CO5	T1,2& R1,3
15	Problems on digestion tank design and soak pits	CO5	T1,2& R1,3
DISCUSSION OF DEFINITION AND TERMINOLOGY			
1	Brief note on Per-capita demand, Domestic water demand, Industrial demand and Institution and commercial demand	CO1	T2,3& R1

2	Analysis on coagulation, flocculation filtration Hardy-Cross and equivalent pipe methods	CO2,4	T2,3& R2,3
3	Basic definitions on Basic Refuse garbage sullage sewage storm water sanitary sewage and sewers	CO3	T2,3& R2,3
4	Overview on screens, grit chambers, skimming tanks and sedimentation tanks	CO4	T2,3& R2,3
5	Brief note on oxidation ponds, sludge digestion tanks and their purposes	CO5	T2,3& R2,3
DISCUSSIONOFQUESTIONBANK			
1	Protected water supply, population forecasts, design period, water demand and types of demand	CO1	T2,3& R1
2	Design of distribution systems, Hardy-Cross and equivalent pipe methods	CO1,2	T2,3& R2,3
3	Conservancy and water carriage systems and B.O.D. and C.O.D. equations	CO3	T2,3& R2,3
4	Design of screens, grit chambers, skimming tanks-sedimentation tanks-principles	CO4	T2,3& R2,3
5	Design of oxidation ponds and sludge digestion tanks	CO5	T2,3& R2,3

Signature of Course Coordinator **HOD, CE**

Dr. JSR Prasad, Professor

INSTITUTE OF AERONAUTICAL ENGINEERING
(Autonomous)
Dundigal, Hyderabad - 500 043

COURSE DESCRIPTION

Department	**CIVIL ENGINEERING**				
Course Title	**ADVANCED STRUCTURAL ANALYSIS AND DESIGN**				
Course Code	ACE016				
Program	B.Tech				
Semester	VII				
Course Type	CORE				
Regulation	IARE-16				
Course Structure	Theory			Practical	
	Lecture	Tutorials	Credits	Laboratory	Credits
	3	1	4	-	-
Course Coordinator	Dr Venu M, Professor				

I COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites
B.Tech	ACE008	V	Structural Analysis
B.Tech	ACE009	V	Reinforced Concrete Structures Design and Drawing
B.Tech	ACE012	VI	Design of Steel Structures and Drawing

II COURSE OVERVIEW:

The course focuses on advanced structural analysis of structures and design. Entire course is divided into two parts. Part one of the course includes the matrix methods of analysis like stiffness method and flexibility method. This includes the analysis of continuous beams, fixed beams, and single storeyed single bay frames. Apart from these, this course covers the approximate methods of analysis for structures subjected to horizontal and vertical loads. Part two of the course covers the advanced structural design. This includes design of retaining walls, design of deep foundations like pile foundations, design of flat slabs, design of water tanks, design of bunkers, silos and chimneys.The main objective is to enable the student to have a good grasp of all the fundamental issues in these advanced topics in structural analysis, besides enjoying the learning process, and developing analytical and intuitive skills.

III MARKS DISTRIBUTION:

Subject	SEE Examination	CIE Examination	Total Marks
Advanced Structural Analysis and Design	70 Marks	30 Marks	100

IV CONTENT DELIVERY / INSTRUCTIONAL METHODOLOGIES:

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

V EVALUATION METHODOLOGY:

The course will be evaluated for a total of 100 marks, with 30 marks for Continuous Internal Assessment (CIA) and 70 marks for Semester End Examination (SEE). Out of 30 marks allotted for CIA during the semester, marks are awarded by taking average of two CIE examinations or the marks scored in the make-up examination.

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 14 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
15%	Remember
15%	Understand
60%	Apply
10%	Analyze

Continuous Internal Assessment (CIA):
CIA is conducted for a total of 30 marks, with 25 marks for Continuous Internal Examination (CIE) and 05 marks for Quiz \Alternative Assessment Tool (AAT).

Component	Theory		Total Marks
Type of Assessment	CIE Exam	Quiz \AAT	
CIA Marks	25	05	30

Continuous Internal Examination (CIE):
Two CIE exams shall be conducted at the end of the 8^{th} and 17^{th} week of the semester respectively. The CIE exam is conducted for 25 marks of 2 hours duration consisting of two parts. Part–A shall have five compulsory questions of one mark each. In part–B, four out of five questions have to be answered where, each question carries 5 marks. Marks are awarded by taking average of marks scored in two CIE exams.

Quiz - Online Examination
Two Quiz exams shall be online examination consisting of 25 multiple choice questions and are to be answered by choosing the correct answer from a given set of choices (commonly four). Such a question paper shall be useful in testing of knowledge, skills, application, analysis, evaluation and understanding of the students. Marks shall be awarded considering the average of two quiz examinations for every course.

Alternative Assessment Tool (AAT)
This AAT enables faculty to design own assessment patterns during the CIA. The AAT converts the classroom into an effective learning center. The AAT may include tutorial hours/classes, seminars, assignments, term paper, open ended experiments, METE (Modeling and Experimental Tools in Engineering), five minutes video, MOOCs etc. The AAT chosen for this course is given in table

Concept Video	Tech-talk	Complex Problem Solving
40%	40%	20%

VI COURSE OBJECTIVES:

The students will try to learn:

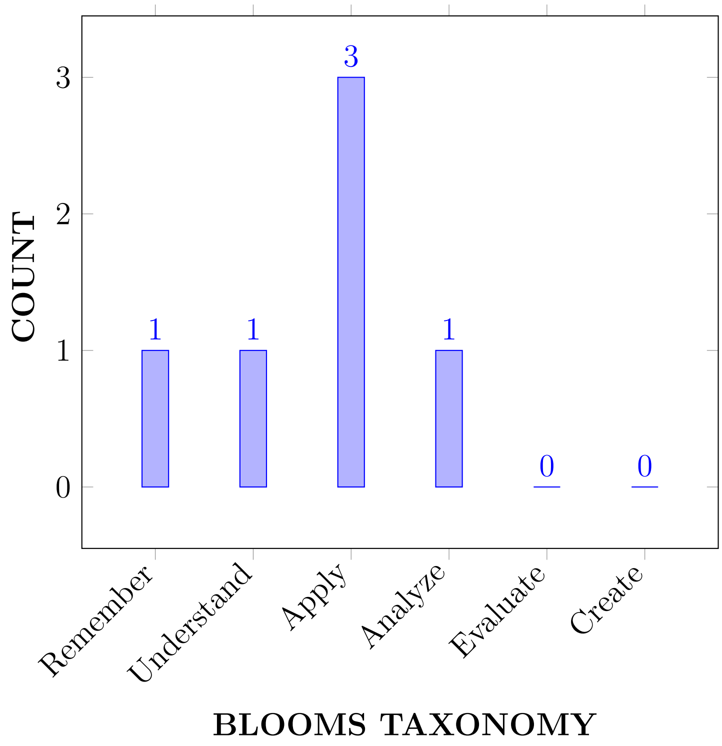
I	The advanced techniques to know the behaviour of structural elements subjected to both vertical and horizontal loads which are used for designing all types of structures.
II	The design of earth retaining structures, flat slabs, deep foundations, material storage structures and industrial chimneys as per Indian standards for designing efficient and effective structures.
III	The Design independently civil engineering structures as per the requirements of client and provide detailed design drawings, quality control reports during construction for ensuring quality and economical structures.

VII COURSE OUTCOMES:

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

CO 1	**Recall** the concepts of indeterminacies, stiffness and flexibility of structures for analysing the structures subjected to different loads.	Remember
CO 2	**Analyse** continuous beams, portal frames for the given loading conditions (vertical and horizontal loads) using the stiffness, flexibility, approximate methods for ensuring structural efficiency.	Analyse
CO 3	**Infer** the design concepts and IS codal provisions in the design of earth retaining structures, water tanks, deep foundations, flat slabs, storage bins and chimneys which will be guiding for designing structures by standard procedures.	Understand
CO 4	**Design** retaining walls and water tanks includes tanks resting on ground and overhead tanks for water storage and earth retaining purposes.	Apply
CO 5	**Design** flat slabs and deep foundations in terms of physical dimensions and reinforcement details for designing multi storied structures and bridges.	Apply
CO 6	**Design** bunkers, silos and chimneys which includes both reinforced concrete and steel for material storage and industry exhausts.	Apply

COURSE KNOWLEDGE COMPETENCY LEVEL



VIII PROGRAM 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.

Program Outcomes	
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

IX 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
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	2	CIE / SEE / AAT
PO 4	**Conduct Investigations of Complex Problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.	2	AAT

3 = High; 2 = Medium; 1 = Low

X HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

PROGRAM SPECIFIC OUTCOMES		Strength	Proficiency Assessed by
PSO 1	Design and Supervise Sub-Structures and Super Structures for Residential and Public Buildings, Industrial Structures, Irrigation Structures, Power Houses, Highways, Railways, Airways, Docs and Harbours.	1	CIE / SEE / AAT

3 = High; 2 = Medium; 1 = Low

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

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	✓	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 2	✓	✓	-	-	-	-	-	-	-	-	-	-	✓	-	-
CO 3	✓	-	-	-	-	-	-	-	-	-	-	-	✓	-	-
CO 4	✓	✓	✓	✓	-	-	-	-	-	-	-	-	✓	-	-
CO 5	✓	✓	✓	✓	-	-	-	-	-	-	-	-	✓	-	-
CO 6	✓	✓	✓	✓	-	-	-	-	-	-	-	-	✓	-	-

XII 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 matched.
CO 1	PO 1	Recall the concepts of the static and kinematic indeterminacy of structures (apply)for its behaviour by applying the principles of **mathematics and engineering fundamentals.**	2
CO 2	PO 1	Recall (knowledge) the different beam generally come across in design, and form the stiffness and flexibility matrices by applying the principles of **mathematics and engineering fundamentals.**	2
	PO 2	Understand the given **problem statement** of structural members related to shear forces and bending moments from the provided **information and data** in reaching substantiated solutions by the **interpretation of results.**	3
	PSO 1	Select the appropriate method for the analysis of structures using **mathematical principles** and **engineering knowledge** for different loads for the design purpose.	2
CO 3	PO 1	Understand the design concepts and codal provisions for designing structures by using **principles of mathematics, science, and engineering fundamentals.**	2

Course Outcomes	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key competencies matched.
	PSO 1	Understand the design procedures based on Indian standards using **mathematical principles** and **engineering knowledge** to support their applications in **next-level courses** of the program. (own engineering discipline).	3
CO 4	PO 1	Understand the different loads to be considered and design process of retaining walls and water tanks by applying the principles of **mathematics and engineering fundamentals.**	2
	PO 2	Analyse the retaining walls and water tanks for critical load combinations to know the design forces using the structural analysis concepts, **formulate** and **state a problem**, and **develop solution** and **document the results.**	4
	PO 3	Design of water tanks and retaining walls includes **Investigate problems** associated with these structures in site locations and **define problems** and **identify constraints** including **environmental and sustainability** limitations, **safety assessment** issues.	5
	PO 4	**Understanding** the appropriate is codes and **engineering knowledge** for the design of retaining walls and water tanks by **Identifying problem, classify problem** and **describe problem** and **quality issues** associated with the given problem in different conditions.	6
	PSO 1	Understand the design of water tanks and retaining walls based on Indian standards using **mathematical principles**; **engineering knowledge** and **document the results** to support their applications in **next-level courses** of the program (own engineering discipline).	4
CO 5	PO 1	Understand the different components in the engineering structures (multistoried structures and bridges) and its behavior by using **mathematics and engineering fundamentals.**	2
	PO 2	Analyse the flat slabs and deep foundations for critical load combinations to know the design forces using the structural analysis concepts, **formulate** and **state a problem**, and **develop solution** and **document the results.**	4
	PO 3	Design of flat slabs and deep foundations includes **Investigate problems** associated with these structures in site locations and **define problems** and **identify constraints** including **environmental and sustainability** limitations, **safety assessment** issues.	5

Course Outcomes	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key competencies matched.
	PO 4	**Understanding** the appropriate is codes and **engineering knowledge** for the design of flat slabs and deep foundations by **Identifying problem, classify problem** and **describe problem** and **quality issues** associated with the given problem in different conditions.	6
	PSO 1	Understand the design of flat slabs and deep foundations based on Indian standards using **mathematical principles**; **engineering knowledge** and **document the results** to support their applications in **next-level courses** of the program (own engineering discipline).	4
CO 6	PO 1	Understand the different loads to be considered while designing bunkers, silos and chimneys and its behavior by using **mathematics and engineering fundamentals.**	2
	PO 2	Analyse the bunkers, silos and chimneys for critical load combinations to know the design forces using the structural analysis concepts, **formulate** and **state a problem**, and **develop solution** and **document the results.**	4
	PO 3	Design of bunkers, silos and chimneys includes **Investigate problems** associated with these structures in site locations and **define problems** and **identify constraints** including **environmental and sustainability** limitations, **safety assessment** issues.	5
	PO 4	**Understanding** the appropriate is codes and **engineering knowledge** for the design of bunkers, silos and chimneys by **Identifying problem**, **classify problem** and **describe problem** and **quality issues** associated with the given problem in different conditions.	6
	PSO 1	Understand the design of bunkers, silos and chimneys based on Indian standards using **mathematical principles**; **engineering knowledge** and **document the results** to support their applications in **next-level courses** of the program (own engineering discipline).	4

XIII 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	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 2	2	3	-	-	-	-	-	-	-	-	-	-	2	-	-
CO 3	2	-	-	-	-	-	-	-	-	-	-	-	3	-	-
CO 4	2	4	5	6	-	-	-	-	-	-	-	-	4	-	-

CO 5	2	4	5	6	-	-	-	-	-	-	-	-	4	-	-
CO 6	2	4	5	6	-	-	-	-	-	-	-	-	4	-	-

XIV 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	66.7	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 2	66.7	30.0	-	-	-	-	-	-	-	-	-	-	20.0	-	-
CO 3	66.7	-	-	-	-	-	-	-	-	-	-	-	30.0	-	-
CO 4	66.7	40.0	50.0	54.5	-	-	-	-	-	-	-	-	40.0	-	-
CO 5	66.7	40.0	50.0	54.5	-	-	-	-	-	-	-	-	40.0	-	-
CO 6	66.7	40.0	50.0	54.5	-	-	-	-	-	-	-	-	40.0	-	-

XV COURSE ARTICULATION MATRIX (PO / PSO MAPPING):

CO'S and PO'S and CO'S and PSO'S on the scale of 0 to 3, 0 being no correlation, 1 being the low correlation, 2 being medium correlation and 3 being high correlation.
0 - $0 \leq C \leq 5\%$ – No correlation
1 -5 $<C\leq 40\%$ – Low/ Slight
2 - 40 % $<C < 60\%$ –Moderate
3 - $60\% \leq C < 100\%$ – Substantial /High

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 2	3	1	-	-	-	-	-	-	-	-	-	-	1	-	-
CO 3	3	-	-	-	-	-	-	-	-	-	-	-	1	-	-
CO 4	3	2	2	2	-	-	-	-	-	-	-	-	1	-	-
CO 5	3	2	2	2	-	-	-	-	-	-	-	-	1	-	-
CO 6	3	2	2	2	-	-	-	-	-	-	-	-	1	-	-
TOTAL	18	7	6	6									6		
AVERAGE	3.0	2.0	2.0	2.0									1.0		

XVI ASSESSMENT METHODOLOGY-DIRECT:

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

XVII ASSESSMENT METHODOLOGY-INDIRECT:

	Assessment of mini projects by experts	✓	End Semester OBE Feedback

XVIII SYLLABUS:

UNIT-I	**MATRIX METHODS OF ANALYSIS**
	Static and kinematic indeterminacy, stiffness and flexibility methods; Stiffness method of analysis for continuous beams including settlement of supports; Single storey portal frames including side sway, pinjointed determinate plane frames; Flexibility method of analysis for continuous beams up to three degree of indeterminacy.
UNIT-II	**APPROXIMATE METHODS OF ANALYSIS**
	Analysis of multi-storey frames for lateral loads: Portal method and cantilever method; Analysis of multistorey frames for gravity (vertical) loads; Substitute frame method.
UNIT-III	**DESIGN OF RETAINING WALLS AND TANKS**
	Design of retaining walls, Design of water tanks. Design concepts and IS code provisions.
UNIT-IV	**DESIGN OF SLABS AND FOUNDATIONS**
	Design of flat slabs, Design of raft and pile foundations; Design concepts and IS code provisions.
UNIT-V	**DESIGN OF CHIMNEY, BUNKER AND SILOS**
	Design of chimneys, Design of bunkers and silos; Design concepts and IS code provisions.

TEXTBOOKS

1. G S Pundit and S P Gupta, "Structural Analysis: A Matrix Approach", Mc Graw Hill Education Publishers, 2ndEdition, 2008.
2. S S Bhavikatti, "Structural Analysis- II", Vikas Publishing House Pvt. Ltd., 3rdEdition, 2009.
3. Varghese," Advanced reinforced concrete structures", Prentice Hall of India Pvt. Ltd, 2009.
4. Pillai and Menon, "Reinforced Concrete Design", Tata McGraw-Hill Publishing Company, 2009.

REFERENCE BOOKS:

1. Devdas Menon, "Structural Analysis", Narosa Publishing House, 2ndEdition, 2008.
2. Devdas Menon, "Advanced Structural Analysis", Narosa Publishing House, 2ndEdition, 2009.
3. C S Reddy, "Basic Structural Analysis", Tata McGraw-Hill Education, 2001.
4. B C Punmia, Ashok Kumar Jain and Arun Kumar Jain, "Reinforced Concrete Structures", Vol. 2, Laxmi Publications, 2012.

WEB REFERENCES:

1. https://nptel.ac.in/courses/105/106/105106050/
2. https://nptel.ac.in/courses/105/106/105106113/

COURSE WEB PAGE:

1. https://lms.iare.ac.in/index?route=course/details&course_id=221

XIX COURSE PLAN:

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

S.No	Topics to be covered	CO's	Reference T: R:
OBE DISCUSSION			
1	Course Objectives, Course Outcomes, Program Outcomes, Co-PO Mapping		
CONTENT DELIVERY (THEORY)			
2	Understand the concepts of static and kinematic indeterminacy.	CO 1	T1:1.1-1.7
3-4	Know the concepts of stiffness method and flexibility method.	CO 1	T1: 4.1-4.5 R2: 3.1-3.7
5-9	Analysis of continuous beam with and without settlement of supports using stiffness method.	CO 2	T1: 5.1-5.4 R2: 5.1-5.5
10-11	Analysis of single storey portal frames including side sway using stiffness method.	CO 2	T1: 6.1-6.8 R2: 6.1-6.4
12	Analysis of pin jointed determinate plane frames using stiffness method.	CO 2	T1: 7.1-7.6
13-14	Analysis for continuous beams up to three degree of indeterminacy using flexibility method.	CO 2	T1: 5.2; 6.2
15	Understand the concepts of different approximate methods of analysis for lateral loads.	CO 2	T2: 6.1 R4: 10.1-10.2
16	Analysis of multi storey frame using portal method.	CO 2	T2: 6.3 R4: 10.6
17	Analysis of multi storey frame using cantilever method.	CO 2	T2: 6.3 R4: 10.7
18-19	Analysis of multi storey frame using substitute frame method.	CO 2	T2: 6.2 R4: 10.3-10.5
20-21	Know the design concepts and IS code provisions for the retaining walls and water tanks.	CO 3	T3: 26.1-26.3
22-24	Understand the design of retaining walls.	CO 4	T4: 14.7-14.8
25-27	Understand the design of water tanks.	CO 4	T3: 26.5-26.10 R4: 3 - 5
28	Know the design concepts and IS code provisions for the flat slabs and deep foundations.	CO 3	T3: 10.1
29-31	Understand the design of flat slab.	CO 5	T3: 10.2-10.8
32-33	Understand the design of raft foundation.	CO 5	T4: 14.1-14.3
34-35	Understand the design of pile foundation.	CO 5	T4: 14.4-14.6

36	Identify the different storage bins based on the purpose of storage	CO 5	T3: 2.1
37-38	Know the design concepts and IS code provisions for the chimneys, bunker and silos.	CO 6	T3: 2.1
39-40	Understand the design of chimney.	CO 6	T3: 3.1-3.12 R4: 8.1-8.7
41-43	Understand the design of bunkers.	CO 6	T3: 2.2-2.7 R4: 7.1-7.6
44-45	Understand the design of silos.	CO 6	T3: 2.8-2.13 R4: 7.1-7.6
PROBLEM SOLVING/ CASE STUDIES			
1	Analysis of continuous beam with and without settlement of supports using stiffness method.	CO 2	T1: 5.1-5.4 R2: 5.1-5.5
2	Analysis of single storey portal frames including side sway using stiffness method.	CO 2	T1: 6.1-6.8 R2: 6.1-6.4
3	Analysis of pin jointed determinate plane frames using stiffness method.	CO 2	T1: 7.1-7.6
4	Analysis for continuous beams up to three degree of indeterminacy using flexibility method.	CO 2	T1: 5.2; 6.2
5	Analysis of multi storey frame using portal method.	CO 2	T2: 6.3 R4: 10.6
6	Analysis of multi storey frame using cantilever method.	CO 2	T2: 6.3 R4: 10.7
7	Analysis of multi storey frame using substitute frame method.	CO 2	T2: 6.2 R4: 10.3-10.5
8	Design of retaining walls.	CO 4	T4: 14.7-14.8
9	Design of water tanks.	CO 4	T3: 26.5-26.10 R4: 3 - 5
10	Design of flat slab.	CO 5	T3: 10.2-10.8
11	Design of raft foundation.	CO 5	T4: 14.1-14.3
12	Design of pile foundation.	CO 5	T4: 14.4-14.6
13	Design of chimney.	CO 6	T3: 3.1-3.12 R4: 8.1-8.7
14	Design of bunkers.	CO 6	T3: 2.2-2.7 R4: 7.1-7.6
15	Design of silos.	CO 6	T3: 2.8-2.13 R4: 7.1-7.6
DISCUSSION OF DEFINITION AND TERMINOLOGY			
1	Analysis of continuous beam and frames with and without settlement of supports using stiffness method and flexibility method.	CO 1, 2	T1: 5.1-5.4, 6.1-6.8, 7.1-7.6 R2: 5.1-5.5, 6.1-6.4
2	Analysis of portal frames using approximate methods i.e. portal method, cantilever method and substitute frame method.	CO 1, 2	T1: 6.1-6.8 R2: 6.1-6.4

3	Design of retaining walls and water tanks.	CO 3, 4	T3: 10.2-10.8 T4: 14.7-14.8 R4: 3 – 5
4	Design of flat slabs, raft foundation and pile foundations.	CO 4, CO 5	T3: 10.2-10.8 T4: 14.1-14.3 T4: 14.4-14.6
5	Design bunkers, silos and chimneys.	CO 6	T3: 2.1-3.12 R4: 7.1-7.6, 8.1-8.7
DISCUSSION OF QUESTION BANK			
1	Analysis of continuous beam and frames with and without settlement of supports using stiffness method and flexibility method.	CO 1, 2	T1: 5.1-5.4, 6.1-6.8, 7.1-7.6 R2: 5.1-5.5, 6.1-6.4
2	Analysis of portal frames using approximate methods i.e. portal method, cantilever method and substitute frame method.	CO 1, 2	T1: 6.1-6.8 R2: 6.1-6.4
3	Design of retaining walls and water tanks.	CO 3, 4	T3: 10.2-10.8 T4: 14.7-14.8 R4: 3 – 5
4	Design of flat slabs, raft foundation and pile foundations.	CO 4, 5	T3: 10.2-10.8 T4: 14.1-14.3 T4: 14.4-14.6
5	Design bunkers, silos and chimneys.	CO 6	T3: 2.1-3.12 R4: 7.1-7.6, 8.1-8.7

Signature of Course Coordinator **HOD, CE**
Dr Venu M, Professor

INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

Dundigal, Hyderabad - 500 043

COURSE DESCRIPTION

Department	**CIVIL ENGINEERING**				
Course Title	**ESTIMATION AND COSTING**				
Course Code	ACE017				
Program	B.Tech				
Semester	VII	CE			
Course Type	CORE				
Regulation	IARE - R16				
Course Structure	Theory			Practical	
	Lecture	Tutorials	Credits	Laboratory	Credits
	3	1	4	-	-
Course Coordinator	Mr. R. Suresh Kumar, Assistant Professor				

I COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites
B.Tech	ACE007	IV	Building Materials and Construction Planning

II COURSE OVERVIEW:

This course is a vital part of any construction project after preparation of engineering drawings and bill of materials. The project cost estimates are prepared for budget approval and sanction. Detailed Project Report (DPR) is mandatory for project approvals. The total cost of project Involves material cost, Operational cost and overhead charges. The entire cost of construction and the infrastructure used for the purpose of construction is estimated and the final costing is carried out on the basis of which a certain percentage of the project cost is paid to the architect and other consultants involved in the project. This course enables to estimate the quantities of item of works involved in buildings, water supply and sanitary works, road works and irrigation works, and also to equip the student with the ability to do rate analysis, Bar Bending Schedule (B.B.S), valuation of properties and preparation of reports for estimation of various items used in the civil engineering structures.

III MARKS DISTRIBUTION:

Subject	SEE Examination	CIE Examination	Total Marks
Estimation And Costing	70 Marks	30 Marks	100

IV DELIVERY / INSTRUCTIONAL METHODOLOGIES:

✓	PPT	✓	Chalk & Talk	✓	Assignments	x	MOOC
x	Open Ended Experiments	x	Seminars	x	Mini Project	x	Videos
x	Others						

V EVALUATION METHODOLOGY:

The course will be evaluated for a total of 100 marks, with 30 marks for Continuous Internal Assessment (CIA) and 70 marks for Semester End Examination (SEE). Out of 30 marks allotted for CIA during the semester, marks are awarded by taking average of two CIA examinations or the marks scored in the make-up examination.

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 14 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 Table: 1.

Percentage of Cognitive Level	Blooms Taxonomy Level
20%	Remember
40 %	Understand
40 %	Apply
20%	Analyze
0 %	Evaluate
0 %	Create

Continuous Internal Assessment (CIA):

CIA is conducted for a total of 30 marks, with 25 marks for Continuous Internal Examination (CIE) and 05 marks for Quiz \Alternative Assessment Tool (AAT).

Component	Theory		Total Marks
Type of Assessment	CIE Exam	Quiz \AAT	
CIA Marks	25	05	30

Continuous Internal Examination (CIE):

Two CIE exams shall be conducted at the end of the 8^{th} and 17^{th} week of the semester respectively. The CIE exam is conducted for 25 marks of 2 hours duration consisting of two parts. Part–A shall have five compulsory questions of one mark each. In part–B, four out of five questions have to be answered where, each question carries 5 marks. Marks are awarded by taking average of marks scored in two CIE exams.

Quiz - Online Examination

Two Quiz exams shall be online examination consisting of 25 multiple choice questions and are to be answered by choosing the correct answer from a given set of choices (commonly four). Such a question paper shall be useful in testing of knowledge, skills, application, analysis, evaluation and understanding of the students. Marks shall be awarded considering the average of two quiz examinations for every course.

Alternative Assessment Tool (AAT)

This AAT enables faculty to design own assessment patterns during the CIA. The AAT converts the classroom into an effective learning center. The AAT may include tutorial hours/classes, seminars, assignments, term paper, open ended experiments, METE (Modeling and Experimental Tools in Engineering), five minutes video, MOOCs etc. The AAT chosen for this course is given in table

Concept Video	Tech-talk	Complex Problem Solving
40%	40%	20%

VI COURSE OBJECTIVES:

The students will try to learn:

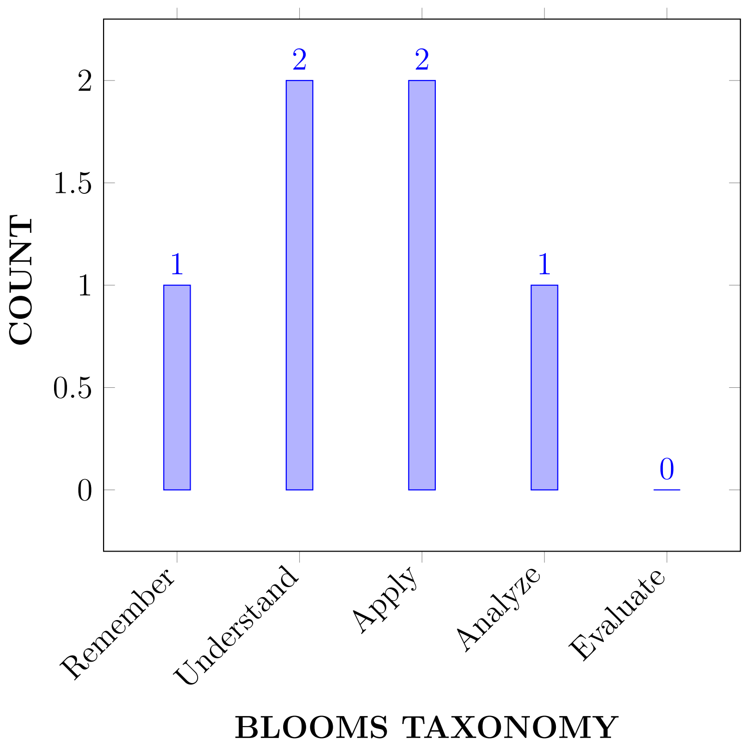
I	The importance and fundamentals of estimation and costing for measuring quantities of construction materials using traditional methods involved in project works.
II	The basic concept of earth work related to roads and canals for estimating earth work quantity using sectional area methods.
III	The concept of bar bending schedule and rate analysis applied for determining quantity of steel and construction costs.
IV	The knowledge of structural valuation, tender documentation and conditions of contract for obtaining required information to file a contract bid in real time.

VII COURSE OUTCOMES:

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

CO 1	**Choose** the stages involved in construction activites for estimating the quantities and cost incurred in the project.	Remember
CO 2	**Make use of** the mid sectional area and mean sectional area methods for determining earth work quantities of road and canal embankment .	Apply
CO 3	**Analyze** the quantities of materials of various components used in construction works such as beams, slabs, columns, and footings, as per specifications for preparation of Rate analysis	Analyze
CO 4	**Outline** the quantities of steel and concrete for preparing bar bending schedule, quantities of various elements of Reinforced cement concrete structures.	Understand
CO 5	**Identify** the use of contract documents, tender documents and specifications for preparation of bill of quantities and bidding details of the projects.	Apply
CO 6	**Classify** the different methods of valuation to asses the the actual value of the property.	Understand

COURSE KNOWLEDGE COMPETENCY LEVEL



VIII PROGRAM 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.

Program 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

IX HOW PROGRAM OUTCOMES ARE ASSESSED:

Program		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	1	CIE/SEE/AAT
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	3	CIE/SEE/AAT
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	CIE/SEE/AAT
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	1	CIE/SEE/AAT

3 = High; 2 = Medium; 1 = Low

X HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

Program		Strength	Proficiency Assessed by
PSO 1	Design and Supervise Sub-Structures and Super Structures for Residential and Public Buildings, Industrial Structures, Irrigation Structures, Power Houses, Highways, Railways, Airways, Docs and Harbours.	1	CIE/SEE/AAT
PSO 3	Make use of Advanced Structural Analysis and Project Management Software for creating Modern Avenues to succeed as an Entrepreneur, Pursue Higher Studies and Career Paths.	3	CIE/SEE/AAT

3 = High; 2 = Medium; 1 = Low

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

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	✓	✓	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 2	✓	✓	-	-	-	✓	-	-	-	-	-	-	-	-	-
CO 3	✓	-	-	-	✓	✓	-	-	-	-	-	-	✓	-	-
CO 4	✓	-	-	-	-	-	-	-	-	-	-	-	✓	-	-
CO 5	✓	✓	-	-	-	✓	-	-	-	-	-	-	✓	-	-
CO 6	✓	-	-	-	✓	-	-	-	-	-	-	✓	-	-	✓

XII 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 matched.
CO 1	PO 1	Identify the general items of works such as earth work excavation ,beams and columns in building and with specified standard units and applying the principles of **mathematical principles** and **engineering fundamentals**.	2
	PO 2	Choose the approximate and detailed estimation methods for the **information and data collection** of various quantities for brick work R.C.C. Retaining walls in the **documentation** purpose.	2
CO 2	PO 1	Apply the different methods like mid sectional area and mean sectional area for estimating the quantities of earth work for roads by using principles of **mathematical principles** and **engineering fundamentals**.	2

	PO 2	Identify problems related to design of road construction and canals for **development of solutions** and **documentation.**	2
	PO 6	Determining The road embankment and cutting of earth work quantities by using **Knowledge of commercial and economic context of engineering processes**	1
CO 3	PO 1	Apply **Mathematical principles** to calculate the quantities of rate analysis of **complex engineering problems.**	2
	PO 5	Apply appropriate techniques, resources, and **modern usage tool** to estimate the quantity of materials required for civil engineering works as per specifications	1
	PO 6	Determine overhead and contingent charges in rate analysis by using **Knowledge and understanding of commercial and economic context of engineering processes** and apply **Knowledge of management techniques to achieve engineering objectives**	2
	PSO 1	Design sub-structures and superstructures for buildings, industrial structures, irrigation structures, powerhouses, transportation infrastructures using **advanced tools** and **engineering fundamentals** develop bill of quantities, tender **documents** etc.	2
CO 4	PO 1	Estimate the quantities of steel and prepare bar bending schedule by using **mathematical principles** and **engineering fundamentals**.	2
	PSO 1	Design sub-structures and superstructures for buildings, industrial structures, irrigation structures, powerhouses, transportation infrastructures using **advanced tools** and **engineering fundamentals** develop bill of quantities, tender **documents** etc.	2
CO 5	PO 1	Estimate the quantities of steel and prepare bar bending schedule by using **mathematical principles** and **engineering fundamentals**.	2
	PO 2	Identify specifications and tendering process for contracts and create various tender **documents** for bidding purpose and apply **mathematics and science fundamentals** to prepare the contracts by considering the **Experimental design** to frame the documents	3
	PO 6	Create the Contract documents, types of contract and conditions of contract using **Awareness of the framework of relevant legal requirements governing engineering activities.**	1

	PSO 1	Design sub-structures and superstructures for buildings, industrial structures, irrigation structures, powerhouses, transportation infrastructures using **advanced tools** and **engineering fundamentals** develop bill of quantities, tender **documents** etc.	2
CO 6	PO 1	Distinguish valuation methods of buildings according to the client requirement for estimating the value of structures by using **Mathematical principles** and **Scientific principles and methodology.**	2
	PO 5	Create, select, and apply appropriate techniques, resources, and modern engineering valuation methods of buildings for estimating value of structures by using **modern usage tool**	1
	PO 12	Recognize the need and have sufficient preparation of quantity surveying methods for estimating any kind of civil structures using modern tools in field to enhance skill and additional efforts for future advancement and life long learning by using **advanced engineering concepts** and **new technology**	2
	PSO 3	Develop **new software** to provide **innovative solutions** in estimation and costing of projects by observing industry trends and needs which will be further useful.	2

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

XIV 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	20	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 2	66.6	20	-	-	-	20	-	-	-	-	-	-	-	-	-
CO 3	66.6	-	-	-	100	40	-	-	-	-	-	-	20	-	-

CO 4	66.6	-	-	-	-	-	-	-	-	-	-	-	-		-
CO 5	66.6	30	-	-	-	20	-	-	-	-	-	-	20	-	-
CO 6	66.6	-	-	-	100	-	-	-	-	-	-	25	-	-	66.6

XV COURSE ARTICULATION MATRIX (PO / PSO MAPPING):

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

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

1 - $5 < C \leq 40\%$ – Low/ Slight

2 - $40\ \% < C < 60\%$ –Moderate

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

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	3	1	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 2	3	1	-	-	-	1	-	-	-	-	-	-	-	-	-
CO 3	3	-	-	-	3	1	-	-	-	-	-	-	1	-	-
CO 4	3	-	-	-	-	-	-	-	-	-	-	-	-		-
CO 5	3	1	-	-	-	1	-	-	-	-	-	-	1	-	-
CO 6	3	-	-	-	3	-	-	-	-	-	-	1	-	-	3
TOTAL	18	3	-	-	6	3	-	-	-	-	-	1	2	-	3
AVERAGE	3.0	1.0	-	-	3.0	1.0	-	-	-	-	-	1.0	1.0	-	3.0

XVI ASSESSMENT METHODOLOGY DIRECT:

CIE Exams	✓	SEE Exams	✓	Seminars	-
Laboratory Practices	-	Student Viva	-	Certification	-
Term Paper	-	Concept Video	✓	Open Ended Experiments	-
Assignments	-	Tech talk	✓		

XVII ASSESSMENT METHODOLOGY INDIRECT:

	Assessment of mini projects by experts	✓	End Semester OBE Feedback

XVIII SYLLABUS:

UNIT - I	**GENERAL ITEMS OF WORK IN BUILDING**
	General items of work in building – Standard units principles of working out quantities for detailed and abstract estimates – Approximate method of estimating. Detailed estimates of buildings
UNIT - II	**EARTHWORKS**
	Earthwork for roads and canals.
UNIT - III	**RATE ANALYSIS**
	Rate analysis - Working out data for various items of work over head.Rate analysis - Contingent charges
UNIT - IV	**REINFORCEMENT BAR BENDING**
	Reinforcement bar bending and bar requirement schedules. Contracts – Types of contracts – Contract documents – Conditions of contract.
UNIT - V	**VALUATION**
	Valuation of buildings, standard specifications for different items of building construction.

TEXTBOOKS

1. B. N. Dutta, "Estimating and Costing", UBS publishers, 2000.
2. G. S. Birdie., "Estimating and Costing", Dhanpat Rai publications, 1988.

REFERENCE BOOKS:

1. Schedule of rates and standard data book by public works department, 2015.
2. I.S. 1200 (Parts I to XXV – 1974/method of measurement of building and Civil Engineering works – B.I.S)
3. M. Chakraborthi, "Estimation, costing and specifications", Laxmi publications, 1982.
4. National building code, 2015.

WEB REFERENCES:

1. https://en.wikipedia.org/wiki/estimating
2. www.nptel.ac.in/courses/105107122/home.htm
3. http://theconstructor.org/practical-guide/quality-control

COURSE WEB PAGE:

1. https://akanksha.iare.ac.in

XIX COURSE PLAN:

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

S.No	Topics to be covered	CO's	Reference T1, R1
OBE DISCUSSION			
1	Discussion on Outcome based education, Course Outcomes, Course Objectives		
CONTENT DELIVERY (THEORY)			
1	Introduction to General items of work in Building.	CO 1	T1: 1.1 -1.2, R1: 1.7
2	Principles of working out quantities.	CO 1	T1: 1.2-1.3, R3:2.7,2.9
3	Preparation of quantities for abstract estimate.	CO 1	T1: 1.4 R1:1.2, R2: 4.8
4	Preparation of quantities for detailed estimate.	CO 1	T1:1.5-1.6, R2: 4.3
5	Calculation of brick work of building with semi-circular portion	CO 1	T1:2.1-2.2
6	Unit of rate and mode of measurement based on IS- 1200	CO 1	T1:2.3-2.4
7	Long wall short wall method for a single room building.	CO 1	T1:2.5-2.6
8	Long wall short wall method for a Two room building& Residential building.	CO 1	T1:2.6.1-2.6.3, R3: 3.4
9	Centre line Method for a single room building.	CO 1	T1:2.7.1-2.7.2
10	Centre line Method for a two room building &Residential building.	CO 1	T1:2.7.3-2.7.4, R3: 5.1
11	Road Estimation cross section of typical road in Banking and Cutting.	CO 2	T1: 7.1-7.3, R1:2.4
12	Different Methods of Road Estimation	CO 2	T1: 7.4-7.6, R2: 2.2
13	Problems on Road Estimating, Problems related to Mid-sectional area method.	CO2	T1: 7.7, R3: 10.4
14	Problems on Road Estimating, Problems related to Mean Sectional area method.	CO 2	T1: 7.8
15	Problems on Road Estimating, Problems related to Prismoidal formula method.	CO2	T1: 7.9

16	Irrigation and Canal works, differentcases of canalsection and their cross section.	CO 2	T1: 9.1-9
17	Problems on Canal works- related to earthwork ofcanals for fully Excavation case.	CO 2	T1: 9.3
18	Problems on Canal works- related to earthwork ofcanals for Partly Excavation & Partly embankment case.	CO 2	T1: 9.4
19	Problems on Canal works- related to earthwork of canals for fully embankment case.	CO 2	T1:9.5-9.6, R1: 6.4
20	Rate analysis of material required for various items of work, rates of various quantities, material, labour.	CO 3	T1:11.1-11.2, R2: 9.15
21	Analysis of rates for Cement Concrete for different mix proportions.	CO 3	T1:11.7-11.8, R2: 7.10
22	Rate analysis - Contingent charges	CO 3	T1:11.9-11.9, R2: 10.11
23	Reinforcement bar bending schedule	CO 4	T2:13.1-13.2
24	Problems related to reinforcement bar bending.	CO 4	T2: 13.313.4
25	Problems related to bar bending schedule	CO 4	T2:17.117.2
26	Introduction to Contracting, contract document	CO 4	T2: 17.3
27	Different types of Contracts	CO 4	T2: 17.4, R2:7.8
28	Contract document- Security performance of contract, conditions of contract	CO 4	T2: 17.5-17.
29	Labour contract, negotiated contract. Contract document- Earnest money deposit & Security deposit.	CO 4	T1:15.5-15.6, R1:11.5
30	Conditions of Contract	CO 4	T1:15.5-15.6, R1:11.5
31	Types of tenders, Scrutinizing of tender, Accepting Tenders, Notice Inviting tender	CO 5	T1:15.7-15.8
32	Valuation of buildings- Sinking Fund, Deprecation, method of valuation.	CO 5	T1:15.7-15.9
33	Valuation of buildings- standard specification for different items of work	CO 6	T1:15.7-15.10, R1:13.2
34	Valuation of buildings, Mortgage lease, fixation of rent.	CO 6	T1:15.7-15.10

35	Valuation of buildings, Free hold & lease hold property.	CO 6	T1:15.7-15.10, R1:13.2
36	Valuation of buildings, Government buildings.	CO 6	T1:15.7-15.10, R1:13.2
37	Scrap value and salvage value	CO1 CO 6	T1:15.5-15.6, R1:11.5
38	Capital cost and Capitalized value	CO1 CO 6	T1:15.7-15.8
39	Obsolescence and Annuity, Year's purchase	CO 6	T1:15.7-15.9
40	Basic principles and methodology of Economics.	CO1 CO 6	T1:15.7-15.10, R1:13.2
41	Calculation of brick work of building with semi-circular portion	CO 1	T1: 1.1 -1.2, R1: 1.7
42	Calculation of brick work of building with semi-circular portion	CO 1	T1: 1.2-1.3, R3:2.7,2.9
43	Unit of rate and mode of measurement based on IS- 1200	CO 1	T1: 1.4 R1:1.2, R2: 4.8
44	Long wall short wall method for a single room building.	CO 2	T1:1.5-1.6, R2: 4.3
PROBLEM SOLVING/ CASE STUDIES			
1	Long wall short wall method for a Two room building & Residential building.	CO 2	T1:2.1-2.2
2	Centre line Method for a single room building.	CO 2	T1:2.3-2.4
3	Problems on Road Estimating, Problems related to Mid-sectional area method.	CO 2	T1:2.5-2.6
4	Problems on Road Estimating, Problems related to Mean Sectional area method.	CO 2	T1:2.7.3-2.7.4, R3: 5.1
5	Problems on Road Estimating, Problems related to Prismoidal formula method.	CO 2	T1: 7.1-7.3, R1:2.4
6	Problems on Canal works- related to earthwork of canals for fully Excavation case.	CO 3	T1: 7.4-7.6, R2: 2.2
7	Problems on Canal works- related to earthwork of canals for Partly Excavation & Partly embankment case.	CO 3	T1: 9.3

8	Calculate the rate analysis for I-Class Brick work in foundation and plinth with 20 x 10 x 10 cm (nominal size) bricks with cement sand mortar 1:6 per cum	CO 5	T1: 9.4
9	Calculate the rate analysis for Random rubble masonry in super structure in 1: 6 cement sand mortar per cum.	CO 5	T1:9.5-9.6, R1: 6.4
10	Calculate the rate analysis for 12mm Cement plastering in ceiling for 1:3 with coarse sand per cum.	CO 3	T1:11.1-11.2, R2: 9.15
11	Estimate the earthwork in canals c/s Partly in excavation and partly in embankment.	CO 2	T1:11.7-11.8, R2: 7.10
12	Reinforcement quantity estimation from bar bending schedule	CO 4	T1: 1.1 -1.2, R1: 1.7
13	Prepare a bar bending schedule for a RCC beam of 4 m. clear span, 300 mm width and 450mm depth. It consists of 2-12 mm dia hanger bars, 2-16mm dia main longitudinal bars and bent up bars at the bottom and Stirrups at a spacing of 180 mm c/c are provided though out the length of the beam. The clear cover to the reinforcement is 40 mm.	CO 4	T1: 7.4-7.6, R2: 2.2
12	Calculate the Valuation of Government buildings by Direct method of valuation	CO 6	T1:11.7-11.8, R2: 7.10
14	A pumping set with a motor has been installed in a building at a cost of Rs 2500. Assuming the life of the pump as 15 years, workout the amount of annual instalment of sinking fund required to be deposited to accumulate the whole amount of 4% compound interest.	CO 5	T2:13.1-13.2
15	A building is situated by the side of a main road of Lucknow city on a land of 500 sqm. The built-up potion in 20 m x15 m. The building is first class type & provided with water supply; sanitary, electric fittings & the age of building is 30 years. Work out the valuation of the property.	CO 1	T1:15.5-15.6, R1:11.5
DISCUSSION OF DEFINITION AND TERMINOLOGY			
1	General items of work in building – Standard units principles of working out quantities for detailed and abstract estimates – Approximate method of estimating. Detailed estimates of buildings	CO 1	T1:1.5, T2: 5.4, R3: 7.3
2	Earthwork for roads and canals.	CO 2	T1:4.5, T2: 5.4, R3: 7.2
3	Rate analysis - Working out data for various items of work over head.Rate analysis - Contingent charges.	CO 3	T1:4.5, T2: 5.4, R3: 7.3

4	Reinforcement bar bending and bar requirement schedules. Contracts – Types of contracts – Contract documents – Conditions of contract.	CO 4, 5	T1:4.5, T2: 5.4, R3: 7.3
5	Valuation of buildings, standard specifications for different items of building construction.	CO 6	T1:4.5, T2: 5.4, R3: 7.3
	DISCUSSION OF QUESTION BANK		
1	General items of work in building – Standard units principles of working out quantities for detailed and abstract estimates – Approximate method of estimating. Detailed estimates of buildings	CO 1	R4:2.1
2	Earthwork for roads and canals	CO 2	T4:7.3
3	Rate analysis - Working out data for various items of work over head.Rate analysis - Contingent charges.	CO 3	R4:5.1
4	Reinforcement bar bending and bar requirement schedules. Contracts – Types of contracts – Contract documents – Conditions of contract.	CO 4 ,5	T1:7.5
5	Valuation of buildings, standard specifications for different items of building construction.	CO 6	T1: 4.1

Signature of Course Coordinator **HOD, CE**
Mr. R. Suresh Kumar, Assistant Professor

INSTITUTE OF AERONAUTICAL ENGINEERING
(Autonomous)
Dundigal, Hyderabad - 500 043

COURSE DESCRIPTION

Department	**CIVIL ENGINEERING**				
Course Title	**GROUND IMPROVEMENT TECHNIQUES**				
Course Code	ACE509				
Program	B.Tech				
Semester	VII				
Course Type	Elective				
Regulation	R 16				
Course Structure	Theory			Practical	
	Lecture	Tutorials	Credits	Laboratory	Credits
	3	-	3	-	-
Course Coordinator	Mr S. SivaRamaKrishna, Assistant Professor				

I COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites
B.Tech	ACE006	IV	Geotechnical Engineering

II COURSE OVERVIEW:

This course deals with the engineering behavior of earth materials by using various soil testing methodologies to devise appropriate solution for the problematic soils. The soils at construction sites are not always totally suitable for supporting physical infrastructure such as buildings, bridges, highways, tunnels and dams. Under these conditions, soil needs to be treated using ground improvement techniques. This course discusses specific types of soil improvement techniques are required in the case of expansive soils and collapsible soil and in the case of earthquake prone areas.

III MARKS DISTRIBUTION:

Subject	SEE Examination	CIE Examination	Total Marks
Ground Improvement Techniques	70 Marks	30 Marks	100

IV CONTENT DELIVERY / INSTRUCTIONAL METHODOLOGIES:

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

V EVALUATION METHODOLOGY:

The course will be evaluated for a total of 100 marks, with 30 marks for Continuous Internal Assessment (CIA) and 70 marks for Semester End Examination (SEE). Out of 30 marks allotted for CIA during the semester, marks are awarded by taking average of two CIE examinations or the marks scored in the make-up examination.

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 14 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
15%	Remember
35%	Understand
50%	Apply
0%	Analyze

Continuous Internal Assessment (CIA):
CIA is conducted for a total of 30 marks, with 25 marks for Continuous Internal Examination (CIE) and 05 marks for Quiz \Alternative Assessment Tool (AAT).

Component	Theory		Total Marks
Type of Assessment	CIE Exam	Quiz \AAT	
CIA Marks	25	05	30

Continuous Internal Examination (CIE):
Two CIE exams shall be conducted at the end of the 8^{th} and 17^{th} week of the semester respectively. The CIE exam is conducted for 25 marks of 2 hours duration consisting of two parts. Part–A shall have five compulsory questions of one mark each. In part–B, four out of five questions have to be answered where, each question carries 5 marks. Marks are awarded by taking average of marks scored in two CIE exams.

Quiz - Online Examination
Two Quiz exams shall be online examination consisting of 25 multiple choice questions and are to be answered by choosing the correct answer from a given set of choices (commonly four). Such a question paper shall be useful in testing of knowledge, skills, application, analysis, evaluation and understanding of the students. Marks shall be awarded considering the average of two quiz examinations for every course.

Alternative Assessment Tool (AAT)
This AAT enables faculty to design own assessment patterns during the CIA. The AAT converts the classroom into an effective learning center. The AAT may include tutorial hours/classes, seminars, assignments, term paper, open ended experiments, METE (Modeling and Experimental Tools in Engineering), five minutes video, MOOCs etc. The AAT chosen for this course is given in table

Concept Video	Tech-talk	Complex Problem Solving
40%	40%	20%

VI COURSE OBJECTIVES:

The students will try to learn:

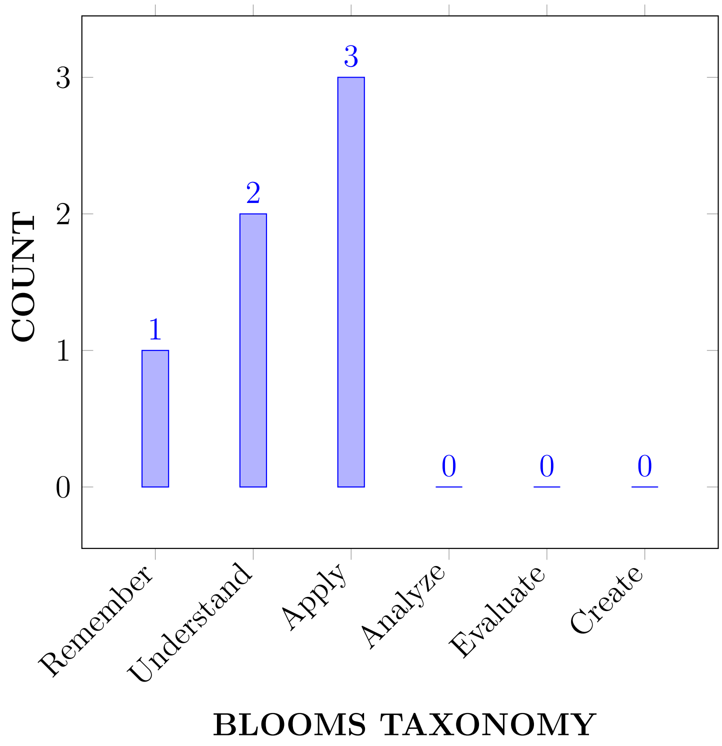
I	The importance and fundamentals of Ground improvement techniques for measuring field parameters by using traditional and modern methods involved in civil construction.
II	The mechanical methods and suitable equipment to proliferate the ground for making the soil to withstand all the loads acting on it.
III	The physical, chemical and hydraulic modification methods and its applications for strengthen the soil.
IV	The applications of modern methods in civil construction alteration works, short creating, soil reinforcement, soil nailing, bolting involved in inclusion and confinement process.

VII COURSE OUTCOMES:

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

CO 1	**Recall** the problems associated with existing ground conditions to propose a suitable method for ground improvement. .	Remember
CO 2	**Explain** the various methods of mechanical modification to increase the bearing capacity of soil.	Understand
CO 3	**Interpret** the existing ground condition for design of the dewatering systems to control the seepage of ground water..	Understand
CO 4	**Select** the appropriate geosynthetics to increase the bearing capacity of the subgrade soil.	Apply
CO 5	**Identify** the suitable grouting technique based on the in-situ evidences to prevent the foundation settlements.	Apply
CO 6	**Choose** the appropriate soil -reinforcement techniques to increase the stability of soils..	Apply

COURSE KNOWLEDGE COMPETENCY LEVEL



VIII PROGRAM 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 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.

Program Outcomes	
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

IX 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.	2	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.	3	CIE / SEE / AAT
PO 4	**Conduct Investigations of Complex Problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.	3	AAT

3 = High; 2 = Medium; 1 = Low

X HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

PROGRAM SPECIFIC OUTCOMES		Strength	Proficiency Assessed by
PSO 1	Design and supervise sub-structures and superstructures for residential and public buildings, industrial structures, irrigation structures, powerhouses, highways, railways, airways, docks and harbours.	3	CIE / SEE / AAT
PSO 2	Focus on Improving Performance of Structures with reference to Safety, Serviceability and Sustainable Green Building Technology.	2	CIE / SEE / AAT

3 = High; 2 = Medium; 1 = Low

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

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	✓	✓	-	-	-	-	-	-	-	-	-	-	✓	-	-
CO 2	✓	✓	-	✓	-	-	-	-	-	-	-	-	-	✓	-
CO 3	✓	✓	-	-	-	-	-	-	-	-	-	-	✓	-	-
CO 4	✓	✓	-	-	-	-	-	-	-	-	-	-	✓	-	-
CO 5	✓	✓	-	✓	-	-	-	-	-	-	-	-	-	✓	-
CO 6	✓	✓	-	-	-	-	-	-	-	-	-	-	-	-	-

XII 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 matched.
CO 1	PO 1	Recollect the basic concept of soil, and to an extent appreciate (understand) the importance of better load bearing soils and get to know major soils in India and its stability by **using science and engineering fundamentals**.	2
	PO 2	Analyse the properties of the soil and **identify** the problems related to design of engineered ground, stability characteristics in longitudinal/ lateral direction stresses acting on beneath soils by **using first principals engineering sciences.**	2
	PSO 1	Understand the various soils testing procedures used for determining engineering properties of soils with the help of **material knowledge, codes of practice.**	2
CO 2	PO 1	Analyze and formulate the engineering problems to determine exact field measurements to serve as a legal record. analyse and identify the problem statement and abstraction for the development of solution. And know the major problems with soils and the solution **using science and engineering fundamentals.**	2
	PO 2	Analyse the properties of soil based on the **data collected** and **implement the various techniques** by **interpreting the results.**	3
	PO 4	Examine the properties of soils by the knowledge of **codes of practice, industry standards and quality issues.**	3
	PSO 2	Examine the mechanical behavior of ground **to improve the performance** of structures by **enhancing safety and serviceability.**	2
CO 3	PO 1	Illustrate the various methods of dewatering systems to increase the bearing capacity of soils and apply the knowledge of science, engineering fundamentals.	2

Course Outcomes	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key competencies matched.
	PO 2	Choose the different methods of dewatering techniques for the soils depending upon the **data collected** and by **interpretation of results**.	2
	PSO 1	Understand the properties of the soils by conducting the **soil investigation and geological survey** procedures to design the dewatering systems such that there will be less **impact on environment**	3
CO 4	PO 1	Illustrate the various functions of geosynthetics to increase the drainage charcteristics of soils and apply the knowledge of science, engineering fundamentals.	2
	PO 2	Choose the different geosynthetics for the soils depending upon the **data collected** and by **interpretation of results**.	2
	PSO 1	Understand the properties of the soils by conducting the **soil investigation and geological survey** procedures to select the appropriate geosynthetic materials.	2
CO 5	PO 1	Identify the suitable method based on the ground requirement, analyze the characteristics of grout and increase the soil bearing capacity by **using science and engineering fundamentals.**	2
	PO 2	Classify the soils depending upon the **data collected** and **implement** the grouting techniques for the weak soils.	2
	PO 4	Understand the **use of technical literature** and other information related to the effects of soils on stability by conducting **synthesis of the information.**	2
	PSO 2	Extend the focus to understand the **innovative and dynamic challenges involve in** improving soils strength	1
CO 6	PO 1	Analyze different soil reinforcing techniques using **fundamentals of mathematics, science, and engineering fundamentals.**	2
	PO 2	Identify the different types of soils by **collecting the information** and **implement the solution** by **interpreting the results**	3

XIII 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	2	2	-	-	-	-	-	-	-	-	-	-	2	-	-
CO 2	2	3	-	3	-	-	-	-	-	-	-	-	-	2	-
CO 3	2	2	-	-	-	-	-	-	-	-	-	-	3	-	-
CO 4	2	2	-	-	-	-	-	-	-	-	-	-	2	-	-

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

XIV 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	67	20	-	-	-	-	-	-	-	-	-	-	20	-	-
CO 2	67	30	-	27	-	-	-	-	-	-	-	-	-	67	-
CO 3	67	20	-	-	-	-	-	-	-	-	-	-	30	-	-
CO 4	67	20	-	-	-	-	-	-	-	-	-	-	20	-	-
CO 5	67	20	-	18	-	-	-	-	-	-	-	-	-	33	-
CO 6	67	30	-	-	-	-	-	-	-	-	-	-	-	-	-

XV COURSE ARTICULATION MATRIX (PO / PSO MAPPING):

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

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

1 -5 $< C \leq 40\%$ – Low/ Slight

2 - 40 % $< C < 60\%$ –Moderate

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

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	2	2	-	-	-	-	-	-	-	-	-	-	2	-	-
CO 2	2	3	-	3	-	-	-	-	-	-	-	-	-	2	-
CO 3	2	2	-	-	-	-	-	-	-	-	-	-	3	-	-
CO 4	2	2	-	-	-	-	-	-	-	-	-	-	2	-	-
CO 5	2	2	-	2	-	-	-	-	-	-	-	-	-	1	-
CO 6	2	3	-	-	-	-	-	-	-	-	-	-	-	-	-
TOTAL	12	14		5									7	3	
AVERAGE	2	3		3									3		2

XVI ASSESSMENT METHODOLOGY-DIRECT:

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

XVII ASSESSMENT METHODOLOGY-INDIRECT:

	Assessment of mini projects by experts	✓	End Semester OBE Feedback

XVIII SYLLABUS:

UNIT-I	**INTRODUCTION TO GROUND MODIFICATION**
	Need and objectives, identification of soil types, in situ and laboratory tests to characterize problematic Soils, mechanical, hydraulic, physical, chemical, electrical, thermal methods and their applications.
UNIT-II	**MECHANICAL MODIFICATION**
	Deep compaction techniques, blasting, vibro compaction, dynamic tamping and compaction piles.
UNIT-III	**HYDRAULIC MODIFICATION**
	Objective and techniques, traditional dewatering methods and their choice, design of dewatering system, electro-osmosis, electro kinetic dewatering. Filtration, drainage and seepage control with geosynthetics, preloading the vertical drains.
UNIT-IV	**PHYSICAL AND CHEMICAL MODIFICATION**
	Modification by admixtures, shotcreting and guniting technology, modification at depth by grouting, crack grouting and compaction grouting. Jet grouting, thermal modification, ground freezing.
UNIT-V	**MODIFICATION BY INCLUSIONS AND CONFINEMENT**
	Soil reinforcement, reinforcement with strip, and grid reinforced soil. In-situ ground reinforcement, and ground anchors, rock bolting and soil nailing.

TEXTBOOKS

1. Hausmann, M.R "Engineering principles of Ground Modifications", Tata McGraw-Hill publications, 1990..
2. Pillai and Menon, "Reinforced Concrete Design", Tata McGraw-Hill Publishing Company, 2009.

REFERENCE BOOKS:

1. Koener, R.M, "Designing with Geosynthetics", Prentice Hall, New Jersey, 1994.
2. Jones C.J.P, "Earth Reinforcement and soil structures", Butterworths, London, 1985.

WEB REFERENCES:

1. https://nptel.ac.in/courses/105/106/105106050/
2. https://nptel.ac.in/courses/105/106/105106113/

COURSE WEB PAGE:

1. https://lms.iare.ac.in/index?route=course/details&course_id=221

XIX COURSE PLAN:

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

S.No	Topics to be covered	CO's	Reference T: R:
OBE DISCUSSION			
1	Course Objectives, Course Outcomes, Program Outcomes, CO-PO Mapping		
CONTENT DELIVERY (THEORY)			
2	Introduction to ground modification	CO 1	T1:11.1
3-4	Need and objectives of ground modification techniques.	CO 1	T1:11.4
5-6	Identification of soil types.	CO 2	T1:16.6
7-8	In Situ and laboratory tests to characterize problematic soils.	CO 3	T1:13.1
9-10	Mechanical, hydraulic, physic-chemical methods of ground Improvement techniques.	CO 4	R1:13.15
11	Electrical, Thermal methods, and their applications of groundModification.	CO 4	T1:13.3 R1:15.5
12	Introduction to mechanical modification	CO 4	T1:13.8
13-14	Analyzing Deep Compaction techniques	CO 4	T1:13.9
15-16	Blasting vibro- compaction	CO 4	T1:14.3
17-18	Objectives and techniques of hydraulic modification	CO 4	T1:15.9
19-20	Traditional dewatering methods and their choice	CO 4	T1:15.5
21-22	Design of dewatering system	CO 4	T1:15.6
23-24	Electro-osmosis technique.	CO 4	T1:15.8
25	Electro kinetic dewatering technique.	CO 4	T1:16.9
26	Filtration technique used in geo-synthetics.	CO 4	T1:16.5
27-28	Preloading the vertical drains.	CO 4	T1:16.3
29-30	Shotcreting and Guniting Technology.	CO 5	T1:17.22
31-32	Modification at depth by grouting.	CO 5	T1:17.22
33-34	Crack grouting and compaction grouting.	CO 5	T1:19.3
35-36	Jet grouting technique, Thermal modification, Ground freezing.	CO 6	T1:19.6.1
37-38	Modification by inclusions and confinement.	CO 6	R2:19.6.2
39-40	Soil reinforcement and grid reinforced soil.	CO 6	R2:21.6.2
41-42	Physical and Chemical Modification of admixtures.	CO 6	R2:22.6.3
43-44	Reinforced soils, grid soils	CO 6	T1:17.4
45-46	Rock bolting and soil nailing	CO 6	R2:17.2.1
PROBLEM SOLVING/ CASE STUDIES			
1	Identification of soil types	CO 3	T1: 5.1-5.4 R2: 5.1-5.5

2	In situ and laboratory tests	CO 3	T1: 6.1-6.8 R2: 6.1-6.4
3	Compaction factor test sieve analysis.	CO 3	T1: 7.1-7.6
4	Index properties tests.	CO 3	T1: 5.2; 6.2
5	Permeability tests	CO 3	T2: 6.3 R4: 10.6
6	Hydraulic methods	CO 3	T2: 6.3 R4: 10.7
7	Application of GIT methods	CO 3	T2: 6.2 R4: 10.3-10.5
8	Deep compaction techniques.	CO 5	T2: 14.7-14.8
9	Dynamic tamping.	CO 5	T2: 26.5-26.10 R4: 3 - 5
10	Compaction piles	CO 6	T3: 10.2-10.8
11	Electro-osmosis, electro kinetic dewatering	CO 6	T1: 14.1-14.3
12	Filtration, drainage and seepage control	CO 6	T2: 14.4-14.6
13	Types of geosynthetics-I.	CO 6	T2: 3.1-3.12 R1: 8.1-8.7
14	Application of GIT methods	CO 6	T3: 2.2-2.7 R2: 7.1-7.6
15	Thermal methods	CO 6	T3: 2.8-2.13 R2: 7.1-7.6
DISCUSSION OF DEFINITION AND TERMINOLOGY			
1	identification of soil types, in situ and laboratory tests to characterize problematic Soils, mechanical, hydraulic, physical, chemical, electrical, thermal methods and their applications	CO 1	T1: 5.1-5.4, 6.1-6.8, 7.1-7.6 R2: 5.1-5.5, 6.1-6.4
2	Deep compaction techniques, blasting, vibro compaction, dynamic tamping and compaction piles	CO 2	T1: 6.1-6.8 R2: 6.1-6.4
3	traditional dewatering methods and their choice, design of dewatering system, electro-osmosis, electro kinetic dewatering. Filtration, drainage and seepage control with geosynthetics, preloading the vertical drains.	CO 3, 4	T1: 10.2-10.8 T2:14.7-14.8 R2: 3 – 5
4	Modification by admixtures, shotcreting and guniting technology, modification at depth by grouting, crack grouting and compaction grouting. Jet grouting, thermal modification, ground freezing.	CO 5	T2: 10.2-10.8 T2: 14.1-14.3 T2: 14.4-14.6
5	Soil reinforcement, reinforcement with strip, and grid reinforced soil. In-situ ground reinforcement, and ground anchors, rock bolting and soil nailing.	CO 6	T3: 2.1-3.12 R4: 7.1-7.6, 8.1-8.7
DISCUSSION OF QUESTION BANK			
1	Introduction to Ground Modification	CO 1	T1: 5.1-5.4, 6.1-6.8, 7.1-7.6 R2: 5.1-5.5, 6.1-6.4

2	Mechanical Modification	CO 2	T1: 6.1-6.8 R2: 6.1-6.4
3	Hydraulic Modification	CO 3, 4	T2: 10.2-10.8
4	Physical and Chemical Modification	CO 5	T1: 10.2-10.8 T2: 14.1-14.3
5	Modification by Inclusions and Confinement	CO 6	T2: 2.1-3.12 R2: 7.1-7.6, 8.1-8.7

Signature of Course Coordinator **HOD,CE**
Mr S. SivaRamaKrishna, Assistant Professor

INSTITUTE OF AERONAUTICAL ENGINEERING
(Autonomous)
Dundigal, Hyderabad - 500 043
COURSE DESCRIPTION

Department	**CIVIL ENGINEERING**				
Course Title	ENERGY FROM WASTE				
Course Code	AEE551				
Program	B.Tech				
Semester	VII				
Course Type	Open Elective				
Regulation	IARE R-16				
Course Structure	Theory			Practical	
	Lecture	Tutorials	Credits	Laboratory	Credits
	3	-	3	-	-
Course Coordinator	Mr. Ch.Balakrishna, Assistant Professor				

I COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites
B.Tech	AHS005	I	Engineering Chemistry
B.Tech	AHS009	II	Environmental Studies

II COURSE OVERVIEW:

The course is designed to create environmental awareness and consciousness among the present generation to become environmental responsible citizens. The course will discuss on the municipal solid waste composition, characteristics and to improve the methods to minimize municipal solid waste generation. This course deals with methods of disposal of solid waste by thermal biochemical processes and production of energy from different types of waste sand to know the environmental impacts of all types of municipal waste. This course will discuss the overall scenario of E-Waste management in India in comparison with other countries around the globe. This course will deals with E-waste legislation and government regulations on E-waste management.

III MARKS DISTRIBUTION:

Subject	SEE Examination	CIE Examination	Total Marks
Energy From Waste	70 Marks	30 Marks	100

IV DELIVERY / INSTRUCTIONAL METHODOLOGIES:

✓	PPT	✓	Chalk & Talk	✓	Assignments	x	MOOC
x	Open Ended Experiments	x	Seminars	x	Mini Project	✓	Videos
x	Others						

V EVALUATION METHODOLOGY:

The course will be evaluated for a total of 100 marks, with 30 marks for Continuous Internal Assessment (CIA) and 70 marks for Semester End Examination (SEE). Out of 30 marks allotted for CIA during the semester, marks are awarded by taking average of two CIE examinations or the marks scored in the make-up examination.

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 14 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
20%	Remember
60%	Understand
20%	Apply
0%	Analyze
0%	Evaluate

Continuous Internal Assessment (CIA):
CIA is conducted for a total of 30 marks, with 25 marks for Continuous Internal Examination (CIE) and 05 marks for Quiz \Alternative Assessment Tool (AAT).

Component	Theory		Total Marks
Type of Assessment	CIE Exam	Quiz \AAT	
CIA Marks	25	05	30

Continuous Internal Examination (CIE):
Two CIE exams shall be conducted at the end of the 8^{th} and 17^{th} week of the semester respectively. The CIE exam is conducted for 25 marks of 2 hours duration consisting of two parts. Part–A shall have five compulsory questions of one mark each. In part–B, four out of five questions have to be answered where, each question carries 5 marks. Marks are awarded by taking average of marks scored in two CIE exams.

Quiz - Online Examination
Two Quiz exams shall be online examination consisting of 25 multiple choice questions and are to be answered by choosing the correct answer from a given set of choices (commonly four). Such a question paper shall be useful in testing of knowledge, skills, application, analysis, evaluation and understanding of the students. Marks shall be awarded considering the average of two quiz examinations for every course.

Alternative Assessment Tool (AAT)
This AAT enables faculty to design own assessment patterns during the CIA. The AAT converts the classroom into an effective learning center. The AAT may include tutorial hours/classes, seminars, assignments, term paper, open ended experiments, METE (Modeling and Experimental Tools in Engineering), five minutes video, MOOCs etc. The AAT chosen for this course is given in table

Concept Video	Tech-talk	Open Ended Experiment
40%	40%	20%

VI COURSE OBJECTIVES:

The students will try to learn:

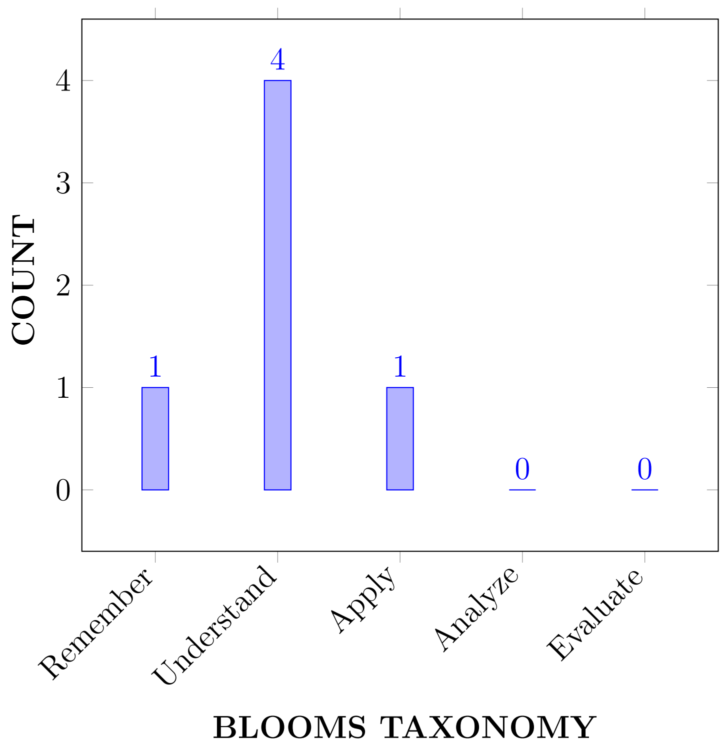
I	The principles of solid waste management in reducing and eliminating dangerous impacts of waste materials on human health and the environment to contribute economic development and superior quality of life.
II	The insight of the design and operations of a municipal solid waste landfill by collection, transfer and transportation of municipal solid waste for the final disposal.
III	The main operational challenges in operating thermal and biochemical energy from waste facilities and device processes involved in recovering energy from wastes.
IV	The scenario of E-Waste management in India and other countries around the globe and assess the impact of electronic waste on human, environment and society by informal recycling and management. The sustainable solution of E-Waste Management can be achieved by adopting modern techniques and Life-Cycle Analysis approach.

VII COURSE OUTCOMES:

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

CO 1	**Identify** the different sources, types of solid waste by the properties of municipal solid waste for segregation and collection of waste.	Remember
CO 2	**Understand** the Composition, characteristics of leachate and preliminary design considerations of landfill to control the emission of gases and monitoring the movement of landfill leachate.	Understand
CO 3	**Outline** the Biochemical conversion of biomass for energy generation by anaerobic digestion of solid waste.	Understand
CO 4	**Illustrate** the thermo-chemical conversion of solid waste by using Gasification and pyrolysisprocess for energy generation.	Understand
CO 5	**Identify** the need to stringent health safeguards and environmental protection laws of India for the effective disposal of E-waste.	Apply
CO 6	**Interpret** the global scenario of environmental concerns and health hazards by the generation of E- waste.	Understand

COURSE KNOWLEDGE COMPETENCY LEVEL



VIII PROGRAM OUTCOMES:

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

Program Outcomes	
PO 7	**Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO 8	**Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO 9	**Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO 10	**Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO 11	**Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO 12	**Life-Long Learning:** Recognize the need for and having the preparation and ability to engage in independent and life-long learning in the broadest context of technological change

IX HOW PROGRAM OUTCOMES ARE ASSESSED:

Program		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 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	CIE/SEE/AAT
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	CIE/SEE/AAT
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.	3	CIE/Quiz/AAT

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.	1	CIE/SEE/AAT

3 = High; 2 = Medium; 1 = Low

X HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

Program		**Strength**	**Proficiency Assessed by**
PSO 2	Focus on Improving Performance of Structures with reference to Safety, Serviceability and Sustainable Green Building Technology.	3	CIE/SEE/AAT

3 = High; 2 = Medium; 1 = Low

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

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	✓	-	✓	-	-	✓	✓	-	-	-	-		-	-	-
CO 2	-	-	✓	-	-	✓	-	-	-	-	-	-	-	-	-
CO 3	✓	-	-	-	-	✓	✓	-	-	-	-	-	-	✓	-
CO 4	✓	-	✓	-	-	-	✓	-	-	-	-		-	-	-
CO 5	-	-	-	-	-	✓	-	-	-	-	-	✓	-	✓	-
CO 6	-	-	-	-	-	✓	-	-	-	-	-	✓	-	-	-

XII 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 matched.**
CO 1	PO 1	Apply the **Scientific principles** for energy generation by applying different technologies from waste management plants.	1
	PO 3	Identify the **constraints including environmental health and safety and risk assessment issues** of different methods of disposal of municipal solid waste by aerobic composting **to promote sustainable development.**	2
	PO 6	Apply the **knowledge of management techniques** by understanding the **requirement for engineering activities**of municipal solid waste for the **sustainable development**.	3
	PO 7	Interpret the discarding of solid waste and their impact on **socio economic, environment** is considered and energy generation activities by aerobic composting of waste.	2

Course Outcomes	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key competencies matched.
CO 2	PO 3	Identify **constraints including environmental and sustainability limitations, health and safety and risk assessment issues** for environmental monitoring system of land fill gases and composition of leachate and **Understanding commercial and economic context** of managing the land fill site	2
	PO 6	Understand the characteristics, generation and movement of leachate in landfills by the **management techniques** which uses for controlling the emission of gases in landfills **to promote sustainable development**	2
CO 3	PO 1	Explain the **Scientific principles** for Energy generation from waste bio-chemical conversion and **to integrate / support the engineering disciplines**	2
	PO 6	Apply the knowledge in planning and operations of waste to Energy plants **for sustainable development** by following **legal legislation** related to solid waste management for **high level of professional and ethical values.**	3
	PO 7	Identify the sources of energy generation by anaerobic digestion of sewage and municipal waste for **socio economic solutions** and direct combustion of municipal solid waste for environmental solutions.	2
	PSO 2	Identify the Energy generation processes from waste by bio-chemical conversion and help in **Sustainable** development and **Safety** of the public life.	2
CO 4	PO 1	Illustrate the methods of pyrolysis process by understanding **Scientific principles and methodology** and apply to **integrate / support study of their own engineering discipline** for solving environmental problems	2
	PO 3	Interpret thermo-chemical conversion sources of energy generation, gasification of waste and **identify constraints including environmental and sustainability limitations**	2
	PO 7	Understand the environmental benefits by using thermo-chemical process will decrease the emission of harmful gases and will attain **Environmental sustainability.**	1
CO 5	PO 6	Define the global scenario of environmental concerns by the increase in the generation of E-waste worldwide causing the **personnel, health, safety, and risk (including environmental risk) issues** and the problem can solved by imposing strong legal regulation for disposing of E-waste and help in **sustainable development**	2

Course Outcomes	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key competencies matched.
	PO 12	List out the health hazards by the generation of E-waste and their impact on environment will be solved by the proper management and formal disposal of E-waste and this can be achieved by long term learning process in **Professional certifications, advanced degree** for developing advanced technologies in recycling of E-waste.	2
	PSO 2	Apply strong environmental protection laws in India for the effective disposal of E-waste and constraints including environmental and **sustainability** development and while recycling the E-waste and problem including production, operation, maintenance and disposal with proper **safety**	2
CO 6	PO 6	Define the global scenario of environmental concerns by the increase in the generation of E-waste worldwide causing the **personnel, health, safety, and risk (including environmental risk) issues** and the problem can solved by imposing strong legal regulation for disposing of E-waste and help in **sustainable development**	2
	PO 12	List out the health hazards by the generation of E-waste and their impact on environment will be solved by the proper management and formal disposal of E-waste and this can be achieved by long term learning process in **Professional certifications, advanced degree** for developing advanced technologies in recycling of E-waste.	2

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

XIV PERCENTAGE OF KEY COMPETENCIES FOR CO – PO/ PSO

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	33.3	-	20.0	-	-	60.0	66.6	-	-	-	-	-	-	-	-
CO 2	-	-	20.0	-	-	40.0	-	-	-	-	-	-	-	-	-
CO 3	66.6	-	-	-	-	60.0	66.6	-	-	-	-	-	-	66.6	-
CO 4	66.6	-	20.0	-	-	-	33.3	-	-	-	-	-	-	-	-
CO 5	-	-	-	-	-	40.0	-	-	-	-	-	25	-	66.6	-
CO 6	-	-	-	-	-	40.0	-	-	-	-	-	25	-	-	-

XV COURSE ARTICULATION MATRIX (PO / PSO MAPPING):

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

0 - $0 \leq$ C$\leq$ 5% – No correlation
1 -5 <C$\leq$ 40% – Low/ Slight
2 - 40 % <C < 60% –Moderate
3 - 60% $\leq$ C < 100% – Substantial /High

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	1	-	1	-	-	2	3	-	-	-	-		-	-	-
CO 2	-	-	1	-	-	1	-	-	-	-	-	-	-	-	-
CO 3	3	-	-	-	-	2	3	-	-	-	-	-	-	3	-
CO 4	3	-	1	-	-	-	1	-	-	-	-		-	-	-
CO 5	3	-	-	-	-	1	3	-	-	-	-	1	-	3	-
CO 6	-	-	-	-	-	1	-	-	-	-	-	1	-	-	-
TOTAL	10	-	3	-	-	7	10	-	-	-	-	2	-	6	-
AVERAGE	3.0	-	1.0	-	-	1.0	3.0	-	-	-	-	1.0	-	3.0	

XVI ASSESSMENT METHODOLOGY DIRECT:

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

XVII ASSESSMENT METHODOLOGY INDIRECT:

	Assessment of mini projects by experts	✓	End Semester OBE Feedback

XVIII SYLLABUS:

UNIT - I	**INTRODUCTION TO WASTE AND WASTE PROCESSING**
	Solid waste sources solid waste sources, types, composition, properties, global warming; Municipal solid waste: Physical, chemical and biological properties, waste collection and, transfer stations, waste minimization and recycling of municipal waste, segregation of waste, size reduction, managing waste, status of technologies for generation of energy from waste treatment and disposal aerobic composting, incineration, furnace type and design, medical waste / pharmaceutical waste treatment technologies, incineration, environmental impacts, measures to mitigate environmental effects due to incineration
UNIT - II	**WASTE TREATMENT AND DISPOSAL**
	Land fill method of solid waste disposal land fill classification, types, methods and sitting consideration; Layout and preliminary design of landfills: Composition, characteristics, generation, movement and control of landfill leachate and gases, environmental monitoring system for land fill gases.
UNIT - III	**BIO-CHEMICAL CONVERSION**
	Energy generation from waste bio-chemical conversion: Sources of energy generation, anaerobic digestion of sewage and municipal waste, direct combustion of MSW-refuse derived solid fuel. Industrial waste, agro residues and anaerobic digestion.
UNIT - IV	**THERMO-CHEMICAL CONVERSION**
	Biogas production, land fill gas generation and utilization, thermo-chemical conversion: Sources of energy generation, gasification of waste using gasifies briquetting, utilization and advantages of briquetting, environmental benefits of bio-chemical and thermo-chemical conversion
UNIT - V	**E-WASTE MANAGEMENT**
	E-waste: E-waste in the global context: Growth of electrical and electronics industry in India, environmental concerns and health hazards; Recycling e-waste: A thriving economy of the unorganized sector, global trade in hazardous waste, impact of hazardous e-waste in India; Management of e-waste: E-waste legislation, government regulations on e-waste management, international experience, need for stringent health safeguards and environmental protection laws of India.

TEXTBOOKS

1. Nicholas P Cheremisinoff, —Handbook of Solid Waste Management and Waste Minimization Technologie, An Imprint of Elsevier, New Delhi, 2003.
2. P AarneVesilind, William A Worrell and Debra R Reinhart, —Solid Waste Engineering, 2 nd edition 2002.

3. M Dutta , B P Parida, B K Guha and T R Surkrishnan, —Industrial Solid Waste Management and Landfilling practice, Reprint Edition New Delhi, 1999.

4. RajyaSabha Secretariat, —E-waste in India: Research unit, Reprint Edition, June, 2011.

REFERENCE BOOKS:

1. C Parker and T Roberts (Ed), —Energy from Waste, An Evaluation of Conversion Technologies, Elsevier Applied Science, London, 1985.

2. KL Shah,"Basics of Solid and Hazardous Waste Management Technology", Prentice Hall, Reprint Edition, 2000.

3. M Datta, —"Waste Disposal in Engineered Landfill", Narosa Publishing House, 1997.

WEB REFERENCES:

1. https://nptel.ac.in/courses/112105171/1

COURSE WEB PAGE:

1. https://akanksha.iare.ac.in

XIX COURSE PLAN:

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

S.No	Topics to be covered	CO's	Reference T1: 4.1
OBE DISCUSSION			
	Outcome Based Education, CO PO attainment and Blooms Taxonomy		
CONTENT DELIVERY (THEORY)			
1	Sources of Municipal Solid waste	CO 1	T1:3.3, T2:1.2, R2: 2.2
2	Types of Municipal Solid waste	CO 1	T1:3.4, T2:1.4
3	Composition of Municipal Solid waste	CO 1	T1:3.5, R2:1.5
4	Effects of Global warming	CO 1	T1:3.7, R2:1.8
5	Segregation of waste, size reduction and managing waste	CO 1	T1: 3.9, R3: 1.10
6	Waste collection and transfer stations	CO 1	T1:5.5, T2:6.2, R3:4.8
7	Waste minimization and recycling of municipal waste	CO 1	T1:5.6, T2:6.3, R3:7.5
8	Properties of Municipal solid waste	CO 1	T1:4.3, T2:5.2, R2: 5.7

9	Incineration, furnace type and design	CO 1	T1: 4.4, R1:3.3
10	Measures to mitigate environmental effects due to incineration	CO 1	T1:4.5, T2: 5.4, R3: 7.3
11	Land fill methods and disposal of solid waste	CO 2	T1:4.6, T2:5.5
12	land fill classification	CO 2	T1: 4.5.2, T2: 5.6
13	Landfill sitting consideration	CO 2	T1:4.6, T2:5.5
14	Layout and preliminary design of landfills	CO 2	T1:4.6.2, T2:5.5.2
15	Characteristics and composition of landfill	CO 2	T1:4.7, T2:5.6
16	Movement and control of landfill leachate and gases	CO 2	T1:4.7, T2:5.8
17	Environmental monitoring system for land fill gases	CO 2	T1:4.7.2, T2:5.8.2
18	Energy generation from waste by bio-chemical conversion	CO 3	T1:4.8, T2:5.9
19	Sources of energy generation from bio solid waste	CO 3	T1:4.9, T2:5.7
20	Anaerobic digestion of sewage and municipal waste	CO 3	T1:6.2, T2:5.6
21	Direct combustion of MSW-refuse derived solid fuel	CO 3	T1:6.3, T2:5.7
22	Industrial waste, agro residues and anaerobic digestion	CO 3	T1:6.4, T2:5.8
23	Biogas production	CO 3	T1:6.5, T2:5.3
24	land fill gas generation and utilization	CO 3	T1:6..6, T2:5.2
25	Thermo-chemical conversion	CO 4	T1:6.7, T2:5.3
26	Sources of energy generation	CO 4	T1:6.5, T2:7.5
27	Gasification of waste using gasifies briquetting	CO 4	T1: 6.2, R2:7.9
28	Utilization and advantages of briquetting	CO 4	T1: 6.2
29	Environmental benefits of bio-chemical	CO 4	T1:6.2, T2:7.2
30	E-waste in the global context	CO 5	T1:6.3, T2:7.3

31	Growth of electrical and electronics industry in India	CO 5	T1:6.4, T2:7.5
32	Environmental concerns and health hazards	CO 5	T1: 6.2, T2: 5.6
33	Recycling e-waste	CO 5	T1:6.3, T2: 5.7
34	A thriving economy of the unorganized sector and global trade in hazardous waste	CO 5	T1:6.4, T2:5.8
35	Impact of hazardous e-waste in India	CO 5	T1:2.1, T2:9.1
36	Management of e-waste	CO 5	T1:2.2, T2:9.2
37	E-waste legislation	CO 5	T1: 2.1, R2: 9.1
38	Government regulations on e-waste management	CO 5	T1:2.6, R1:5.1
39	International experience in management of e-waste	CO 6	T1:2.7, R1:5.2
40	Need for stringent health safeguards and environmental protection laws of India.	CO 6	T1:2.8, R1:5.5
41	Summarize government regulations on E-waste management	CO 6	T1:2.1, R1:5.6
42	Outline international E-waste management and the guidelines imposed for formal disposal	CO 6	T1:2.2, R1:5.4
43	Explain the need for stringent health safeguards of human health and their effects	CO 6	T1:2.4,R1:5
44	Discuss the need for environmental protection laws and	CO 6	T1:2.4, R1:5.5
45	Outline environmental protection laws of India with respect to E-waste management.	CO 6	T1:2.4, R1:5.5
PROBLEM SOLVING/ CASE STUDIES			
1	Explain different Types of Municipal Solid waste	CO 1	T1:3.3, T2:1.2, R2: 2.2
2	Explain the Composition of Municipal Solid waste	CO 1	T1:3.4, T2:1.4
3	Effects of Global warming	CO 1	T1:3.5,R2:1.5
4	Illustrate the importance of Land fill classification	CO 2	T1:4.5, T2: 5.4, R3: 7.3
5	Landfill sitting consideration	CO 2	T1:4.6, T2:5.5
6	Layout and preliminary design of landfills	CO 2	T1: 4.5.2, T2: 5.6

7	Anaerobic digestion of sewage and municipal waste	CO 3	T1:4.6, T2:5.5
8	Direct combustion of MSW-refuse derived solid fuel	CO 3	T1:4.6.2, T2:5.5.2
9	Industrial waste, agro residues and anaerobic digestion	CO 3	T1:4.7, T2:5.6
10	Explain the Thermo-chemical conversion	CO 4	T1:4.7, T2:5.8
11	E-waste in the global context	CO 5	T1:4.7.2, T2:5.8.2
12	Growth of electrical and electronics industry in India	CO 5	T1:4.7.2, T2:5.8.2
13	E-waste legislation	CO 5	T1:4.8, T2:5.9
14	Government regulations on e-waste management	CO 6	T1:4.9, T2:5.7
15	International experience in management of e-waste	CO 6	T1:6.3, T2: 5.7
DISCUSSION OF DEFINITION AND TERMINOLOGY			
1	Solid waste sources solid waste sources, types, composition, properties, Municipal solid waste: Physical, chemical and biological properties, waste collection and, transfer stations, waste minimization and recycling of municipal waste, environmental impacts, measures to mitigate environmental effects due to incineration	CO 1	T1:1.5, T2: 5.4, R3: 7.3
2	Land fill method of solid waste, classification, types, methods and sitting consideration; Layout and preliminary design of landfills: Composition, characteristics, generation, movement and control of landfill leachate and gases, environmental monitoring system for land fill gases.	CO 2	T1:4.5, T2: 5.4, R3: 7.2
3	Energy generation from waste bio-chemical conversion: Sources of energy generation, anaerobic digestion of sewage and municipal waste, direct combustion of MSW-refuse derived solid fuel. Industrial waste, agro residues and anaerobic digestion.	CO 3	T1:4.5, T2: 5.4, R3: 7.3
4	Biogas production, land fill gas generation and utilization, thermo-chemical conversion:gasification of waste using gasifies briquetting, utilization and advantages of briquetting, environmental benefits of bio-chemical and thermo- chemical conversion	CO 4	T1:4.5, T2: 5.4, R3: 7.3

5	E-waste in the global context: Growth of electrical and electronics industry in India, environmental concerns and health hazards; global trade in hazardous waste, Management of e-waste, legislation, government regulations on e-waste management, international experience and environmental protection laws of India	CO 5	T1:4.5, T2: 5.4, R3: 7.3
DISCUSSION OF QUESTION BANK			
1	Introduction to Waste and Waste Processing	CO 1	T1:3.3, T2:1.2, R2: 2.2
2	Waste Treatment and Disposal	CO 2	T 1.4:7.3
3	Bio-Chemical Conversion	CO 3	T1:6.2, T2:5.6
4	Thermo-Chemical Conversion	CO 4	T1:6.7, T2:5.3
5	E-Waste Management	CO 5, CO 6	T1:2.4, R1:5.5

Signature of Course Coordinator **HOD, CE**
Mr. CH. Balakrishna, Assistant Professor

INSTITUTE OF AERONAUTICAL ENGINEERING
(Autonomous)
Dundigal, Hyderabad - 500 043

CIVIL ENGINEERING
COURSE DESCRIPTION

Course Title	**ENVIRONMENTAL ENGINEERING LABORATORY**				
Course Code	ACE112				
Program	B.Tech				
Semester	VII	CE			
Course Type	CORE				
Regulation	IARE - R16				
Course Structure	Theory			Practical	
	Lecture	Tutorials	Credits	Laboratory	Credits
	-	-	-	3	2
Course Coordinator	Mr. K Lokesh, Assistant Professor				

I COURSE OVERVIEW:
The Environmental Engineering laboratory has gained significance in determining the physical and chemical properties of water along with its suitability as drinking water as per the Bureau of Indian Standards. This laboratory focuses on developing processes to improve the natural and built sustainable environment for all living beings.

II COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites
UG	ACE015	VII	Environmental Engineering

III COURSE OVERVIEW:
The Environmental Engineering laboratory has gained significance in determining the physical and chemical properties of water along with its suitability as drinking water as per the Bureau of Indian Standards. This laboratory focuses on developing processes to improve the natural and built sustainable environment for all living beings.

IV MARKS DISTRIBUTION:

Subject	SEE Examination	CIE Examination	Total Marks
Environmental Engineering Laboratory	70 Marks	30 Marks	100

V DELIVERY / INSTRUCTIONAL METHODOLOGIES:

✓	Demo Video	✓	Lab Worksheets	✓	Viva Questions	✓	Probing further Questions

VI EVALUATION METHODOLOGY:
Each laboratory will be evaluated for a total of 100 marks consisting of 30 marks forinternal assessment and 70 marks for semester end lab examination. Out of 30 marks ofinternal assessment, continuous lab assessment will be done for 20 marks for the day today performance and 10 marks for the final internal lab assessment.

Semester End Examination (SEE): The semester end labexamination for 70 marks shall be conducted by two examiners, one of them beingInternal Examiner and the other being External Examiner, both nominated by thePrincipal from the panel of experts recommended by Chairman, BOS. The emphasis on the experiments is broadly based on the following criteria given in Table: 1

	Experiment Based	Programming based
20 %	Objective	Purpose
20 %	Analysis	Algorithm
20 %	Design	Programme
20 %	Conclusion	Conclusion
20 %	Viva	Viva

Continuous Internal Assessment (CIA):

CIA is conducted for a total of 30 marks (Table 1), with 20 marks for continuous lab assessment during day to day performance, 10 marks for final internal lab assessment.

Component			Total Marks
Type of Assessment	**Day to day performance**	**Final internal lab assessment**	
CIA Marks	20	10	30

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.

1. **Experiment Based**

Objective	Analysis	Design	Conclusion	Viva	Total
2	2	2	2	2	10

2. **Programming Based**

Objective	Analysis	Design	Conclusion	Viva	Total
-	-	-	-	-	-

VII COURSE OBJECTIVES:

The students will try to learn:

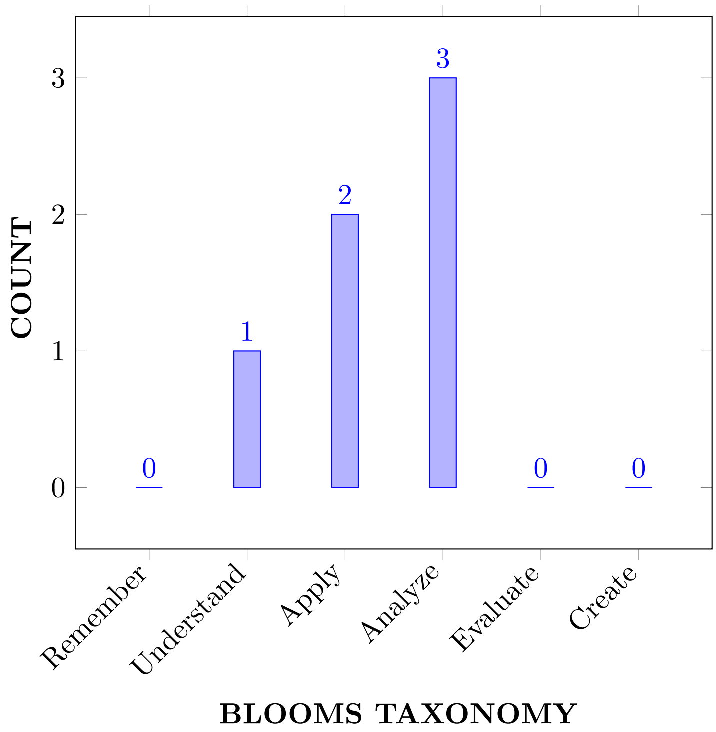
I	Investigate the different characteristics of water & wastewater.
II	Outline the procedure for preparations of stock and standard solutions, their handling, storage, etc.
III	Assess the suitability of water for drinking, irrigation purpose and concreting works
IV	Determine the BOD, COD and bacterial density of portable water.

VIII COURSE OUTCOMES:

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

CO 1	**Demonstrate** the physical and chemical parameters of water and its suitability for drinking purposes and building construction.	Understand
CO 2	**Measure** the turbidity and conductivity of water for presence of suspended particles	Apply
CO 3	**Determine** the pH, alkalinity and acidity in water to check the presence of sufficient amount of alkalines and acids	Apply
CO 4	**Determine** the water for presence of chlorides, Iron, Nitrates and Phosphorous which induces salinity, color and toxicity.	Analyze
CO 5	**Determine** the optimum dosage of coagulant to remove impurities in the flocculation process	Analyze
CO 6	**Determine** dissolved oxygen content, BOD and COD in water for the survival of aquatic animals and amount of pollutants.	Analyze

COURSE KNOWLEDGE COMPETENCY LEVEL



IX HOW PROGRAM OUTCOMES ARE ASSESSED:

Program		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	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	1	LAB Exercises
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 Exercises
PO 7	**Life-long learning:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development	3	SEE

3 = High; 2 = Medium; 1 = Low

X HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

Program		Strength	Proficiency Assessed by
PSO 2	Broadness and Diversity: Graduates will have a broad understanding of economic, environmental, societal, health and safety factors involved in infrastructural development, and shall demonstrate ability to function within multidisciplinary teams with competence in modern tool usage.	1	LAB Exercises

3 = High; 2 = Medium; 1 = Low

XI 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	Acquaint with Engineering Knowledge on water quality standards in relation to public health safety	1
	PO 3	Provide safe water in promoting health and reducing societal poverty	2
CO 2	PO 1	The knowledge of Environmental Engineering fundamentals are used to estimate transparency of water and design treatment system including distribution systems.	1

	PO 6	Make use of Experimental tools for amounts of impurities will lead to a higher conductivity	1
CO 3	PO 1	Acquaint the knowledge of water treatment methods thoroughly, to produce specific water quality suitable for good public health	1
	PO 6	Assess the degree or level of water got treated during treatment of wastewater to judge health, safety, and cultural issues	3
	PSO 2	Develop safe infrastructure for mineral processing waste and contamination monitoring.	2
CO 4	PO 3	Applying the knowledge to design components for the public health .	2
	PSO 2	Apply the knowledge of functional behaviour of the system for designing a test cases for designing solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public safety	2
CO 5	PSO 2	Make use of source and Experimental tools in municipal water treatment for health factors	2
	PO 7	Demonstrate the knowledge of examination of water and waste water which has been contaminated for sustainable development	2
CO 6	PO 3	Design solutions for water treatment that meets the specified needs for the cultural, societal, environment, public health and safety	2
	PO 1	Engineering skills are required in maintenance of distribution system components and equipment affected by pollutants.	2
	PO 7	Engineering Demonstrate the sustainable development of environment by reducing pollutant contents	2

XII MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

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

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

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO 1	33.3	-	20	-	-	-	-	-	-	-	-	-	-	-	-
CO 2	33.3	-	-	-	-	40	-	-	-	-	-	-	-	-	-
CO 3	33.3	-	-	-	-	60	-	-	-	-	-	-	-	20	-
CO 4	-	-	20	-	-	-	-	-	-	-	-	-	-	20	-
CO 5	-	-	-	-	-	-	66.7	-	-	-	-	-	-	20	-
CO 6	66.7	-	20	-	-	-	66.7	-	-	-	-	-	-	-	-

XIV COURSE ARTICULATION MATRIX (PO – PSO MAPPING):

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

0 - $0 \leq C \leq 5\%$ – No correlation
1-5 $< C \leq 40\%$ – Low/ Slight
2 - $40\ \% < C < 60\%$ –Moderate
3 - $60\% \leq C < 100\%$ – Substantial /High

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO 1	1	-	1	-	-	-	-	-	-	-	-	-	-	-	-
CO 2	1	-	-	-	-	1	-	-	-	-	-	-	-	-	-
CO 3	1	-	-	-	-	2	-	-	-	-	-	-	-	1	-
CO 4	-	-	1	-	-	-	-	-	-	-	-	-	-	1	-
CO 5	-	-	-	-	-	-	3	-	-	-	-	-	-	1	-
CO 6	2	-	1	-	-	-	3	-	-	-	-	-	-	-	-
TOTAL	5	-	3	-	-	3	6	-	-	-	-	-	-	3	-
AVERAGE	1.25	-	1	-	-	1.5	3	-	-	-	-	-	-	1	-

XV ASSESSMENT METHODOLOGY DIRECT:

CIE Exams	-	SEE Exams	Assignments	Seminars	-
Laboratory Practices	-	Student Viva	Mini Project	Certification	-

XVI ASSESSMENT METHODOLOGY INDIRECT:

✓	Early Semester Feedback	✓	End Semester OBE Feedback
X	Assessment of Mini Projects by Experts		

XVII SYLLABUS:

WEEK I	INTRODUCTION TO ENVIRONMENTAL ENGINEERING LABORATORY DETERMINATION OF PH AND TURBIDITY
	Introduction to environmental engineering. Do's and Don'ts in the lab. Batch I: To determine the pH of given samples using universal indicator, pH paper and digital pH meter Batch II: Determination of turbidity of the given sample using nephelometer in NTU.
WEEK II	**DETERMINATION OF PH AND TURBIDITY**
	Batch I: Determination of turbidity of the given sample using nephelometer in NTU. Batch II: To determine the pH of given samples using universal indicator, pH paper and digital pH meter
WEEK III	**DETERMINATION OF CONDUCTIVITY AND TOTAL DISSOLVED SOLIDS (ORGANIC AND INORGANIC)**
	Batch I: Determining the electrical conductivity of the given water sample. Batch II: Determination of total dissolved solids of the sample.
WEEK IV	**DETERMINATION OF CONDUCTIVITY AND TOTAL DISSOLVED SOLIDS (ORGANIC AND INORGANIC)**
	Batch I: Determination of total dissolved solids of the sample. Batch II: Determining the electrical conductivity of the given water sample
WEEK V	DETERMINATION OF ALKALINITY, ACIDITY OF WATER AND CHLORIDE AND IRON IN WATER
	Batch I: Determining the amount of alkalinity present in the given samples anddetermine the acidity of the given sample of water. Batch II: Determine the quantity of iron present in the given sample of water and determining the amount of chloride present in the given water sample by Mohr‘s method.
WEEK VI	DETERMINATION OF ALKALINITY,ACIDITY OF WATER AND CHLORIDE AND IRON IN WATER
	Batch I: Determine the quantity of iron present in the given sample of water and determining the amount of chloride present in the given water sample by Mohr‘s method. Batch II: Determining the amount of alkalinity present in the given samples and determine the acidity of the given sample of water.
WEEK VII	**DETERMINATION OF DISSOLVED OXYGEN AND NITRATES IN WATER**
	Batch I: Determine the nitrate nitrogen of the given sample of water. Batch II: Determine the quantity of dissolved oxygen present in the given sample(s) by using modified Winkler‘s (Azide modification) method.
WEEK VIII	**DETERMINATION OF DISSOLVED OXYGEN AND NITRATES IN WATER**
	Batch I: Determine the quantity of dissolved oxygen present in the given sample(s) by using modified Winkler‘s (azide modification) method Batch II: Determine the nitrate nitrogen of the given sample of water.

WEEK IX	**DETERMINATION OF OPTIMUM DOSE OF COAGULANT AND CHLORINE DEMAND**
	Batch I: Determining the optimum coagulant dosage for clarifying the given sample of water by using alum as the coagulant and performing the jar test experiment. Batch II : Determining the chlorine demand
WEEK X	**DETERMINATION OF OPTIMUM DOSE OF COAGULANT AND CHLORINE DEMAND**
	Batch I : Determining the chlorine demand Batch II: Determining the optimum coagulant dosage for clarifying the given sample of water by using alum as the coagulant and performing the jar test experiment.
WEEK XI	**DETERMINATION OF TOTAL PHOSPHORUS AND B.O.D.**
	Batch I: Determining the amount of B.O.D. exerted by the given sample Batch II: Determining the total phosphorus.
WEEK XII	**DETERMINATION OF TOTAL PHOSPHORUS AND B.O.D.**
	Batch I: Determining the total phosphorus Batch II: Determining the amount of B.O.D. exerted by the given sample.
WEEK XIII	**DETERMINATION OF C.O.D IN WATER .**
	Batch I: Determining the amount of C.O.D. exerted by the given sample Batch II: Determining the amount of C.O.D. exerted by the given sample.

TEXTBOOKS

1. G. Rich, —Environmental Systems Engineering‖, Tata McGraw-Hill, 1973.
2. Fair, Geyer, Okum, — Water and Wastewater Engineering: Water Supply and Wastewater Removal, John Wiley & Sons Canada, Limited, 3rd Edition, 2010.

REFERENCE BOOKS:

1. IS 3025 (Part 15)- 1984: Method of Sampling and Test (Physical and Chemical) for Water and Wastewater : Total Residue (total Solids, Dissolved and Suspended, First Revision.
2. E.D. Schrocder, —Water and Waste Treatment‖, Tata McGraw-Hill Education, 1977

XVIII 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	Determination of pH	CO 1,CO 3	T1:1.4,R1:1.2
2	Determination of turbidity	CO 1,CO 2	T1:1.5,R1:1.3
3	Determination of Conductivity	CO 2,CO 4	T2:12.2, R2:13.1
4	Determination of Total Dissolved Dolids	CO 3,CO 4	T2:12.3,R2:13
5	Determination of Alkalinity and Acidity of water	CO 3,CO 4	T1:9.1,R2:3
6	Determination of Chloride and Iron in Water	CO 3,CO 4	T1:9.1,R2:3
7	Determination of Dissolved Oxygen	CO 2 CO 4	T2:1.9, R2:1.8
8	Determination of Nitrates in Water	CO 2 CO 4	T2:2, R2:1.9
9	Determination of Optimum Dose of Coagulant	CO 4 CO 5	T2:1.4, R1:1.2

10	Determination of Chlorine Demand	CO 4 CO 5	T2:1.7, R2:1.3
11	Determination of Total Phosphrous	CO 4 CO 5	T1:1.4, R1:1.
12	Determination of B.O.D	CO 5 CO 6	T1:7.1, R2:3.8
13	Determination of C.O.D	CO 5 CO 6	T1:8.1, R2:1.8

XIX EXPERIMENTS FOR ENHANCED LEARNING (EEL):

S.No	Design Oriented Experiments
1	Evaluate the chemical water quality of a local pond,
2	Conduct tests to evaluate coagulant dose for settling
3	Groundwater contamination and remediation
4	Water and air quality sensors and modeling

Signature of Course Coordinator **HOD, CE**
Mr. K Lokesh, Assistant Professor

INSTITUTE OF AERONAUTICAL ENGINEERING
(Autonomous)
Dundigal, Hyderabad - 500 043
COURSE DESCRIPTION

Department	CIVIL ENGINEERING				
Course Title	ADVANCED STRUCTRAL DESIGN LABORTARY				
Course Code	ACE113				
Program	B.Tech				
Semester	VII	CE			
Course Type	CORE				
Regulation	R16				
Course Structure	Theory			Practical	
	Lecture	Tutorials	Credits	Laboratory	Credits
	-	-	-	3	2
Course Coordinator	Mr S. SivaRamaKrishna, Assistant Professor				

I COURSE OVERVIEW:

STAAD.Pro is one of the most widely used structural analysis and design software products worldwide. It supports over 90 international steel, concrete, timber and aluminium design codes. It can make use of various forms of analysis from the traditional static analysis to more recent analysis methods like p-delta analysis, geometric non-linear analysis, Pushover analysis (Static-Non Linear Analysis) or a buckling analysis. It can also make use of various forms of dynamic analysis methods from time history analysis to response spectrum analysis. The response spectrum analysis feature is supported for both user defined spectra as well as a number of international code specified spectra.

II COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites
B.Tech	ACE008	V	Structural Analysis

III MARKS DISTRIBUTION:

Subject	SEE Examination	CIE Examination	Total Marks
Adavnced Structural Design Lab	70 Marks	30 Marks	100

IV DELIVERY / INSTRUCTIONAL METHODOLOGIES:

✓	Demo Video	✓	Lab Worksheets	✓	Viva Questions	✓	Probing further Questions

V EVALUATION METHODOLOGY:

Each laboratory will be evaluated for a total of 100 marks consisting of 30 marks for b internal assessment and 70 marks for semester end lab examination. Out of 30 marks ofinternal assessment, continuous lab assessment will be done for 20 marks for the day today performance and 10 marks for the final internal lab assessment.

Semester End Examination (SEE): The semester end labexamination for 70 marks shall be conducted by two examiners, one of them beingInternal Examiner and the other being External Examiner, both nominated by thePrincipal from the panel of experts recommended by Chairman, BOS. The emphasis on the experiments is broadly based on the following criteria given in Table: 1

	Experiment Based	Programming based
20 %	Objective	Purpose
20 %	Analysis	Algorithm
20 %	Design	Programme
20 %	Conclusion	Conclusion
20 %	Viva	Viva

Continuous Internal Assessment (CIA):

CIA is conducted for a total of 30 marks (Table 1), with 20 marks for continuous lab assessment during day to day performance, 10 marks for final internal lab assessment.

Component			Total Marks
Type of Assessment	**Day to day performance**	**Final internal lab assessment**	
CIA Marks	20	10	30

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.

1. **Experiment Based**

Objective	Analysis	Design	Conclusion	Viva	Total
2	2	2	2	2	10

2. **Programming Based**

Objective	Analysis	Design	Conclusion	Viva	Total
2	2	2	2	2	10

VI COURSE OBJECTIVES:

The students will try to learn:

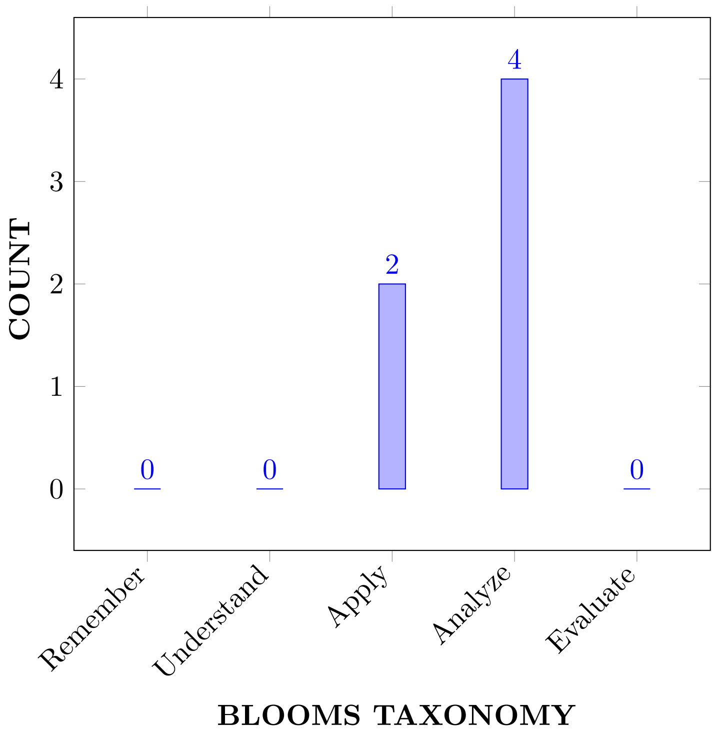
I	The basic elements with different loading types and supports with the aid of STAAD Pro software.
II	The analysis and design of 2D Frame and multi-storey buildings with different load sets.
III	The synthesize steel structures with truss elements subjected to lateral load.
IV	The Modeling and analysis of bridge truss and deck slab for moving loads.

VII COURSE OUTCOMES:

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

CO 1	**Analyze** continues beam, Single and Multistoried frame structures for maximum shear force, bending moment due to vertical loads and Gravity loads	Analyze
CO 2	**Design** of beam, slab, column for multistoried Buildings	Analyze
CO 3	**Analyze** Reinforced Concrete Structures for Horizontal load.	Apply
CO 4	**Design** of tension members, compression members and connections for Trusses used in industrial structures and workshop sheds.	Analyze
CO 5	**Design** of Isolated and Combined Footings for reinforced Concrete Structures and Steel Structures.	Analyze
CO 6	**Analyze** the bridge Deck for maximum Shear forces and bending moments due to vertical and Horizontal loads.	Apply

COURSE KNOWLEDGE COMPETENCY LEVEL



VIII HOW PROGRAM OUTCOMES ARE ASSESSED:

Program		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.	2	Lab Exercises
PO 2	**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	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 modelling to complex Engineering activities with an understanding of the limitations	1	Lab Exercises

3 = High; 2 = Medium; 1 = Low

IX HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

Program		Strength	Proficiency Assessed by
PSO 1	Design and Supervise Sub-Structures and Super Structures for Residential and Public Buildings, Industrial Structures, Irrigation Structures, Power Houses, Highways, Railways, Airways, Docs and Harbours	1	Lab Exercises

3 = High; 2 = Medium; 1 = Low

X JUSTIFICATIONS FOR CO – (PO, PSO) MAPPING -DIRECT:

COURSE OUTCOMES	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key Competencies
CO 1	PO 1	Recall (knowledge) the different beam generally come across in design, and calculate tension by applying the principles of **mathematics and engineering fundamentals.**	2

	PO 2	Understand the given **problem statement** of structural members related to young's modulus from the provided **information and data** in reaching substantiated solutions by the **interpretation of results.**	3
	PO 5	Make use of **modern engineering tools** for calculation of tension in members.	1
	PSO 1	Select the appropriate method for the analysis of structures using **Safety** and **serviceability of structure** for different loads for the design purpose.	2
CO 2	PO 1	Understand the different components in the engineering structures (multistoried structures and bridges) and its behavior by **using mathematics and engineering fundamentals.**	2
	PO 2	Analyse the flat slabs and deep foundations for critical load combinations to know the design forces using the structural analysis concepts **formulate** and **state a problem,** and **develop solution** and **document the results.**	4
	PO 3	Design of flat slabs and deep foundations includes **Investigate problems** associated with these structures in site locations and **define problems and identify constraints including environmental and sustainability limitations, safety assessment**issues.	5
	PSO 1	Understand the design of flat slabs and deep foundations based on Indian standards using **mathematical principles; engineering knowledge and document the results to support** their applications in next-level courses of the program	4
CO 3	PO 1	Understand the different components in the engineering structures (multistoried structures and bridges) and its behavior by **using mathematics and engineering fundamentals.**	2
	PO 2	Analyse structures for critical wind load combinations to know the design forces using the structural analysis concepts, **formulate and state a problem, and develop solution and document the results**	4
	PO 5	Analysis of RCC structures by the use of modern engineering and IT tools including prediction and modeling to complex engineering activities with an **understanding of the limitations**	1
CO 4	PO 1	Understand the different components in the engineering structures (multistoried structures and bridges) and its behavior by **using mathematics and engineering fundamentals.**	2
	PO 2	Analyze steel specimen for the concept of sudden load acting on a specimen using Izod and Charpy test by **formulate** and **state a problem,** and **develop solution** and **document the results.**	4

	PO 3	Design of trusses includes **Investigate problems** associated with these structures in site locations and **define problems define problems and identify constraints including environmental and sustainability limitations, safety assessment issues**	5
	PO 5	Use of **Modern tools** in the design of steel by the concept of sudden loading in steel specimen.	1
	PSO 1	Understand the design of trusses and deep foundations based on Indian standards using **mathematical principles; engineering knowledge and document the results to support their applications in next-level courses** of the program (own engineering discipline).	4
CO 5	PO 1	Understand the different components in the engineering structures (multistoried structures and bridges) and its behavior by **using mathematics and engineering fundamentals.**	2
	PO 5	Design of trusses by the Use of modern engineering and IT tools including prediction and modeling to complex engineering activities with an **understanding of the limitations**	1
CO 6	PO 1	Make use of advanced methods of analysis for solving engineering problems related to structures by applying the principles of **engineering fundamentals** and their **integration and support with other engineering disciplines, mathematics.**	2
	PO 2	Analyze the structures for critical load combinations to know the design forces using the structural analysis concepts, **formulate and state a problem, and develop solution and document the results**	4
	PO 3	Design of civil engineering structures includes **Investigate problems** associated with these structures in site locations and **define problems define problems and identify constraints including environmental and sustainability limitations, safety assessment issues**	5

XI MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

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

XII ASSESSMENT METHODOLOGY DIRECT:

CIE Exams	✓	SEE Exams	✓	Seminars	-
Laboratory Practices	✓	Student Viva	✓	Certification	-
Assignments	-				

XIII ASSESSMENT METHODOLOGY INDIRECT:

	Assessment of Mini Projects by Experts	✓	End Semester OBE Feedback

XIV SYLLABUS:

WEEK I	**INTRODUCTION TO STAAD PRO**
	Basic commands used in STAAD Pro
WEEK II	**ANALYSIS OF CONTINUOUS BEAM**
	Analysis of continuous beam using STAAD Pro.
WEEK III	**ANALYSIS OF SINGLE STOREY FRAME**
	Analysis of single storey frame
WEEK IV	**ANALYSIS OF MULTI-STOREY FRAME**
	Analysis of multi-storey frame.
WEEK V	**DESIGN OF MULTI-STOREY FRAME**
	Design of multi-storey frame design.
WEEK VI	**ANALYSIS OF MULTI-STOREYED BUILDING**
	Determine the stiffness of the spring and the Modulus of rigidity of wire material.
WEEK VII	**DESIGN OF MULTI-STOREYED BUILDING**
	Design of multi-storeyed building
WEEK VIII	**WIND LOAD ANALYSIS ON RCC BUILDING**
	Wind load analysis on RCC building.
WEEK IX	**ANALYSIS AND DESIGN OF STEEL TRUSS**
	Analysis and design of steel truss.
WEEK X	**ANALYSIS AND DESIGN OF ISOLATED FOOTING**
	Analysis and design of isolated footing
WEEK XI	**ANALYSIS AND DESIGN OF COMBINED FOOTING**
	Analysis and design of combined footing.
WEEK XII	**ANALYSIS OF BRIDGE DECK**
	Analysis of bridge deck slab.
WEEK XIII	**REVISION**
	Spare session for additional repetitions and review.

TEXTBOOKS

1. R. S Kurmi, Gupta, “Strength of Materials”, S. Chand, 24th Edition, 2005.
2. Gere, Timoshenko, “Mechanics of Materials”, McGraw Hill, 3rd Edition, 1993.
3. William Nash, “Strength of Materials”, Tata McGraw Hill, 4th Edition, 2004.

REFERENCE BOOKS:

1. Strength of Materials by R. Subramanian, Oxford University Press, New Delhi.
2. Mechanics of Materials - Ferdinand P. Beer, E. RusselJhonston Jr., John T. DEwolf – TMH 2002.

XV 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	Introduction to Staad Pro	CO 1	T2:2.3
2	Analysis of Continuous Beam.	CO 1	R1:2.6
3	Analysis of Single Storey Frame	CO 2	T1:2.6
4	Analysis of Multi-Storey Frame.	CO 2	T2:2.7 R1:2.18
5	Design of Multi-Storey Frame.	CO 3	T2:2.22
6	Analysis of Multi-Storeyed Building	CO 3	T2:2.25
7	Design of Multi-Storeyed Building.	CO 5	T2:2.26 R1:2.55
8	Wind Load Analysis on Rcc Building.	CO 4	T2:2.3
9	Analysis and Design of Steel Truss	CO 5	R1:2.6
10	Analysis and Design of Isolated Footing.	CO 5	T1:2.6
11	Analysis and Design of Combined Footing.	CO 6	R1:7.2
12	Analysis of Bridge Deck.	CO 6	R1:7.2
13	Spare session for additional repetitions and review.	CO 1 to CO 6	R1:7.3

XVI EXPERIMENTS FOR ENHANCED LEARNING (EEL):

S.No	Design Oriented Experiments
1	Design of Cantilever Beams
2	Design of Grid and Flat Slabs.
3	Design of Steel Framed Structures

Signature of Course Coordinator **HOD,CE**
Mr. S SivaRamaKrishna, Assistant Professor

INSTITUTE OF AERONAUTICAL ENGINEERING
(Autonomous)
Dundigal, Hyderabad - 500 043

CIVIL ENGINEERING

COURSE DESCRIPTION

Course Title	**PROJECT PLANNING AND DEVELOPMENT LABORATORY**				
Course Code	ACE114				
Program	B.Tech				
Semester	VII	CE			
Course Type	Core				
Regulation	IARE - R16				
Course Structure	Theory			Practical	
	Lecture	Tutorials	Credits	Laboratory	Credits
	-	-	-	3	2
Course Coordinator	Mr. Ch. Balakrishna, Assistant Professor				

I COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites
B.Tech	ACE007	IV	Building Materials Construction and Planning

II COURSE OVERVIEW:

Project planning involves a series of steps that determine how to achieve a particular community or organizational goal or set of related goals. A project charter provides a brief description of the project scope, quality, time, cost, and resource constraints as described during project planning. Tender documents may be prepared for a range of contracts, such as equipment supply, the main construction contract including design by the contractor, demolition, enabling works. Valuation is the technique of estimation or determining the fair price or value of property such as building, a factory, other engineering structures of various types, land etc.

III MARKS DISTRIBUTION:

Subject	SEE Examination	CIE Examination	Total Marks
Project Planning and Development laboratory	70 Marks	30 Marks	100

IV DELIVERY / INSTRUCTIONAL METHODOLOGIES:

✓	Demo Video	✓	Lab Worksheets	✓	Viva Questions	✓	Probing further Questions

V EVALUATION METHODOLOGY:

Each laboratory will be evaluated for a total of 100 marks consisting of 30 marks forinternal assessment and 70 marks for semester end lab examination. Out of 30 marks ofinternal assessment, continuous lab assessment will be done for 20 marks for the day today performance and 10 marks for the final internal lab assessment.

Semester End Examination (SEE): The semester end labexamination for 70 marks shall be conducted by two examiners, one of them beingInternal Examiner and the other being External Examiner, both nominated by thePrincipal from the panel of experts recommended by Chairman, BOS. The emphasis on the experiments is broadly based on the following criteria given in Table: 1

	Experiment Based	Programming based
20 %	Objective	Purpose
20 %	Analysis	Algorithm
20 %	Design	Programme
20 %	Conclusion	Conclusion
20 %	Viva	Viva

Continuous Internal Assessment (CIA):

CIA is conducted for a total of 30 marks (Table 1), with 20 marks for continuous lab assessment during day to day performance, 10 marks for final internal lab assessment.

Component			Total Marks
Type of Assessment	**Day to day performance**	**Final internal lab assessment**	
CIA Marks	20	10	30

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.

1. **Experiment Based**

Objective	Analysis	Design	Conclusion	Viva	Total
2	2	2	2	2	10

2. **Programming Based**

Objective	Analysis	Design	Conclusion	Viva	Total
-	-	-	-	-	-

VI COURSE OBJECTIVES:

The students will try to learn:

I	The concepts of the construction techniques, equipment, project feasibility and project planning through site visits.

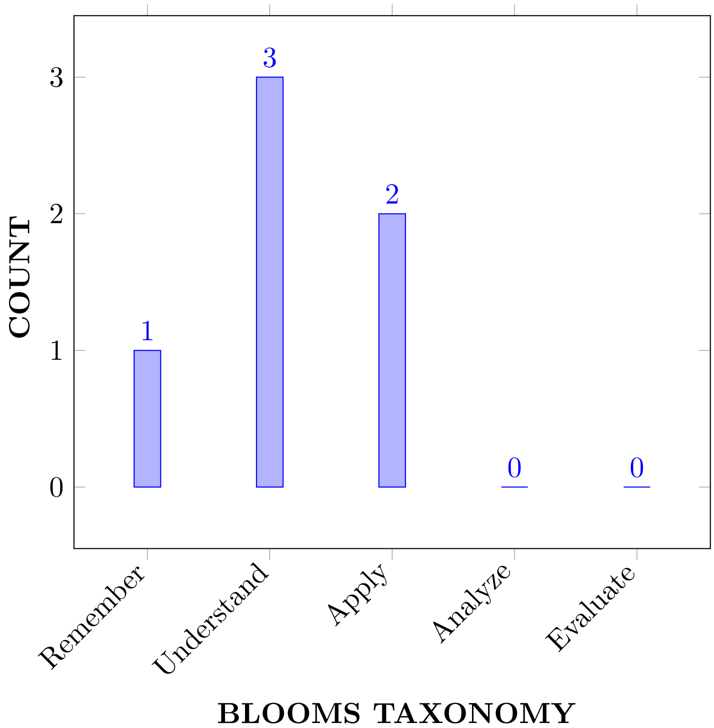
II	The work flow of construction activities and cash flow analysis by CPM models.
III	The feasibility aspects, billing procedures and accounting system of civil structures.
IV	The process of tendering, bidding and valuation for a project.

VII COURSE OUTCOMES:

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

CO 1	**Classify** the planning, scheduling and controlling of construction activities for the successful completion of project.	Understand
CO 2	**Identify** the construction activities of the project in a sequential order to complete the task without any delay.	Apply
CO 3	**Make use of** network analysis of construction activities and optimize resources by using bar chart, CPM networks.	Apply
CO 4	**Explain** the cost, financial accounting systems and cost accounts of project by creating cash flows analysis.	Understand
CO 5	**Demonstrate** the tendering procedures, accounting system and billing procedures by visiting an on-going major construction work.	Understand
CO 6	**Select** the procedure of valuation of land and building by using various methods like Rental Method of Valuation and Direct Comparisons of the capital value.	Remember

COURSE KNOWLEDGE COMPETENCY LEVEL



VIII HOW PROGRAM OUTCOMES ARE ASSESSED:

Program		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	Lab Exercises
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	3	Lab Exercises
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	Videos
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	Videos

3 = High; 2 = Medium; 1 = Low

IX HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

Program		Strength	Proficiency Assessed by
PSO 3	Make use of Advanced Structural Analysis and Project Management Software for creating Modern Avenues to succeed as an Entrepreneur, Pursue Higher Studies and Career Paths.	3	Lab Exercises

3 = High; 2 = Medium; 1 = Low

X 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 the planning and scheduling by the **Scientific principles and methodology** and **Mathematical principles**to complete the project.	2
	PO 5	Identify the different construction activities of project and plan the resources **computer software** and schedule the activities to avoid the delays.	1

	PO 10	Communicate effectively with different departments regarding **subject matter** and in formal **style** to finish the work in time.	2
	PSO 3	Make use of advanced tools in **project management** for planning, scheduling and help to become **entrepreneurs** by using advanced software in resources planning to **fulfill user needs.**	3
CO 2	PO 1	Apply the knowledge of Engineering fundamentals of construction activities of a project in a sequential order and follow the **methodology** and discussing with **other engineering disciplines to integrate / support** each other to complete the work without any delays.	2
	PO 10	Communicate effectively on complex Engineering activities in a project with different departments in formal **style** and write the reports with **clarity** so others also will be able to understand.	2
	PO 11	Understand the Engineering and management principles in construction, the activities in a project are divided into **work breakdown structure** and **schedule** the resources according to **budget** available and maintain the **quality** in construction.	4
CO 3	PO 5	Apply appropriate techniques and use **computer software** in resources scheduling.	1
	PO 11	Understand the Engineering and management principles to optimize the **human resources** and with good **communication** skills with clarity can help to complete the work.	2
CO 4	PO 11	Understand the Engineering and management principles for cost analysis and financial accounting by proper utilization of **budget** and to maintain the **quality** for **deliver** the project .	3
	PSO 3	Make use of advanced **project management software** for creating modern avenues to succeed as an **entrepreneur.**	2
CO 5	PO 1	Understand the tendering procedures, accounting system and billing procedures by visiting an on-going major construction work by the **Scientific principles and methodology** and **Mathematical principles** to complete the project.	2
	PO 10	Communicate effectively with different departments regarding **subject matter** and in formal **style** to finish the work in time.	2
CO 6	PO 1	Apply the knowledge of Engineering fundamentals and follow procedure of valuation of land and building by using the **methodology**and discussing with **other engineering disciplines to integrate / support** each other to complete the work without any delays.	2

	PO 11	Select the procedure of valuation of land and building by **communicating** with different departments using Rental Method of Valuation and Direct Comparisons of the capital value and to complete the valuation within **budget**.	2

XI MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

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

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

COURSE OUTCOMES	**PROGRAM OUTCOMES**												**PSO'S**		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO 1	66.7	0.0	0.0	0.0	100	0.0	0.0	0.0	0.0	40.0	0.0	0.0	0.0	0.0	100
CO 2	66.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	40.0	33.3	0.0	0.0	0.0	0.0
CO 3	0.0	0.0	0.0	0.0	100	0.0	0.0	0.0	0.0	0.0	16.6	0.0	0.0	0.0	0.0
CO 4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	25.0	0.0	0.0	0.0	66.6
CO 5	66.7	0.0	0.0	0.0	0.0	0.0	0	0.0	0.0	40.0	0.0	0.0	0.0	0.0	0.0
CO 6	66.7	0.0	0.0	0.0	0.0	0.0	0	0.0	0.0	0.0	16.6	0.0	0.0	0.0	66.6

XIII COURSE ARTICULATION MATRIX (PO – PSO MAPPING):

CO'S and PO'S and CO'S and PSO'S on the scale of 0 to 3, 0 being no correlation, 1 being the low correlation, 2 being medium correlation and 3 being high correlation.
0 - 0$\leq$ C$\leq$ 5% – No correlation
1-5 <C$\leq$ 40% – Low/ Slight
2 - 40 % <C < 60% –Moderate
3 - 60% $\leq$ C < 100% – Substantial /High

COURSE OUTCOMES	**PROGRAM OUTCOMES**												**PSO'S**		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO 1	3	0	0	0	3	0	0	0	0	1	0	0	0	0	3
CO 2	3	0	0	0	0	0	0	0	0	1	1	0	0	0	0

CO 3	0	0	0	0	3	0	0	0	0	0	1	0	0	0	0
CO 4	0	0	0	0	0	0	0	0	0	0	1	0	0	0	3
CO 5	3	0	0	0	0	0	0	0	0	1	0	0	0	0	0
CO 6	3	0	0	0	0	0	0	0	0	0	1	0	0	0	3
TOTAL	12	-	-	-	6	-	-	-	-	3	4	-	-	-	9
AVERAGE	3	-	-	-	3	-	-	-	-	1	1	-	-	-	3

XIV ASSESSMENT METHODOLOGY DIRECT:

CIE Exams	✓	SEE Exams	✓	Seminars	-
Laboratory Practices	✓	Student Viva	✓	Certification	-
Assignments	-				

XV ASSESSMENT METHODOLOGY INDIRECT:

	Assessment of Mini Projects by Experts	✓	End Semester OBE Feedback

XVI SYLLABUS:

WEEK I	**SITE VISIT-I**
	Site visit to study the construction techniques and use of major construction equipment associated with the ongoing work. Report on the site visit to be submitted.
WEEK II	**SITE VISIT-II**
	Site visit to study the construction techniques and use of major construction equipment associated with the ongoing work. Report on the site visit to be submitted.
WEEK III	**NEW ADVANCES IN CONSTRUCTION**
	Collection of techno- commercial information on the new construction materials, methods and construction equipment available in the market.
WEEK IV	**WORK FLOW OF CONSTRUCTION ACTIVITIES**
	Performing and reporting of time and motion study work measurement of any one construction activity.
WEEK V	**QUANTITY ESTIMATION AND PURCHASE**
	Field exercise on estimation of quantities and bulk purchases
WEEK VI	**PRECEDENCE NETWORK**
	Preparation, crashing and updating of precedence network for a major construction work
WEEK VII	**CASH FLOW ANALYSIS**
	Exercise on cash flow analysis

WEEK VIII	**MODEL PREPARATION**
	Preparation of models and charts related to various construction techniques, equipment, organizational structures of existing companies. This is a group activity to generate interest and explore creativity.
WEEK IX	**SITE VISIT-III**
	Study of feasibility aspects, tendering procedures, accounting system, fund raising and other financial aspects, billing procedures etc associated with on-going major construction work. Visit report is to be submitted.
WEEK X	**SITE VISIT-IV**
	Study of feasibility aspects, tendering procedures, accounting system, fund raising and other financial aspects, billing procedures etc associated with on-going major construction work. Visit report is to be submitted.
WEEK XI	**TENDERING**
	Collection and study of tender notices, tender documents of contract document associated with civil engineering works.
WEEK XII	**VALUATION**
	Valuation of land and building using various methods. A report to be submitted on the same.
WEEK XIII	**REVISION**
	Revision
WEEK XIV	**REVISION**
	Revision

TEXTBOOKS

1. Ghalot, P.S., Dhir,D. M., Construction Planning and Management, Wiley Eastern Limiled,1992.

2. Punmia,B. C., Project Planning and Control with PERT and CPM, Laxmi Publications, new deIhi,1987.

REFERENCE BOOKS:

1. 1. Sengupta, Guha, ―Construction Management And Planning‖. Tata McGraw-Hill Inc, 1994.

2. 2. George J.Ritz , ―Total Construction Project Management‖, McGraw-Hill Inc, 1994.

XVII 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	Site Visit-I.	CO 1	R1: 2.4
2	Site Visit-II	CO 2	R2: 4 2
3	New Advances In Construction	CO 2	R1: 4.3
4	Work Flow Of Construction Activities	CO 3	R1: 3.2
5	Quantity Estimation And Purchase	CO 4	R1: 5.4
6	Precedence Network	CO 6	R3: 6.2
7	Cash Flow Analysis	CO 4	R3: 7.1

8	Model Preparation	CO 3	R2: 6.6
9	Site Visit-III.	CO 5	R2: 7.2
10	Site Visit-IV	CO 5	R1: 8.1
11	Tendering.	CO 5	R1:8.4
12	Valuation	CO 6	R1:7.3, R2: 8.1
13	Revision	CO 6	R1:7.3, R2: 8.1
14	Revision	CO 6	R1:7.3, R2: 8.1

XVIII EXPERIMENTS FOR ENHANCED LEARNING (EEL):

S.No	Design Oriented Experiments
1	Work Flow Of Construction Activities.
2	Quantity Estimation And Purchase.
3	Precedence Network
4	Cash Flow Analysis.
5	Valuation

Signature of Course Coordinator **HOD, CE**
Mr. Ch. Balakrishna, Assistant Professor

INSTITUTE OF AERONAUTICAL ENGINEERING
(Autonomous)
Dundigal, Hyderabad - 500 043

COURSE DESCRIPTION

Department	**CIVIL ENGINEERING**				
Course Title	**FOUNDATION ENGINEERING**				
Course Code	ACE018				
Program	B.Tech				
Semester	VII				
Course Type	CORE				
Regulation	R-16				
Course Structure	Theory			Practical	
	Lecture	Tutorials	Credits	Laboratory	Credits
	3	-	3	-	-
Course Coordinator	Dr. Vemula Anand Reddy, Associate Professor				

I COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites
B.Tech	ACE003	III	Engineering Geology
B.Tech	ACE006	IV	Geotechnical Engineering

II COURSE OVERVIEW:

Foundation engineering is a branch of geotechnical engineering which applies soil mechanics, structural engineering and project serviceability requirements for design and construction of foundations for on shore, offshore, and in-land structures. This course addresses the design of shallow, deep and well foundations, the stability of slopes, stability of retaining walls and embankments against failure. The course also discusses the safety and serviceability considerations in the design of foundations.

III MARKS DISTRIBUTION:

Subject	SEE Examination	CIE Examination	Total Marks
Foundation Engineering	70 Marks	30 Marks	100

IV CONTENT DELIVERY / INSTRUCTIONAL METHODOLOGIES:

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

V EVALUATION METHODOLOGY:

The course will be evaluated for a total of 100 marks, with 30 marks for Continuous Internal Assessment (CIA) and 70 marks for Semester End Examination (SEE). Out of 30 marks allotted for CIA during the semester, marks are awarded by taking average of two CIA examinations or the marks scored in the make-up examination.

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 14 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
33.3%	Remember
16.7%	Understand
50%	Apply
0 %	Analyze
0%	Evalaute
0%	Create

Continuous Internal Assessment (CIA):
CIA is conducted for a total of 30 marks, with 25 marks for Continuous Internal Examination (CIE) and 05 marks for Quiz \Alternative Assessment Tool (AAT).

Component	Theory		Total Marks
Type of Assessment	CIE Exam	Quiz \AAT	
CIA Marks	25	05	30

Continuous Internal Examination (CIE):
Two CIE exams shall be conducted at the end of the 8^{th} and 17^{th} week of the semester respectively. The CIE exam is conducted for 25 marks of 2 hours duration consisting of two parts. Part–A shall have five compulsory questions of one mark each. In part–B, four out of five questions have to be answered where, each question carries 5 marks. Marks are awarded by taking average of marks scored in two CIE exams.

Quiz - Online Examination
Two Quiz exams shall be online examination consisting of 25 multiple choice questions and are to be answered by choosing the correct answer from a given set of choices (commonly four). Such a question paper shall be useful in testing of knowledge, skills, application, analysis, evaluation and understanding of the students. Marks shall be awarded considering the average of two quiz examinations for every course.

Alternative Assessment Tool (AAT)
This AAT enables faculty to design own assessment patterns during the CIA. The AAT converts the classroom into an effective learning center. The AAT may include tutorial hours/classes, seminars, assignments, term paper, open ended experiments, METE (Modeling and Experimental Tools in Engineering), five minutes video, MOOCs etc. The AAT chosen for this course is given in table

Concept Video	Tech-talk	Complex Problem Solving
40%	40%	20%

VI COURSE OBJECTIVES:

The students will try to learn:

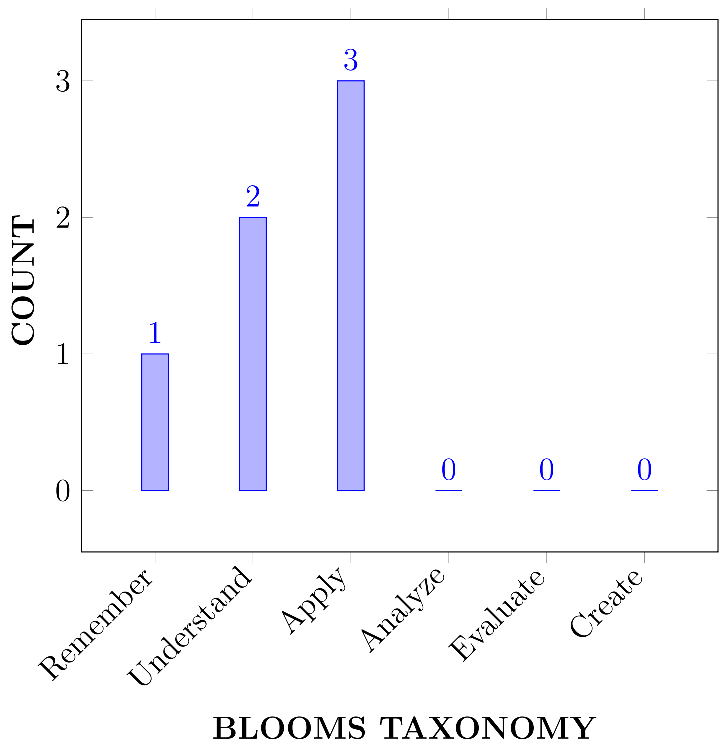
I	Identify the methods of soil exploration, different field tests, planning.
II	TUnderstand earth pressure by Rankine's theory, Coulomb's earth pressure theory and Culmann's graphical method.
III	Implement the Indian standard methods for calculating safe bearing pressure.
IV	Analyze pile foundation, load carrying capacity of piles based on static and dynamic pile formulae.

VII COURSE OUTCOMES:

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

CO 1	**Recall** the methods of soil exploration and sampling for characterization of soils at different depth from ground level.	Remember
CO 2	**Summarize** the finite and infinite slopes of soil to provide the safety against slope failures.	Understand
CO 3	**Identify** the type of earth pressure to choose appropriate design parameters for construction of retaining walls.	Apply
CO 4	**Illustrate** the bearing capacity of an area to select the type of foundation for construction of residential, public and industrial structures.	Apply
CO 5	**Identify** the load carrying capacity and settlement of pile foundations for estimating bearing capacity in construction of various infrastructure projects, public and industrial structures.	Apply
CO 6	**Classify** different shapes and components of well foundations for construction of bridges and harbors.	Understand

COURSE KNOWLEDGE COMPETENCY LEVEL



VIII PROGRAM 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

IX 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,AAT,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.	1	CIE,AAT,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	1	CIE,AAT,SEE
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.	1	CIE,AAT,SEE
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	3	CIE,AAT,SEE

3 = High; 2 = Medium; 1 = Low

X HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

PROGRAM SPECIFIC OUTCOMES		Strength	Proficiency Assessed by
PSO 1	Design and Supervise Sub-Structures and Super Structures for Residential and Public Buildings, Industrial Structures, Irrigation Structures, Power Houses, Highways, Railways, Airways, Docs and Harbours.	2	Quiz

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

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	✓	-	-	-	✓	-	-	-	-	-	-	-	-	-	-
CO 2		✓	✓	-	-	-	-	-	-	-	-	-	✓	-	-
CO 3	✓	-	-	✓	-	-	-	-	-	-	-	-	✓	-	-
CO 4	✓	-	-	✓	-	-	-	-	-	-	-	-	✓	-	-
CO 5	✓	-	-	-	-	-	-	-	-	-	-	-	-	-	-

XII 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 matched.
CO 1	PO 1	Explain the methods of soil exploration, sampling and boring for soil properties by using the fundamental principles of **science and engineering.**	2
	PO 5	Explain the methods of soil exploration, sampling and boring for soil properties by using **modern tool usage**	1
CO 2	PO 2	**Identify** the failures of finite and infinite slopes of soil and **develop the solutions** for finding the factor of safety in slope construction.	2
	PO 3	Identify the failures of finite and infinite slopes for slope stability which will cause **health and safety and risk assessment issues.**	1
	PSO 1	Collect **geological survey, Material knowledge, Soil investigation** report and summarize the failures of finite and infinite slopes for slope stability by using related **Code of practices** for finding the factor of safety in **slope construction.**	5
CO 3	PO 1	Classify various earth pressure theories and stability of retaining walls for accretion of earth at different topological conditions by using **engineering fundamentals and scientific principles.**	2
	PO 4	Classify various earth pressure theories and stability of retaining walls for accretion of earth at different topological conditions by using **appropriate codes of practice and industry standards**	1
	PSO 1	Collect **geological survey data**, Material knowledge, and Soil investigation of various **earth pressure theories, stability and construction of retaining walls** for accretion of earth at different topological conditions using related **Code of practices.**	5
CO 4	PO 1	Identify the bearing capacity of shallow foundation by different methods for construction of residential, public and industrial structures by using **engineering fundamentals and scientific principles.**	2

Course Outcomes	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key competencies matched.
	PO 4	Identify the bearing capacity of shallow foundation by different methods for construction of residential, public and industrial structures by using **appropriate codes of practice and industry standards**	1
	PSO 1	Collect **geological survey data**, Material knowledge, and Soil investigation of various **earth pressure theories, stability and construction of retaining walls** for accretion of earth at different topological conditions using related **Code of practices.**	5
CO 5	PO 1	Identify the bearing capacity of deep foundations by different methods for construction of residential, public and industrial structures by using **engineering fundamentals and scientific principles.**	2
	PO 4	Identify the bearing capacity of deep foundation by different methods for construction of residential, public and industrial structures by using **appropriate codes of practice and industry standards**	1
	PSO 1	Collect **geological survey data**, Material knowledge, and Soil investigation of various **earth pressure theories, stability and construction of retaining walls** for accretion of earth at different topological conditions using related **Code of practices.**	5
CO 6	PO 1	Illustrate different shapes and components for sinking appropriate well in construction of bridges and harbours using **engineering fundamentals and scientific principles.**	2

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

XIV 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	-	-	-	100	-	-	-	-	-	-	-	-	-	-
CO 2	-	20	10	-	-	-	-	-	-	-	-	-	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 3	66.6	-	-	9.09	-	-	-	-	-	-	-		50	-	-
CO 4	66.6	-	-	9.09	-	-	-	-	-	-	-		50	-	-
CO 5	66.6	-	-	9.09	-	-	-	-	-	-	-		50	-	-
CO 6	66.6	-	-	-	-	-	-	-	-	-	-	-	-	-	-

XV COURSE ARTICULATION MATRIX (PO / PSO MAPPING):

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

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

1 -5 <C$\leq$ 40% – Low/ Slight

2 - 40 % <C < 60% –Moderate

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

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

XVI ASSESSMENT METHODOLOGY-DIRECT:

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

XVII ASSESSMENT METHODOLOGY-INDIRECT:

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

XVIII SYLLABUS:

MODULE I	**SOIL EXPLORATION**
	Need and methods of soil exploration, boring and sampling methods, pits and trenches, drifts and shafts, methods of boring, auger borings, wash borings, rotary drilling, percussion drilling, core drilling, types of soil samples, disturbed samples, undisturbed samples, design features affecting the sample disturbance, split spoon samplers, scraper bucket samplers, shell by tubes and thin walled samplers, piston samplers, preservation and handling of samples. penetration tests, monotonic and cyclic, field permeability tests, insitu tests using pressure meter, observation of ground water table, instrumentation in soil engineering, strain gauges, resistance and inductance type plate load test, pressure meter, geophysical methods, planning of programme and preparation of soil investigation report.
MODULE II	**SLOPE STABILITY**
	Infinite and finite earth slopes, types of failures, factor of safety of infinites slopes, stability analysis by Swedish arc method, standard method of slices, Bishop's Simplified method, Taylor's Stability number, and stability of slopes of earth dams under different conditions.
MODULE III	**EARTH PRESSURE THEORIES AND RETAINING WALLS**
	Rankine's theory of earth pressure, earth pressures in layered soils, Coulomb's earth pressure theory, Culmann's graphical method.Types of retaining walls, stability of retaining walls against overturning, sliding, bearing capacity and drainage from backfill.
MODULE IV	**SHALLOW AND DEEP FOUNDATIONS**
	Types, choice of foundation, location of depth, safe bearing capacity, Terzaghi, Meyerhof, Skempton and IS Methods. Safe bearing pressure based on N value, allowable bearing pressure, safe bearing capacity, plate load test, allowable settlements of structures, Analysis of foundation, individual, strip, combined footings and mat foundations conventional, elastic approach, soil structure interaction principles.Types of piles, load carrying capacity of piles based on static pile formulae in dynamic pile formulae, pile load tests, load carrying capacity of pile groups in sand clays, settlement of pile groups. Introduction to Foundations on expansive soils and marine foundations.
MODULE V	**WELL FOUNDATIONS**
	Different shapes of wells, components of well, sinking of well, tilts and shifts, principles of analysis and design, seismic influences, IRC guidelines.

TEXTBOOKS

1. B. M. Das, "Principles of foundation engineering" Cengage Learning, 2012.
2. Gopal Ranjan and A.S.R.Rao,"Basic and applied soil mechanics" New age international Pvt.Ltd. 2004.
3. V.N.S Murthy ,"Geotechnical Engineering: Principles and practices of soils mechanics and foundation engineering", Taylor & Francis Group, 2002.

REFERENCE BOOKS:

1. C. Venkataramiah, "Geotechnical engineering", New Age International Pvt.Ltd,2002.
2. Manojdutta and Gulati, "Geotechnical engineering", Tata McGraw hill publishers NewDelhi, 2005.

3. Garg, K.R.Arora,"Soil mechanics and foundation engineering", standard publishers and distributors, New Delhi,2005.

WEB REFERENCES:

1. www.nptel.ac.in/courses/105107120/1
2. www.nptel.ac.in/courses/105/105/105105176/
3. www.nptel.ac.in/courses/105/105/105105185/

COURSE WEB PAGE:

1. http://site.iugaza.edu.ps/afoul/files/2010/02/Environmental_book.pdf
2. https://libguides.rowan.edu/com

XIX COURSE PLAN:

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

S.No	Topics to be covered	CO's	Reference T1: 4.1
OBE DISCUSSION			
1	Discussion on OBE, CO's and CLO's of Foundation Engineering		
CONTENT DELIVERY (THEORY)			
2	Soil Exploration and Importance	CO 1	T 2,3
3	Sampling methods for field and laboratory investigation	CO 1	T 2,3 & R 1
4	Penetration test methods for site investigation	CO 1	T 2,3 & R 1
5	Pressure meter tests	CO 1	T 2,3 & R 1
6	Site investigation report	CO 1	T 2,3 & R 1
7	Stability of slopes	CO 1	T 2,3 & R 1
8	Methods for slope analysis	CO 1	T 2,3 & R 1
9	Analysis of finite slopes	CO 1, 2	T 2,3 & R 1
10	Analysis of finite slopes-I	CO 1	T 2,3 & R 1
11	Analysis of finite slopes-II	CO 1	T 2,3 & R 1
12	Stability of slopes of earth dam	CO 1	T 2,3 & R 1
13	Earth Pressure theories	CO 2	T 2,3 & R 2, 3
14	Earth pressure theories-I	CO 2	T 2,3 & R 2, 3
15	Introduction to Retaining walls	CO 2	T 2,3 & R 2, 3

16	Stability of retaining walls	CO 2	T 2,3 & R 2, 3
17	Construction of retaining walls	CO 2	T 2,3 & R 2, 3
18	Governing design parameters for retaining wall design	CO 2	T 2,3 & R 2, 3
19	Construction of retaining walls for emabankments	CO 2	T 2,3 & R 2, 3
20	Types of Foundations	CO 2	T 2,3 & R 2, 3
21	Shallow Foundations	CO 2	T 2,3 & R 2, 3
22	Shallow Foundations and SBC	CO 2	T 1,2 & R 1, 2
23	Shallow Foundations and methods of foundation design	CO 2	T 1,2 & R 1, 2
24	Shallow Foundation design methods	CO 2	T 1,2 & R 1, 2
25	Shallow Foundations design methods using IS codes	CO 2	T 1,2 & R 1, 2
26	Shallow Foundations design methods using IS code method	CO 3	T 1,2 & R 1, 2
27	Shallow Foundations design and various design parameters	CO 4	T 1,2 & R 1, 2
28	Types of deep foundations	CO 5	T 1,2 & R 1, 2
29	Pile load tests and design parameters	CO 4	T 1,2 & R 1,3
30	Well Foundations and caissons	CO 2& 4	T 1,2 & R 1,3
31	Well Foundations and types of wells	CO 4	T 1,2 & R 1,3
32	Various parameters for well foundation design	CO 4	T 1,2 & R 1,3
33	Special Cases on Foundations and design	CO 4	T 1,2 & R 1,3
34	Special Cases on Foundations for SW site	CO 2, 4	T 1,2 & R 1,3
35	Special Cases on Foundations for WW site	CO 4	T 1,2 & R 1,3
36	Special Cases on Foundations WW site - I	CO 2, 4	T 1,2 & R 1,3
37	Various parameters for well foundation design	CO 2, 4	T 1,2 & R 1,3
38	Well Foundations and caissons	CO 6	T 1,2 & R 1,3
39	Field problems for driving a well foundation	CO 6	T 1,2 & R 1,3

40	Design parameter and various parts involved in well foundation	CO 6	T 1,2 & R 1,3
41	Special types well foundations	CO 6	T 1,2 & R 1,3
42	Special type of well foundations and their applications	CO 5	T 1,2 & R 1,3
PROBLEM SOLVING/ CASE STUDIES			
1	Finite and Infinite slopes derivation for C and Phi soils	CO 1	T 2,3 & R 1
2	Stability of slopes using Swedish circle methods	CO 1	T 2,3 & R 1
3	Stability of slopes using method of slices and Bishop's simplified method	CO 1	T 2,3 & R 1
4	Slope protection of a earth dam	CO 1	T 2,3 & R 1
5	Stability of slopes using Taylors method	CO 2	T 2,3 & R 2, 3
6	Rankine theory of earth pressure derivation	CO 2	T 2,3 & R 2, 3
7	Active earth pressure of cohesive soils	CO 2, 4	T 2,3 & R 2, 3
8	Passive earth pressure of cohesive soils	CO 4	T 2,3 & R 2, 3
9	Active earth pressure of cohesive soils	CO 1, 3	T 2,3 & R 2, 3
10	Passive earth pressure of cohesive soils	CO 3	T 1,2 & R 1, 2
11	Terzaghi method for bearing capacity of strip footing	CO 3	T 1,2 & R 1, 2
12	Meryohoff method for bearing capacity of strip footing	CO 4	T 1,2 & R 1, 2
13	Effect of water table on bearing capacity of strip foundations	CO 4	T 1,2 & R 1, 2
14	Determination bearing capacity using PLT and SPT test methods	CO 6	T 1,2 & R 1,3
15	Bearing capacity from housels approach	CO 6	T 1,2 & R 1,3
DISCUSSION OF DEFINITION AND TERMINOLOGY			
1	Distinguish between disturbed and undisturbed samples	CO 1	T 2,3 & R 1
2	List various methods of drilling holes	CO 2,4	T 2,3 & R 2, 3
3	Explain how do you obtain undisturbed samples	CO 3	T 2,3 & R 2, 3
4	Over view on screens, grit chambers, skimming tanks and sedimentation tanks	CO 4	T 2,3 & R 2, 3
5	What is soil exploration What is Boring log	CO 6	T 2,3 & R 2, 3

DISCUSSION OF QUESTION BANK			
1	Distinguish between disturbed and undisturbed samples	CO 1	T 2,3 & R 1
2	Explain how do you obtain undisturbed samples	CO 1,2	T 2,3 & R 2, 3
3	List various methods of soil explorations	CO 3	T 2,3 & R 2, 3
4	List various methods of drilling holes	CO 4	T 2,3 & R 2, 3
5	The cone penetration resistance obtained in a clay soil in a CPT was 50 kg/cm2. Determine the undrained strength of clay. The total overburden pressure at the depth was 100 kN/m2.	CO 6	T 2,3 & R 2, 3

Signature of Course Coordinator **HOD,CE**

Dr Vemula Anand Reddy, Associate Professor

INSTITUTE OF AERONAUTICAL ENGINEERING
(Autonomous)
Dundigal, Hyderabad - 500 043

COURSE DESCRIPTION

Department	**CIVIL ENGINEERING**				
Course Title	**INDUSTRIAL MANAGEMENT AND PSYCHOLOGY**				
Course Code	AHS016				
Program	B.Tech				
Semester	VII				
Course Type	SKILL				
Regulation	R-16				
Course Structure	Theory			Practical	
	Lecture	Tutorials	Credits	Laboratory	Credits
	3	-	3	-	-
Course Coordinator	Mr.V. Suryaprakash Reddy, Assistant Professor				

I COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites
B.Tech	AHS015	V	Business Economics and Financial Analysis

II COURSE OVERVIEW:

The course focuses on basics and advanced Engineering Psychology in the scientific study of behavior and mental processes. This course initially discusses about management and its principles. Followed by how the organizations are structured and which suitable organization structure can be adapted for an organization. Then the last parts contain about basics of psychology and how Psychologists use systematic scientific methods in an effort to understand more about the how's and whys of behavior and human thought processes. The course further deals with broad fields of developmental psychology, cognitive psychology and social psychology.

III MARKS DISTRIBUTION:

Subject	SEE Examination	CIE Examination	Total Marks
Industrial Management and Psychology	70 Marks	30 Marks	100

IV CONTENT DELIVERY / INSTRUCTIONAL METHODOLOGIES:

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

V EVALUATION METHODOLOGY:

The course will be evaluated for a total of 100 marks, with 30 marks for Continuous Internal Assessment (CIA) and 70 marks for Semester End Examination (SEE). Out of 30 marks allotted for CIA during the semester, marks are awarded by taking average of two CIE examinations or the marks scored in the make-up examination.

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 14 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
20%	Remember
50%	Understand
30%	Apply
0%	Analyze
0%	Evaluate
0%	Create

Continuous Internal Assessment (CIA):
CIA is conducted for a total of 30 marks, with 25 marks for Continuous Internal Examination (CIE) and 05 marks for Quiz \Alternative Assessment Tool (AAT).

Component	Theory		Total Marks
Type of Assessment	CIE Exam	Quiz \AAT	
CIA Marks	25	05	30

Continuous Internal Examination (CIE):
Two CIE exams shall be conducted at the end of the 8^{th} and 17^{th} week of the semester respectively. The CIE exam is conducted for 25 marks of 2 hours duration consisting of two parts. Part–A shall have five compulsory questions of one mark each. In part–B, four out of five questions have to be answered where, each question carries 5 marks. Marks are awarded by taking average of marks scored in two CIE exams.

Quiz - Online Examination
Two Quiz exams shall be online examination consisting of 25 multiple choice questions and are to be answered by choosing the correct answer from a given set of choices (commonly four). Such a question paper shall be useful in testing of knowledge, skills, application, analysis, evaluation and understanding of the students. Marks shall be awarded considering the average of two quiz examinations for every course.

Alternative Assessment Tool (AAT)
This AAT enables faculty to design own assessment patterns during the CIA. The AAT converts the classroom into an effective learning center. The AAT may include tutorial hours/classes, seminars, assignments, term paper, open ended experiments, METE (Modeling and Experimental Tools in Engineering), five minutes video, MOOCs etc. The AAT chosen for this course is given in table

Concept Video	Tech-talk	Complex Problem Solving
40%	40%	20%

VI COURSE OBJECTIVES:

The students will try to learn:

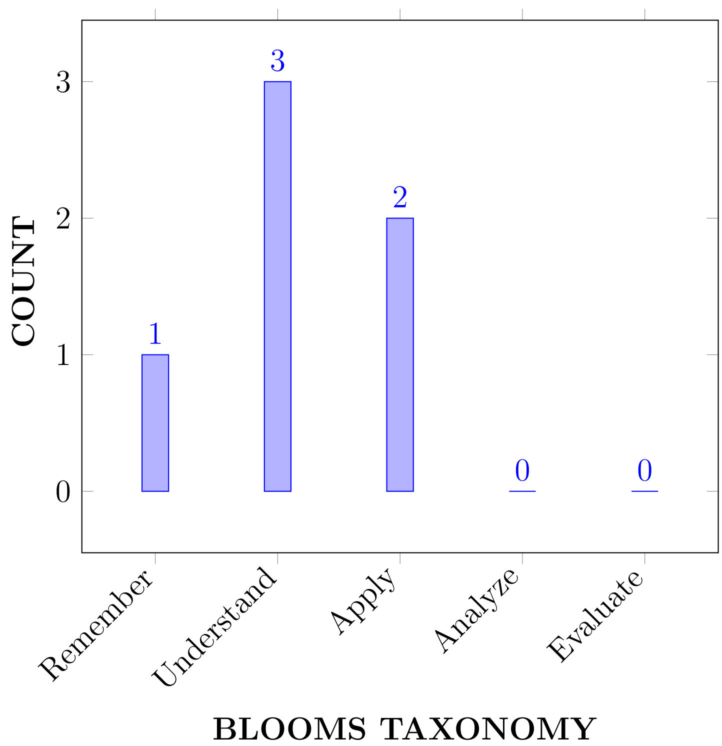
I	The nature, importance and functions of management along with management theories of an organization.
II	The different organizational structures for effective and efficient management of human resources to achieve defined organizational goal.
III	The Basics of Human resource management and marketing functions in an organization.
IV	The fundamentals and application of human psychology in various fields such as information technology, mass media and economic development.

VII COURSE OUTCOMES:

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

CO 1	**Explain** different scientific management techniques for smooth running of an organization	Understand
CO 2	**Explain** how organizational structure contributes for the achievement of each organization's mission.	Understand
CO 3	**Outline** the evolution of human resource management for its current application in various organizations.	Understand
CO 4	**Model** suitable jobs for providing certain amount of challenge and job satisfaction.	Apply
CO 5	**Demonstrate** past and current trends in the field of psychology for better understanding of human behaviour.	Remember
CO 6	**Make use of** principles of psychology in information technology, mass media, disadvantaged groups for the economic development and betterment of society.	Apply

COURSE KNOWLEDGE COMPETENCY LEVEL



VIII PROGRAM 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

IX HOW PROGRAM OUTCOMES ARE ASSESSED:

PROGRAM OUTCOMES		Strength	Proficiency Assessed by
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.	1	CIE/ SEE/ AAT
PO 8	**Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.	1	CIE/ SEE/ AAT
PO 9	**Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.	1	CIE/ SEE/ AAT
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	CIE/ SEE/ AAT

3 = High; 2 = Medium; 1 = Low

X HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

PROGRAM SPECIFIC OUTCOMES		Strength	Proficiency Assessed by
-	-	-	-

3 = High; 2 = Medium; 1 = Low

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

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	-	-	-	-	-	-	-	-	-	-	✓	-	-	-	-
CO 2	-	-	-	-	-	-	-	-	-	-	✓	-	-	-	-
CO 3	-	-	-	-	-	-	✓	✓	-	-	-	-	-	-	-
CO 4	-	-	-	-	-	-	-	-	✓	-	-	-	-	-	-
CO 5	-	-	-	-	-	-	-	-	✓	-	-	-	-	-	-
CO 6	-	-	-	-	-	-	-	✓	-	-	-	-	-	-	-

XII 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 matched.
CO 1	PO 11	Develop **communication** with others by applying various management scientific techniques	1
CO 2	PO 11	To get along with the organizational structures being a **critical success factor** for the achievement of **quality** and **deliverables** of the organizational goals	3
CO 3	PO 7	Demonstrate the knowledge of the **socio economic and political** changes in the evolution of human resource management	1
	PO 8	Apply ethical principles as a human resource manager to perform their duties with **high degree of trust and integrity.**	1
CO 4	PO 9	Model suitable jobs with an **ability to work with all levels of people in an organization and also to get along with other employees** in the organization	2
CO 5	PO 9	Demonstrating the past and current trends in the field of psychology for understanding the **independency, maturity and team work** capability of certain candidate for recruiting into an organization	3
CO 6	PO 8	Make use of psychological principles in various fields like IT , mass media etc., **to stand up for what they believed in.**	1

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

XIV 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	-	-	-	-	-	-	-	-	-	-	8.33	-	-	-	-
CO 2	-	-	-	-	-	-	-	-	-	-	25	-	-	-	-
CO 3	-	-	-	-	-	-	33.3	33.3	-	-	-	-	-	-	-

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	-	-	-	-	-	-	-	-	16.7	-	-	-	-	-	-
CO 5	-	-	-	-	-	-	-	-	25	-	-	-	-	-	-
CO 6	-	-	-	-	-	-	-	33.3	-	-	-	-	-	-	-

XV COURSE ARTICULATION MATRIX (PO / PSO MAPPING):

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

0 - $0 \leq C \leq 5\%$ – No correlation
1 - $5 < C \leq 40\%$ – Low/ Slight
2 - $40\ \% < C < 60\%$ –Moderate
3 - $60\% \leq C < 100\%$ – Substantial /High

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-
CO 2	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-
CO 3	-	-	-	-	-	-	1	1	-	-	-	-	-	-	-
CO 4	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-
CO 5	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-
CO 6	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-
TOTAL	-	-	-	-	-	-	1	2	2	-	2	-	-	-	-
AVERAGE	-	-	-	-	-	-	1.0	1.0	1.0	-	1.0	-	-	-	-

XVI ASSESSMENT METHODOLOGY-DIRECT:

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

XVII ASSESSMENT METHODOLOGY-INDIRECT:

	Assessment of mini projects by experts	✓	End Semester OBE Feedback

XVIII SYLLABUS:

MODULE I	INTRODUCTION TO MANAGEMENT
	Nature and importance of management, functions of management, theories of management-taylors scientific management theory, fayols principles of management, maslow's theory of human needs, douglas mcgregor's theory x and theory y, two factor theory, leadership styles, social responsibilities of management.

MODULE II	**ORGANIZATIONAL STRUCTURES**
	Designing organizational structures: Departmentation and decentralization, types of organization structures, line organization, line and staff organization, functional organization, committee organization, matrix organization, virtual organization, cellular organization, team structure, boundary less organization, inverted pyramid structure, lean and flat organization structure and their merits, demerits and suitability.
MODULE III	**HUMAN RESOURCE MANAGEMENT AND MARKETING MANAGEMENT**
	Human Resources Management (HRM): evolution of HRM, basic functions of hr manager: manpower planning, recruitment, selection, training and development, placement, wage and salary administration, promotion, transfer, separation, performance appraisal, grievance handling and welfare administration, job evaluation and merit rating. Marketing: functions of marketing, marketing mix, marketing strategies based on product life cycle., channels of distribution
MODULE IV	**FUNDAMENTALS OF PSYCHOLOGY**
	Definition, goals, fields and applications, development of psychology from middle 19th century, psychology in ancient India, the founding of experimental psychology: Contributions of Weber, Fechner, Wundt and Eddinghaus, William James and Galton, development of psychology in India.
MODULE V	**APPLICATIONS AND FIELDS OF PSYCHOLOGY**
	Applications of psychology to disadvantaged groups, problems of social integration, information technology and mass media, economic development. fields of psychology: social psychology, educational psychology, experimental psychology, clinical psychology, personality psychology.

TEXTBOOKS

1. A.R. Aryasri, Management Science, Tata MC Graw Hill, 2009.

2. Susan Nolen Hoeksema, Barbara L. Fredrickson, Geoff R. Loftus and Willem A. Wagenaar, "Atkinson & Hilgard's Introduction to Psychology", CENGAGE Learning, 15th Edition, 2009.

3. Bell,P.A.,Greene,Thomas C.,Fisher,J.D.and Baum A."Environmental Psychology" Belmont,CA:Tho son Wadsworth. Ricker Library, 5th Edition, 2001.

REFERENCE BOOKS:

1. Sahakian, William, S. Ed., History of Psychology, F.E. Peacock Publishers, Inc. Itasca, U.S.A., 1981.

2. Charles G. Morris, Albert Anthony Maisto, Ann Levine, Psychology: An Introduction, Prentice Hall 2002.

WEB REFERENCES:

1. https://nptel.ac.in/courses/112105171/1

COURSE WEB PAGE:

https://lms.iare.ac.in/index?route=course/details&course_id=224

XIX COURSE PLAN:

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

S.No	Topics to be covered	CO's	Reference T1: 4.1
OBE DISCUSSION			
1	Course outcomes, Course objectives, Program outcomes amd Program specific outcomes		
CONTENT DELIVERY (THEORY)			
1	Define Nature and Importance of management, functions of management	CO 1	T1:13.3
2-3	Describe the concept of theories of management-taylors scientific management theory.	CO 1	R1:11.48
4-5	Describe the Concept of fayols principles of management, maslow's theory of human needs.	CO 1	T1:26.6 R1:18.50
6-7	Describe the concept of douglas mcgregor's theory x and theory y, two factor theory, leadership styles, social responsibilities of management.	CO 1	T1:26.7 R1:11.51
8-9	Define the Designing of organizational structures: Departmentation and decentralization, types of organization structures.	CO 2	T1:16.8
10-11	Identify line and staff organization, functional organization, committee organization, matrix organization.	CO 2	T1:8.10
12-13	Lean and flat organization structure and their merits, demerits and suitability.	CO 2	T1:16.14 R1:17.55,
14-15	Human Resources Management (HRM): evolution of HRM, basic functions of hr manager: manpower planning, recruitment, selection.	CO 3	T1:06.15 R1:20.54
16-18	Basic functions of hr manager: manpower planning, recruitment, selection.	CO 3	T1:14.13 R1:13.1
19-20	Training and development, placement, wage and salary administration, promotion, transfer separation.	CO 3	T1:15.02 R1:12.14
21	handling welfare administration	CO 3	T1:15.22 R1:17.14
22-23	Performance appraisal, grievance handling and welfare administration, job evaluation and merit rating.	CO 4	T1:20.16 R1:19.09
24	Define the concept Marketing: functions of marketing, marketing mix, marketing.	CO 4	T1:15.14 R1:11.32
25-26	Strategies based on product life cycle., channels of distribution.	CO 4	T1:15.17 R1:61.13
27	Defintion of Psychology	CO 5	T1:15.18 R1:16.23
28-29	Recognize the psychology in ancient India, the founding of experimental psychology: Contributions of Weber, Fechner, Wundt and Eddinghaus.	CO 5	T1:15.17 R1:11.23
30	William James and Galton, development of psychology in India.	CO 5	T2:17.2 R2:19.64

31	Goals of fudamental psychology	CO 5	T2:17.2 R2:40.62
32	Understand the fields and fundamentals of psychology.	CO 5	T2:37.3 R2:41.71
33	Understand the development of psychology from middle 19th century.	CO 5	T2:17.4 R2:11.68
34-35	Information technology and mass media, economic development. fields of psychology.	CO 5	T2:17.2 R2:19.17
36-38	Technology and mass media, economic development. fields of psychology.	CO 6	T2:17.2 R2:19.64
39	Fields of psychology: social psychology.	CO 6	T2:07.8 R2:71.23
40-41	Educational psychology.	CO 6	T2:07.24 R2:31.18
42	Experimental psychology.	CO 6	T2:67.09 R2:91.84
43	Clinical psychology.	CO 6	T2:57.12 R2:41.22
44-45	Personality psychology.	CO 6	T2:57.14 R2:61.85
PROBLEM SOLVING/ CASE STUDIES			
1	Nature and Importance of management, functions of management	CO 1	T1:13.3
2	concept of theories of management-taylors scientific management theory.	CO 1	R1:11.48
3	Concept of fayols principles of management, maslow‘s theory of human needs.	CO 1	T1:26.6 R1:18.50
4	concept of douglas mcgregor‘s theory x and theory y, two factor theory, leadership styles, social responsibilities of management.	CO 1	T1:26.7 R1:11.51
5	Designing of organizational structures,Departmentation and decentralization, types of organization structures	CO 2	T1:16.8
6	Identify line and staff organization, functional organization, committee organization, matrix organization.	CO 2	T1:8.10
7	Lean and flat organization structure and their merits, demerits and suitability.	CO 2	T1:16.14 R1:17.55
8	Basic functions of hr manager manpower planning, recruitment, selection.	CO 3	T1:14.13 R1:13.1
9	Training and development, placement, wage and salary administration, promotion, transfer separation.	CO 3	T1:15.02 R1:12.14
10	Strategies based on product life cycle., channels of distribution.	CO 4	T1:15.17 R1:61.13
11	William James and Galton, development of psychology in India.	CO 5	T2:17.2 R2:19.64
12	Information technology and mass media, economic development. fields of psychology.	CO 6	T2:17.2 R2:19.17
13	Educational psychology.	CO 6	T2:07.24 R2:31.18

14	Experimental psychology.	CO 6	T2:67.09 R2:91.84
15	Clinical psychology.	CO 6	T2:57.12 R2:41.22
DISCUSSION OF DEFINITION AND TERMINOLOGY			
1	Define Nature and Importance of management, functions of management	CO 1	T1:13.3
2	Define the Designing of organizational structures Departmentation and decentralization, types of organization structures.	CO 2	T1:16.8
3	Training and development, placement, wage and salary administration, promotion, transfer separation.	CO3, CO4	T1:15.02 R1:12.14
3	Define the concept Psychology: contributions of weber fechner and Eddinghaus.	CO 5	T1:15.14 R1:11.32
5	Experimental psychology.	CO 6	T2:67.09 R2:91.84
DISCUSSION OF QUESTION BANK			
1	Module I(theories of management-taylors scientific management theory, fayols principles of management, maslow's theory of human needs, douglas mcgregor's theory x and theory y)	CO 1	R4:2.1
2	Module II (types of organization structures, line organization, line and staff organization, functional organization, committee organization, matrix organization, virtual organization)	CO 2	T4:7.3
3	Module III (manpower planning, recruitment, selection, training and development, placement, wage and salary administration)	CO 3, CO 4	R4:5.1
4	Module IV (development of psychology from middle 19th century, psychology in ancient India)	CO 5	T1:7.5
5	Module V (Applications of psychology to disadvantaged groups, problems of social integration, information technology and mass media)	CO 6	T1: 4.1

Signature of Course Coordinator **HOD,CE**

V.Suryaprakash Reddy,Assistant Professor

INSTITUTE OF AERONAUTICAL ENGINEERING
(Autonomous)
Dundigal, Hyderabad - 500 043

COURSE DESCRIPTION

Department	**CIVIL ENGINEERING**				
Course Title	**REHABILITATION & RETROFITTING OF STRUCTURES**				
Course Code	ACE505				
Program	B.Tech				
Semester	VII				
Course Type	Professional Elective				
Regulation	R16				
Course Structure	Theory			Practical	
	Lecture	Tutorials	Credits	Laboratory	Credits
	3	-	3	-	-
Course Coordinator	Mr. K. Anand Goud, Assistant Professor.				

I COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites
B.Tech	ACE010	V	Concrete Technology

II COURSE OVERVIEW:

The primary objective of this course is to introduce the concept of Rehabilitation, retrofitting and study how to overcome the defects in regular construction practices, establish their effectiveness in overcoming the problems faced, study their efficiency. The course consists of Retrofitting components in addition to adapting new techniques in construction practices. Retrofitting aims to strengthen a structure to satisfy the requirements of the current codes for seismic design. In this respect, seismic retrofit is beyond conventional repair or even rehabilitation. The applications include different types of buildings, industrial structures, bridges, urban transport structures, marine structures and earth retaining structures. The benefits of retrofitting include the reduction in the loss of lives and damage of the essential facilities, and functional continuity of the life line structures. For an existing structure of good condition, the cost of retrofitting tends to be smaller than the replacement cost. Thus, the retrofitting of structures is an essential component of long term disaster mitigation.

III MARKS DISTRIBUTION:

Subject	SEE Examination	CIE Examination	Total Marks
Rehabilitation and Retrofitting of Structures	70 Marks	30 Marks	100

IV CONTENT DELIVERY / INSTRUCTIONAL METHODOLOGIES:

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

V EVALUATION METHODOLOGY:

The course will be evaluated for a total of 100 marks, with 30 marks for Continuous Internal Assessment (CIA) and 70 marks for Semester End Examination (SEE). Out of 30 marks allotted for CIA during the semester, marks are awarded by taking average of two CIA examinations or the marks scored in the make-up examination.

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 14 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
16.6%	Remember
50 %	Understand
33.3 %	Apply
0 %	Analyze
0 %	Evaluate
0 %	Create

Continuous Internal Assessment (CIA):
CIA is conducted for a total of 30 marks (Table 2), with 20 marks for continuous internal examination (CIE), 05 marks for quiz and 05 marks for alternative assessment tool

Component	Theory		Total Marks
Type of Assessment	CIE Exam	Quiz \AAT	
CIA Marks	25	05	30

Continuous Internal Examination (CIE):
Two CIE exams shall be conducted at the end of the 8th and 16th week of the semester respectively. The CIE exam is conducted for 20 marks of 2 hours duration consisting of five descriptive type questions out of which four questions have to be answered where, each question carries 5 marks. Marks are awarded by taking average of marks scored in two CIE exams

Quiz - Online Examination
Two Quiz exams shall be online examination consisting of 25 multiple choice questions and are to be answered by choosing the correct answer from a given set of choices (commonly four). Such a question paper shall be useful in testing of knowledge, skills, application, analysis, evaluation and understanding of the students. Marks shall be awarded considering the average of two quiz examinations for every course.

Alternative Assessment Tool (AAT)
This AAT enables faculty to design own assessment patterns during the CIA. The AAT converts the classroom into an effective learning center. The AAT may include tutorial hours/classes, seminars, assignments, term paper, open ended experiments, METE (Modeling and Experimental Tools in Engineering), five minutes video, MOOCs etc. The AAT chosen for this course is given in table

5 Minutes Video	Tech-talk	Open Ended Experiment
40%	40%	20%

VI COURSE OBJECTIVES:

The students will try to learn:

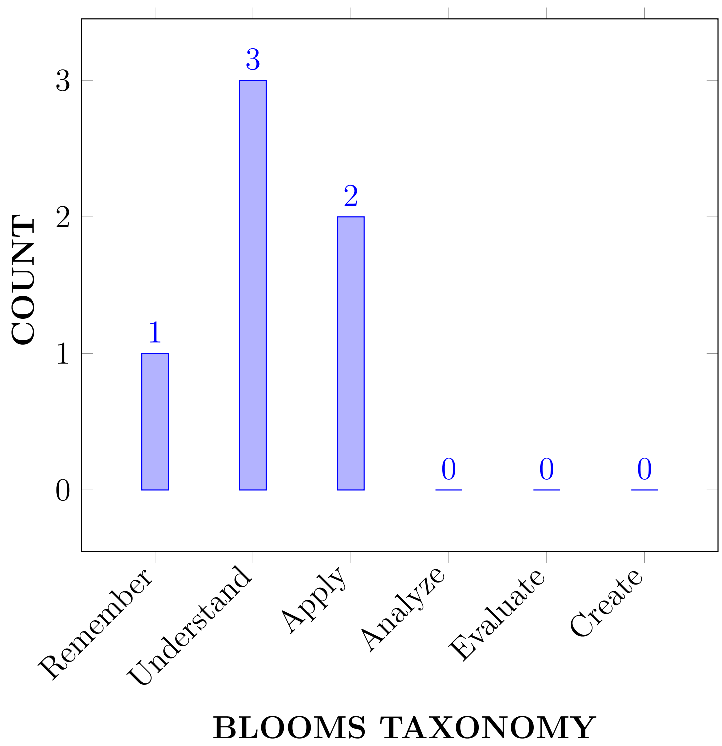
I	The basic concepts of degradation, damage grades in civil structures for evaluating Structural performance by using rehabilitation and retrofitting methods.
II	The knowledge on structural maintenance, repairs and rehabilitation for obtaining assessment of damage in construction failure.
III	The mechanism of corrosion and surface deterioration in structures for preventing structural damage.
IV	The application of special materials for improving the performance of the traditional structures.
V	The application of modern techniques in existing structures for strengthening and demolition in real time situations.

VII COURSE OUTCOMES:

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

CO 1	**Explain** the damage mechanism and preventive measures for protecting the structure from damages.	Understand
CO 2	**Interpret** the importance and facets of maintenance for scheduling regular inspection of residential and industrial structures.	Understand
CO 3	**Summarize** corrosion protection methods of steel and deterioration of materials for protecting structures from rusting and fatigue failures.	Understand
CO 4	**Identify** the materials and technics of repair for rehabilitation and retrofitting of structures.	Remember
CO 5	**Make use of** non-destructive testing procedures, demolition methods for assessing and improving the performance of structures.	Apply
CO 6	**Select** uitable engineered and non-engineered techniquesin existing structures for strengthening and demolition.	Apply

COURSE KNOWLEDGE COMPETENCY LEVEL



VIII PROGRAM OUTCOMES:

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

Program Outcomes	
PO 7	**Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO 8	**Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO 9	**Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO 10	**Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO 11	**Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO 12	**Life-Long Learning:** Recognize the need for and having the preparation and ability to engage in independent and life-long learning in the broadest context of technological change

IX HOW PROGRAM OUTCOMES ARE ASSESSED:

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

PROGRAM OUTCOMES		Strength	Proficiency Assessed by
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.	3	CIE / SEE/ AAT

3 = High; 2 = Medium; 1 = Low

X HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

PROGRAM OUTCOMES		Strength	Proficiency Assessed by
PSO 1	Understand, analyze, design and supervise sub-structures and superstructures for residential and public buildings, industrial structures, irrigation structures, powerhouses, highways, railways, airways, docks and harbours.	2	CIE / SEE / AAT
PSO 2	Focus on improving performance of structures with reference to safety & serviceability and sustainable green building technology.	3	CIE / SEE / AAT

3 = High; 2 = Medium; 1 = Low

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

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	✓	✓	-	-	-	-	-	-	-	-	-	-	✓	-	-
CO 2	-	-	✓	✓	-	-	-	-	-	-	-	-	✓	✓	-
CO 3	✓	✓	-	✓	-	-	-	-	-	-	-	-	✓	✓	-
CO 4	✓	-	✓	-	✓	-	-	-	-	-	-	-	-	✓	-
CO 5	-	-	-	✓	✓	-	-	-	-	-	-	-	-	-	-
CO 6	-	-	-	✓	✓	-	-	-	-	-	-	-	✓	-	-

XII JUSTIFICATIONS FOR CO – (PO, PSO) MAPPING -DIRECT:

Course Outcomes	POs / PSOs	Justification for mapping (Students will be able to)	No. of key competencies
CO 1	PO 1	Explain the mechanism of damages involved in the deterioration by using **engineering fundamentals and principles of science.**	2
	PO 2	**Identify** the damages based on the symptoms and develop the solutions to prevent the **deterioration of structures**	2
	PSO 1	Explain the mechanism of damages caused due to **environmental impacts** on residential, industrial buildings, **water treatment and distribution systems** based on **material knowledge** to **ensure the quality of structures** and to improve efficiency of **retrofitting techniques.**	5
CO 2	PO 3	Describe the importance of **aesthetics** and **maintenance** of structure by developing the **solutions** to avoid the **environmental** effects and safety issues.	4
	PO 4	Understand the importance and facets of maintenance by appropriate **codes of practices and industry standards** with the **knowledge of material characteristics** and processes to **improve the quality of structures**	3
	PSO 1	Supervise sub-structures, superstructures, and identify the performance of structures using **codes of practices, material knowledge** by **regular inspection** and remediation measures for **quality assurance.**	4
	PSO 2	Focus on improving performance of structures with Reference to **safety & serviceability** and sustainable green building technology by assessment procedures.	2
CO 3	PO 1	Explain the damages and their remedies involved in the deterioration by using **engineering fundamentals and principles of science.**	2
	PO 2	Identify the corrosion damage and explain the mechanism of corrosion which is involved in the **deterioration of structures and develop the solutions** to prevent the corrosion.	2
	PO 4	Understand industry standards with the knowledge of **material characteristics and processes** to improve the quality of structures.	2

	PSO 1	Explain Corrosion protection methods of residential, industrial building, **Water treatment and distribution systems** based on **material knowledge, codes of practices** to ensure the quality of structure and to improve efficiency of **retrofitting techniques.**	5
	PSO 2	Focus on protection methods of corrosion for improving performance of structures with reference to **safety, serviceability.**	2
CO 4	PO 1	Identify the materials for repair and rehabilitation of structures by understanding the characteristics and applications with the basic knowledge of **engineering fundamentals.**	1
	PO 3	Identify the materials to establish **innovative solutions** for rehabilitation of structure by considering **environmental and sustainability limitations.**	3
	PO 5	Make use of different techniques for structural retrofitting.Select and apply appropriate techniquesfor retrofitting of structures by **understanding the limitations.**	1
	PSO 2	Focus on protection methods of corrosion for **improving performance** of structures with reference to **safety,serviceability**	3
CO 5	PO 4	Perform non-destructive testing on existing structures by understanding the **industry standards and technical literature**	2
	PO 5	Select and apply appropriate non-destructive technique to know the durability of structure by **understanding the limitations**	1
CO 6	PO 4	Choose suitable demolition techniques due to the quality issues of structures with the knowledge of characteristics of **particular materials, equipment**, processes and understanding the contexts in which **engineering knowledge** can be applied.	3
	PO 5	Select and apply appropriate **demolition technique** by understanding the effect of damage of structure.	1
	PSO 1	Explain engineered and non-engineered **techniques of strengthening**, demolition and supervise sub-structures and superstructures for residential and public buildings for **safety**.	2

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

XIV 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	66.7	20	-	-	-	-	-	-	-	-	-	-	50	-	-
CO 2	-	-	40	27.3	-	-	-	-	-	-	-	-	40	66.7	-
CO 3	66.7	20	-	18.2	-	-	-	-	-	-	-	-	50	66.7	-
CO 4	33.3	-	30	-	100	-	-	-	-	-	-	-	-	100	-
CO 5	-	-	-	18.2	100	-	-	-	-	-	-	-	-	-	-
CO 6	-	-	-	27.3	100	-	-	-	-	-	-	-	66.7	-	-

XV COURSE ARTICULATION MATRIX (PO / PSO MAPPING):

CO'S and PO'S and CO'S and PSO'S on the scale of 0 to 3, 0 being no correlation, 1 being the low correlation, 2 being medium correlation and 3 being high correlation.
0 - $0 \leq$ C$\leq$ 5% – No correlation
1-5 <C$\leq$ 40% – Low/ Slight
2 - 40 % <C < 60% –Moderate
3 - 60% $\leq$ C < 100% – Substantial /High

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

XVI ASSESSMENT METHODOLOGY-DIRECT:

CIE Exams	✓	SEE Exams	✓	Seminars	-
Laboratory Practices	-	Student Viva	-	Certification	-
Term Paper	-	Concept Video	✓	Open Ended Experiments	-
Assignments	✓	Tech talk	✓		

XVII ASSESSMENT METHODOLOGY-INDIRECT:

	Assessment of mini projects by experts	✓	End Semester OBE Feedback

XVIII SYLLABUS:

UNIT- I	**INTRODUCTION**
	Deterioration of structures; distress in structures; causes and prevention, mechanism of damage; types of damage; damage under accidental and cyclic loads, cracking in structures, evaluation of damage.
UNIT- II	**MAINTENANCE AND DIAGNOSIS OF FAILURE**
	Maintenance, repair and rehabilitation, facets of maintenance, importance of maintenance, various aspects of inspection; Assessment procedure for evaluating a damaged structure; Diagnosis of construction failures.
UNIT- III	**DAMAGES AND THEIR REMEDIES**
	Corrosion damage of reinforced concrete, methods of corrosion protection, corrosion inhibitors, corrosion resistant steels, cathodic protection, rust eliminators. Causes of deterioration of concrete, steel, masonry and timber structures, surface deterioration, efflorescence, causes and preventive measures; coatings for embedded steel and set concrete.
UNIT- IV	**MATERIALS AND TECHNIQUES OF REPAIR**
	Special concrete and mortar, concrete chemicals, expansive cement, polymer concrete sulphur infiltrated concrete, ferro cement, fiber reinforced concrete, methods of repair in concrete, steel, masonry and timber structures. Gunite and shotcrete, epoxy injection.

UNIT- V	**STRENGTHENING AND DEMOLITION ASPECT**
	Strengthening of existing structures; repairs to overcome low member strength, deflection, cracking, chemical disruption, weathering, wear, fire, leakage, marine exposure, use of non-destructive testing techniques for evaluation, load testing of structure; demolition of structures using engineered and non-engineered techniques; case studies.

TEXTBOOKS

1. Shetty .M.S., "Concrete, Technology", Theory and Practice, S.Chand and Company, New Delhi 2010.
2. 2. Allen .R.T. and Edwards .S.C., "Repair of Concrete Structures" Blakie and Sons, UK 1987.

REFERENCE BOOKS:

1. Raiker .R.N. "Learning from Failures, Deficiencies in Design, Construction and Service", R&D Centre (SDCPL), RaikarBhavan, Bombay 1987.
2. "Repair & Rehabilitation" "Compilation from The Indian Concrete Journal", - ACC - RCD Publication 2001.
3. Revision compbell, Allen and Itarold Roper, "Concrete Structures Materials Maintenance and Repair" Longman Scientific and Technical UK 1991.

WEB REFERENCES:

1. http://nptel.ac.in/courses/105102088/
2. http://nptel.ac.in/courses/105101088/

COURSE WEB PAGE:

XIX COURSE PLAN:

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

S.No	Topics to be covered	CO's	Reference T1: 4.1
OBE DISCUSSION			
1	Course objectives, Course outcomes, Program Outcomes and CO-PO Mapping		
CONTENT DELIVERY (THEORY)			
2	Introduction to Rehabilitation and Retrofitting of Structures.	CO 1	T2:26.3 R2: 3.1
3	Describe the deterioration of structures.	CO 1	T2:2.2.2
4-5	What are the causes for deterioration of structures and able to give the preventive measures for it.	CO 1	T2:2.2.2 R3:3.7
6	Describe the mechanism of damage and types of damage.	CO 1	T2:2.2.2
7-8	Analyzing the damage of structures in detail.	CO 1	T1:8.1

9	Understand the distress in structures.	CO 1	T1:7.1 R2: 1.2
10-11	What are the causes for distress in structures and able to give the preventive measures for it.	CO 1	T2:3.2.3 R2: 1.3
12	What is meant by Maintenance, repair and rehabilitation?	CO 2	T2:4.2.3
13-14	Understand the facets of maintenance: i) Prevention ii) Repair	CO 2	T2:4.5.2
15	Describe the various aspects of inspection.	CO 2	T2:4.7.9
16-17	Write the Assessment procedure for evaluating a damaged structure.	CO 2	T2:5.2.1 R2: 6.4
18	Identifying the diagnosis of construction failures.	CO 3	T2:5.4
19-20	Describe the Corrosion damage of reinforced concrete.	CO 3	T2:5.5.3
21-22	Different methods of corrosion protection.	CO 3	T2:6.2.2
23-24	Describe the Corrosion inhibitors, Corrosion resistant steels, cathodic protection and rust eliminators.	CO 3	R1:2.5 R2: 8.2
25-26	Describe the causes for deterioration of concrete, steel, masonry and timber structures.	CO 3	R2:2.2.5 R2: 9.2
27	Discuss the concept of surface deterioration, efflorescence.	CO 3	R3:5.6.2
28-29	Discuss different causes and preventive measures of surface deterioration and efflorescence.	CO 3	R3:5.4.8 R2: 9.6
30-31	Describe special concrete and mortar.	CO 4	T2:8.1.2
32-33	Discuss different types of special concrete such as polymer concrete Sulphur infiltrated concrete, fiber reinforced concrete, ferro cement and expansive cement.	CO 4	T2:8.3.5 R2: 5.3
34-35	Discuss different methods of repairs in concrete, steel, masonry and timber structures.	CO 4	T2:8.5
36-37	Describe strengthening techniques for existing structures.	CO 4	T2:8.9.2
38-39	Describe Various repair works to overcome low member strength, deflection, cracking, chemical disruption, weathering, wear, fire, leakage, marine exposure.	CO 4	T2:9.2 R3: 4.6
40-41	Describe the use of Non –destructive techniques for evaluation.	CO 5	T2:9.5.3
42-43	Describe a case study of demolition of structure using engineered technique.	CO 6	T2:9.6.2 R3: 8.5

44-45	Describe some of the non-engineered techniques used for demolition of structures.	CO 6	T2:9.7.5 R3: 8.12
PROBLEM SOLVING / CASE STUDIES			
1	Introduction to Rehabilitation and Retrofitting of Structures.	CO 1	T2:26.3 R2: 3.1
2	Analyzing the damage of structures in detail.	CO 1	T1:8.1
3	Describe the mechanism of damage and types of damage.	CO 1	T2:2.2.2
4	Understand the facets of maintenance i) Prevention ii)Repair	CO 2	T2:26.3 R2: 3.1
5	Describe the various aspects of inspection.	CO 2	T2:26.3 R2: 3.1
6	Write the Assessment procedure for evaluating a damaged structure.	CO 2	T2:5.2.1 R2: 6.4
7	Different methods of corrosion protection.	CO 3	T2:26.3 R2: 3.1
8	Discuss different causes and preventive measures of surface deterioration and efflorescence.	CO 3	T2:26.3 R2: 3.1
9	Discuss different methods of repairs in concrete, steel, masonry and timber structures.	CO 4	T2:26.3 R2: 3.1
10	Describe strengthening techniques for existing structures.	CO 4	T2:26.3 R2: 3.1
11	Describe Various repair works to overcome low member strength, deflection, cracking, chemical disruption, weathering, wear, fire, leakage, marine exposure.	CO 4	T2:9.2 R3: 4.6
12	Non –destructive techniques for evaluation.	CO 5	T2:26.3, R2: 3.1
13	Introduction to Rehabilitation and Retrofitting of Structures.	CO 5	T2:26.3 R2: 3.1
14	Study of demolition of structure using engineered technique.	CO 6	T2:26.3 R2: 3.1
15	Non-engineered techniques used for demolition of structures.	CO 6	T2:26.3 R2: 3.1
DISCUSSION OF DEFINATION AND TERMINOLOGY			
1	Introduction	CO 1	R4:2.1
2	Maintenance and diagnosis of failure	CO 2	T4:7.3
3	Damages and their remedies	CO 3	R4:5.1
4	Materials and techniques of repair	CO 4	T1:7.5
5	Strengthening and demolition aspect	CO 4,5	T1: 4.1

DISCUSSION OF QUESTION BANK			
1	Introduction	CO 1	R4:2.1
2	Maintenance and diagnosis of failure	CO 2	T4:7.3
3	Damages and their remedies	CO 3	R4:5.1
4	Materials and techniques of repair	CO 4	T1:7.5
5	Strengthening and demolition aspect	CO 4,5	T1: 4.1

Signature of Course Coordinator **HOD,CE**
Mr. K. Anand Goud, Assistant Professor