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

COURSE DESCRIPTION

Department	**CIVIL ENGINEERING**				
Course Title	**ENGLISH**				
Course Code	AHSC01				
Program	B. Tech				
Semester	I				
Course Type	Foundation				
Regulation	UG-20				
Course Structure	Theory			Practical	
	Lecture	Tutorials	Credits	Laboratory	Credits
	2	-	2	-	-
- Course Coordinator	Dr. M.Sailaja, Associate 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). 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
37%	Remember
63 %	Understand
-	Apply
-	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		Marks	Total Marks
CIA	Continuous Internal Examination – 1 (Mid-term)	10	30
	Continuous Internal Examination – 2 (Mid-term)	10	
	AAT-1	5	
	AAT-2	5	
SEE	Semester End Examination (SEE)	70	70
Total Marks			100

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:

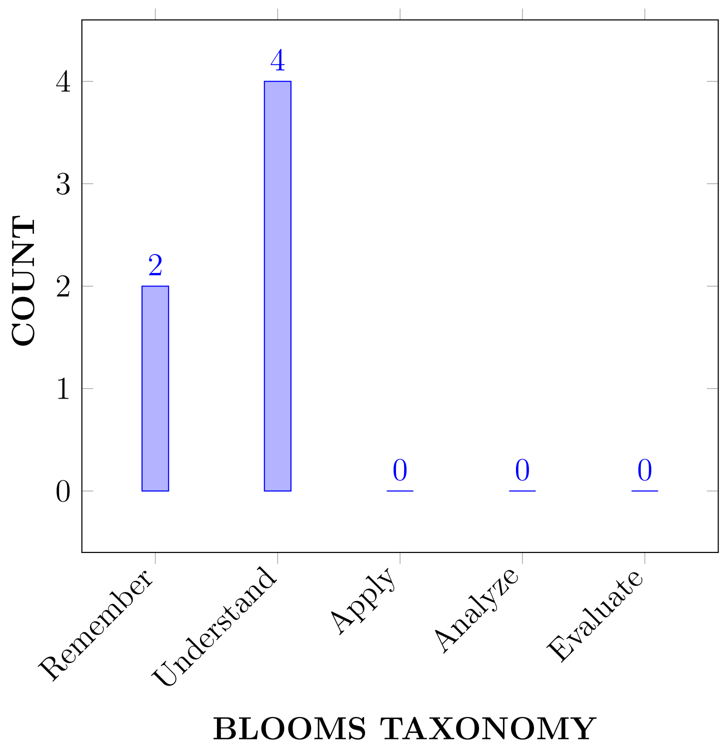
I	Standard pronunciation, appropriate word stress, and necessary intonation patterns for effective communication towards achieving academic and professional targets.
II	Appropriate grammatical structures and also using the nuances of punctuation tools for practical purposes.
III	A critical aspect of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

VII COURSE OUTCOMES:

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

CO 1	**Discuss** the prime necessities of listening skill for academic and non-academic purposes.	Remember
CO 2	**Illustrate** appropriate speaking strategies to explain a topic in a clear-cut manner.	Understand
CO 3	**Choose** acceptable language for developing life skills to overcome the challenges at professional platform.	Understand
CO 4	**Interpret** the grammatical aspects effectively in speaking and writing at functional usage.	Understand
CO 5	**Describe** the importance of reading skill and various strategies to enhance professional growth and success.	Remember
CO 6	**Summarize** writing skills for fulfilling the academic and non-academic requirements of various written communicative functions.	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 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	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	-	-	-	-	-	-	-	-	-	✓	-	-	-	-	-

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	-	-	-	-	-	-	-	-	-	✓	-	-	-	-	

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 10	Discuss the heeds of functional grammar and punctuation tools in speaking and writing by generating the clarity of an audio text.	5
CO 2	PO 10	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 8	T1:103.103
38	Introduction to informal letters.	CO 7	TI:105.108
39	Introduction to formal letters.	CO 7	TI:109.110
40	Introduction of email writing and formal and informal emails.	CO 7	TI:111.112
41	Significance of Report Writing.	CO 8	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 8	TI:100,102
55	Logical bridges and Verbal bridges in writing.	CO 8	TI:102,104
56	Soft skills and Interpersonal Communication.	CO 8	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 23	TI: 9,10
66	Problem solving and decision making.	CO 3	TI: 9,10

Signature of Course Coordinator **HOD**

INSTITUTE OF AERONAUTICAL ENGINEERING
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COURSE DESCRIPTION

Department	**CIVIL ENGINEERING**				
Course Title	**LINEAR ALGEBRA AND CALCULUS**				
Course Code	AHSC02				
Program	B.Tech				
Semester	I				
Course Type	Foundation				
Regulation	UG - 20				
Course Structure	Theory			Practical	
	Lecture	Tutorials	Credits	Laboratory	Credits
	3	1	4	-	-
Course Coordinator	Mr. P Shantan Kumar, Assistant Professor				

I COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites
10+2	-	-	Basic Principles of Algebra and Calculus

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 and Fourier series expansions 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 Calculus	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 Table: 1.

Table 1: The expected percentage of cognitive level of questions in SEE.

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 20 marks for continuous internal examination (CIE) and 10 marks for Alternative Assessment Tool (AAT).

Component		Marks	Total Marks
CIA	Continuous Internal Examination – 1 (Mid-term)	10	30
	Continuous Internal Examination – 2 (Mid-term)	10	
	AAT-1	5	
	AAT-2	5	
SEE	Semester End Examination (SEE)	70	70
Total Marks			100

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:

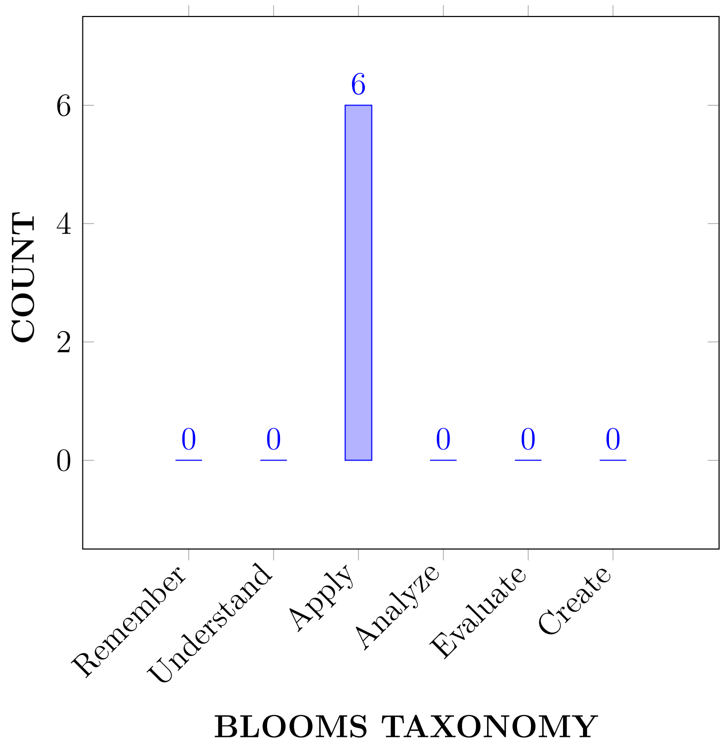
I	The principles of Eigen value analysis and linear transformations, Matrix rank finding methods.
II	The calculus of functions of several variables and the concept of maxima-minima for a three-dimensional surface.
III	The analytical methods for solving higher order differential equations with constant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

VII COURSE OUTCOMES:

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

CO 1	**Compute** the rank and inverse of real and complex matrices with elementary transformation methods.	Apply
CO 2	**Use** the Eigen values, Eigen vectors for developing modal and Spectral matrices from the given matrix..	Apply
CO 3	**Make use of** Cayley Hamilton theorem for finding positive and negative powers of the matrix.	Apply
CO 4	**Utilize** the mean–value theorems and partial derivatives in estimating the extreme values for functions of several variables	Apply
CO 5	**Solve** the Second and higher order linear differential equations with constant coefficients by using substitution and method of variation of parameters..	Apply
CO 6	**Apply** the Fourier Series expansion of periodic, even and odd functions in analyzing the square wave, sine wave rectifiers.	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.
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.	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		
	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	**Explain** the role of rank and inverse of real and complex matrices in solving **complex engineering problems** by using elementary transformation methods **(principles of mathematics).**	2
CO 2	PO 1	**Determine** the Eigen values, Eigen vectors, Spectral matrix **complex engineering problems modeled by matrices** with help of Characterstic Equation **(principles of mathematics).**	2
	PO 2	**Model** the problem into matrices, prepare precise **statement** of the problem and apply the concepts of Eigen values and Eigen vectors to **develop the solution** and **interpret, validate** the results through proper **documentation**	6
CO 3	PO 1	**Make use of** Cayley Hamilton theorem for finding positive and negative powers of the matrix and apply them in the **complex engineering problems** modeled by matrices **(principles of mathematics).**	2
CO 4	PO 1	**Explain** the mean–value theorems for the single variable functions andthe extreme values for functions of several variables apply them in the **complex engineering problems** Ordinary and Partial derivatives .	2

CO 5	PO 1	**Determine**the solution of **complex engineering problems** modeled by Second and higher order linear differential equations with constant coefficients by using substitution method and method of variation of parameters.	2
	PO 2	**Model** the problem with the help of ordinary differential equations, prepare precise **statement** of the problem and apply method of variation of parameters and other analytical methods to **develop the solution** and **interpret, validate** the results through proper **documentation**	6
CO 6	PO 1	**Build** the Fourier series expansion **for the complex engineering problems** modeled by given periodic, even and odd functions in various intervals with the help of Fourier coefficients formulae **(principles of mathematics).**	2
	PO 2	**Model** the problem with the help of suitable periodic functions, prepare precise **statement** of the problem and apply Fourier series expansions to **develop the solution** and **interpret, validate** the results through proper **documentation**	6

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

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

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

COURSE	PROGRAM OUTCOMES												PSO'S		
OUTCOMES	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO 1	67	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 2	67	60	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 3	67	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 4	67	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 5	67	60	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 6	67	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		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO 1	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 2	3	3	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 3	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 4	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 5	3	3	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 6	3	3	-	-	-	-	-	-	-	-	-	-	-	-	-
TOTAL	18	9	-	-	-	-	-	-	-	-	-	-	-	-	-
AVERAGE	3	3	-	-	-	-	-	-	-	-	-	-	-	-	-

XVI ASSESSMENT METHODOLOGY DIRECT:

CIE Exams	✓	SEE Exams	✓	Assign-ments	-	Seminars	-
Labora-tory Practices	-	Student Viva	-	Mini Project	-	Certifica-tion	-
Term Paper	-	Tech - talk	✓	Concept Video	✓	-	-

XVII ASSESSMENT METHODOLOGY-INDIRECT:

x	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, finding rank of a matrix by reducing to Echelon form and Normal form; Finding the inverse of a matrix using Gauss-Jordan 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; Diagonalization of matrix.
MODULE III	**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, Jacobian, functional dependence, maxima and minima of functions with two variables and three variables. Method of Lagrange multipliers.
MODULE IV	**HIGHER ORDER LINEAR DIFFERENTIAL EQUATIONS**
	Linear differential equations of second and higher order with constant coefficients. Non-homogeneous term of the type f(x) = e^{ax} , sinax , cosax , x^n , e^{ax}v(x) and Method of variation of parameters.
MODULE V	**FOURIER SERIES**
	Fourier expansion of periodic function in a given interval of length 2π; Fourier series of even and odd functions; Fourier series in an arbitrary interval;

TEXT BOOKS

1. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 36^{th} Edition, 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, 9^{th} Edition, John Wiley & Sons, 2006.
2. Veerarajan T., Engineering Mathematics for first year, Tata McGraw-Hill, New Delhi, 2008.
3. D. Poole, Linear Algebra: A Modern Introduction, 2^{nd} Edition, Brooks/Cole, 2005.

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	Outcome based education	-	-
CONTENT DELIVERY (THEORY)			
2	Theory of Matrices: Types of Real Matrices	CO 1	T2:32.1 R1:4.1
3	Real Matrices: Symmetric, Skew-Symmetric Matrices	CO 1	T2:32.1 R1:4.2
4	Real Matrices: Orthogonal Matrices	CO 1	T2:32.1 R1:4.3
5	Complex Matrices: Hermitian, Skew- Hermitian	CO 1	T2:32.1 R1:4.3
6	Complex Matrices: Unitary Matrices	CO 1	T2:32.5 R1:4.6
7	Elementary Operations: Elementary Row and Column Transformations	CO 1	T2:32.5 R1:4.6
8	Rank of a Matrix by Echelon Form	CO 1	T2:32.4 R1:4.5
9	Rank of a Matrix by Normal Form	CO 1	T2:32.7 R1:4.8
10	Inverse of a Matrix by Gauss-Jordan Method	CO 1	T2-7.1 R1:7.4
11	Eigen Values of a Matrix	CO 2	T2-7.1 R1:7.4
12	Eigen Vectors of a Matrix	CO 2	T2-7.1 R1:7.4
13	Diagonalization of Matrix by Linear Transformation.	CO 2	T2:7.1 R1:7.4
14	Cayley-Hamilton Theorem- Statement, Verification	CO 3	T2:7.1 R1:7.4
15	Applications of Cayley – Hamilton: Finding Inverse and Powers of a Matrix	CO 3	T3-2.9 R1:2.1
16	Linear Dependence and Independence of Vectors	CO 2	T3-2.5 R1:2.8
17	Mean Value Theorems:1: Rolle's Theorem	CO 4	T3-2.5 R1:2.8
18	Mean Value Theorems:2: Lagrange's Theorem	CO 4	T3-2.5 R1:2.8

19	Mean Value Theorems:3: Cauchy's Theorem	CO 4	T3-2.5 R1:2.8
20	Functions of Several Variables: Partial Differentiation	CO 4	T3-2.5 R1:2.8
21	Jacobian Transformations	CO 4	T3-2.61 R1:2.10
22	Functional Dependence	CO 4	T1-7.1 R2:7.5
23	Maxima and Minima of Functions with Two Variables	CO 4	T3-2.61 R1:2.10
24	Maxima and Minima of Functions with Three Variables	CO 4	T1-7.1 R2:7.6
25	Application Method of Lagrange Multipliers	CO 4	T1-7.1 R2:7.7
26	Method of Lagrange Multipliers	CO 4	T3-2.5 R1:2.8
27	Linear Differential Equations of Second and Higher Order with Constant Coefficients	CO 5	T3-2.5 R1:2.8
28	Linear Differential Equations of Second and Higher Order with Constant Coefficients	CO 5	T3-2.5 R1:2.8
29	Non-Homogeneous term of the type F (X) = e^{ax}	CO 5	T3-2.5 R1:2.8
30	Non-Homogeneous term of the type F (X) = Sinax , Cosax	CO 5	T2-7.1 R1:7.4
31	Non-Homogeneous term of the type F (X) = X^n	CO 5	T2:7.1 R1:7.4
32	Non-Homogeneous term of the type F (X) = e^{ax}v(X)	CO 5	T2:7.1 R1:7.4
33	Method of Variation of Parameters	CO 5	T3-2.9 R1:2.1
34	Fourier Expansion of Periodic Function in a Given Interval of Length 2π	CO 6	T3-2.5 R1:2.8
35	Fourier Expansion of Periodic Function in a Given Interval of Length $(-\pi,\pi)$	CO 6	T3-2.5 R1:2.8
36	Fourier Series of Even Functions in a Given Interval of Length $(-\pi,\pi)$	CO 6	T2:7.1 R1:7.4
37	Fourier Series of Odd Functions in a Given Interval of Length $(-\pi,\pi)$	CO 6	T3-2.9 R1:2.1
38	Fourier Series in an Arbitrary Interval (0,2l)	CO 6	T3-2.5 R1:2.8
39	Fourier Series in an Arbitrary Interval (-l,l)	CO 6	T2:7.1 R1:7.4
40	Half- Range Fourier Sine Expansions in a Given Interval of Length $(0,\pi)$	CO 6	T3-2.9 R1:2.1

41	Half- Range Fourier Cosine Expansions in a Given Interval of Length (0,π)	CO 6	T3-2.5 R1:2.8
PROBLEM SOLVING/ CASE STUDIES			
42	Rank of the Matrix by Echelon and Normal Form	CO 1	T2:32.1 R1:4.2
43	Eigen Values and Eigen Vectors of The Matrix	CO 2	T2:32.1 R1:4.3
44	Finding Powers of the Matrix by Cayley Hamilton Theorem	CO 3	T2:32.1 R1:4.3
45	Finding Spectral Matrix by Linear Transformation.	CO 2	T2-7.1 R1:7.4
46	Jacobian Transformation in Cartesian and Polar Forms	CO 4	T2-7.1 R1:7.4
47	Finding Functional Relationship.	CO 4	T2:7.1 R1:7.4
48	Finding Critical Points.	CO 4	T2:7.1 R1:7.4
49	Solving Non-Homogeneous Differential Equations.	CO 5	T3-2.5 R1:2.8
50	Solving Second Order Non-Homogeneous Differential Equations by Method of Variation of Parameters.	CO 5	T3-2.5 R1:2.8
51	Finding Fourier Series	CO 6	T3-2.5 R1:2.8
52	Fourier Expansion of Periodic Function in a Given Interval of Length 2π	CO 6	T3-2.5 R1:2.8
53	Fourier Expansion of Periodic Function in a Given Interval of Length (-π,π)	CO 6	T3-2.61 R1:2.10
54	Fourier Series in An Arbitrary Interval (-l,l)	CO 6	T2:7.1 R1:7.4
55	Finding Fourier Sine Series in Interval (0,l)	CO 6	T3-2.9 R1:2.1
56	Finding Fourier Cosine Series in Interval (0,l)	CO 6	T3-2.5 R1:2.8
DISCUSSION OF DEFINITION AND TERMINOLOGY			
57	Real, Complex Matrices and Rank of a Matrix	CO 1	T3-2.5 R1:2.8
58	Eigen Values and Eigen Vectors, Diagonalization	CO 2,C0 3	T3-2.5 R1:2.8
59	Mean Value Theorems, Jacobian Transformations, Functionally Dependent and Independent	CO 4	T3-2.5 R1:2.8
60	Higher Order Differential Equations	CO 5	T3-2.5 R1:2.8
61	Fourier Series (Even, Odd, Neither Functions)	CO 6	T3-2.61 R1:2.10

DISCUSSION OF QUESTION BANK			
62	Theory of Matrices	CO 1	T2:7.1 R1:7.4
63	Linear Transformations	CO 2,C0 3	T3-2.9 R1:2.1
64	Functions of Several Variables	CO 4	T3-2.5 R1:2.8
65	Higher Order Differential Equations	CO 5	T2:32.1 R1:4.3
66	Fourier Series.	CO 6	T2-7.1 R1:7.4

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

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

CIVIL ENGINEERING

COURSE DESCRIPTION

Course Title	**ENGINEERING PHYSICS**					
Course Code	AHSC03					
Program	B.Tech					
Semester	I	AE/CE/ECE/EEE/ME				
Course Type	Foundation					
Regulation	IARE - UG 20					
Course Structure	Theory			Practical		
	Lecture	Tutorials	Credits	Laboratory	Credits	
	3	-	4	3	1.5	
Course Coordinator	Ms.Sujani Singavarapu, Assistant Professor					

I COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites
10+2	-	-	Basic Principles of Physics

II COURSE OVERVIEW:

This course is structured specifically to make the students understand some of the core topics in physics essential for further studies in engineering. It focuses on illustrating and developing an understanding of the interplay between problem solving and their practical applications which include experimental techniques and modern equipment. The topics include quantum mechanics, semiconductors, LASER and fiber optics,light and optics, harmonic oscillations and waves in one dimension. At the end, this course helps students to appreciate the diverse real-time applications in technological fields in respective branches.

III MARKS DISTRIBUTION:

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

IV DELIVERY / INSTRUCTIONAL METHODOLOGIES:

✓	PPT	✓	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 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 below.

Percentage of Cognitive Level	Blooms Taxonomy Level
0 %	Remember
66.7 %	Understand
33.3 %	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).

<table>
<tr><th colspan="2">Component</th><th>Marks</th><th>Total Marks</th></tr>
<tr><td rowspan="4">CIA</td><td>Continuous Internal Examination – 1 (Mid-term)</td><td>10</td><td rowspan="4">30</td></tr>
<tr><td>Continuous Internal Examination – 2 (Mid-term)</td><td>10</td></tr>
<tr><td>AAT-1</td><td>5</td></tr>
<tr><td>AAT-2</td><td>5</td></tr>
<tr><td>SEE</td><td>Semester End Examination (SEE)</td><td>70</td><td>70</td></tr>
<tr><td colspan="3">Total Marks</td><td>100</td></tr>
</table>

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. **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 below.

Concept Video	Tech-talk	Complex Problem Solving
50%	50%	-

VI COURSE OBJECTIVES:

The students will try to learn:

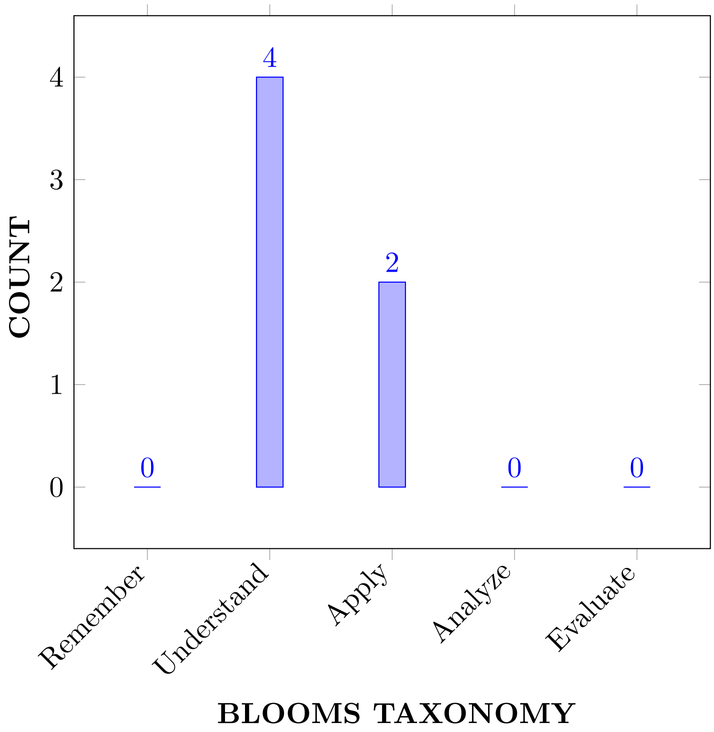
I	Basic formulations in wave mechanics for the evolution of energy levels and quantization of energies for a particle in a potential box with the help of mathematical description.
II	Fundamental properties of semiconductors including the band gap, charge carrier concentration, doping and charge carrier transport mechanisms.
III	Simple optical setups and experimental approaches of light and LASER using its interaction with matter.
IV	Basic comparative studies between different harmonic oscillators and different waves using such relationships on practical problems. .

VII COURSE OUTCOMES:

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

CO 1	**Apply** the concepts of dual nature of matter and Schrodinger wave equation to a particle enclosed in simple systems.	Understand
CO 2	**Demonstrate** the classification of solids and important aspects of semiconductors in terms of carrier concentration and Fermi level.	Apply
CO 3	**Compare** the concepts of LASER and normal light in terms of mechanism and working principles for applications in various fields and scientific practices.	Understand
CO 4	**Explain** functionality of components in optical fiber communication system by using the basics of signal propagation, attenuation and dispersion.	Understand
CO 5	**Interpret** the phenomenon of interference and diffraction by using the principles of wave motion and superposition.	Understand
CO 6	**Make use of** the concept of simple harmonic motion and arrive at expressions for damped, forced harmonic oscillators and wave equations by using necessary mathematical formulations.	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/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/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	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	Laboratory experiments

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	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key Competencies
CO 1	PO 1	**Outline** drawbacks of classical mechanics,basic principles of dual nature of matter wave,derive mathematical equation of matter waves and come to conclusion of quantization of energy used in quantum dots.	3
	PO 2	**Explain** the given **problem statement** and **formulate** quantum confinement problems related to particle enclosed in small dimension from the provided **information** and **data** in reaching substantial conclusions by the **interpretation of results**	4
	PSO 3	**Make use of** the knowledge of **quantum mechanics in experimental tools.**	1

CO 2	PO 1	**Illustrate** the charge transport mechanism in intrinsic and extrinsic semiconductors using energy level diagrams,calculate their charge carrier concentration and use those expressions to integrate with other engineering disciplines.	3
	PO 2	**Explain** the given problem statement and formulate mobility and conductivity aspects of a material from the provided information and data in reaching substantial conclusions **by the interpretation** of **Hall coefficient value.**	4
	PO 4	**Identify** the use of semiconductors under study and their conduction mechanism for the **research based knowledge** and **technological development.**	2
CO 3	PO 1	**Compare** the concepts of LASER and normal light in terms of mechanism and **working principles** for **applications** in different fields and **scientific practices.**	3
CO 4	PO 1	**Explain** functionality of components in optical fiber communication **system** by using the **basics** of signal propagation, attenuation and dispersion.	3
	PO 2	**Identify the given problem** and **formulate** expressions for acceptance angle and numerical aperture with the given **information and data** by applying principles of information propagation through optical wave guides.	4
CO 5	PO 1	**Outline** the **scientific principles** of light and its propagation evolution of different theories, and use the principles of wave motion and superposition using **mathematical principles** to understand the interference and diffraction phenomena in light	3
	PO 4	**Explain** from **technical literature the knowledge of the equipment** on which scientists performed experiments to understand the superposition of light and pattern formation by relating it to conditions for constructive and destructive interference.	2
CO 6	PO 1	**Outline** the basic **scientific principles** of force and characteristics of a simple harmonic oscillator to understand the forces acting on given oscillator to arrive at equations of damped,forced oscillators and wave equations using basic **mathematical principles**	3
	PO 2	**Explain** how damping and forced oscillations happen in a system and **identify the problems** and advantages for different conditions of damping.	4

	PSO 1	**Make use of** the knowledge of harmonic oscillations while designing the structure of buildings **to avoid damping and noise.**	1

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

COURSE OUTCOMES	Program Outcomes/ No. of Key Competencies Matched												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	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 5	3	-	-	2	-	-	-	-	-	-	-	-	-	-	-
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	-	18	-	-	-	-	-	-	-	-	-	-	-
CO 3	100	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 4	100	40	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 5	100	-	-	18	-	-	-	-	-	-	-	-	-	-	-
CO 6	100	40	-	-	-	-	-	-	-	-	-	-	35	-	-

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												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	-	-	1	-	-	-	-	-	-	-	-	-	-	-
CO 6	3	2	-	-	-	-	-	-	-	-	-	-	1	-	-
TOTAL	18	8	-	2	-	-	-	-	-	-	-	-	1	-	
AVERAGE	3	2	-	1	-	-	-	-	-	-	-	-	1	-	-

XVI ASSESSMENT METHODOLOGY DIRECT:

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

XVII ASSESSMENT METHODOLOGY INDIRECT:

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

XVIII SYLLABUS:

MODULE I	**QUANTUM MECHANICS**
	Introduction to quantum physics, De-broglie's hypothesis, Wave-particle duality, Davisson and Germer experiment, Time-independent Schrodinger equation for wave function, Physical significance of the wave function, Schrodinger equation for one dimensional problems–particle in a box.
MODULE II	**INTRODUCTION TO SOLIDS AND SEMICONDUCTORS**
	Introduction to classical free electron theory and quantum theory, Bloch's theorem for particles in a periodic potential (Qualitative treatment), Kronig-Penney model (Qualitative treatment), classification: metals, semiconductors, and insulators. Intrinsic and extrinsic semiconductors, Carrier concentration, Dependence of Fermi level on carrier-concentration and temperature, Hall effect
MODULE III	**LASERS AND FIBER OPTICS**
	Characteristics of lasers, Spontaneous and stimulated emission of radiation, Metastable state, Population inversion, Lasing action, Ruby laser, He-Ne laser and applications of lasers. Principle and construction of an optical fiber, Acceptance angle, Numerical aperture, Types of optical fibers (Single mode, multimode, step index, graded index), Optical fiber communication system with block diagram and Applications of optical fibers .
MODULE IV	**LIGHT AND OPTICS**
	Principle of superposition of waves, Young's double slit experiment, Fringe width, Newton's rings. Fraunhofer diffraction from a single slit, double slit (extension to N slits) and diffraction grating experiment.
MODULE V	**HARMONIC OSCILLATIONS AND WAVES IN ONE DIMENSION**
	Simple harmonic oscillator, Damped harmonic oscillator, Forced harmonic oscillator. Transverse waves and Longitudinal wave equation, Reflection and transmission of waves at a boundary, Harmonic waves.

TEXTBOOKS

1. P.K.Palanisamy, "Engineering Physics", SCITECH publications, 2nd Edition,2010.
2. R. K. Gaur, S. L. Gupta, "Engineering Physics", Dhanpat Rai Publications, 8th Edition, 2001.
3. Dr. K. Vijaya Kumar, Dr. S. Chandralingam, "Modern Engineering Physics", Chand & Co. New Delhi, 1st Edition, 2010.
4. Manoj.K.Harbola, T.Vijaya Krishna, T. Madhu Mohan," Engineering Physics", Cengage Publications,1st Edition, 2010.

REFERENCE BOOKS:

1. H.J. Pain, "The Physics of Vibrations and Waves", Wiley, 2006.
2. Ghatak, "Optics", McGraw Hill Education, 2012.
3. O. Svelto, "Principles of Lasers", Springer Science & Business Media, 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
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	Introduction to quantum physics- Black body radiation, Planck's law, Photoelectric effect, Compton effect	CO 1	T1:6.1 R1:1.12.1,
3	De-Broglie's hypothesis,	CO 1	T1:6.3 R1:1.16
4	Wave-particle duality -Matter wave concept	CO 1	T1:6.2 R1:1.13.1
5	Davisson and Germer experiment	CO 1	T1:6.4.1 R1:1.13.2
6	Time-independent Schrodinger equation for wave function	CO 1	T1:6.6 R1:1.13.3
7	Born interpretation of the wave function	CO 1	T1:6.6.1 R1:1.17.1
8	Schrodinger equation for one -dimensional problems– particle in a box.	CO 1	T1:6.7 R1:1.17.3
9	Introduction to classical free electron theory & quantum theory.	CO 2	T1:7.2 R1:1.17.3
10	Bloch's theorem for particles in a periodic potential,	CO 2	T1:7.4 R1:2.3
11	Kronig-Penney model (Qualitative treatment)	CO 2	T1:7.5 R1:2.3
12	Types of electronic materials: metals, semiconductors, and insulators	CO 2	T1:7.6,7.7 R1:2.6.2
13	Intrinsic semiconductors - concentration of electrons in conduction band.	CO 2	T1:8.3.1 R1:2.8
14	Intrinsic semiconductors - concentration of holes in valence band	CO 2	T1:8.3.2 R1:2.9.2
15	Extrinsic semiconductors- Carrier concentration in N-Type	CO 2	T2:8.5 R1:2.10
16	Extrinsic semiconductors- Carrier concentration in P- Type	CO 2	T1:8.6 R1:2.10
17	Dependence of Fermi level on carrier-concentration and temperature	CO 2	T1:8.5,8.6 R1:2.10.2
18	Hall effect	CO2	T1:8.9 R1:2.32
19	Introduction and characteristics of LASER	CO 3	T1:12.1. R1:8.2

20	Spontaneous and stimulated emission of radiation,Meta stable state, Population inversion, Lasing action	CO 3	T1:12.2 R1:8.3.3
21	Ruby laser,He-Ne laser	CO 3	T1:12.3,12.8 R1:8.7.2
22	Applications of LASER	CO 3	T1:12.8.12.9 R1:8.7.2
23	Principle and construction of an optical fiber	CO 4	T1:13.2 R2:12.24
24	Acceptance angle, Numerical aperture	CO 4	T1:13.2 R3:12.25
25	Types of optical fibers (Single mode, multimode, step index, graded index)	CO 4	T1:13.3 R3:3.2
26	Optical fiber communication system with block diagram	CO 4	T1:13.7 R3:3.2
27	Applications of optical fibers .	CO 4	T1:13.12 R1:8.10
28	Principle of Superposition of waves	CO 5	T4:4.3 R1:8.11.1
29	Young's double slit experiment	CO 5	T4:4.7 R1:8.11.2
30	Newton's rings	CO 5	T4:4.14 R1:8.12.1
31	Fraunhofer diffraction from a single slit	CO 5	T4:4.19 R1:8.12.2
32	Fraunhofer diffraction from a Double slit	CO 5	T4:4.21 R1:8.20
33	Fraunhofer diffraction from diffraction grating	CO 5	T4:4.22 R1:8.19
34	Simple Harmonic Oscillators	CO 6	T4:2.3 R1:8.77
35	Damped harmonic oscillator	CO 6	T4:2.8,2.9 R1:7.2
36	Forced mechanical oscillators	CO 6	T4:2.14 R1:7.7
37	Impedance, Steady state motion of forced damped harmonic oscillator	CO 6	T4:2.17 R1:7.8
38	Transverse wave on a string, the wave equation on a string	CO 6	T4:3.3 R1:7.9.2
39	Longitudinal waves and the wave equation	CO 6	T4:3.7 R1:7.9.1
40	Reflection and transmission of waves at a boundary	CO 6	T4:3.4 R1:7.10
41	Harmonic waves	CO 6	T4:3.6 R1:7.11, 11.1

PROBLEM SOLVING/ CASE STUDIES			
1	De-Broglie hypothesis-wavelength expression	CO 1	T1:6.3 R1:1.161
2	Schrodinger equation for one dimensional problems–particle in a box.	CO 1	T1:6.6 R1:1.161
3	Physical significance of the wave function	CO 1	T1: 6.6.1 R1:1.161.
4	Carrier concentration	CO 2	T1:8.3-6, R1:2.8,2.10
5	Fermi level	CO 2	T1:8.5,8.6 R1: 2.10
6	Hall Effect	CO 2	T1:8.9, R1: 2.32
7	Lasers	CO 3	T1: 12.3 R3:12.26
8	Acceptance angle & Numerical aperture	CO 4	T1: 13.2 R3:12.26
9	Refractive indices of core and cladding, fractional refractive index change	CO 4	T1: 13.3 R3:12.26
10	Youngs double-slit	CO 5	T4: 4.7 R1:8.12.1
11	Fringe width	CO 5	T4: 4.7 R1:8.12.1
12	Newton rings	CO 5	T4: 4.14 R1:8.12.1
13	Diffraction grating	CO 5	T4: 4.22 R1:8.12.1
14	Simple Harmonic Oscillator	CO 6	T4:2.3 R1: 8.78
15	Harmonic waves	CO 6	T4:3.6 R1: 7.9.3
DISCUSSION OF DEFINITION AND TERMINOLOGY			
1	Quantum mechanics	CO 1	T1:6.1-6.7 R1:1.161.
2	Introduction to Solids and Semiconductors	CO 2	T1:7.2-7, 8.3-9 , R1: 2.8, 2.10
3	Lasers and Fiber Optics	CO 3, CO 4	T1: 12.1-12.9,13.2-13.12 R3:12.26
4	Light and Optics.	CO 5	T4: 4.3-4.22 R1:8.12.1

5	Harmonic Oscillations and Waves in One Dimension	CO 6	T4:2.3-3.7 R1: 8.78, 7.9.3
DISCUSSION OF QUESTION BANK			
1	Module 1	CO 1	T1:6.1-6.7 R1:1.161.
2	Module 2	CO 2	T1:6.1-6.7 R1: 2.8, 2.10
3	Module 3	CO 3, CO 4	T1: 12.1-12.9,13.2-13.12 R3:12.26
4	Module 4	CO 5	T4: 4.3-4.22 R1:8.12.1
5	Module 5	CO 6	T4:2.3-3.7 R1: 8.78, 7.9.3

Signature of Course Coordinator **HOD,FE**
Ms.Sujani Singavarapu

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

COURSE DESCRIPTION

Department	Civil Engineering				
Course Title	Python Programming				
Course Code	ACSC01				
Program	B.Tech				
Semester	I	Civil			
Course Type	Core				
Regulation	UG-20				
Course Structure	Theory			Practical	
	Lecture	Tutorials	Credits	Laboratory	Credits
	3	1	4	-	-
Course Coordinator	Mr. B Dilip chakravarthy, Assistant Professor				

I COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites
B.Tech	ACSC01	I	NIL

II COURSE OVERVIEW:

This course introduces students to writing computer programs. This course presents the principles of structured programming using the Python language, one of the most increasingly preferred languages for programming today. Because of its ease of use, it is ideal as a first programming language and runs on both the PC and Macintosh platforms. However, the knowledge gained in the course can be applied later to other languages such as C and Java. The course uses iPython Notebook to afford a more interactive experience. Topics include fundamentals of computer programming in Python,object-oriented programming and graphical user interfaces.

III MARKS DISTRIBUTION:

Subject	SEE Examination	CIE Examination	Total Marks
Python Programming	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
33.3 %	Remember
50 %	Understand
16.66 %	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		Marks	Total Marks
CIA	Continuous Internal Examination – 1 (Mid-term)	10	30
	Continuous Internal Examination – 2 (Mid-term)	10	
	AAT-1	5	
	AAT-2	5	
SEE	Semester End Examination (SEE)	70	70
Total Marks			100

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:

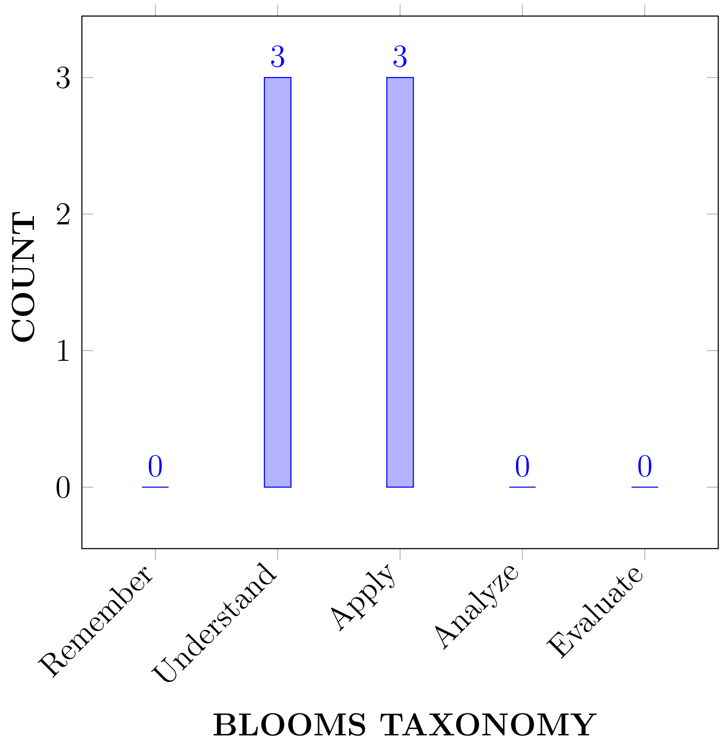
I	**Acquire programming skills in core Python**
II	**Acquire Object-oriented programming skills in Python.**
III	**Develop the skill of designing graphical-user interfaces (GUI) in Python.**
IV	**Develop the ability to write database applications in Python.**
V	**Acquire Python programming skills to move into specific branches - Internet of Things (IoT), Data Science, Machine Learning (ML), Artificial Intelligence (AI) etc.**

VII COURSE OUTCOMES:

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

CO 1	**Demonstrate** the basic concepts of python programming with the help of data types,operators, expressions, and console input/output.	Understand
CO 2	**Make use of** control statements for altering the sequential execution of programs in solving problems.	Apply
CO 3	**Demonstrate** operations on built-in container data types (list, tuple, set, dictionary) and strings.	Understand
CO 4	**Illustrate** operations and applications on strings with the help of built in functions.	Understand
CO 5	**Solve** the problems by using modular programming concepts through functions.	Apply
CO 6	**Identify** object oriented programming constructs for developing large, modular and reusable real-time programs.	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/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.	2	CIE/SEE
PO 3	**Design/Development of Solutions:** Design solutions for complex Engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and Environmental considerations	3	CIE/SEE
PO 5	**Modern Tool Usage:** Create, select, and apply appropriate techniques,resources, and modern Engineering and IT tools including prediction and modelling to complex Engineering activities with an understanding of the limitations.	3	CIE/SEE
PO 10	**Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations,and give and receive clear instructions..	3	Tech Talk/Open Ended Experiments/Concept Vedios
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	CIE/SEE

3 = High; 2 = Medium; 1 = Low

X HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

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	Tech talk /Open ended experiments
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	Tech talk /Open ended 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	Understand (knowledge) the basic concept of operators, precedence of operators and associativity while evaluating mathematical expressions in program statements. These concepts provide an insight into expression evaluation by applying the principles of mathematics and science.	3
CO 1	PO 5	With the help of modern engineering tools we can easily Understand the basic concept of operators, precedence of operators and associativity while evaluating mathematical expressions in program statements These concepts provide an insight into expression evaluation by applying the principles of mathematics and science.	1
CO 1	PO 10	Extend the knowledge of Python programming to communicate effectively with the Engineering community and society at large.	3
CO 1	PSO 1	Understand features of procedural as well as object-oriented programming while writing and analyzing computer programs in the areas related to Machine Learning, Big data and Artificial Intelligence	3
CO 2	PO 1	By applying the knowledge of mathematics,science and engineering fundameentals we can effectively use control statements.	3
CO 2	PO 2	Apply control statements in problem indentification,statement and validation .	5
CO 2	PO 3	Apply control statements to investigate and understand different complex engineering problems complex problems efficiently.	8
CO 2	PO 5	By applying control statements to model complex engineering activities	1

Course Outcomes	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key competencies matched.
CO 2	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
CO 2	PSO 1	Apply features of procedural as well as object-oriented programming while writing and analyzing computer programs in the areas related to Machine Learning, Big data and Artificial Intelligence	3
CO 2	PSO 3	Acquire sufficient knowledge of object-oriented concepts and apply it in real-time for building successful career and doing higher studies.	3
CO 3	PO 1	Summarize indexing and slicing mechanisms for extracting a portion of data in a sequence using principles of mathematics, and engineering fundamentals.	3
CO 3	PO 3	Demonstrate the importance of indexing mechanisms in sequences such as lists, strings, sets, tuple and dictionary while developing solutions for complex engineering problems and design system using principles of mathematics, science, and engineering fundamentals. Use creativity to develop more innovative solutions.	6
CO 3	PO 5	Demonstarte lists,tuples and dictionaries With the usage of modern tools	1
CO 3	PSO 1	Summarize indexing mechanisms to design and develop efficient real-time computational problems.	3
CO 3	PSO 3	Infer sufficient knowledge of container data types and apply it in real-time for building successful career and doing higher studies.	3
CO 4	PO 1	Demonstrate different modules/packages in Python while developing solutions using the fundamentals of mathematics, science, and engineering.	3
CO 4	PO 3	Understand the usage of modules/packages while developing solutions for complex engineering problems and design system using principles of mathematics, science, and engineering fundamentals. Use creativity to develop more innovative solutions.	8
CO 4	PO 5	Interpret different string functions by using modern tools	1
CO 4	PO 10	Extend the focus to understand the usage of modules/packages and communicate effectively with the Engineering community and with society at large.	3
CO 4	PO 12	Summarize string handling functions to implement in project management	7
CO 4	PSO 1	Demonsrtate different modules to understand, design and analyze computer programs in reducing time and space complexities of various applications.	3

Course Outcomes	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key competencies matched.
CO 4	PSO 3	Illustrate modern computer tools in implementing string handling mechanisms for various applications to become a successful professional in the domains.	3
CO 5	P0 1	Make use of parameter passing and different types of arguments in user-defined functions to design efficiently modular programs by applying the knowledge of mathematics, science, Engineering fundamentals.	3
CO 5	P0 2	Apply modular programming concepts for problem identification,formulation and data collection .	8
CO 5	PO 3	Select strong foundation of writing efficient modular programs using parameter passing mechanisms for career building by understanding the requirements and communicating effectively with engineering community.	7
CO 5	PO 5	Develop different functions by using modern tools	1
CO 5	PSO 1	Develop design and analyse python programming in the areas of concept of passing of parameters and arguments in functions to do modular programming.	3
CO 6	PO 1	Apply scientific principles and methodologies, Mathematical principles and other engineering disciplines for the procedural and object-oriented programming concepts used in Python.	3
CO 6	PO 2	Apply object oriented concepts in problem indentification,statement and validation .	7
CO 6	PO 3	Identify the need of object-oriented concepts while developing solutions for complex engineering problems and design system using principles of mathematics, science, and engineering fundamentals. Use creativity to develop more innovative solutions..	7
CO 6	PO 5	Develop object oriented principles using modern tools	1
CO 6	PO 10	Apply the knowledge of Python programming to communicate effectively with the Engineering community and society at large.	3
CO 6	PO 12	Identify the need of object oriented principles for preparation ad ability to engage in independent and lifelong learning	6
CO 6	PSO 1	Focus on writing programs using procedural and object oriented concepts for applications such as computational geometry, machine learning, Big data and AI by understanding and applying the engineering principles learning	3
CO 6	PSO 3	Acquire sufficient knowledge of object-oriented concepts and apply it in real-time for building successful career and doing higher studies.	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	-	-	-		3	-		3	-	-
CO 2	3	5	8	-	1	-	-	-	-	3	-	-	3	-	3
CO 3	3		6		1	-	-	-	-	-	-	-	3	-	3
CO 4	3	-	8	-	1	-	-	-	-	3	-	7	3		3
CO 5	3	8	7	-	1	-	-	-	-	-	-	-	3	-	-
CO 6	3	7	7	-	1	-	-	-	-	3	-	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
	3	10	10	11	1	5	3	3	12	5	12	12	1	3	2
CO 1	100	0.0	0.0	0.0	100	0.0	0.0	0.0	0.0	60	0.0	0.0	100	0.0	0.0
CO 2	100	50	80	0.0	100	0.0	0.0	0.0	0.0	60	0.0	0.0	100	0.0	100
CO 3	100	0.0	60	0.0	100	0.0	0.0	0.0	0.0	0.0	0.0	0.0	100	0.0	100
CO 4	100	50	80	0.0	100	0.0	0.0	0.0	0.0	60	0.0	88	100	0.0	100
CO 5	100	80	70	0.0	100	0.0	0.0	0.0	0.0	0.0	0.0	0.0	100	0.0	0.0
CO 6	100	80	70	0.0	100	0.0	0.0	0.0	0.0	60	0.0	75	100	0.0	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	-	-	-	-	3	-	-	3	-	-
CO 2	3	2	3	-	3	-	-	-	-	3	-	-	3	-	3
CO 3	3	-	3	-	3	-	-	-	-	-	-	-	3	-	3
CO 4	3	-	3	-	3	-	-	-	-	3	-	3	3	-	3
CO 5	3	2	3	-	3	-	-	-	-	-	-	-	3	-	-
CO 6	3	3	3	-	3	-	-	-	-	3	-	3	3	-	3
TOTAL	18	7	15	-	18	-	-	-	-	12	-	6	18	-	12
AVERAGE	3.0	2.3	3	-	3.0	-	-	-	-	3.0	-	3.0	3.0	-	3.0

XVI ASSESSMENT METHODOLOGY-DIRECT:

CIE Exams	✓	SEE Exams	✓	Seminars	-
Laboratory Practices	-	Student Viva	-	Certification	-
Term Paper	-	5 Minutes Video	✓	case studies	-
Assignments	-	Open ended experiments	✓		

XVII ASSESSMENT METHODOLOGY-INDIRECT:

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

XVIII SYLLABUS:

MODULE I	**Introduction to Python**
	Introduction to Python: Features of Python, History and Future of Python, Working with Python – interactive and script mode, Identifiers and Keywords, Comments, Indentation and Multi-lining, Data types – built-in data types, Operators and Expressions, Console Input/Output, Formatted printing,Built-in Functions, Library Functions.
MODULE II	**DECISION CONTROL STATEMENTS**
	Selection/Conditional Branching Statements: if, if-else, nested if, if-elif-else statement(s), Basic Loop Structures/ Iterative Statements – while and for loop, Nested loops, break and continue statement, pass Statement, else Statement used with loops..
MODULE III	**CONTAINER DATA TYPES**
	Lists: Accessing List elements, List operations, List methods, List comprehension; Tuples: Accessing Tuple elements, Tuple operations, Tuple methods, Tuple comprehension, Conversion of List comprehension to Tuple, Iterators and Iterables, zip() function. Sets: Accessing Set elements, Set operations, Set functions, Set comprehension;Dictionaries: Accessing Dictionary elements, Dictionary operations, Dictionary Functions, Nested Dictionary, Dictionary comprehension.s.
MODULE IV	**STRINGS AND FUNCTIONS**
	Strings: Accessing string elements, string properties, string operations. Functions: Communicating with functions, Variable Scope and lifetime, return statement, Types of arguments, Lambda functions, Recursive functions..
MODULE V	**CLASSES AND OBJECTS**
	Classes and Objects – Defining Classes, Creating Objects, Data Abstraction and Hiding through Classes, Class Method and self Argument, Class variables and Object variables, init() and de () method, Public and private data members, Built-in Class Attributes, Garbage Collection. OOPs Features:Abstraction, Encapsulation, Inheritance, and Polymorphism.

TEXTBOOKS:

1. Reema Thareja, "Python Programming - Using Problem Solving Approach", Oxford Press, 1st Edition, 2017.
2. Dusty Philips, "Python 3 Object Oriented Programming", PACKT Publishing, 2nd Edition,2015.

REFERENCE BOOKS:

1. Yashavant Kanetkar, Aditya Kanetkar, "Let Us Python", BPB Publications, 2nd Edition, 2019.
2. Martin C. Brown, "Python: The Complete Reference", Mc. Graw Hill, Indian Edition, 2018.
3. Michael H. Goldwasser, David Letscher, "Object Oriented Programming in Python", Prentice Hall, 1st Edition, 2007.
4. Taneja Sheetal, Kumar Naveen, "Python Programming – A Modular Approach", Pearson, 1st Edition, 2017
5. Nageswar Rao, "Core Python Programming", Dreamtech Press, 2018.

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 mapping COs with POs. (OBE)		
CONTENT DELIVERY (THEORY)			
1-2	Introduction to Python: Features of Python, History and Future of Python	CO 1	T1:3.1 –3.3
3-4	Working with Python – interactive and script mode, Identifiers and Keywords, Comments, Indentation and Multi-lining, Databtypes – built-in data types	CO 1	T1:3.4-3.9
5-8	Operators and Expressions	CO 1	T1:3.12
9-10	Console Input/Output, Formatted printing, Built-in Functions, Library Functions	CO 1	T1:3.15
11-14	Control Statement(s)	CO 2	T1: 4.1 –4.8
15-17	Lists and Tuples	CO 3	T1:3.15
18-19	Conversion of List comprehension to Tuple, Iterators and Iterables, zip() function	CO 3	T1:3.15
20-21	Sets, Dictionaries:	CO 3	T1:3.15
22-23	Nested Dictionary, Dictionary comprehension	CO 3	T1:3.15
24-25	Strings: Accessing string elements, string properties, string operations	CO 4	T1: 6.1 –6.8
26-27	Functions: Communicating with functions, Variable Scope and lifetime, return statement	CO 5	T1:5.1 –5.5

28-29	Types of arguments, Lambda functions, Recursive functions	CO 5	T1:5.6 –5.8
30-31	Classes and Objects – Defining Classes, Creating Objects	CO 6	T1 : 9.1 – 9.3
32-33	Data Abstraction and Hiding through Classes, Class Method and self Argument	CO 6	T1: 9.2 – 9.4
34-36	Class variables and Object variables, init() and del () method	CO 6	T1:9.5 – 9.7
37-38	Public and private data members, Built-in Class Attributes, Garbage Collection	CO 6	T1:9.8 – 9.13
39-41	OOPs Features: Abstraction, Encapsulation, Inheritance, and Polymorphism	CO 6	T1:10.1-10.3
PROBLEM SOLVING/ CASE STUDIES			
1	Data Types	CO 1	T1:3.7.1-3.7.4
2	Operators and Expressions	CO 1	T1:3.12.1-3.12.10
3	Built-in Functions , Library functions	CO 1	T1:6.4-6.10
4	Conditional branching Statements	CO 2	T1:4.1-4.2
5	Iterative Statements	CO 2	T1:4.3-4.8
6	Lists	CO 3	T1:8.2-8.2.10
7	Tuples	CO 3	T1:8.4.1
8	Sets	CO 3	T1:8.5.1
9	Dictionaries	CO 3	T1:8.6.1-8.6.12
10	Strings	CO 4	T1:6.1-6.10
11	Functions	CO 5	T1:5.1:5.10
12	Classes and Objects	CO 6	T1:9.1-9.15
13	__init()__and __del__() method	CO 6	T1:9.4-9.6
14	Inheritance	CO 6	T1:10.1-10.4
15	Polymorphism	CO 6	T1:10.2.1
DISCUSSION OF DEFINITION AND TERMINOLOGY			
1	Define bound and unbound variable.	CO 1	T1:9.1
2	Define a control structure?	CO 2	T1:4.1-4.8
3	How to slice lists in Python?	CO 3	T1:8.2-8.6
4	Write the syntax of defining a function?	CO 5	T1:5.1-5.2

5	List out the features of object oriented programming.	CO 6	T19.1-9.3
DISCUSSION OF QUESTION BANK			
1	Write the features and applications of Python programming language?	CO 1	T1:3.1-3.3
2	Write a program to calculate the roots of a quadratic equation?	CO 1	T1:3.5-3.7
3	Write a program to remove all duplicate elements from a list?	CO 3	T1:8.2-8.6
4	Write a program that accepts a string from user and redisplays the same string after removing vowels from it?	CO 4	T1:6.1-6.3
5	Write a program that has a class Person string name and date of birth (DOB) of a person. The program should subtract the DOB from today's date to find out whether a person is eligible for vote or not?	CO 6	T1:9.1-9.3

Course Coordinator
B Dilip Chakravarty

HOD CSE(CS)

INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

Dundigal, Hyderabad - 500 043

COURSE DESCRIPTION

Course Title	**ENGLISH LANGUAGE AND COMMUNICATION SKILLS LABORATORY**				
Course Code	AHSC04				
Program	B.Tech				
Semester	I	CE			
Course Type	Foundation				
Regulation	UG-20				
Course Structure	Theory			Practical	
	Lecture	Tutorials	Credits	Laboratory	Credits
	-	-	-	2	1
Course Coordinator	Dr. M.Sailaja, Associate 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:

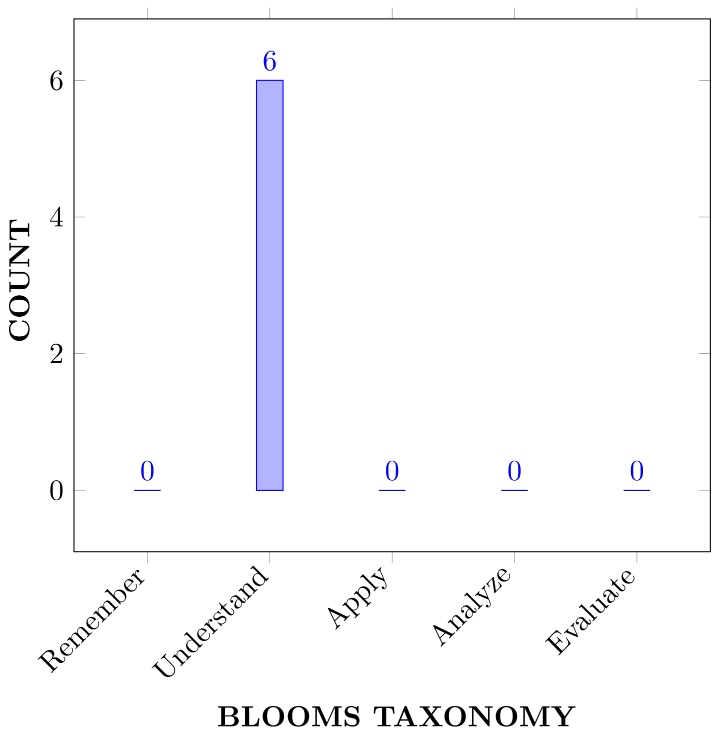
I	Facilitate computer-assisted multi-media instructions to make possible individualized and independent language learning.
II	The critical aspect of speaking and reading for interpreting in-depth meaning of the sentences.
III	Use language appropriately for social interactions such as public speaking, 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 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 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 OUTCOMES	PROGRAM OUTCOMES			PSO'S
	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. M.Sailaja, Associate Professor

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

CIVIL ENGINEERING
COURSE DESCRIPTION

Course Title	**PHYSICS LABORATORY**				
Course Code	AHSC05				
Program	B.Tech				
Semester	I	CE			
Course Type	FOUNDATION				
Regulation	IARE - UG 20				
Course Structure	Theory			Practical	
	Lecture	Tutorials	Credits	Laboratory	Credits
	-	-	-	3	1.5
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
-	-	-	Basic principles of physics	1.5

III MARKS DISTRIBUTION:

Subject	SEE Examination	CIE Examination	Total Marks
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:

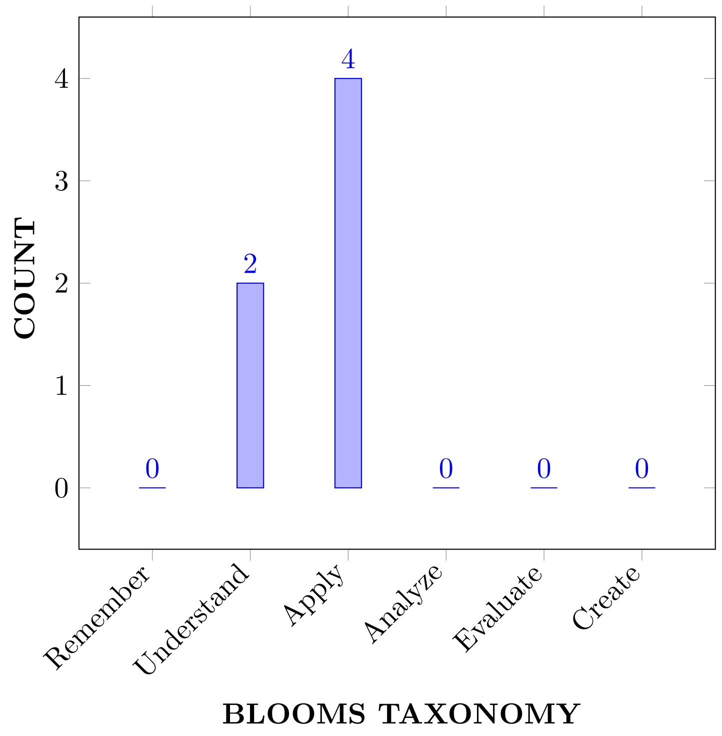
I	To familiarize with the lab facilities, equipment, standard operating procedures.
II	About the different kinds of functional electric and magnetic materials which paves a way for them to use in various technical and engineering applications.
III	The analytical techniques and graphical analysis to study 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	**Identify** the type of semiconductor using the principle of Hall Effect and also determine the energy gap of a semiconductor diode.	Apply
CO 2	**Illustrate** principle, working and application of wave propagation and compare results with theoretical harmonics and overtones.	Understand
CO 3	**Investigate** the energy losses associated with a given Ferro magnetic material and also magnetic field induction produced at various points along the axis of current carrying coil.	Apply
CO 4	**Examine** launching of light through optical fiber from the concept of light gathering capacity of numerical aperture.	Understand
CO 5	**Utilize** ththe phenomena of interference and diffraction for the determination of various parameters like radius of curvature of convex lens, wavelength of laser light and width of single slit.	Apply
CO 6	**Investigate** V-I/L-I characteristics of various optoelectronic devices like Light Emitting Diode, Photodiode to understand their basic principle of functioning as well as to infer the value of Planck's constant.	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 Hall effect and make use of mathematical expression for Hall coefficient to deduce the type of semiconductor.	2
	PO 2	Understand the given problem statement of identification of type of semiconductor and formulate Hall coefficient from experimental collection of information and data in reaching substantial conclusions by the interpretation of results.	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 energy losses associated with a given ferromagnetic material and make use of graphical representation of hysteresis loop exhibited by magnetic material.	2
	PO 2	Understand the given problem statement of energy losses associated with a given ferromagnetic material and formulate hysteresis loop from experimental collection of information and data in reaching substantial conclusions by the interpretation of results.	4
	PO 4	Apply simulation tool to get hysteresis curve of a ferromagnetic material and understand energy losses associated with material.	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	Understand the phenomenon of single slit diffraction and make use of it to determine the slit width by using laser light as monochromatic source.	1
CO 6	PO 1	Explain the V-I characteristics of light emitting diode and infer the value of planck's constant by plotting temperature versus current curve.	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 photo 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	**HAL LEFFECT (LORENTZFORCE)**
	Determination of charge carrier density.
WEEK 2	**MELDE'S EXPERIMENT**
	Determination of frequency of a given tuning fork
WEEK 3	**STEWART GEE'S APPARATUS**
	Magnetic field along the axis of current carrying coil – Stewart and Gee's method.
WEEK 4	**B-H CURVE WITH CRO**
	To determine the value of retentivity and coercivity of a given magnetic material.
WEEK 5	**ENERGY GAP OF A SEMICONDUCTOR DIODE**
	Determination of energy gap of a semiconductor diode.
WEEK 6	**PHOTO DIODE**
	Studying V-I characteristics of Photo Diode.
WEEK 7	**OPTICAL FIBER**
	Evaluation of numerical aperture of a given optical fiber.
WEEK 8	**WAVELENGTH OF LASER LIGHT**
	Determination of wavelength of a given laser light using diffraction grating.
WEEK 9	**PLANK'S CONSTANT**
	Determination of Plank's constant using LED.
WEEK 10	**LIGHT EMITTING DIODE**
	Studying V-I Characteristics of LED.
WEEK 11	**NEWTONS RINGS**
	Determination of radius of curvature of a given plano - convex lens.
WEEK 12	**SINGLE SLIT DIFFRACTION**
	Determination of width of a given single slit.

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	Determination of charge carrier density.	CO 1	T1:13.5
2	Determination of frequency of a given tuning fork.	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 the energy loss per unit volume of a given magnetic material per cycle by tracing the Hysteresis loop.	CO 3	T1:15.7
5	Determination of energy gap of a semiconductor diode.	CO 1	T1:16.8
6	Studying V-I Characteristics of Photo Diode.	CO 6	T1:16.9
7	Evaluation of numerical aperture of a given optical fiber.	CO 4	T1:17.9
8	Determination of wavelength of a given laser light using diffraction grating.	CO 5	T1:18.10
9	Determination of Plank's constant using LED.	CO 6	T1:19.10
10	Studying V-I characteristics of LED	CO 6	T1:19.9
11	Determination of radius of curvature of a given Plano-convex lens.	CO 5	T1:23.10
12	Determination of width of a given single slit.	CO 5	T1:23.10

XVI EXPERIMENTS FOR ENHANCED LEARNING (EEL):

S.No	Design Oriented Experiments
1	To determine the wavelength of different colored light using white light source by Newton's ring method
2	To study the bending losses and transmission losses of an optical Fiber
3	To observe the dispersion of prism by using spectrometer.
4	Study the characteristics of Laser diode.
5	To illustrate the interference pattern produced from the air wedge.
6	To determine the voltage current characteristics of solar cell

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

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

CIVIL ENGINEERING
COURSE DESCRIPTION

Course Title	**PYTHON PROGRAMMING LABORATORY**				
Course Code	ACAC02				
Program	B.Tech				
Semester	I	CE			
Course Type	Core				
Regulation	IARE - UG 20				
Course Structure	Theory			Practical	
	Lecture	Tutorials	Credits	Laboratory	Credits
	-	-	-	3	1.5
Course Coordinator	Ms Jalaja Vishnubhotla, Assistant Professor CSE (AI&ML)				

I COURSE OVERVIEW:
This course introduces students to writing computer programs. This course presents the principles of structured programming using the Python language, one of the most increasingly preferred languages for programming today. Because of its ease of use, it is ideal as a first programming language and runs on both the PC and Macintosh platforms. However, the knowledge gained in the course can be applied later to other languages such as C and Java.The course uses iPython Notebook to afford a more interactive experience. Topics include fundamentals of computer programming in Python, object-oriented programming and graphical user interfaces.

II COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites
B.Tech	AHSC02	I	-

III MARKS DISTRIBUTION:

Subject	SEE Examination	CIE Examination	Total Marks
PYTHON PROGRAMMING LABORATORY	70 Marks	30 Marks	100

IV DELIVERY / INSTRUCTIONAL METHODOLOGIES:

X	Demo Video	X	Lab Worksheets	X	Viva Questions	X	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	Acquire programming skills in core Python.
II	Acquire Object-oriented programming skills in Python.
III	Develop the skill of designing graphical-user interfaces (GUI) in Python.
IV	Develop the ability to write database applications in Python
V	Acquire Python programming skills to move into specific branches - Internet of Things (IoT), Data Science, Machine Learning (ML), Artificial Intelligence (AI) etc.

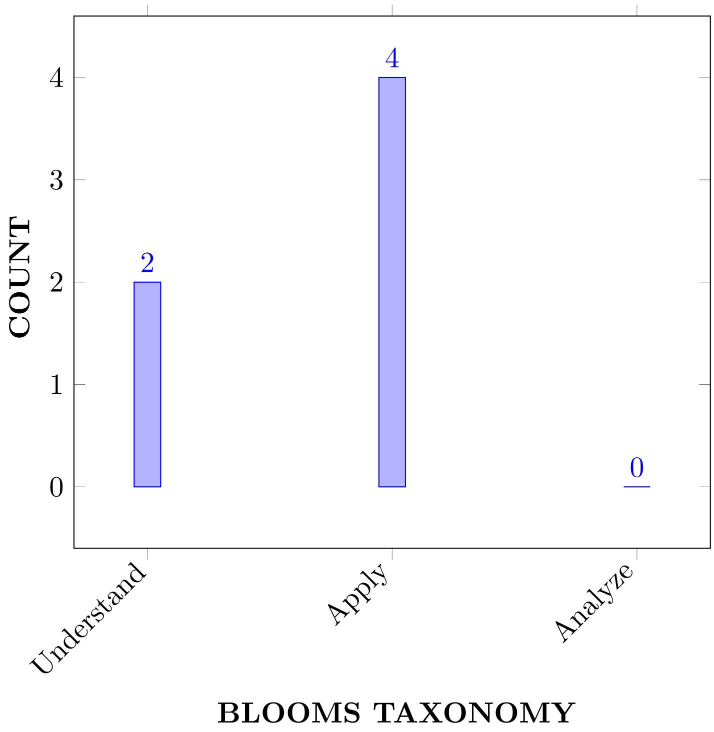
VII COURSE OUTCOMES:

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

CO 1	**Demonstrate** the basic concepts of python programming with the help of data types, operators and expressions, console input/output	Understand
CO 2	**Make use of** control statements for altering the sequential execution of programs in solving problems.	Apply
CO 3	**Demonstrate** operations on built-in container data types (list, tuple, set, dictionary) and strings.	Understand

CO 4	**Make use of** operations and applications on strings with the help of built in functions	Apply
CO 5	**Solve** the problems by using modular programming concepts through functions.	Apply
CO 6	**Identify** object-oriented programming constructs for developing large, modular and reusable real-time programs	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	CIE / SEE/ 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	CIE / SEE/ 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	CIE / SEE/ 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.	3	Lab Exercises
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	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	Demonstrate the data types of Python Programming by understating their importance and applicability (apply) in. **solving (complex) engineering problems by applying the principles of Mathematics and Engineering.**	3

	PO 2	Demonstrate the data types of Python Programming **with provided information and data in reaching substantiated conclusions by the interpretation of results.** .	3
	PO 5	Demonstrate the data types,operators,expressions and console I/O of Python Programming **for solving problems with the help of built in functions in Python programming**.	3
	PSO 3	Use datatypes,operators and expressions of Python Programming **in solving mathematical and statistical problems**	3
CO 2	PO 1	Illustrate the usage of control statements in solving real world problems **by applying principles of Mathematics, Science and Engineering.**	3
	PO 2	Illustrate the usage of control statements in solving real world problems **for visualizing the distribution of data in solving analysis problems.** .	2
	PO 5	Illustrate the usage of control statements along with built in functions of Python programming **for visualizing distribution of data with the help of built in function in Python programming language** .	3
	PSO 3	Use real time data to implement machine learning basics with Python programming **by analyzing the data and its relationships.** .	3
CO 3	PO 1	Illustrate the operations on built in container data types and strings **by applying the principles of Mathematics, Science and Engineering.** .	3
	PO 2	Illustrate the operations on built in container data types and strings in solving (complex) data centric engineering problems **from the provided information and substantiate with the interpretation of variations in the results.** .	3
	PSO 3	Implement the Python Programming basics **by exploring data analysis to solve complex problems.** .	3
CO 4	PO 1	Conclude the insights of data using exploratory data analysis **by applying the principles of Mathematics, Science and Engineering.**.	3
	PO 5	Define the list of operations on strings using built in functions **Find the different ways to model data and understand the limitations.**.	2
	PSO 3	Implement all string related operations using Python Programming programming **by exploring data limitations for generating predictions.** .	3
CO 5	PO 1	Apply the Modular Approach real world problems **by understanding the concepts of functions and code reusability**.	3

	PO 3	Understand the given problem statement and formulate (complex) engineering system **for developing a modular approach in solving problems that meet specified needs**.	2
	PO 5	Make use of functions **for creating the concept of code reusability**.	3
	PSO 3	Understand the concept of modularity by implementing different user defined and built functions **from real world problems to visualize the data to analyze the complexity.**.	3
CO 6	PO 1	Apply the knowledge of **engineering fundamentals**, and an **Mathematics and Engineering fundamentals principles to create a object oriented model on real time problems**.	3
	PO 3	Apply object oriented and modular concepts on **solving real world problems** reaching **and reusable conclusions**.	3
	PSO 3	Use built in functions in Python **for solving modular and reusable real time problems**.	3

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

COURSE OUTCOMES	PROGRAM OUTCOMES				PROGRAM OUTCOMES		
	PO 1	PO 2	PO 3	PO 5	PSO 1	PSO 2	PSO 3
CO 1	2		2	3			3
CO 2	3		3				3
CO 3	3	2	3				3
CO 4	3		3				3
CO 5	3	2	3				3
CO 6	3	2	3				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 1	**OPERATORS**
	a.Read a list of numbers and write a program to check whether a particular element is present or not using membership operators. b. Read your name and age and write a program to display the year in which you will turn 100 years old c. Read radius and height of a cone and write a program to find the volume of a cone d.Write a program to compute distance between two points taking input from the user (Hint: use Pythagorean theorem)
WEEK 2	**CONTROL STRUCTURES**
	a. Read your email id and write a program to display the no of vowels, consonants, digits and white spaces in it using if…elif…else statement. b. Write a program to create and display a dictionary by storing the antonyms of words. Find the antonym of a particular word given by the user from the dictionary using while loop c. Write a Program to find the sum of a Series 1/1! + 2/2! + 3/3! + 4/4! +…….+ n/n!. (Input :n = 5, Output : 2.70833)
WEEK 3	**LIST**
	a. Read a list of numbers and print the numbers divisible by x but not by y (Assume x = 4 and y = 5). b. Read a list of numbers and print the sum of odd integers and even integers from the list.(Ex: [23, 10, 15, 14, 63], odd numbers sum = 101, even numbers sum = 24) c. Read a list of numbers and print numbers present in odd index position. (Ex: [10, 25, 30, 47, 56, 84, 96], The numbers in odd index position: 25 47 84) d. Read a list of numbers and remove the duplicate numbers from it. (Ex: Enter a list with duplicate elements: 10 20 40 10 50 30 20 10 80, The unique list is: [10, 20, 30, 40, 50, 80])
WEEK 4	**TUPLE**
	a. Given a list of tuples. Write a program to find tuples which have all elements divisible by K from a list of tuples. testlist = [(6, 24, 12), (60, 12, 6), (12, 18, 21)], K = 6, Output : [(6, 24, 12), (60, 12, 6)] b. Given a list of tuples. Write a program to filter all uppercase characters tuples from given list of tuples. (Input: testlist = [("GFG", "IS", "BEST"), ("GFg", "AVERAGE"), ("GfG",), ("Gfg", "CS")], Output : [(GFG, IS, BEST)]). c. Given a tuple and a list as input, write a program to count the occurrences of all items of the list in the tuple. (Input : tuple = ('a', 'a', 'c', 'b', 'd'), list = ['a', 'b'], Output : 3)
WEEK 5	**SET**

	a.Write a program to generate and print a dictionary that contains a number (between 1 and n) in the form (x, x*x). b.Write a program to perform union, intersection and difference using Set A and Set B. c.Write a program to count number of vowels using sets in given string (Input : "Hello World", Output: No. of vowels : 3) d.Write a program to form concatenated string by taking uncommon characters from two strings using set concept (Input : S1 = "aacdb", S2 = "gafd", Output : "cbgf").
WEEK 6	**DICTIONARY**
	a. Write a program to do the following operations: i. Create a empty dictionary with dict() method ii. Add elements one at a time iii. Update existing keys value iv. Access an element using a key and also get() method v. Deleting a key value using del() method b. Write a program to create a dictionary and apply the following methods: i. pop() method ii. popitem() method iii. clear() method c.Given a dictionary, write a program to find the sum of all items in the dictionary
WEEK 7	**STRINGS**
	a. Given a string, write a program to check if the string is symmetrical and palindrome or not. A string is said to be symmetrical if both the halves of the string are the same and a string is said to be a palindrome string if one half of the string is the reverse of the other half or if a string appears same when read forward or backward. b. Write a program to read a string and count the number of vowel letters and print all letters except 'e' and 's'. c. Write a program to read a line of text and remove the initial word from given text. (Hint: Use split() method, Input : India is my country. Output : is my country) d. Write a program to read a string and count how many times each letter appears. (Histogram)
WEEK 8	**USER DEFINED FUNCTIONS**
	a. A generator is a function that produces a sequence of results instead of a single value. Write a generator function for Fibonacci numbers up to n. b.Write a function mergedict(dict1, dict2) to merge two Python dictionaries. c.Write a fact() function to compute the factorial of a given positive number. d.Given a list of n elements, write a linearsearch() function to search a given element x in a list.
WEEK 9	**BUILT-IN FUNCTIONS**

	a. Write a program to demonstrate the working of built-in statistical functions mean(), mode(), median() by importing statistics library b. Write a program to demonstrate the working of built-in trignometric functions sin(), cos(), tan(), hypot(), degrees(), radians() by importing math module c. Write a program to demonstrate the working of built-in Logarithmic and Power functions exp(), log(), log2(), log10(), pow() by importing math module.
WEEK 10	**CLASS AND OBJECTS**
	a.Write a program to create a BankAccount class. Your class should support the following methods for i) Deposit ii) Withdraw iii) GetBalanace iv) PinChange b.Create a SavingsAccount class that behaves just like a BankAccount, but also has an interest rate and a method that increases the balance by the appropriate amount of interest (Hint:use Inheritance). c.Write a program to create an employee class and store the employee name, id, age, and salary using the constructor. Display the employee details by invoking employeeinfo() method and also using dictionary dict. d.Access modifiers in Python are used to modify the default scope of variables. Write a program to demonstrate the 3 types of access modifiers: public, private and protected.
WEEK 11	**MISCELLANEOUS PROGRAMS**
	Write a program to find the maximum and minimum K elements in Tuple using slicing and sorted() method (Input: testtup = (3, 7, 1, 18, 9), k = 2, Output: (3, 1, 9, 18)) b. Write a program to find the size of a tuple using getsizeof() method from sys module and built-in sizeof() method c.Write a program to check if a substring is present in a given string or not d. Write a program to find the length of a string using various methods: i. Using len() method ii. Using for loop and in operator iii. Using while loop and slicing
WEEK 12	**ADDITIONAL PROGRAMS - FILE HANDLING**
	a. Write a program to read a filename from the user, open the file (say firstFile.txt) and then perform the following operations: i. Count the sentences in the file. ii. Count the words in the file. iii. Count the characters in the file. b. Create a new file (Hello.txt) and copy the text to other file called target.txt. The target.txt file should store only lower case alphabets and display the number of lines copied c.Write a Python program to store N students records containing name, roll number and branch. Print the given branch students details only.

TEXTBOOKS

1. Michael H Goldwasser, David Letscher, “Object Oriented Programming in Python”, Prentice Hall, 1st Edition, 2007.
2. Yashavant Kanetkar, Aditya Kanetkar, “Let us Python”, BPB publication, 1st Edition, 2019

3. Ashok Kamthane, Amit Kamthane, "Programming and Problem Solving with Python", McGraw Hill Education (India) Private Limited, 2018.
4. Taneja Sheetal, Kumar Naveen, "Python Programming – A modular approach", Pearson, 2017

REFERENCE BOOKS:

1. www.oikostat.ch.
2. https://realpython.com/python3-object-oriented-programming//
3. https://python.swaroopch.com/oop.html#syllabus.
4. https://python-textbok.readthedocs.io/en/1.0/ObjectOrientedProgramming.html/

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	Operators	CO 1	R1: 1
2	Control structures	CO 1	R3: 2
3	List	CO 2	R1: 7
4	Tuple	CO 2	R1: 8
5	Set	CO 3	R1: 2.4
6	Dictionary	CO 3	R1: 9
7	Strings	CO 4	R1: 10
8	User Defined Functions	CO 4	R3: 15
9	Built in Functions	CO 5	R1: 9
10	Class and Objects	CO5	R1: 10
11	Miscelaneous Programs	CO 6	R4:7
12	Additionaal programs - File Handling	CO 6	R4:10

XVI EXPERIMENTS FOR ENHANCED LEARNING (EEL):

S.No	Design Oriented Experiments
1	Python program to Right rotate a numpy array to n.
2	Python program to multiply all elements in a Dictionary.
3	Python Program to put positive and negative numbers in a seperate list.
4	Python program to remove given key from a Dictionary.

Signature of Course Coordinator **HOD, CSE(AI&ML)**
Ms Jalaja Vishnubhotla, Assistant Professor

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

CIVIL ENGINEERING
COURSE DESCRIPTION

Course Title	**CHEMISTRY**				
Course Code	AHSC06				
Program	B.Tech				
Semester	II	CIVIL			
Course Type	FOUNDATION				
Regulation	IARE - UG20				
Course Structure	Theory			Practical	
	Lecture	Tutorials	Credits	Laboratory	Credits
	2	-	2	-	-
Course Coordinator	Dr V N S R Venkateswararao, Associate Professor				

I COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites
10+2	-	-	Basic Principles of chemistry

II COURSE OVERVIEW:

The course discusses elements and compounds and their applied industrial applications. It deals with topics such as batteries, corrosion and control of metallic materials, water and its treatment for different purposes, engineering materials such as plastics, elastomers and biodegradable polymers, their preparation, properties and applications, energy sources and environmental science. Sustainable chemistry that focuses on the design of the products and processes that minimize or eliminate the use and generation of hazardous substances is also included.

III MARKS DISTRIBUTION:

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

IV DELIVERY / INSTRUCTIONAL METHODOLOGIES:

✓	PPT	✓	Chalk & Talk	x	Assignments	x	MOOCs
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
50 %	Understand
50 %	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		Marks	Total Marks
CIA	Continuous Internal Examination – 1 (Mid-term)	10	30
	Continuous Internal Examination – 2 (Mid-term)	10	
	AAT-1	5	
	AAT-2	5	
SEE	Semester End Examination (SEE)	70	70
Total Marks			100

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 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.

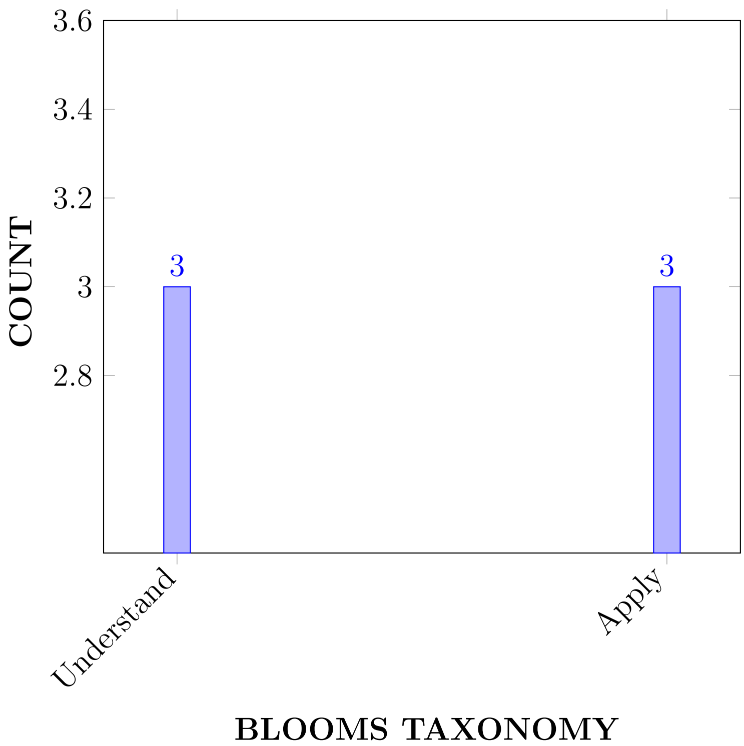
III	The polymerization reactions with respect to mechanisms and its significance in industrial applications.
IV	The significance of green chemistry to reduce pollution in environment by using natural resources.

VII COURSE OUTCOMES:

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

CO 1	**Explain** the electrochemical principles, corrosion process in metals for protection of different metals from corrosion	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	**Identify** the hardness of water by different treatment methods for finding the hardness causing salts in water.	Apply
CO 4	**Compare** different types of polymerization reactions, mechanism of lubrication for utilizing in industries.	Understand
CO 5	**Make use** of green synthesis methods, different types of solid, liquid and gaseous fuels in terms of calorific value for utilizing in industries and automobiles.	Apply
CO 6	**Outline** the different types of natural resources and their applicability for understanding the effect of pollutants on air, water and soil that cause the environmental pollution.	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		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 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		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 (COs)	POs / PSOs	Justification for mapping (Students will be able to)	No. of key competencies
CO 1	PO 1	**Explain** the operation of electrochemical systems in batteries, corrosion process in metals for protecting the metals from corrosion 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
CO 3	PO 1	**Explain** different treatment methods to produce soft water from raw water for solving **engineering problems** by applying the **principles of science.**	2
	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
CO 4	PO 1	**Illustrate** different types of polymerization reactions for synthesizing polymers from monomers, different types of lubricants to reduce friction in machines working under various temperature conditions by using **principles of science** for solving **engineering** problems	2
CO 5	PO 1	**Explain** the importance of green synthesis to minimize the generation of hazardous substances, different types of solid, liquid and gaseous fuels with their characteristics and calorific value by applying **mathematical** expressions for finding calorific value using **principles of science** and mathematics for solving engineering problems.	3

	PO 2	**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
	PO 7	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
CO 6	PO 1	**Explain** the concept of **living** and non living resources and the utility of these resources, 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	**Make use** of renewable and non renewable resources, control measures for air pollution, water pollution, soil pollution and noise pollution in **socio economic** an **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	2	2	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 4	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 5	3	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
	3	10	10	11	1	5	3	3	12	5	12	8	2	2	2
CO 1	66.6	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 2	100	20	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 3	66.6	20	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 4	66.6	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 5	100	20	-	-	-	-	66.6	-	-	-	-	-	-	-	-
CO 6	66.6	-	-	-	-	-	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
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**		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO 1	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 2	3	1	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 3	3	1	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 4	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 5	3	1	-	-	-	-	3	-	-	-	-	-	-	-	-
CO 6	3	-	-	-	-	-	3	-	-	-	-	-	-	-	-
TOTAL	18	3	-	-	-	-	6	-	-	-	-	-	-	-	-
AVERAGE	3	1	-	-	-	-	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	Early Semester Feedback	✓	End Semester OBE Feedback
X	Assessment of Mini Projects by Experts		

XVIII SYLLABUS:

MODULE I	**ELECTROCHEMISTRY AND BATTERIES**
	Electro chemical cells: Electrode potential, standard electrode potential, Calomel electrode and Nernstequation; Electrochemical series and its applications; Numerical problems; Batteries: Primary (Dry cell) and secondary batteries (Lead-acid storage battery, Li-ion battery). Corrosion: Causes and effects of corrosion: Theories of chemical and electrochemical corrosion, mechanism of electrochemical corrosion; Corrosion control methods: Cathodic protection, sacrificial anode and impressed current Cathodic protection; Surface coatings: Metallic coatings- Methods of coating- Hot dipping- galvanization and tinning, electroplating
MODULE II	**WATER TECHNOLOGY**
	Introduction: Hardness of water, causes of hardness; types of hardness: temporary and permanent hardness, expression and units of hardness; estimation of hardness of water by complexometric method; potable water and its specifications, Steps involved in the treatment of water, disinfection of water by chlorination and ozonization; External treatment of water; Ion-exchange process; Desalination of water: Reverse osmosis, numerical problems
MODULE III	**ENGINEERING MATERIALS**
	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; Biodegradable polymers. Elastomers: Natural rubber, processing of natural rubber, vulcanization; Buna-s and Thiokol rubber; Lubricants: characteristics of lubricants, mechanism of lubrication – thick film, thin film, extreme pressure lubrication, properties – flash and fire point, cloud and pour point, viscosity and oiliness of lubricants.
MODULE IV	**GREEN CHEMISTRY AND FUELS**
	Introduction: Definition of green chemistry, methods of green synthesis: aqueous phase, microwave method, phase transfer catalyst and ultra sound method. Fuels: definition, classification of fuels ; Solid fuels: coal; analysis of coal: proximate and ultimate analysis; Liquid fuels: Petroleum and its refining; Gaseous fuels: Composition, characteristics and applications of LPG and CNG; Calorific value: Gross Calorific value(GCV) and Net Calorific value(NCV), numerical problems.
MODULE V	**NATURAL RESOURCES AND ENVIRONMENTAL POLLUTION**
	Natural 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; Land resources; Energy resources: renewable and non-renewable energy sources, use of alternate energy source. Environmental pollution: Causes, effects and control measures of air pollution, water pollution, soil pollution and noise pollution.

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. Prashanth rath, B.Rama Devi, Ch.Venkata Ramana Reddy, Subhendu Chakroborty, Cengage Learning Publishers, 1st Edition, 2018
4. Anubha Kaushik, C.P.Kaushik, “Environmental Studies” New Age International publishers, 4th Edition, 2015.
5. Dr B.N.Srinivas, P.Kishore, K.Subba Rao “Engineering Chemistry” University Science Press,2015,1st Edition.

REFERENCE BOOKS:

1. 1. Dr.Bharathi Kumari, “A text book of Engineering Chemistry”, VGS Book Links, 8th Edition,2016.
2. 2. B. Siva Shankar, “Engineering Chemistry”, Tata McGraw Hill Publishing Limited, 3rd Edition, 2015.
3. 3. S. S. Dara, Mukkanti, “Text of Engineering Chemistry”, S. Chand Co, New Delhi, 12thEdition, 2006.

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	-	W1
CONTENT DELIVERY (THEORY)			
1	Outcome Based Education.		
2	Recall the concept of electro chemical cells.	CO 1	T1:6.1,R1: 2.6
3	Explain the electrode potential, standard electrode potential, electrochemical series and its applications.	CO 2	T1:6.2,R1: 2.9
4	Derive Nernst equation , numerical problems on cell potential.	CO 2	T1:6.5,R1: 2.6.3
5	Demonstate about calomel electrode. Batteries: primary (dry cell).	CO 1	T1: 6.7, R1:2.12
6	Explain the secondary batteries (Lead-acid storage battery), Li-ion battery.	CO 1	T1:6.12,R1: 2.12
7	Recognize the causes and effects of corrosion, chemical corrosion.	CO 1	T1:7.1, R1:2.14
8	Explain the electrochemical corrosion, mechanism of electrochemical corrosion.	CO 1	T1:7.2, R1:2.17
9	Explain about cathodic protection, sacrificial anode and impressed current.	CO 1	T1:7.14, R1:2.20

10	Apply metallic coatings, methods of coatings, hot dipping, galvanizing , tinning and electroplating.	CO 1	T1:7.14,R1: 2.22
11	Recall the hardness of water, causes of hardness.	CO 3	T1:1.3,R1: 1.4
12	Explain the types of hardness, temporary and permanent, units of hardness.	CO 3	T1:1.3,1.5,
13	Estimation of hardness of water by complexometric method,	CO 3	T1:1.5,R1: 1.6.2
14	Estimation of hardness of water by complexometric method.	CO 3	T1:1.14,R1: 1.6.4
15	Define potable water and its specifications, steps involved in treatment of water, disinfection of water by chlorination and ozonization.	CO 3	T1:1.12,R1: 1.6.5
16	Explain about external treatment of water; ion-exchange process.	CO 3	T1:1.11, R1:1.8.1
17	Explain about desalination of water: reverse osmosis.	CO 3	T1:1.13, R1:1.10
18	Recall polymers-classification with examples and Explain about the polymerization-addition, condensation and co- polymerization	CO 4	T1: 3.5,R1: 3.1
19	Explain the concept of compounding of plastics.	CO 4	T1:1.4, R1: 3.1.4
20	Expalin the preparation, properties and applications of polyvinyl chloride, teflon.	CO 4	T1:3.5,R1: 3.2
21	Explain the bakelite and nylon-6, 6.	CO 4	T1: 3.12,R1: 3.2.2
22	Define biodegradable polymers, synthetic biodegradable polymers.	CO 4	T1:3.14,R1: 3.2.3
23	Explain rubbers, natural rubber its process and vulcanization, Buna-s and thiokol rubber.	CO 4	T1: 3.15, R1:3.2.3
24	Elastomers: Synthetic rubbers,Buna-s and thiokol rubber.	CO 4	T1: 3.22, R1:3,3.4
25	Lubricants: characteristics of lubricants, mechanism of lubrication – thick film, thin film, extreme pressure lubrication.	CO 4	T1: 3.24,R1: 3.5
26	Properties–flash and fire point, cloud and pour point, viscosity and oiliness of lubricants.	CO 4	T1: 3.25,R1: 3.7
27	Definition and importance of green chemistry, methods of green synthesis: aqueous phase method.	CO 5	T5:6.8, T2:1.1
28	Explain the microwave method and phase transfer catalyst.	CO 5	T5: 6.8.3,T2: 8.1
29	Explain the ultra sound method.	CO 5	T5: 6.8.3, T2:9.2
30	Define fuels, classification of fuels and characteristics of a good fuels.	CO 5	T1:4.2, R1:6.2.1
31	Explain solid fuels, coal, Analysis of coal, proximate and ultimate analysis.	CO 5	T1:4.4.1, R1:7.1
32	Explain liquid fuels, petroleum and its refining.	CO 5	T1:4.5.2, R1:15.2
33	Explain the gaseous fuels, Composition, characteristics and applications of LPG and CNG.	CO 5	T1:4.6, R1:9.2

34	Apply the concept of calorific value, gross calorific value (GCV) and Net calorific value(NCV) to find calorific value of fuel, numerical problems.	CO 5	T1:4.8, R1:5.2
35	Recall natural resources: classification of resources, living and nonliving resources.	CO 6	T4:2.1
36	Explain the water resources: use and over utilization of surface and ground water, floods and droughts, Dams, benefits and problems.	CO 6	T4:2.2
37	Define energy resources, renewable and non-renewable energy sources.	CO 6	T4:2.3
38	Explain the alternate energy sources, land resources	CO 6	T4:2.5,5.2
39	Define environmental pollution, causes, effects and control of air pollution.	CO 6	T4: 4.2
40	Explain the causes, effects and control of water pollution.	CO 6	T4: 4.6
41	Explain the causes, effects and control of soil pollution and noise pollution.	CO 6	T4:4.12
PROBLEM SOLVING/ CASE STUDIES			
42	Problems on EMF of voltaic cell	CO 2	T1:6.2,R1: 2.9
43	Problems on EMF of a cell	CO 2	T1:6.5,R1: 2.6.3
44	Problems on electrode potential of the half cell by using Nernst equation	CO 2	T1:6.2,R1: 2.9
45	Problems on electrode potential of EMF of the cell by using Nernst equation.	CO 2	T1:6.5,R1: 2.6.3
46	Problems on temporary and permanent hardness in Degree French.	CO 3	T1:1.5, R1: 1.6.2
47	Problems on temporary, permanent and total hardness in ppm	CO 3	T1:1.14,R1: 1.6.4
48	Problems on the temporary, permanent and total hardness of water in Degree Clark.	CO 3	T1:1.5,R1: 1.6.2
49	Problems on the temporary, permanent and total hardness of water in Mg/L.	CO 3	T1:1.14,R1: 1.6.4
50	Problems on the total hardness in terms of calcium carbonate equivalents by using EDTA method.	CO 3	T1:1.5,R1: 1.6.2
51	Problems on the permanent hardness in terms of calcium carbonate equivalents by using EDTA method.	CO 3	T1:1.14,R1: 1.6.4
52	Problems on the temporary hardness in terms of calcium carbonate equivalents by using EDTA method.	CO 3	T1:1.5,R1: 1.6.2
53	Problems on the higher and lower calorific values of the fuel.	CO 5	T1:4.8, R1:5.2
54	Problems on the gross and net calorific values of the fuel.	CO 5	T1:4.8, R1:5.2
55	Problems on HCV and LCV	CO 5	T1:4.8, R1:5.2
56	Problems on GCV and NCV	CO 5	T1:4.8, R1:5.2

DISCUSSION OF DEFINITION AND TERMINOLOGY			
57	Definitions & terminology discussion on electrochemistry and corrosion	CO 1	T1:1.3,R1: 1.4
58	Definitions & terminology discussion on water technology	CO 3	T1: 3.5,R1: 3.1
59	Definitions & terminology discussion on engineering	CO 4	T1: 3.5,R1: 3.1
60	Definitions & terminology discussion on green chemistry and fuels	CO 5	T1:4.2, R1:6.2.1
61	Definitions & terminology discussion on natural resources and environmental pollution	CO 1, CO 6	T4:2.1,2.8
DISCUSSION OF QUESTION BANK			
62	Question bank discussion on electrochemistry and Corrosion	CO 1	T1: 6.1, R1:2.12
63	Question bank discussion on water technology	CO 3	T1:1.3, R1: 1.4
64	Question bank discussion on engineering materials	CO 4	T1: 3.5,R1: 3.1
65	Question bank discussion on green chemistry and fuels	CO5	T1:4.2, R1:6.2.1
66	Question bank discussion on natural resources and environmental Pollution	CO 6	T4:2.1,2.8

Course Coordinator: **HOD, CIVIL**
Dr V N S R Venkateswararao,Associate Professor

COURSE DESCRIPTION

Department	**CIVIL ENGINEERING**
Course Title	**ENGINEERING MECHANICS**
Course Code	AMEC01
Program	B. Tech
Semester	TWO
Course Type	Foundation
Regulation	UG-20
Course Coordinator	Dr. B D Y Sunil, Associate Professor

Course Structure

Theory			Practical	
Lecture	Tutorials	Credits	Laboratory	Credits
3	-	3	-	-

I COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites
B.Tech	AHSC02	1	Linear Algebra and Calculus

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). Student's performance in the course shall be judged by taking into account the results of CIA and SEE together. Table-1 shows the typical distribution of weightage for CIA and SEE..

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
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		Marks	Total Marks
CIA	Continuous Internal Examination – 1 (Mid-term)	10	30
	Continuous Internal Examination – 2 (Mid-term)	10	
	AAT-1	5	
	AAT-2	5	
SEE	Semester End Examination (SEE)	70	70
Total Marks			100

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:

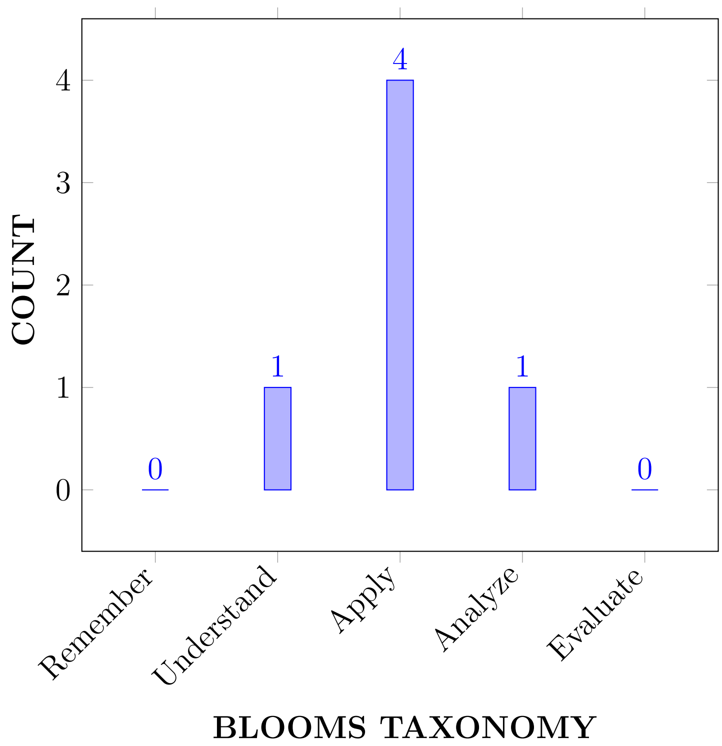
I	The application of mathematics and science principles to represent the free body diagrams in the area of rigid body mechanics.
II	The conditions of static and dynamic equilibrium of bodies subjected to a particular force system for solving the field problems.
III	The effects of force and motion while carrying out the innovative design functions of engineering.

VII COURSE OUTCOMES:

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

CO 1	**Identify** and unknown forces by free body diagrams to a given equilibrium force system through mechanics laws and derived laws.	Analyze
CO 2	**Interpret** the static and dynamic friction laws for the equilibrium state of a wedge, ladder and screw jack.	Understand
CO 3	**Identify** the centroid and centre of gravity for the simple and composite plane sections from the first principles.	Apply
CO 4	**Calculate** moment of inertia and mass moment of inertia of a circular plate, cylinder, cone and sphere from the first principles.	Apply
CO 5	**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 6	**Determine** the governing equation for momentum and vibrational phenomenon of mechanical system by using energy principles for obtaining co efficient and circular frequency.	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	Build the prototype of UAVs and aero-foil models for testing by using low speed wind tunnel towards research in the area of experimental aerodynamics.	3	CIE/Quiz/AAT
PO 2	Focus on formulation and evaluation of aircraft elastic bodies for characterization of aero elastic phenomena.	1	[CIE/Quiz/AAT]
PO 4	Make use of multi physics, computational fluid dynamics and flight simulation tools for building career paths towards innovative startups, employability and higher studies.	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
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	**INTRODUCTION TO ENGINEERING MECHANICS**
	Classification of Engineering Mechanics, Basic Terminologies in Mechanics, Laws of Mechanics, Derived Laws, Characteristics of a Force, System of Forces, Composition of Forces, Resolution of Forces, Composition of Forces by Method of Resolution, Resultant of Non-Concurrent Force System, Supports and Reactions, Free Body Diagrams, Equilibrium of Bodies, Equilibrant, Equilibrium of Connected Bodies, Moment of a Force, Varignon's Theorem, Couple, Resolution of a Force into a Force and a Couple.
MODULE II	**FRICTION**
	Frictional Force, Laws of Friction, Angle of Friction, Angle of Repose and Cone of Friction, Types of friction, Limiting friction, Static and Dynamic Friction; Ladder friction, wedge friction, screw jack & differential screw jack.
MODULE III	**CENTROID, CENTRE OF GRAVITY AND MOMENT OF INERTIA**
	Centre of Gravity, Centroid, Difference between Centre of gravity and Centroid, Determination of Centroid of Simple Figures from First Principle, Centroid of Composite Sections, Centre of Gravity from First Principles, Centre of Gravity of Composite Bodies. Moment of Inertia, Polar Moment of Inertia, Radius of Gyration, Theorems of Moment of Inertia, Moment of Inertia from First Principle, Moment of Inertia of Standard Sections and Composite sections, Mass Moment of Inertia, Determination of Mass Moment of Inertia from First Principles, Parallel Axis Theorem/Transfer Formula, Mass Moment of Inertia of Composite Bodies.
MODULE IV	**PARTICLE DYNAMICS AND WORK ENERGY PRINCIPLE**
	Kinetics of Rigid Bodies – Newton's II law, D'Alembert's principle and its applications in plane motion and connected bodies. Work, Work Done by a Varying Force, Energy, Power, Work Energy Equation for Translation, Work Done by a Spring.
MODULE V	**IMPULSE MOMENTUM AND MECHANICAL VIBRATIONS**
	Linear Impulse and Momentum, Connected Bodies, Conservation of Momentum, Coefficient of restitution, Types of Impact. Vibrations - Basic terminology, free and forced vibrations, types of pendulum, Derivation for frequency and time period of simple, compound and torsion pendulums.

TEXTBOOKS

1. Irving H. Shames (2006), "Engineering Mechanics", Prentice Hall, 4th Edition,2013
2. S. Bhavikatti, "A Text Book of Engineering Mechanics", New Age International,1st Edition, 2012
3. R. C. Hibbler (2006), "Engineering Mechanics: Principles of Statics and Dynamics", Pearson Press.

REFERENCE BOOKS:

1. F. P. Beer and E. R. Johnston (2011), "Vector Mechanics for Engineers", Vol I - Statics, Vol II, – Dynamics, Tata McGraw Hill , 9th Edition,2013.
2. A.K.Tayal, "Engineering Mechanics", Uma Publications, 14th Edition, 2013.
3. R. K. Bansal "Engineering Mechanics", Laxmi Publication, 8thEdition, 2013.
4. Basudeb Bhattacharya, "Engineering Mechanics", Oxford University Press, 2nd Edition, 2014. item K.Vijay Reddy, J. Suresh Kumar, "Singer's Engineering Mechanics Statics and Dynamics", B S Publishers, 1st 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.

OBE DISCUSSION			
1	Discussion on Objectives and Outcomes of the course Engineering Mechanics		
CONTENT DELIVERY (THEORY)			
1	Introduction to Engineering Mechanics, Classification and Laws of mechanics	CO 1	T2:5.5 R1:1.12.1
2	Force and force characteristics, System of forces	CO 1	T2:5.6 R1:1.12.3
3	Resultant, Resultant of coplanar concurrent force system	CO 1	T2:5.10 R1:1.15
4	Composition and resolution of forces, Composition of concurrent forces by method of resolution	CO 1	T2:5.15 R1:1.16
5	Free body diagram, Supports and reactions	CO 1	T2:5.17 R1:1.13.1
6	Equilibrium of bodies, Equilibrant	CO 1	T2:5.18 R1:1.13.2
7	Conditions of equilibrium	CO 1	T2:5.19 R1:1.13.3
8	Moment, Varignon's theorem, Couple	CO 1	T2:5.20 R1:1.7.1
9	Resolution of force into force and a couple	CO 1	T2:5.24 R1:1.17.3
10	Introduction to friction, Laws of friction, Important terms in friction, Types of friction	CO 2	T2:6.3 R1:2.6.1
11	Equilibrium of body on horizontal plane and rough inclined plane	CO 2	T2:6.5 R1:2.6.2
12	Effect of friction in connected bodies	CO 2	T2:5.5 R1:1.12.1
13	Friction in ladder applications	CO 2	T2:5.6 R1:1.12.3

14	Friction in wedge applications	CO 2	T2:5.10 R1:1.15
15	Screw jack, Efficiency of a screw jack and condition for maximum efficiency	CO 2	T2:5.15 R1:1.16
16	Over hauling and self-locking screws, differential screw jack	CO 2	T2:5.17 R1:1.13.1
17	Centre of gravity, Centroid, difference between centre of gravity and centroid	CO 3	T2:5.18 R1:1.13.2
18	Determination of centroid for simple sections	CO 3	T2:5.19 R1:1.13.3
19	Determination of centroid for composite sections	CO 3	T2:5.20 R1:1.7.1
20	Determination of centre of gravity of bodies, lines and arcs	CO 3	T2:5.24 R1:1.17.3
21	Moment of inertia, Radius of gyration, Polar moment of inertia, Theorems of moment of inertia	CO 4	T2:5.5 R1:1.12.1
22	Moment of inertia from first principles	CO 4	T2:5.6 R1:1.12.3
23	Moment of inertia of standard sections and composite sections	CO 4	T2:5.10 R1:1.15
24	Mass moment of inertia, Parallel axis theorem/transfer formula, Mass Moment of inertia of Composite Bodies	CO 4	T2:5.15 R1:1.16
25	Kinetics – introduction, Important terms, Newtons laws of motion, Relation between force and mass	CO 5	T2:5.17 R1:1.13.1
26	D'Alembert's principle and its application in plane motion	CO 5	T2:5.18 R1:1.13.2
27	Motion of lift, Motion of body on inclined plane, Problems	CO 5	T2:5.19 R1:1.13.3
28	D'Alembert's principle and its application for connected bodies	CO 5	T2:5.20 R1:1.7.1
29	Work, Energy and Power, Principles for problem solving using work energy method	CO 5	T2:5.24 R1:1.17.3
30	Work energy equation for translation	CO 5	T2:6.3 R1:2.6.1
31	Work done by spring	CO 5	T2:6.5 R1:2.6.2
32	Linear impulse and momentum, Conservation of momentum	CO 6	T2:5.5 R1:1.12.1
33	Impact of elastic bodies, Impact and types of impact	CO 6	T2:5.6 R1:1.12.3
34	Coefficient of restitution, Recoil of gun	CO 6	T2:5.10 R1:1.15
35	Introduction to vibrations, Free and forced vibrations, Simple harmonic motion and important terms	CO 6	T2:5.15 R1:1.16
36	Derivation for frequency and time period of simple pendulum	CO 6	T2:5.17 R1:1.13.1

37	Time period of simple pendulum when hanging from the ceiling of a lift, Gain or loss of oscillations due to change in ‘g’ and ‘l’ of simple pendulum	CO 6	T2:5.18 R1:1.13.2
38	Derivation for frequency and time period of compound pendulum	CO 6	T2:5.19 R1:1.13.3
39	Derivation for frequency and time period of torsional pendulum	CO 6	T2:5.20 R1:1.7.1
40	Oscillation of spring and arrangement of springs	CO 6	T2:5.24 R1:1.17.3
PROBLEM SOLVING/ CASE STUDIES			
1	Resultant of a force system	CO 1	T2:5.5 R1:1.12.1
2	Equilibrium of bodies	CO 1	T2:5.6 R1:1.12.3
3	Resultant by using Varignon’s theorem	CO 1	T2:5.10 R1:1.15
4	Frictional force implementation	CO 2	T2:5.15 R1:1.16
5	Ladder friction	CO 2	T2:5.17 R1:1.13.1
6	Wedge friction	CO 2	T2:5.18 R1:1.13.2
7	Screw jack	CO 2	T2:5.19 R1:1.13.3
8	Centroid of simple and composite sections	CO 3	T2:5.20 R1:1.7.1
9	Centre of gravity of simple and composite bodies	CO 3	T2:5.24 R1:1.17.3
10	Moment of inertia and mass moment of inertia	CO 4	T2:6.3 R1:2.6.1
11	D’Alembert’s principle for kinetic problems	CO 5	T2:6.5 R1:2.6.2
12	Work energy equation for translation in plane motion and connected bodies	CO 5	T2:5.5 R1:1.12.1
13	Impulse momentum for connected bodies	CO 6	T2:5.6 R1:1.12.3
14	Impact of elastic bodies	CO 6	T2:5.10 R1:1.15
15	Time period and frequency for various pendulums	CO 6	T2:5.15 R1:1.16
DISCUSSION OF DEFINITION AND TERMINOLOGY			
1	Module – 1 – Introduction to Engineering Mechanics	CO 1	T2:5.5 R1:1.12.1
2	Module – 2– Friction	CO 2	T2:5.6 R1:1.12.3
3	Module – 3 – Centroid, Centre of Gravity and Moment of Inertia	CO 3, CO4	T2:5.10 R1:1.15

4	Module – 4 – Particle Dynamics and Work Energy Principle	CO 5	T2:5.15 R1:1.16
5	Module – 5 – Impulse Momentum and Mechanical Vibrations	CO 6	T2:5.17 R1:1.13.1
DISCUSSION OF QUESTION BANK			
1	Module – 1 – Introduction to Engineering Mechanics	CO 1	T2:5.5 R1:1.12.1
2	Module – 2 – Friction	CO 2	T2:5.6 R1:1.12.3
3	Module – 3 – Centroid, Centre of Gravity and Moment of Inertia	CO 3, CO4	T2:5.10 R1:1.15
4	Module – 4 – Particle Dynamics and Work Energy Principle	CO 5	T2:5.15 R1:1.16
5	Module – 5 – Impulse Momentum and Mechanical Vibrations	CO 6	T2:5.17 R1:1.13.1

Signature of Course Coordinator **HOD,ME**

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

COURSE DESCRIPTION

Department	**CIVIL ENGINEERING**				
Course Title	**MATHEMATICAL TRANSFORM TECHNIQUES**				
Course Code	AHSC07				
Program	B.Tech				
Semester	II				
Course Type	Foundation				
Regulation	UG-20				
Course Structure	Theory			Practical	
	Lecture	Tutorials	Credits	Laboratory	Credits
	3	1	4	-	-
Course Coordinator	Mr.Satyanarayana G, Assistant Professor				

I COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites
B.Tech	AHSC02	I	Linear Algebra and Calculus
B.Tech	-	-	-
B.Tech	-	-	-

II COURSE OVERVIEW:

This course focuses on transformations from theoretical based mathematical laws to its practical applications in the domain of various branches of engineering field. The course includes the transformations such as Laplace, Fourier, applications of scalar and vector field over surface, volume and multiple integrals. The course is designed to extract the mathematical developments, skills, from basic concepts to advance level of engineering problems to meet the technological challenges.

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	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). 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).

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30 %	Understand
60 %	Apply
0 %	Analyze

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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		Marks	Total Marks
CIA	Continuous Internal Examination – 1 (Mid-term)	10	30
	Continuous Internal Examination – 2 (Mid-term)	10	
	AAT-1	5	
	AAT-2	5	
SEE	Semester End Examination (SEE)	70	70
Total Marks			100

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:

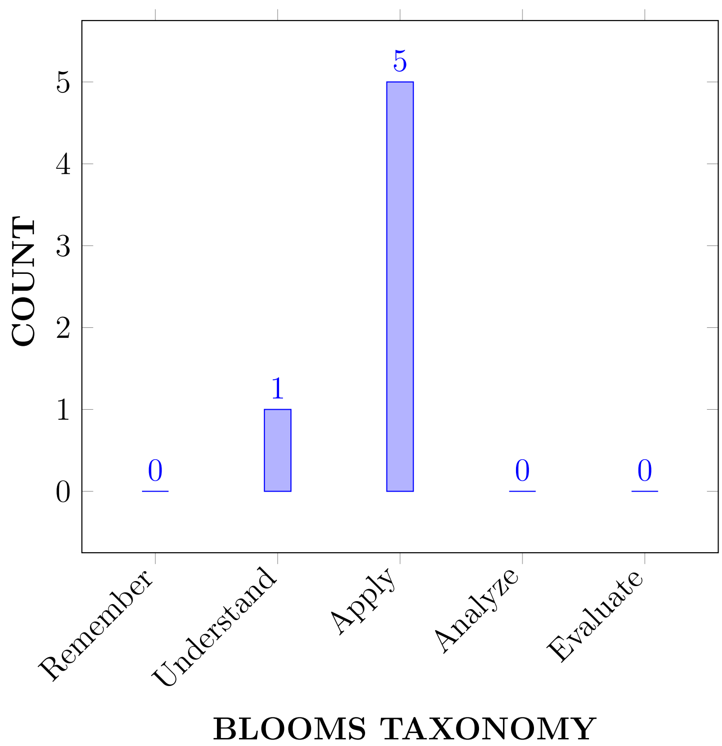
I	The transformation of ordinary differential equations in Laplace field and its applications
II	The operation of non-periodic functions by Fourier transforms.
III	The concepts of multiple integration for finding areas and volumes of physical quantities.
IV	The Integration of several functions by transforming the co-ordinate system in scalar and Vector fields.

VII COURSE OUTCOMES:

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

CO 1	**Explain** the properties of Laplace and inverse transform to various functions such as continuous, piecewise continuous, step, impulsive and complex variable functions.	Understand
CO 2	**Make use of** the integral transforms which converts operations of calculus to algebra in solving linear differential equations	Apply
CO 3	**Apply** the Fourier transform as a mathematical function that transforms a signal from the time domain to the frequency domain, non-periodic function up to infinity	Apply
CO 4	**Apply** the definite integral calculus to a function of two or more variables in calculating the area of solid bounded regions	Apply
CO 5	**Develop** the differential calculus which transforms vector functions, gradients. Divergence, curl, and integral theorems to different bounded regions in calculating areas.	Apply
CO 6	**Solve** Lagrange's linear equation related to dependent and independent variables the nonlinear partial differential equation by the method of Charpit concern to the 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.

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	

PROGRAM OUTCOMES		Strength	Proficiency Assessed by
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	
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 properties of Laplace and inverse transform to to **complex engineering problems** of various functions such as continuous, piecewise continuous, step, impulsive and complex variable functions with **principle of mathematics** .	2
CO2	PO 2	**Describe** the **formulation of** integral transforms (knowledge) which converts **complex engineering problems** using (apply) operations of calculus to algebra along with **basic principles of mathematics** reaching substantiated conclusions by the **interpretation of results** in solving linear differential equations	6
	PO4	**Explain** the integral transforms in solving ordinary differential equations will be **quantitatively measured** by using **MATLAB computer software**.	5
	PSO1	**Describe** the integral transforms concern CIVIL ENGINEERING(apply) which converts operations of calculus to algebra in solving linear differential equations **in the design and implementation of complex systems.**.	2
CO3	PO 1	**Apply** the Fourier transform as a mathematical function that transforms a signal from the time domain to the **complex engineering problems** by the frequency domain, non-periodic function up to infinity with **Principle of Mathematics**	2
	PO2	**Apply** the Fourier transform as a **formulation** of mathematical function in **complex engineering problems** which transforms a non-periodic function using **principles of mathematics** to attain conclusions by the **interpretation of results**	6
	PSO1	**Identify** the properties of complex Fourier transform concern CIVIL ENGINEERING which **intensifies (apply)** the boundary value problems in the **design and implementation** of complex systems.	2
CO4	PO2	**Apply** the **formulation** of definite integral calculus to a function of **complex engineering problems** of two or more variables using **principle of mathematics** in calculating the area of solid bounded regions by the **interpretation of results**.	6
CO5	PO2	**Develop** the **statement** and **formulation** differential calculus of **complex engineering problems** which transforms vector functions, gradients. Divergence, curl, and integral theorems using **principle of mathematics** to different bounded regions in calculating areas. by **interpretation of results**	6

Course Outcomes	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key competencies matched.
CO6	PO1	**Solve** Lagrange's linear equation related to **complex engineering problems** such as dependent and independent variables the nonlinear partial differential equation by the method of Charpit concern to the engineering field **Principle of Mathematics**.	2
	PO2	**Describe** 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**.	6

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

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	-	60	-	45	-	-	-	-	-	-	-	-	100	-	-
CO 3	66.7	60	-	-		-	-	-	-	-	-		100	-	-
CO 4	-	60	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 5	-	60	-	-		-	-	-	-	-	-		-	-	-
CO 6	66.7	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	-	2	-	-	-	-	-	-	-	-	3	-	-
CO 3	3	3	-	-	-	-	-	-	-	-	-	-	3	-	-
CO 4	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 5	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 6	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:

✓	Early Semester Feedback	✓	End Semester OBE Feedback

XVIII SYLLABUS:

MODULE I	**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 to ordinary differential equations.
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	**MULTIPLE INTEGRALS**
	Double Integrals: Evaluation of double integrals in Cartesian coordinates and Polar coordinates; Change of order of integration; Area as a double integral; Transformation of coordinate system. Triple Integrals: Evaluation of triple integrals in Cartesian coordinates; volume of a region using triple integration.

MODULE IV	**VECTOR DIFFERENTIAL CALCULUS**
	Scalar and vector point functions; Definitions of Gradient, divergent and curl with examples; Solenoidal and irrigational vector point functions; Scalar potential function. Line integral, surface integral and volume integral, Green's theorem in a plane, Stoke's theorem and Gauss divergence theorem without proofs.
MODULE V	**PARTIAL DIFFERENTIAL EQUATIONS**
	Formation of partial differential equations by elimination of arbitrary constants and arbitrary functions, solutions of first order linear equations; Charpit's method;

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	Introduction to Laplace transform	CO1	T1:21.1 , 21.4 R1:5.1
3	First, second shifting theorems and change of scale property of Laplace transforms	CO1	T1:21.2 R1:5.1
4	Laplace transforms of Derivatives, Integrals, multiplication and Division by t to a function	CO1	T1:21.4 R1:5.1
5	Laplace transform of periodic functions	CO2	T1:21.7-21.10 R1:5.2-5.4
6	First, second shifting theorems and change of scale property of Inverse Laplace Transforms	CO1	T1:21.12 R1:5.1,5.6
7	Inverse Laplace transforms of Derivatives, Integrals, multiplication and Division by s to a function	CO2	T1:21.13 R1:5.1,5.3
8	Convolution theorem	CO2	T1:21.13 R1:5.4
9	Application of Laplace Transforms	CO2	T1:21.14 R1:5.5
10	Fourier integrals	CO3	T1:22.1-22.2 R1:10.8
11	Fourier transform	CO3	T1:22.3 R1:10.8
12	Fourier sine transform	CO3	T1:22.4 R1:10.9
13	Fourier Cosine Transforms	CO3	T1:22.5 R1:10.9
14	Properties of Fourier Transforms	CO3	T1:22.4 R1:10.9
15	Inverse Fourier Transform	CO3	T2:15.5 R1:7.5
16	Finite Fourier Transform	CO3	T2:16.5 R1:7.6
17	Infinite Fourier Transform	CO3	T2:16.5 R1:7.6
18	Double integrals in Cartesian form	CO4	T2:10.1 R1:16.1
19	Double integrals in Polar coordinates	CO4	T2:10.1 R1:16.2
20	Change of order of integration	CO4	T2:10.3 R1:16.4
21	Evaluation of Double Integrals for the Bounded Regions	CO4	T2:11.3 R1:16.5
22	Transformation of coordinates system	CO4	T2:11.3 R1:16.5

23	Triple integrals in Cartesian form	CO4	T2:11.3 R1:16.5
24	Volume of a region using triple integration	CO4	T2:11.3 R1:16.5
25	Problems on double and triple integrals	CO4	T2:11.3 R1:16.5
26	Scalar and Vector Point Function(Definitions of Gradient, divergent, curl and Scalar Potential function)	CO5	T2: 11.3 R1:16.11
27	Solenoidal and irrotational vectors	CO5	T1:17.1-17.2 R1:16.1-16.2
28	Line integral	CO5	T2: 11.3 R1:16.11
29	surface integral	CO5	T2: 11.3 R1:16.9
30	volume integral	CO5	T2: 11.4 R1:16.18
31	Green‘s theorem	CO5	T2: 11.3 R1:16.11
32	Stoke‘s theorem	CO5	T2: 11.3 R1:16.9
33	Gauss divergence theorem	CO5	T2: 11.4 R1:16.18
34	Elimination of arbitrary constants(Formation of PDE)	CO6	T1:17.1-17.2 R1:16.1-16.2
35	Elimination of arbitrary functions(Formation of PDE)	CO6	T1:17.5-17.6 R1:16.3.1
36	Non-Linear Partial differential equation of first order	CO6	T1:17.1-17.2 R1:16.1-16.2
37	Standard forms I, II ,III and IV	CO6	T1:17.1-17.2 R1:16.1-16.2
38	Non-Linear Partial differential equation of first order Standard forms V	CO6	T1:17.5-17.6 R1:16.3.1
39	Non-Linear Partial differential equation of first order Standard forms VI	CO6	T1:17.1-17.2 R1:16.1-16.2
40	Lagrange’s Linear equation- Method of grouping	CO6	T1:17.5-17.6 R1:16.3.1

41	Lagrange's Linear Equation -Method of Multipliers	CO6	T1:17.1-17.2 R1:16.1-16.2
PROBLEM SOLVING/ CASE STUDIES			
42	Solving problems on Laplace Transform of First, second shifting theorems and change of scale property	CO 1	T1:21.1,21.4 R1:5.1
43	Solving problems on Inverse Laplace transforms of derivatives, integrals, multiplied by s, divided by s	CO 2	T1:21.13 R1:5.1,5.3
44	Solving problems on Convolution theorem	CO 2	T1:21.14 R1:5.5
45	Solving problems on Fourier sine and cosine integral	CO 3	T1:22.3 R1:10.8
46	Solving problems on finite Fourier transforms	CO 3	T1:22.4 R1:10.9
47	Solving problems on Evaluation of double integrals in Cartesian coordinates	CO 4	T2:10.1 R1:16.1
48	Solving problems on Transformation of coordinates system	CO 4	T2:10.1 R1:16.2
49	Solving problems on Evaluation of triple integrals in Cartesian coordinates	CO 4	T2:10.1 R1:16.2
50	Solving problems on Solenoidal and irrotational	CO 5	T2:11.3 R1:16.5
51	Solving problems on Green's theorem	CO 5	T2: 11.3 R1:16.11
52	Solving problems on Green's theorem	CO 5	T2: 11.3 R1:16.11
53	Solving problems on Stokes theorem	CO 5	T2: 11.3 R1:16.9
54	Gauss divergence theorem	CO 5	T2: 11.4 R1:16.18
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 Laplace transforms	CO 1,2	T1:21.1,21.4 R1:5.1
58	Definitions and terminology on Fourier transforms	CO 3	T1:22.1-22.2R1:10.8
59	Definitions and terminology on multiple integrals	CO 4	T2:15.5 R1:7.5
60	Definitions and terminology on vector calculus	CO 5	T2:10.3 R1:16.4

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	Disscussion of Laplace transforms	CO 1,2	T1:21.1,21.4 R1:5.1
63	Disscussion of Fourier transforms	CO 3	T1:22.1-22.2 R1:10.8
64	Disscussion of multiple integrals	CO 4	T2:15.5 R1:7.5
65	Disscussion of vector calculus	CO 5	T2:10.3 R1:16.4
66	Disscussion 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

COURSE DESCRIPTION

Department	**CIVIL ENGINEERING**				
Course Title	**BASIC ELECTRICAL ENGINEERING**				
Course Code	AEEC01				
Program	B.Tech				
Semester	II	CE			
Course Type	Foundation				
Regulation	IARE - UG20				
Course Structure	Theory			Practical	
	Lecture	Tutorials	Credits	Laboratory	Credits
	3	-	3	-	-
Course Coordinator	Ms.T Saritha Kumari, Assistant Professor				

I COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites
B.Tech	AHSC02	I	-

II COURSE OVERVIEW:

The Basic Electrical Engineering enables knowledge on electrical quantities such as current, voltage, and power, energy to know the impact of technology in global and societal context. This course provides knowledge on basic DC and AC circuits used in electrical and electronic devices, highlights the importance of transformers, electrical machines in generation, transmission and distribution of electric power, identify the types of electrical machines suitable for particular applications.

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). 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
17%	Remember
50%	Understand
33%	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		Marks	Total Marks
CIA	Continuous Internal Examination – 1 (Mid-term)	10	30
	Continuous Internal Examination – 2 (Mid-term)	10	
	AAT-1	5	
	AAT-2	5	
SEE	Semester End Examination (SEE)	70	70
Total Marks			100

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:

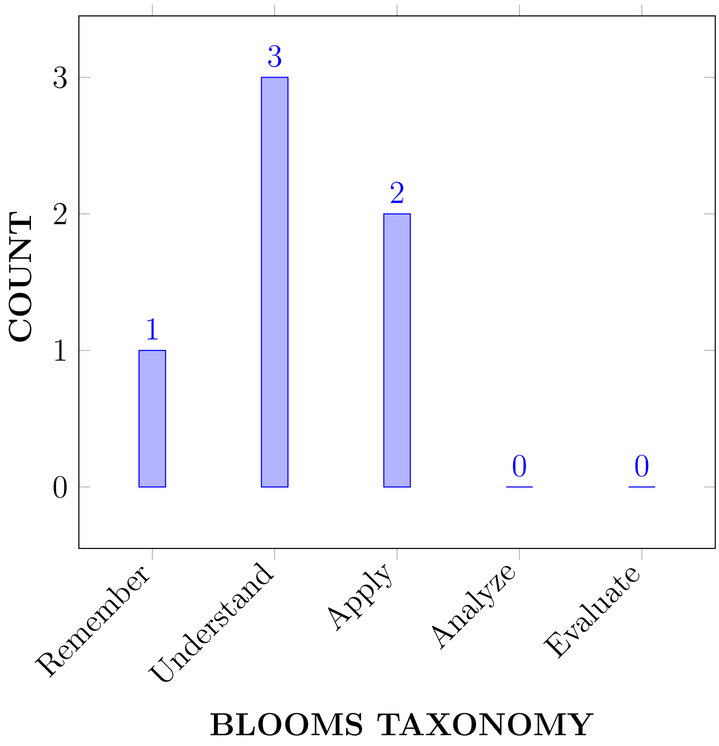
I	The fundamentals of electrical circuits and analysis of circuits with DC excitation using circuit laws.
II	The application of circuit laws in network theorems and graph theory to simplify complex networks.
III	The construction and working principle of DC generator, DC motor, andtypes of DC machines based on field excitation method.
IV	The theory of Faraday's law of mutual induction and working of single phase transformer.
V	The concept of rotating magnetic field and constructional features, principle and types of AC machines.

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	**Define** basic nomenclature of single phase AC circuits for obtaining impedance, admittance of series and parallel circuits.	Remember
CO 3	**Make use of** various network theorems and graph theory for simplifying complex electrical networks.	Apply
CO 4	**Demonstrate** the construction, principle and working of DC machines for their performance analysis.	Understand
CO 5	**Illustrate** working , construction and obtain the equivalent circuit of single phase transformers.	Understand
CO 6	**Explore** electromagnetic lawsused for the construction and opertaion of synchronous and asynchronous machines.	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 1	Build the prototype of UAVs and aero-foil models for testing by using low speed wind tunnel towards research in the area of experimental aerodynamics.	3	CIE/Quiz/AAT
PO 2	Focus on formulation and evaluation of aircraft elastic bodies for characterization of aero elastic phenomena.	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.	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	✓	-	-	-	-	-	-	-	-	-	-	-	-	-	-

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**	Recollect the concept of electricity is described through scientific principles, importance Kirchhoff laws in relation with law of conservation of energy and charge circuits are explained using mathematics, engineering fundamentals and various source transformation techniques are adopted for solving complex circuits.	3
	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**	Make use of Alternating quantity for obtaining form, peak factor concept of impedance and admittance using the knowledge of mathematics, science, and engineering fundamentals.	3
CO 3	**PO 1**	Demonstrate various network theorems in order to determine the same using principles of mathematics, science, and engineering fundamentals.	3
	PO 2	Verify various network theorems for their validation using mathematical calculations.	1
	PSO 1	Simplify complex electrical networks by applying various circuit theorems by using computer programs.	1
CO 4	**PO 1**	The principle of operation and characteristics of DC machines are explained by applying engineering fundamentals including device physics.	3
CO 5	**PO 1**	Understand how classification DC machines are done and their power flow with the knowledge of mathematics and engineering sciences.	3
	PSO 1	Develop equivalent circuit of single phase transformer referred to both sides by developing computer programs.	1
CO 6	**PO 1**	Understand the working of induction motors and alternators using engineering principles and mathematical equations.	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	1	-	-	-	-	-	-	-	-	-	-	1	-	-
CO 4	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 5	3	-	-	-	-	-	-	-	-	-	-	-	1	-	-
CO 6	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	10	-	-	-	-	-	-	-	-	-	-	25	-	-
CO 4	100	-	-	-	-	-	-	-	-	-	-		-	-	-
CO 5	100	-	-	-	-	-	-	-	-	-	-	-	25	-	-
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	1	-	-	-	-	-	-	-	-	-	-	1	-	-
CO 2	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 3	3	1	-	-	-	-	-	-	-	-	-	-	1	-	-
CO 4	3	-	-	-	-	-	-	-	-	-	-		-	-	-
CO 5	3	-	-	-	-	-	-	-	-	-	-	-	1	-	-
CO 6	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TOTAL	18	2	-	-	-	-	-	-	-	-	-	-	3	-	-
AVERAGE	3.0	0.3	-	-	-	-	-	-	-	-	-	-	0.5	-	-

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 ELECTRICAL CIRCUITS**
	Circuit concept: Ohm's law, Kirchhoff's laws, equivalent resistance of networks, Source transformation, Star to delta transformation, mesh and nodal analysis; Single phase AC circuits: Representation of alternating quantities, RMS, average, form and peak factor, concept of impedance and admittance.
MODULE II	**NETWORK THEOREMS AND NETWORK TOPOLOGY**
	Network Theorems: Superposition, Reciprocity, Thevenin's, Norton's, Maximum power transfer for DC excitations circuits. Network Topology: Definitions, Graph, Tree, Incidence matrix, Basic Cut Set and Basic Tie Set Matrices for planar networks.
MODULE III	**DC MACHINES**
	DC generators: Principle of operation, construction, EMF equation, types of DC generators. Losses and efficiency. DC motors: Principle of operation, back EMF, torque equation, types of DC motors, Losses and efficiency, numerical problems.
MODULE IV	**SINGLE PHASE TRASNFORMERS**
	Single Phase Transformers: Principle of operation, construction, types of transformers, EMF equation, operation of transformer under no load and on load, Phasor diagrams, equivalent circuit, efficiency, regulation and numerical problems.
MODULE V	**AC MACHINES**
	Three Phase Induction motor: Principle of operation, slip, slip -torque characteristics, efficiency and applications; Alternators: Introduction, principle of operation, constructional features, calculation of regulation by synchronous impedance method and numerical problems.

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/computer-science-engineering-autonomous/basic -electrical-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 2	T1-5.5 to 5.8
5	Derivation for Star-delta and delta-star transformations	CO 2	T1-5.8 to 5.9
6	Mesh analysis and Nodal Analysis	CO 2	T1-5.11 to 5.12
7	Representation of alternating quantities	CO 3	T1-5.14 to 5.15
8	RMS and Average values of an AC signal	CO 2	T1-5.16 to 5.16

9	Form and peak factor, concept of impedance and admittance	CO 2	T1-5.16 to 5.16
10	Superposition theorem for DC excitations circuits	CO 3	T1-6.1 to 6.3
11	Reciprocity theorem for DC excitation	CO 3	T1-6.8 to 6.9
12	Thevenin's theorem for DC excitations circuits	CO 3	T1-6.2 to 6.3
13	Norton's theorem for DC excitations circuits	CO 3	T1-6.3 to 6.4
14	Maximum power transfer theorem for DC excitations circuits	CO 3	T1-11.1
15	Incidence matrix for planar networks	CO 3	T1-11.2 to 11.3
16	Basic Cut Set matrix for planar networks	CO 4	T1-11.2 to 11.3
17	Basic Tie Set matrix for planar networks	CO 3	T1-11.9 to 11.10
18	Principle of operation for DC generators	CO 4	R2-7.1 to 7.2
19	Construction and EMF equation for DC generators	CO 4	R2-7.4
20	Types of DC generators	CO 4	R2-7.3
21	Principle of operation for DC motors	CO 4	R2-7.3.1 to 7.3.2
22	Back EMF, torque equation for DC motors	CO 4	R2-7.3.3 to 7.3.6
23	Types of DC motors	CO 4	R2-7.6
24	Losses and efficiency for DC generators, motors	CO 4	T1-13.1 to 13.3
25	Principle of operation for Single Phase Transformers	CO 5	T1-13.1 to 13.3
26	Construction and EMF equation for Single Phase Transformers	CO 5	T1-13.5 to 13.6
27	Types of transformers and turns ratio	CO 5	T1-13.6 to 13.7
28	Operation of transformer under no load	CO 5	T1-13.7 to 13.9
29	Operation of transformer under on load	CO 5	T1-13.8
30	Equivalent circuit for Transformers	CO 5	T1-17.1 to 17.2
31	Phasor diagrams of transformer	CO 5	T1-17.3 to 17.4
32	Losses of Transformers	CO 5	T1-17.6 to 17.7
33	Efficiency of Transformers	CO 5	T1-13.11
34	Regulation for Transformers	CO 5	T1-13.12
35	Three Phase Induction motor: Principle of operation	CO 5	T1-13.13
36	slip, slip -torque characteristics	CO 6	T1-13.14

37	Efficiency of Induction motor	CO 6	T1-13.16 to 13.18
38	Applications of Induction motor	CO 6	T1-13.19
39	Alternators: Introduction, principle of operation	CO 6	T1-13.19
40	Constructional features	CO 6	T1-13.20
41	Calculation of regulation by synchronous impedance method and numerical problems.	CO 6	T1-13.20
PROBLEM SOLVING/ CASE STUDIES			
42	Numerical Examples on electrical quantities, Ohm's law, KCL, KVL	CO 2	T1-5.8 to 5.9
43	Numerical Examples on series, parallel elements and star to delta transformation and mesh analysis	CO 2	T1-5.5 to 5.8
44	Numerical Examples on nodal analysis and alternating quantities	CO 3	T1-6.8 to 6.9
45	Numerical Examples on Superposition theorem	CO 3	T1-6.2 to 6.3
46	Numerical Examples on reciprocity and maximum power transfer theorems	CO 3	R2-7.1 to 7.2
47	Numerical Examples on Thevenin's and Norton's theorems	CO 3	T1-13.1 to 13.3
48	Numerical Examples on Basic cut set and Tie set matrices	CO 3	T1-13.5 to 13.6
49	Numerical Examples on EMF equation and types of DC generators	CO 4	T1-13.6 to 13.7
50	Numerical Examples on torque equation of DC motor	CO 4	T1-13.1 to 13.3
51	Numerical Examples on types of DC motors	CO 4	T1-13.13
52	Numerical Examples on EMF equation and equivalent circuit of 1 phase transformer	CO 5	T1-13.16 to 13.18
53	Numerical Examples on, efficiency for Transformers	CO 5	T1-13.14
54	Numerical Examples on, regulation for Transformers	CO 5	T1-13.16 to 13.18
55	Numerical Examples on EMF of Alternators	CO 6	T1-13.19
56	Numerical Examples on regulation of Alternators	CO 6	T1-13.20
DISCUSSION OF DEFINITION AND TERMINOLOGY			
57	Definitions and terminology from basics of electrical circuits	CO 1	T1-5.1 to 5.3
58	Definitions on network theorems	CO 3	T1-6.1 to 6.3
59	Definitions on DC machines	CO 4	R2-7.1 to 7.2
60	Definitions on single phase transformers	CO 5	T1-13.1 to 13.3
61	Definitions on AC machines	CO 6	T1-13.11
DISCUSSION OF QUESTION BANK			
62	Questions from electrical circuits	CO 1	T1-5.1 to 5.3

63	Questions from network theorems	CO 3	T1-6.1 to 6.3
64	Questions from DC machines	CO 4	R2-7.1 to 7.2
65	Questions from single phase transformers	CO 5	T1-13.1 to 13.3
66	Questions from AC machines	CO 6	T1-13.11

Mrs T Saritha Kumari, Asst Professor **HOD,CSE**

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

CIVIL ENGINEERING
COURSE DESCRIPTION

Course Title	PROGRAMMING FOR PROBLEM SOLVING LABORATORY				
Course Code	ACSC03				
Program	B.Tech				
Semester	II	CE			
Course Type	Foundation				
Regulation	IARE - R20				
Course Structure	Theory			Practical	
	Lecture	Tutorials	Credits	Laboratory	Credits
	-	-	-	3	1.5
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
B.Tech	ACSB02	II	-

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.

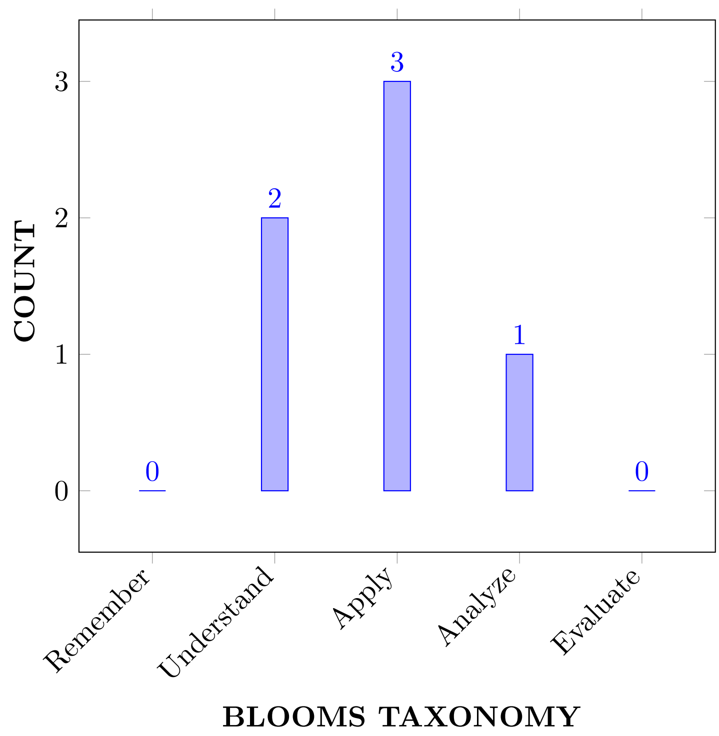
III	The practical implementation and usage of non linear data structures for solving problems of different domain.
IV	The knowledge of more sophisticated data structures to solve problems involving balanced binary search trees, AVL Trees, B-trees and B+ trees, hashing.
V	The graph traversals algorithms 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	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	Viva-voce Laboratory Practices
PSO 2	Focus on Improving Performance of Structures with reference to Safety, Serviceability and Sustainable Green Building Technology .	2	Viva-voce Laboratory Practices

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	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 Engineerig 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
CO 7	PO 1	Make use of linear data structures to organize the data in a particular way so to use them in the most effective way by applying the **basic knowledge of mathematics, science, engineering fundamentals**	2
	PO 2	Build strong foundation of data Structures which tells the program how to store data in memory and forming some relations among the data and use them in **design and development of new products.**	2
	PO 3	Recognize the need of linear data structures such as linked list, array, stack and queue by **designing solutions for complex Engineering problems** in real-time.	1
	PSO 1	Acquire sufficient knowledge to develop real-time applications by making use of linear data structures in (**career building and higher studies.**	3
CO 8	PO 1	Describe (knowledge) the usage of data structures in organizing, managing, and storing different data formats that enables efficient access and modification by applying the **fundamentals of mathematics, science, and engineering.**	3
	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.	

	PO 3	Understand the applications of basic data structures such as stacks, queues, linked lists in (**designing and developing solutions of complex engineering applications.**	4
	PSO 1	Make use of modern computer tools for applying the basic data structure concepts in building real-time applications for a successful career.	
CO 9	PO 1	Apply the sophisticated hierarchical data structures to organize keys in form of a tree to use in many real-life applications by **using the principles of mathematics and engineering fundamentals.**	3
	PO 2	Make use of non-linear data structures such as balanced trees in by **identifying, formulating and analyzing complex engineering problems** such as databases, syntax tree in compilers and domain name servers etc. **with the help of basic mathematics and engineering sciences**.	3
	PO 3	Extend the concept of tree data structures to **design and develop solutions for complex engineering problems**.	3
	PSO 1	Make use of modern computer tools in implementing non-linear data structures for various applications to become a successful professional in the domain.	3
CO 10	PO 1	Demonstrate different tree structures in Python to implement real-time problems by **applying basic knowledge of science and engineering fundamentals.**	3
	PO 2	Illustrate the importance of tree data structures used for various applications **by identifying, formulating and analyzing complex engineering problems** such as operating systems and compiler design.	3
	PO 3	Make use of tree data structures to **design and develop solutions for complex engineering problems** and which is the key organizing factor in software design. Data structures can be used to organize the storage and retrieval of information stored in both main memory and secondary memory.	3
	PSO 1	Acquire sufficient knowledge in field of data structures and its applications by using modern computer tools so that new product development can take place, which leads to become successful entrepreneur and or to obtain higher education.	3
CO 11	PO 1	Understand (knowledge) the benefits of dynamic and static data structures implementations and choose appropriate data structure for specified problem domain **using knowledge of mathematics, science and engineering fundamentals.**	3
	PO 2	Recognize the need of dynamic and static data structures **in identifying, formulating and analyzing complex engineering problems.**	3

	PO 3	Describe (knowledge) the usage of static and dynamic data structures in designing solutions for complex Engineering problems.	3
	PSO 1	Build sufficient knowledge of dynamic data structures by using modern tools so that new product can be developed, which leads to become successful entrepreneur in the present market.	3
CO 12	PO 1	Build strong foundation of quickly determining the efficiency of an algorithm or data structure for solving computing problems with respect to performance by using knowledge of mathematics, science and engineering fundamentals.	3
	PO 2	Recognize the importance of suitable data structures in checking the efficiency of algorithms used for complex engineering problems.	3
	PO 3	Make use of broad usage of data structures in designing and developing of complex engineering applications.	3
	PSO 1	Extend the concept of data structures in solving complex engineering problems using modern engineering tools to become a successful professional in the domain.	3

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

COURSE OUTCOMES	PROGRAM OUTCOMES				
	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

REFERENCE BOOKS:

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 7	R1: 7.1
11	Determine the rate of flow through Nothches.	CO 7	R1:7.2
12	Determine the rate of flow through a Orifice meter	CO 7	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	**ENGINEERING WORKSHOP PRACTICE LABORATORY**				
Course Code	AMEC02				
Program	B.Tech				
Semester	II				
Course Type	Foundation				
Regulation	IARE-UG20				
Course Structure	Theory			Practical	
	Lecture	Tutorials	Credits	Laboratory	Credits
	-	-	-	2	1
Course Coordinator	Mr.B.Vijaya Krishna, Assistant Professor.				

I COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites
B.Tech	AMEC04	II	-

II 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.

III MARKS DISTRIBUTION:

Subject	SEE Examination	CIE Examination	Total Marks
Engineering Workshop Practice 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 %	To test the preparedness for the experiment.	-
20 %	To test the performance in the laboratory.	-
20 %	To test the calculations and graphs related to the concern experiment.	-
20 %	To test the results and the error analysis of the experiment.	-
20 %	To test the subject knowledge through viva – voce.	-

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.

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:

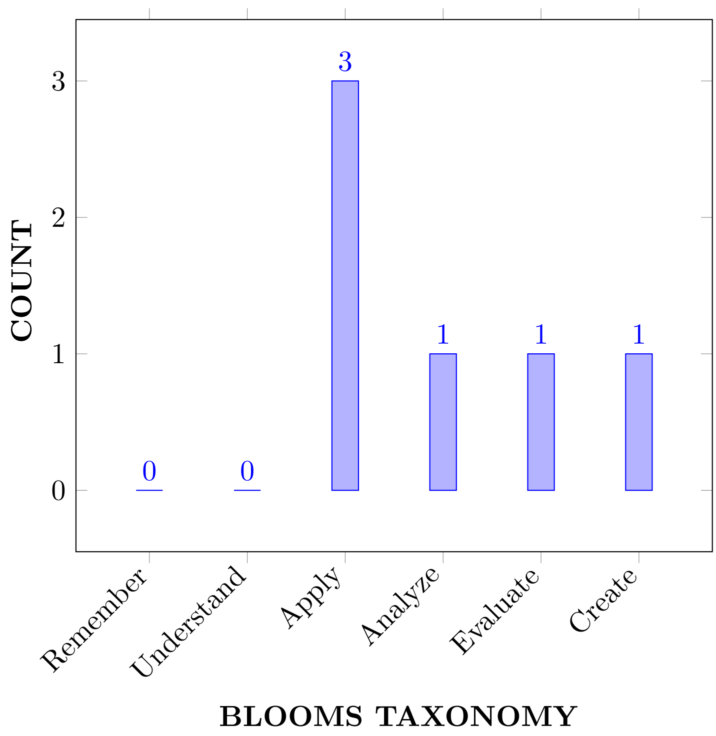
I	Use of common instruments including measuring, marking and cutting tools in various types of manufacturing processes.
II	Basic manufacturing concepts used in carpentry, fitting, black-smithy and tin-smithy.
III	Demonstrating skills by converting electrical circuit's diagrams into electrical wiring.
IV	Compare experimental results with diagrammatic measurements and to determine the source of any apparent differences.

VII COURSE OUTCOMES:

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

CO 1	**Identify** the ability to work from drawings and blueprints and demonstrate proficiency with hand tools common to carpentry.	Apply
CO 2	**Determine** the ability to Produce Fitting jobs as per specified dimensions in addition to demonstrating proficiency with hand tools common to fitting.	Evulate
CO 3	**Create** works of metal art using fire and furnace to convert given shape into useable elements using basic blacksmith techniques .	Create
CO 4	**Organisze** the moulding techniques for producing casting of different and complex shapes using various patterns.	Apply
CO 5	**Develop** various engineering and household articles such as tin boxes, cans, funnels, ducts etc., from a flat sheet of metal.	Apply
CO 6	**Compare** various wiring diagrams using conduit system of wiring and Prepare different types of wiring joints on the given circuit boards using appropriate electrical tools.	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		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 Experiments / 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.	2	Lab Experiments / CIE / 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.	2	Lab Experiments / CIE / SEE
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	Lab Experiments / CIE / SEE

3 = High; 2 = Medium; 1 = Low

X 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	2	Lab Experiments / 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	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
	PS03	Make use of **Experimental tools** for Building Career Paths towards **Innovation Startups**, Employability in different mechanical trades.	2
CO 2	PO 1	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
	PO5	Develop the given **resources and engineering tools**into required shape as given in the diagrammatical representation..	2
	PSO3	Make use of **Experimental tools** for Building Career Paths towards **Innovation Startups**, Employability in different mechanical trades..	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 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
	PO11	**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

Note: For Key Attributes refer **Annexure - I**

XIII 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
	3	**10**	**10**	**11**	**1**	**5**	**3**	**3**	**12**	**5**	**12**	**8**	**5**	**11**	**7**
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

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
	3	**10**	**10**	**11**	**1**	**5**	**3**	**3**	**12**	**5**	**12**	**8**	**5**	**11**	**7**
CO 1	33.3	-	20	-	100	-	-	-	-	-	16.6	-	-	-	66.6
CO 2	33.3	-	-	-	100	-	-	-	-	-	-	-	-	-	66.6
CO 3	33.3	-	20	-	100	-	-	-	-	-	-	-	-	-	66.6
CO 4	33.3	-	20	-	100	-	-	-	-	-	16.6	-	-	-	-
CO 5	-	-	-	-	100	-	-	-	-	-	16.6	-	-	-	-
CO 6	33.3	-	-	-	100	-	-	-	-	-	16.6	-	-	-	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 - $0 \leq C < 5\%$ – 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	1	-	1	-	3	-	-	-	-	-	1	-	-		3
CO 2	1	-	-	-	3	-	-	-	-	-	-	-	-	-	3
CO 3	1	-	1	-	3	-	-	-	-	-	-	-	-	-	3
CO 4	1	-	1	-	3	-	-	-	-	-	1	-	-	-	-
CO 5	1	-	-	-	3	-	-	-	-	-	1	-	-	-	-
CO 6	1	-	-	-	3	-	-	-	-	-	1	-	-	-	3

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
TOTAL	**6**	**0**	**3**	**0**	**18**	**0**	**0**	**0**	**0**	**0**	**4**	**0**	**0**	**0**	**12**
AVERAGE	**1**	**0**	**1**	**0**	**3**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**3**

XVI ASSESSMENT METHODOLOGY DIRECT:

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

XVII ASSESSMENT METHODOLOGY INDIRECT:

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

XVIII SYLLABUS:

WEEK-I	**CARPENTRY-I**
	Batch I: Preparation of Tenon joint as per given dimensions. Batch II: Preparation of Mortise joint as per given taper angle.
WEEK-II	**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-III	**FITTING - I**
	Batch I: Make a straight fit for given dimensions. Batch II: Make a square fit for given dimensions.
WEEK-IV	**FITTING - II**
	Batch I: Make a V fit for given dimensions. Batch II: Make a semicircular fit for given dimensions.
WEEK-V	**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-VI	**BLACKSMITHY- II**
	Batch I: Prepare Fan hook for given dimensions. Batch II: Prepare Round to Square for given dimensions.
WEEK-VII	**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-VIII	**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-IX	**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-X	**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-XI	**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-XII	**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.

REFERENCE BOOKS:

1. Gowri P. Hariharan, A. Suresh Babu," Manufacturing Technology – I", Pearson Education, 2018.
2. Roy A. Lindberg, "Processes and Materials of Manufacture", Prentice Hall India, 4th Edition, 2018.
3. Rao P.N., "Manufacturing Technology", Vol. I and Vol. II, Tata McGraw-Hill House, 2019.
4. Workshop technology by K.L.Narayana, 2020.

WEB REFERENCE BOOKS:

http://www.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
1	Tenon joint and Mortise joint.	CO 1	R1:11.1-11.5
2	Dove tail joint and Lap joint.	CO 2	R1:11.1-11.5
3	Straight fit and Square fit.	CO 3	R1:4.8 , R1:7.2
4	V fit and Semicircular fit.	CO 4	R1:4.8 , R1:7.2

5	S-bend and J-bend.	CO 3	R2:10.4 , R2:7.2
6	(a)Fan and Round to Square shape.	CO 4	R2:10.4 , R1:7.2
7	Wheel flange and bearing housing.	CO 4	R2:10.4 , R1:7.2
8	Bearing housing and Wheel flange .	CO 5	R1:8.2-8.5
9	(Rectangular tray and Round tin.	CO 5	R1:11.1-11.5
10	Make a Square Tin and Conical Funnel.	CO 5	R1:10.1 , R1:10.2
11	Series connection and parallel Connection.	CO 6	R1:11.1-11.5
12	One bulb controlled by two switches and tube light connection..	CO 6	R3:3.12 , R1:12.7

XX EXPERIMENTS FOR ENHANCED LEARNING (EEL):

S.No	Design Oriented Experiments
1	Connecting & Verifying Bell Circuit through House wiring trade.
2	Making of semitriangular fit using fitting trade.
3	Making of star shape using blacksmithy trade.
4	Preparation of hexognal tin using tinsmithy trade.
5	Preparation of dumbell shape using .

Course Coordinator
Mr. B.VijayaKrishna, Assistant Professor

HOD,CE

ANNEXURE - I

KEY ATTRIBUTES FOR ASSESSING PROGRAM OUTCOMES

PO Number	NBA Statement / Key Competencies Features (KCF)	No. of KCF's
PO 1	Apply the knowledge of mathematics, science, Engineering fundamentals, and an Engineering specialization to the solution of complex Engineering problems **(Engineering Knowledge).** Knowledge, understanding and application of 1. Scientific principles and methodology. 2. Mathematical principles. 3. Own and / or other engineering disciplines to integrate / support study of their own engineering discipline.	3
PO 2	Identify, formulate, review research literature, and analyse complex Engineering problems reaching substantiated conclusions using first principles of mathematics natural sciences, and Engineering sciences (**Problem Analysis).** 1. Problem or opportunity identification 2. Problem statement and system definition 3. Problem formulation and abstraction 4. Information and data collection 5. Model translation 6. Validation 7. Experimental design 8. Solution development or experimentation / Implementation 9. Interpretation of results 10. Documentation	**10**
PO 3	Design solutions for complex Engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and Environmental considerations (**Design/Development of Solutions).** 1. Investigate and define a problem and identify constraints including environmental and sustainability limitations, health and safety and risk assessment issues 2. Understand customer and user needs and the importance of considerations such as aesthetics 3. Identify and manage cost drivers 4. Use creativity to establish innovative solutions	**10**

	5. Ensure fitness for purpose for all aspects of the problem including production, operation, maintenance and disposal 6. Manage the design process and evaluate outcomes. 7. Knowledge and understanding of commercial and economic context of engineering processes 8. Knowledge of management techniques which may be used to achieve engineering objectives within that context 9. Understanding of the requirement for engineering activities to promote sustainable development 10. Awareness of the framework of relevant legal requirements governing engineering activities, including personnel, health, safety, and risk (including environmental risk) issues	
PO 4	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 (**Conduct Investigations of Complex Problems).** 1. Knowledge of characteristics of particular materials, equipment, processes, or products 2. Workshop and laboratory skills 3. Understanding of contexts in which engineering knowledge can be applied (example, operations and management, technology development, etc.) 4. Understanding use of technical literature and other information sources Awareness of nature of intellectual property and contractual issues 5. Understanding of appropriate codes of practice and industry standards 6. Awareness of quality issues 7. Ability to work with technical uncertainty 8. Understanding of engineering principles and the ability to apply them to analyse key engineering processes 9. Ability to identify, classify and describe the performance of systems and components through the use of analytical methods and modeling techniques 10. Ability to apply quantitative methods and computer software relevant to their engineering discipline, in order to solve engineering problems 11. Understanding of and ability to apply a systems approach to engineering problems.	**11**
PO 5	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 **(Modern Tool Usage).** 1. Computer software / simulation packages / diagnostic equipment / technical library resources / literature search tools.	**1**

PO 6	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 (**The Engineer and Society).** 1. Knowledge and understanding of commercial and economic context of engineering processes 2. Knowledge of management techniques which may be used to achieve engineering objectives within that context 3. Understanding of the requirement for engineering activities to promote sustainable development 4. Awareness of the framework of relevant legal requirements governing engineering activities, including personnel, health, safety, and risk (including environmental risk) issues 5. Understanding of the need for a high level of professional and ethical conduct in engineering.	**5**
PO 7	Understand the impact of the professional Engineering solutions in societal and Environmental contexts, and demonstrate the knowledge of, and need for sustainable development (**Environment and Sustainability).** Impact of the professional Engineering solutions (Not technical) 1. Socio economic 2. Political 3. Environmental	**3**
PO 8	Apply ethical principles and commit to professional ethics and responsibilities and norms of the Engineering practice (**Ethics).** 1. Comprises four components: ability to make informed ethical choices, knowledge of professional codes of ethics, evaluates the ethical dimensions of professional practice, and demonstrates ethical behavior. 2. Stood up for what they believed in 3. High degree of trust and integrity	**3**
PO 9	Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings (**Individual and Teamwork).** 1. Independence 2. Maturity – requiring only the achievement of goals to drive their performance 3. Self-direction (take a vaguely defined problem and systematically work to resolution) 4. Teams are used during the classroom periods, in the hands-on labs, and in the design projects. 5. Some teams change for eight-week industry oriented Mini-Project, and for the seventeen -week design project.	**12**

	6. Instruction on effective teamwork and project management is provided along with an appropriate textbook for reference 7. Teamwork is important not only for helping the students know their classmates but also in completing assignments. 8. Students also are responsible for evaluating each other's performance, which is then reflected in the final grade. 9. Subjective evidence from senior students shows that the friendships and teamwork extends into the Junior years, and for some of those students, the friendships continue into the workplace after graduation 10. Ability to work with all levels of people in an organization 11. Ability to get along with others 12. Demonstrated ability to work well with a team	
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).** "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**
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 (**Project Management and Finance).** 1. Scope Statement 2. Critical Success Factors 3. Deliverables 4. Work Breakdown Structure 5. Schedule 6. Budget 7. Quality 8. Human Resources Plan 9. Stakeholder List 10. Communication 11. Risk Register 12. Procurement Plan	**12**

PO 12	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 (**Life - Long Learning).** 1. Project management professional certification / MBA 2. Begin work on advanced degree 3. Keeping current in CSE and advanced engineering concepts 4. Personal continuing education efforts 5. Ongoing learning – stays up with industry trends/ new technology 6. Continued personal development 7. Have learned at least 2-3 new significant skills 8. Have taken up to 80 hours (2 weeks) training per year	**8**

KEY ATTRIBUTES FOR ASSESSING PROGRAM SPECIFIC OUTCOMES

PO Number	NBA Statement / Key Competencies Features (KCF)	No. of KCF's
PSO1	Formulate and evaluate engineering concepts of design, thermal and production to provide solutions for technology aspects in digital manufacturing.	**3**
PSO2	Formulate and Evulate the concept of thermo fluid.	**3**
PSO3	Make use of computational and experimental tools for creating innovative career paths, to be an entrepreneur and desire for higher studies.	**3**

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

CIVIL ENGINEERING

COURSE DESCRIPTION

Department	CIVIL ENGINEERING				
Course Title	SURVEYING AND GEOMATICS				
Course Code	ACEC01				
Program	B.Tech				
Semester	III				
Course Type	CORE				
Regulation	UG20				
Course Structure	Theory			Practical	
	Lecture	Tutorials	Credits	Laboratory	Credits
	3	-	3	-	-
Course Coordinator	Mr. V. RAJU, Assistant Professor				

I COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites
-	-	-	-

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 and Geomatics	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
16.7 %	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) and 10 marks for Alternative Assessment Tool (AAT).

Component		Marks	Total Marks
CIA	Continuous Internal Examination – 1 (Mid-term)	10	30
	Continuous Internal Examination – 2 (Mid-term)	10	
	AAT-1	5	
	AAT-2	5	
SEE	Semester End Examination (SEE)	70	70
Total Marks			100

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:

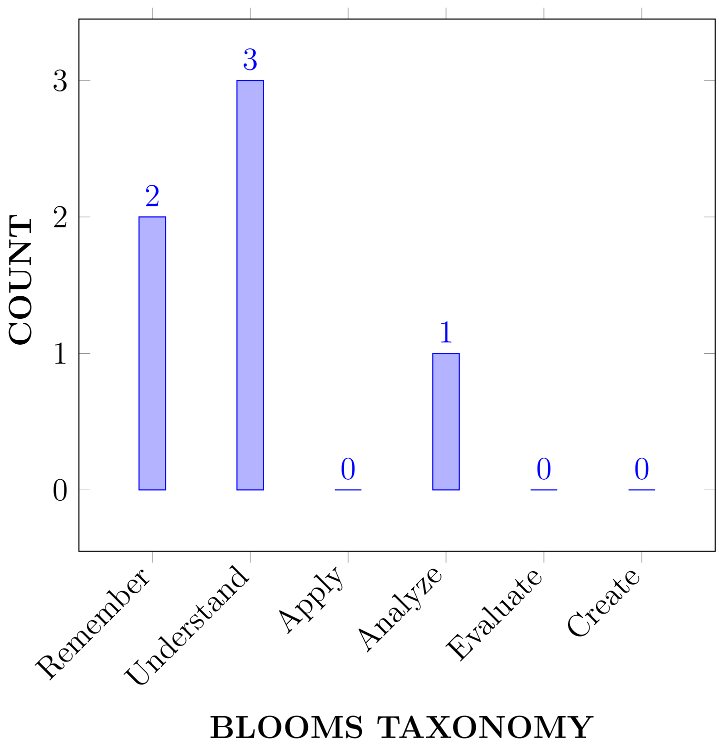
I	The importance and fundamentals of surveying for measuring field parameters using traditional and modern instruments involved in civil construction.
II	The designing of curves and path alignment at suitable locations by implementing the principles of geometry and trigonometry.
III	The programming tools of perspective geometry for preparing 3D geographical maps using aerial and terrestrial photogrammetric surveying
IV	The applications of Remote Sensing in civil construction alteration works, detecting land use and land cover, creating base maps for visual reference.
V	The Modern surveying techniques for addressing the field measurement problems in real time.

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 setting out curves in tracing alignment and path at suitable locations .	Understand
CO 3	**Demonstrate** different types of digital instruments used in surveying for accurate measurement and data record keeping .	Understand
CO 4	**Explain** the practical application on total station using the principle of Electronic Distance Measurement for minimizing local errors.	Understand
CO 5	**Recall** the importance of terrestrial photogrammetry, flight planning and Stereoscopy for preparing 3D 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	PROGRAM OUTCOMES												PSO'S		
OUTCOMES	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	Formulate the **problem statement** and **model the system** for **getting the solution** of digital instruments used in surveying for accurate measurement and data record keeping.	3

	PO 5	Understand the technical concepts of advanced surveying instruments and **simulate** the data recorded for various applications.	1
	PSO 1	Identify appropriate digital instruments used to formulate,analyse and **design** for **procurement and construction** of structures.	2
CO 4	PO 2	Identify the practical application of total station in **identifying** the local errors from the first principals of mathematics and **generate the solutio**n	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	-	3	-	-	1	-	-	-	-	-	-		2	-	-
CO 4	-	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	-	30	-	-	100	-	-	-	-	-	-	-	20	-	-
CO 4	-	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≤ 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	1	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 2	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 3	-	1	-	-	3	-	-	-	-	-	-	-	1	-	-
CO 4	-	3	-	-	-	-	-	-	-	-	-	-	-		-
CO 5	3	-	-	-	-	-	-	-	-	-	-	-	1	-	-
CO 6	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-
TOTAL	9	6	-	-	3	-	-	-	-	-	-	-	2	-	-
AVERAGE	3	1.5	-	-	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 TO SURVEYING**
	Principles, Linear, angular and graphical methods, Survey stations, Survey lines ranging, bearing of survey lines, levelling: Plane table surveying, Principles of levelling booking and reducing levels; differential, reciprocal levelling, profile levelling and cross sectioning. Digital and Auto Level, Errors in levelling; contouring: Characteristics, methods, uses; areas and volumes. Triangulation and Trilateration Theodolite survey: Instruments, Measurement of horizontal and vertical angle; Horizontal and vertical control methods, triangulation network signals. Baseline choices instruments and accessories extension of base lines corrections Satellite station reduction to centre, Inter visibility of height and distances, Trigonometric levelling, Axis single corrections.
MODULE II	**CURVES**
	Elements of simple and compound curves, Method of setting out, Elements of Reverse curve, Transition curve, length of curve, Elements of transition curve, Vertical curves.
MODULE III	**MODERN FIELD SURVEY SYSTEMS**
	Principle of Electronic Distance Measurement, Modulation, Types of EDM instruments, Distomat, Total Station, Parts of a Total Station, Accessories, Advantages and Applications, Field Procedure for total station survey, Errors in Total Station Survey. Global Positioning Systems (GPS), Segments, GPS measurements, errors and biases, Surveying with GPS, Co-ordinate transformation, accuracy considerations.
MODULE IV	**PHOTOGRAMMETRIC SURVEYING**
	Introduction, Basic concepts, perspective geometry of aerial photograph, relief and tilt displacements, terrestrial photogrammetry, flight planning; Stereoscopy, ground control extension for photographic mapping aerial triangulation, radial triangulation, methods; photographic mapping, mapping using paper prints, mapping using stereo plotting instruments, mosaics, map substitutes
MODULE V	**REMOTE SENSING**
	Introduction, Electromagnetic Spectrum, interaction of electromagnetic radiation with the atmosphere and earth surface, remote sensing data acquisition: platforms and sensors; visual image interpretation; digital image processing.

TEXTBOOKS

1. Madhu, N, Sathikumar, R and Satheesh Gobi, “Advanced Surveying: Total Station, GIS and Remote Sensing”, Pearson India, 2 nd Edition, 2006.
2. Manoj, K. Arora and Badjatia, “Geomatics Engineering”, Nem Chand Bros, 2011.
3. Bhavikatti, S.S., “Surveying and Levelling”, I.K. International, Vol. I and II, 2010.

REFERENCE BOOKS:

1. Chandra, A.M., “Higher Surveying”, New Age International (P) Limited, 3 rd Edition, 2002
2. Anji Reddy, M., “Remote sensing and Geographical information system”, B. S. Publications, 2001
3. Arora, K.R., “Surveying”, Standard Book House, Vol-I, II and III, 2015.

WEB REFERENCE

1. . https://nptel.ac.in/courses/105104100/43

E-Text Books:

1. https://www.jntubook.com/surveying-textbook-free-download.

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 1	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 1	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 2	T2:5.2
9	Explain the procedure of setting out simple circular curve by Perpendicular offset from tangent method.	CO 2	R2:7.5
10	Explain the important features of total station.	CO 3	R2:7.5
11	Explain about errors and biases of Global Positioning System.	CO 4	R2:7.5
12	Explain about control and operating segment in Global Positioning System.	CO 4	R2:7.5
13	Explain in detail about the field procedure of total station to calculate an area of field.	CO 5	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 30m chain used for a survey was found to be 20.10 m at the beginning and 20.50 m at the end of the work. The area of the plan drawn to a scale of 1cm= 6m was measured with the help of a planimeter and was found to be 32.56 sq.cm find the true area of the field	CO 1	R4:2.1
2	Two roads meet at an angle of 127^0 30'. Calculate the necessary data for setting out a curve of 15 chains radius to connect the two straight points of the road if it is intended to set the curve by chain and offsets only. Explain carefully how you would set out the curve in the field. Assume the length of chain as 20m. Solve using Radial offsets method.	CO 2	T4:7.3
3	Write a short note on principle of electronic distance measurement? Discuss about remote elevation and remote distance method 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 two energy sources available for earth passive remote sensing and elucidate with their spectral characteristic curves	CO 6	T1: 4.1

Signature of Course Coordinator **HOD,CE**
Mr. V. RAJU, Assistant Professor

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

COURSE DESCRIPTION

Department	**CIVIL ENGINEERING**				
Course Title	**STRENGTH OF MATERIALS**				
Course Code	ACEC02				
Program	B.Tech				
Semester	III				
Course Type	Core				
Regulation	UG-20				
Course Structure	Theory			Practical	
	Lecture	Tutorials	Credits	Laboratory	Credits
	3	1	4	-	-
Course Coordinator	Dr.U.Vamsi Mohan, Professor				

I COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites
B.Tech	AMEC01	II	Engineering Mechanics

II COURSE OVERVIEW:

Strength of Materials, deals with deformable solids, requires basic knowledge of principles of mechanics from Engineering Mechanics course and acts as a pre-requisite to the advanced courses on Structural Analysis and Design. This course introduces the concepts of simple stresses, strains and principal stresses on deformable solids and focuses on the analysis of members subjected to axial, bending, and torsional loads. In a nutshell, the course aims at developing the skill to solve engineering problems on strength of materials. Eventually, through this course content, engineers can analyze the response of various structural members under different loading conditions and design the same, satisfying the safety and serviceability conditions.

III MARKS DISTRIBUTION:

Subject	SEE Examination	CIE Examination	Total Marks
Strength of Materials	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
10%	Remember
40%	Understand
30%	Apply
20 %	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		Marks	Total Marks
CIA	Continuous Internal Examination – 1 (Mid-term)	10	30
	Continuous Internal Examination – 2 (Mid-term)	10	
	AAT-1	5	
	AAT-2	5	
SEE	Semester End Examination (SEE)	70	70
Total Marks			100

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:

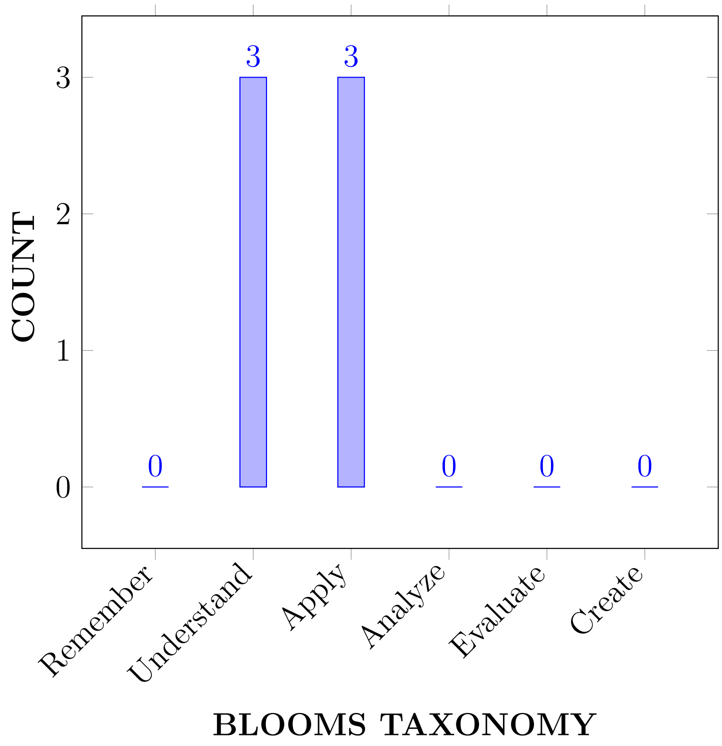
I	The concepts and principles of stress and strain, and behavior of structural elements subjected to gradual, sudden and impact loading.
II	The behavior of determinate beams in response to various applied loads and load combinations.
III	The energy transmission through solid and hollow circular shafts and various applications of close coiled helical springs.
IV	The behavior of structural members subjected to combined stresses by using Mohr's circle of stresses and strains.

VII COURSE OUTCOMES:

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

CO 1	**Summarize** the concepts of stress, strain and strain energy in conjunction with elastic properties of materials for understanding the behaviour of simple and composite bars subjected to uniaxial and biaxial stresses.	Understand
CO 2	**Interpret** the relationship between bending moment, shear force and rate of loading with the help of Shear force and bending moment diagrams for better understanding response of the member under external loads.	Understand
CO 3	**Apply** the theory of simple bending to beams for computing the flexural strength and distribution of bending and shear stress across the section.	Apply
CO 4	**Apply** the torsion equation to springs, solid and hollow circular shafts for computing torsional stiffness of springs and power transmitted by shafts.	Apply
CO 5	**Illustrate** the concepts of principal stresses and principal strains with the help of Mohr's circle of stresses for solving two-dimensional stress problems.	Understand
CO 6	**Apply** the concepts various theories of failure for finding the cause of failure and to take care of it in the design.	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, 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/SEE, QUIZ, 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 super-structures for residential and public buildings, industrial structures, irrigation structures, power houses, 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		
	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	Explain the basic properties of materials and the concept of stress, strain and strain energy stored due to external loads and apply the Castigliano's theorem for computing the deflections of the members by making use of **mathematical principles and engineering fundamentals.**	2
	PSO 1	Computes tensile and compressive strength of members, with the help of the **knowledge** of elastic properties of materials.	1
CO 2	PO 1	Use the **mathematical principles and engineering fundamentals** in understanding the relationship between bending moment, shear force, slope and deflection.	2
	PO 2	**Formulates the problem** on determinate beams for **development of solution** to find bending moment and shear force and **analyse the complex engineering problems** using the **principles of mathematics and engineering sciences.**	5
	PSO 1	Understands the behavior of members, with the help of the **knowledge** of relationship between the loading, shear force and bending moment.	1
CO 3	PO 2	**Formulate the problem** on determinate beams for **development of solution** to find strength and stress distribution and **analyse the complex engineering problems** using the **principles of mathematics and engineering sciences.**	5
	PSO 1	Design the section of members required for resisting loading, with the help of the **knowledge** of theory of simple bending.	1
CO 4	PO 1	Understand the concepts of torsion and their effects on shafts by using the **principles of mathematics and engineering fundamentals.**	2

	PO 2	**Formulate the problem** on solid and hollow shaft for **development of solution** to find transmission of power and **analyse the complex engineering problems** using the **principles of mathematics and engineering sciences.**	5
	PSO 1	Computes torsional strength of shafts and springs , with the help of the **knowledge** of torsion equation.	1
CO 5	PO 1	Understand the concepts of principal stresses and strains and apply Mohr's circle of stresses for solving the two-dimensional stress problems, making use of the knowledge of **mathematics, engineering fundamentals**	2
	PO 2	Determine the principal stresses and strains in a structural member, by **formulating the problem** for **development of solution**, also **analyse the complex engineering problems** using the **principles of mathematics and engineering sciences.**	5
	PSO 1	Calculate the principal stresses and strains developed, with the help of the **knowledge of elastic properties of materials.**	1
CO 6	PO 1	Understand various causes of failure for taking remedial measures in the design, using the principles of **mathematics and engineering fundamentals.**	2
	PO 2	**Data regarding failures of existing structures is collected, problem statement is defined and formulates the problem for the development of solution for engineering structures** such as beams, shafts.	4
	PSO 2	Devise new methods to **enhance the performance** of various members of the structure against the applied loads for satisfying **safety and serviceability** conditions.	2

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

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

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	66.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10.0	0.0	0.0
CO 2	66.6	50.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10.0	0.0	0.0
CO 3	0.0	50.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10.0	0.0	0.0
CO 4	66.6	50.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10.0	0.0	0.0
CO 5	66.6	50.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10.0	0.0	0.0
CO 6	66.6	40.0	0.0	0.0	0.0	0.0	0.0	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≤ 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	-	-	-	-	-	-	-	-	-	-	-	1	-	-
CO 2	3	2	-	-	-	-	-	-	-	-	-	-	1	-	-
CO 3	-	2	-	-	-	-	-	-	-	-	-	-	1	-	-
CO 4	3	2	-	-	-	-	-	-	-	-	-	-	1	-	-
CO 5	3	2	-	-	-	-	-	-	-	-	-	-	1	-	-
CO 6	3	2	-	-	-	-	-	-	-	-	-	-	-	1	-
TOTAL	15	10	-	-	-	-	-	-	-	-	-	-	5	1	-
AVERAGE	3	2	-	-	-	-	-	-	-	-	-	-	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	**SIMPLE STRESSES AND STRAINS**
	Concept of stress and strain, types of stresses and strains, Hooke's law, stress - strain diagram for mild steel, elasticity and plasticity, working stress, factor of safety, elastic moduli and the relationship between them; Bars of varying section, composite bars, temperature stresses. Strain energy – Resilience, Gradual, sudden, impact loadings, simple applications.
MODULE II	**SHEAR FORCE AND BENDING MOMENT**
	Introduction, Types of supports and beams, Sign convention for SF and BM, Shear Force and Bending Moment diagrams. BM and SF diagrams for cantilevers and simply supported beams with and without overhangs. Calculation of maximum BM and SF and the point of contra-flexure under concentrated loads, uniformly distributed loads over the whole span or part of span, combination of loads, uniformly varying load and couples.
MODULE III	**BENDING AND SHEAR STRESSES IN BEAMS**
	BENDING STRESS: Assumptions in the theory of simple bending, derivation of bending equation, Neutral axis, determination bending stresses, section modulus of rectangular and circular sections (Solid and Hollow), I, T, Angle and Channel sections, design of simple beam. **SHEAR STRESS**: Derivation of formula – Shear stress distribution in rectangular, triangular, circular, I and T sections.
MODULE IV	**TORSION OF CIRCULAR SHAFTS AND SPRINGS**
	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 shafts, combined bending and torsion and end thrust, design of shafts according to theories of failure. **SPRINGS**: Introduction, types of springs, deflection of close and open coiled helical springs under axial pull and axial couple, springs in series and parallel.
MODULE V	**PRINCIPAL STRESSES AND STRAINS AND THEORIES OF FAILURES**
	PRINCIPAL STRESSES AND STRAINS: Introduction, 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, introduction to analytical and graphical solutions. **THEORIES OF FAILURES**: Various theories of failures like Maximum principal stress theory, maximum principal strain theory, maximum shear stress theory, maximum strain energy theory, maximum shear strain energy theory.

TEXTBOOKS

1. R. K. Bansal, "A Textbook of Strength of Materials", Laxmi publications Pvt. Ltd., New Delhi, 2nd Edition, 2007.

2. F. Beer, E. R. Johnston, J. DeWolf, "Mechanics of Materials", Tata McGraw-Hill Publishing Company Ltd., New Delhi, India, 1st Edition, 2008

3. S. S. Bhavikatti, "Strength of Materials", Vikas Publishing House Pvt. Ltd., New Delhi, 5th Edition, 2013.

REFERENCE BOOKS:

1. B. C. Punmia, Ashok K Jain and Arun K Jain, "Mechanics of Materials", Laxmi Publications Pvt. Ltd., New Delhi, 12th Edition, 2007.

2. R. Subramanian, "Strength of Materials", Oxford University Press, 2nd Edition, 2010

3. Hibbeler, R. C., "Mechanics of Materials", East Rutherford, NJ: Pearson Prentice Hall, 6th Edition, 2004.

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			
0	Course objectives, Course outcomes, Program Outcomes and CO-PO Mapping		
CONTENT DELIVERY (THEORY)			
1	Introduction to Strength of Materials - Basic principles of mechanics – Prerequisites.	CO 1	R2: 1.1
2	Introduction to simple stresses and strains	CO 1	T2: 2.1.1,2.1.2 R2: 3.1,3.2
3	Types of stresses and strains - Hooke's law - Stress-strain diagram for mild steel.	CO 1	T1: 1-2 R2: 3.1,3.2
4	Working stress, Factor of safety - Elasticity and Plasticity	CO 1	T1: 1-2 R2: 3.1,3.2
5	Shear stress - Lateral strain, Poisson's ratio and Volumetric strain.	CO 1	T1: 1.1, 1.2 R2: 3.3
6	Elastic moduli and the relationship between them.	CO 1	T1: 1.1, 1.2
7	Stresses in bars of uniform sections.	CO 1	T1: 1.1, 1.2
8	Stresses in bars of uniformly tapering sections.	CO 1	T1: 1.1, 1.2
9	Elongation of bar of uniform section due to self-weight.	CO 1	T1: 1.1, 1.2 R2: 3.5-3.6
10	Principle of superposition.	CO 1	T1: 1.1, 1.2
11	Stresses in bars of varying sections of same material - Stresses in bars of varying sections of different materials.	CO 1	T1: 63-65 R2: 10.2
12	Stresses in Composite sections. Temperature stresses in uniform and tapering sections.	CO1	T1: 63-65 R2: 10.2

13	Temperature stresses in Composite sections.	CO 1	T2:2.2, 2.12 R2: 9.3
14	Strain Energy – Proof resilience – Inelastic strain energy.	CO 1	T2:2.2, 2.12 R2: 9.3
15	Strain energy of prismatic bar hanging under its own weight - Strain energy of freely hanging prismatic bar with an axial load.	CO 1	T1: 19-20 R2: 4.2
16	Strain energy in bars of varying sections.Strain energy due to gradual, sudden and impact loading.	CO 1	T1:22 R2: 4.4
17	Stresses induced due to state of biaxial stresses.	CO 1	T1:24 R2: 5.4
18	Maximum shear stress induced in wire - Deflection of spring -Stiffness of springs – Numerical Examples.	CO 1	T1:24 R2: 5.4
19	Principal Stresses – Mohr's circle of stresses, ellipse of stress and their applications.	CO 1	T1:26 R2: 5.6
20	Types of beams – Types of Supports – Concept of shear force and bending moment.	CO2	T1:22 R2: 4.4
21	S.F and B.M diagrams for simply supported beams subjected to point loads, uniformly distributed load.	CO 2	T1:22 R2: 4.4
22	S.F and B.M diagrams for simply supported beams subjected to uniformly varying loads and combination of loads.	CO 2	T1:22 R2: 4.4
23	S.F and B.M diagrams for overhanging beams subjected to point loads, uniformly distributed load.	CO 2	T1:21 R2: 4.5
24	S.F and B.M diagrams for overhanging beams subjected to uniformly varying loads and combination of these loads – Point of contraflexure.	CO 2	T1:21 R2: 4.5
25	S.F and B.M diagrams for a cantilever beam subjected to uniformly varying loads and combination of these loads.	CO 2	T1:32 R2: 7.6
26	Relation between S.F, B.M and rate of loading at a section of a beam.	CO 2	T1:32 R2: 7.6
27	Theory of simple bending – Assumptions – Bending equation: M/I=f/y=E/R . Section modulus of rectangular and circular sections.	CO 3	T1:34-35-36 R2: 7.8
28	Section modulus of I,T, Angle and Channel sections. Design of simple beam sections.	CO 3	T1:34-35-36 R2: 7.8
29	Shear stress distribution across various beam sections like rectangular, circular, triangular sections.	CO 3	T1:34-35-36 R2: 7.8
30	Shear stress distribution across various beam sections like I, T and angle sections.	CO 3	T1:23 R1: 4.1
31	Theory of pure torsion and assumptions made in pure torsion – Torsion equation.	CO 4	T1:23 R1: 4.2
32	Torsional moment and polar section modulus. Equation for power transmitted by shafts and its efficiency.	CO 4	T1:24 R1: 4.3

33	Strength of shaft for varying sections, composite shafts and numerical examples.	CO 4	T1:24 R1: 4.3
34	Types of springs. Stiffness and efficiency of springs connected in series and parallel and numerical examples.	CO 4	T1:24 R1: 4.3
35	Maximum shear stress induced in wire - Deflection of spring -Stiffness of springs – Numerical Examples.	CO 4	T1:24 R2: 5.4
36	Principal stresses and strains- Stresses induced due to uniaxial stress-Stresses induced due to state of simple/pure shear.- Numerical Examples	CO 5	T1:4.1, 4.2 R1: 4.7
37	Stresses due to biaxial stresses - Stresses due to biaxial stresses along with shear stress- Numerical Examples.	CO 5	R1: 4.2, 4.3
38	Mohr's circle of stresses- Numerical examples.	CO 5	R1: 4.7
39	Introduction to various theories of failure. Modes of failure. Safety factors, Limitations of failure theories.	CO 6	R1: 7.2, 7.3
40	Maximum principal stress theory (Rankine) and Maximum shear stress theory (Guest-Tresca).	CO 6	R1:7.4, 7.5
41	Maximum principal strain (Saint-Venant), Total strain energy per unit volume (Haigh), Shear strain energy per unit volume (Maxwell-Huber-von Mises).	CO 6	R1:7.6, 7.7
PROBLEM SOLVING/ CASE STUDIES			
1	Numerical Examples on Stresses in bars of uniformly tapering sections.	CO 1	R2:7.5
2	Numerical Examples on Stresses in bars of varying sections of different materials Temperature stresses.	CO 1	T2:3
3	Numerical Examples on Stresses in Composite sections.	CO 1	R2:7.5
4	Numerical Examples on Stresses in Composite sections.	CO 1	R2:7.5
5	Numerical Examples on Strain energy in tapering sections.	CO 1	R2:7.5
6	Numerical Examples on Strain energy in tapering sections.	CO 1	R2:7.5
7	Numerical Examples on S.F and B.M diagrams for simply supported beams.	CO 2	R4:5.2
8	Numerical Examples on S.F and B.M diagrams for cantilever beams.	CO 2	T2:5.2
9	Numerical Examples on bending theory.	CO 3	T1: 4.1
10	Numerical Examples on shear stress distribution.	CO 3	T3:4.5
11	Numerical Examples on Torsion of circular shafts.	CO 4	R2:7.5
12	Numerical Examples on power transmission.	CO 4	R2:7.5
13	Numerical Examples on close coiled helical springs.	CO 4	R2:7.5
14	Numerical examples on Principal stresses and theories of failure.	CO 5	R1:7.5
15	Numerical examples on Principal stresses and theories of failure	CO 5	R1:7.5
DISCUSSION OF DEFINITION AND TERMINOLOGY			
1	Definitions and terminology from simple stresses and strains.	CO 1	T1: 1-2 R2: 3.1,3.2

2	Definitions and terminology from shear force and bending moment.	CO 2	T1: 19-20 R2: 4.2
3	Definitions and terminology from bending and shear stresses.	CO 3	T1:23 R1: 4.1
4	Definitions and terminology from torsion of circular shafts and springs.	CO 4	T3:5.1, 5.2 R2: 8.1-8.4
5	Definitions and terminology from Principal stresses and theories of failure	CO 5	R1: 7.1
DISCUSSION OF QUESTION BANK			
1	Questions from simple stresses and strains.	CO 1	T1: 1.1, 1.2
2	Questions from shear force and bending moment.	CO 2	T1:22 R2: 4.4
3	Questions from bending and shear stresses.	CO 3	T1:24 R2: 5.4
4	Questions from torsion of circular shafts and springs.	CO 4	T1:61 R2: 12.3
5	Questions from Principal stresses and theories of failure	CO 5	R1:7.8

Signature of Course Coordinator **HOD,CE**
Dr. U.Vamsi Mohan, Professor

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

Course Title	**ENGINEERING GEOLOGY**				
Course Code	ACEC04				
Program	B.Tech				
Semester	III	CE			
Course Type	CORE				
Regulation	IARE-UG20				
Course Structure	Theory			Practical	
	Lecture	Tutorials	Credits	Laboratory	Credits
	3	-	3	-	-
Course Coordinator	Ms. P. Sri Poojitha, Assistant Professor				

I COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites
B.Tech	AHSC06	II	Engineering Chemistry

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 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
33%	Remember
67 %	Understand
0 %	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) and 10 marks for Alternative Assessment Tool (AAT).

Component		Marks	Total Marks
CIA	Continuous Internal Examination – 1 (Mid-term)	10	30
	Continuous Internal Examination – 2 (Mid-term)	10	
	AAT-1	5	
	AAT-2	5	
SEE	Semester End Examination (SEE)	70	70
Total Marks			100

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 course should enable the students to:

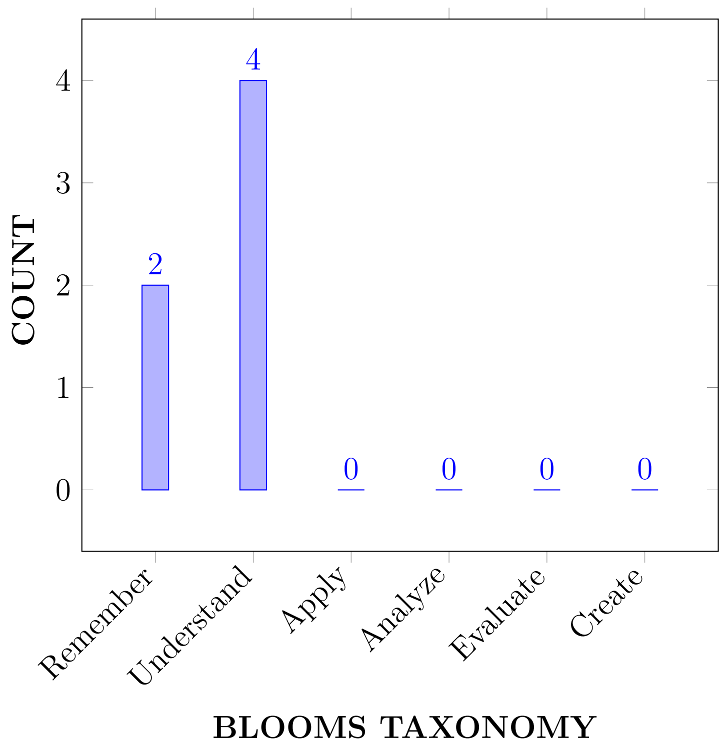
I	The process of formation of rocks, their classifications and properties of minerals
II	The identification of different geological structures encountered in nature
III	The different hazards such as earthquakes, landslides etc. causes and their effects
IV	The importance of geophysical and geological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

VII COURSE OUTCOMES:

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

CO 1	**Relate** the concepts of how minerals form and their uses for identifying the rock forming..	Understand
CO 2	**Classify** rocks using basic geological systems for selective construction material..	Understand
CO 3	**Interpret** graphs and models used in structural geology for demonstrating stress, strain and tectonics.	Understand
CO 4	**Relate** the geologic concepts and approaches of rock for engineering projects.	Remember
CO 5	**Compare** past tectonic settings of an area for evaluation of current structures.	Understand
CO 6	**List out** the design and construction procedures required for controlling safety of rock behaviour in dam construction	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 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: 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.	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
CO 1	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
	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

CO 2	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.	1
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.	1
CO 4	PO 1	Explain geological hazards (engineering fundamentals), mass wasting processes, methodology, and good building stones.	2
	PO 4	Use seismic and methodology to investigate subsurface and develop a native construction plan for awareness of quality issues.	2
	PSO 2	Explain basic concepts, common rocks, minerals, and their significance and performance improvement.	1
CO 5	PO 4	Identify geological features of prospective civil engineering project sites with the help of model studies.	2
	PO 7	Perform testing on existing structures by understanding the technical literature and retro fitting.	2
	PSO 2	Select and apply appropriate non-destructive technique to know the durability by understanding the limitations.	1
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	3	-	-	-	-	-	1	-	-	-	-	-	-	2	-
CO 2	1	-	1	-	-	-	2	-	-	-	-	-	2	-	-
CO 3	2	-	-	-	-	-	-	-	-	-	-	-	2	-	-
CO 4	2	-	-	2	-	-	-	-	-	-	-	-	-	1	-
CO 5	-	-	-	2	-	-	2	-	-	-	-	-	-	1	-
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	100	-	-	-	-	-	33.3	-	-	-	-	-	-	66.6	-
CO 2	33.3	-	10	-	-	-	66.6	-	-	-	-	-	20	-	-
CO 3	66.6	-	-	-	-	-	-	-	-	-	-	-	20	-	-
CO 4	66.6	-	-	18.2	-	-	-	-	-	-	-	-		33.3	-
CO 5	-	-	-	18.2	-	-	66.6	-	-	-	-	-	-	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≤ C≤ 5% – No correlation

2 - 40 % <C < 60% –Moderate

1 <C≤ 40% – Low/ Slight

3 - 60% ≤ C < 100% – Substantial /High

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

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

XVIII SYLLABUS:

MODULE I	INTRODUCTION
	Branches of geology useful to civil engineering, scope of geological studies in various civil engineering projects. Department dealing with this subject in India and their scope of work- GSI, Granite Dimension Stone Cell, NIRM. Mineralogy-Mineral, Origin and composition. Physical properties of minerals, susceptibility of minerals to alteration, basic of optical mineralogy, SEM, XRD., Rock forming minerals, megascopic identification of common primary & secondary minerals.

MODULE II	**PETROLOGY**
	Rock forming processes. Specific gravity of rocks. Ternary diagram. Igneous petrology- Volcanic Phenomenon and different materials ejected by volcanoes. Types of volcanic eruption. Concept of Hot spring and Geysers. Characteristics of different types of magma. Division of rock on the basis of depth of formation, and their characteristics. Chemical and Mineralogical Composition. Texture and its types. Various forms of rocks. IUGS Classification of phaneritic and volcanic rock.. Field Classification chart. Structures. Classification of Igneous rocks on the basis of Chemical composition. Detailed study of Acidic Igneous rocks like Granite, Rhyolite or Tuff, Felsite, Pegmatite, Hornfels. Metamorphic Aureole, Kaolinization. Landform as Tors. Engineering aspect to granite. Basic Igneous rocks Like Gabbro, Dolerite, Basalt. Engineering aspect to Basalt. Sedimentary petrology- mode of formation, Mineralogical Composition. Texture and its types, Structures, Gradation of Clastic rocks. Classification of sedimentary rocks and their characteristics. Detailed study of Conglomerate, Breccia, Sandstone, Mudstone and Shale, Limestone Metamorphic petrology Agents and types of metamorphism, metamorphic grades, Mineralogical composition, structures & textures in metamorphic rocks. Important Distinguishing features of rocks as Rock cleavage, Schistosity, Foliation. Classification. Detailed study of Gneiss, Schist, Slate with engineering consideration.
MODULE III	**PHYSICAL GEOLOGY AND ROCK MECHANICS**
	Weathering. Erosion and Denudation. Factors affecting weathering and product of weathering. Engineering consideration. Superficial deposits and its geotechnical importance: Water fall and Gorges, River meandering, Alluvium, Glacial deposits, Laterite (engineering aspects), Desert Landform, Loess, Residual deposits of Clay with flints. Solifluction deposits, mudflows, Coastal deposits. Sub surface investigations in rocks and engineering characteristics or rocks masses; Structural geology of rocks. Classification of rocks, Field & laboratory tests on rocks, Stress deformation of rocks, Failure theories and sheer strength of rocks, Bearing capacity of rocks.
MODULE IV	**GEOLOGICAL HAZARDS**
	Rock Instability and Slope movement: Concept of sliding blocks. Different controlling factors. Instability in vertical rock structures and measures to prevent collapse. Types of landslide. Prevention by surface drainage, slope reinforcement by Rock bolting and Rock anchoring, retaining wall, Slope treatment. Case study on black clay. Ground water: Factors controlling water bearing capacity of rock. Pervious & impervious rocks and ground water. Lowering of water table and Subsidence. Earthquake: Magnitude and intensity of earthquake. Seismic sea waves. Revelation from Seismic Records of structure of earth. Case Study on Elevation and Subsidence in Himalayan region in India. Seismic Zone in India.

MODULE V	GEOLOGY OF DAM AND RESERVOIR SITE
	Required geological consideration for selecting dam and reservoir site. Failure of Reservoir. favorable & unfavorable conditions in different types of rocks in presence of various structural features, precautions to be taken to counteract unsuitable conditions, significance of discontinuities on the dam site and treatment giving to such structures.

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			
	Discussion on OBE and Course Outcomes		
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**
Ms. P. Sri Poojitha, Assistant Professor

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

COURSE DESCRIPTION

Department	**CIVIL ENGINEERING**				
Course Title	**FLUID MECHANICS**				
Course Code	ACEC03				
Program	B.Tech				
Semester	III	CE			
Course Type	Core				
Regulation	IARE - UG-20				
Course Structure	Theory			Practical	
	Lecture	Tutorials	Credits	Laboratory	Credits
	3	-	3	-	-
Course Coordinator	Ms. Durga Sharma, Assistant Professor				

I COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites
B.Tech	AHSC02	I	Linear Algebra and Calculus
B.Tech	AHSC07	II	Mathematical Transform Techniques
B.Tech	AMEB03	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 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
%	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:

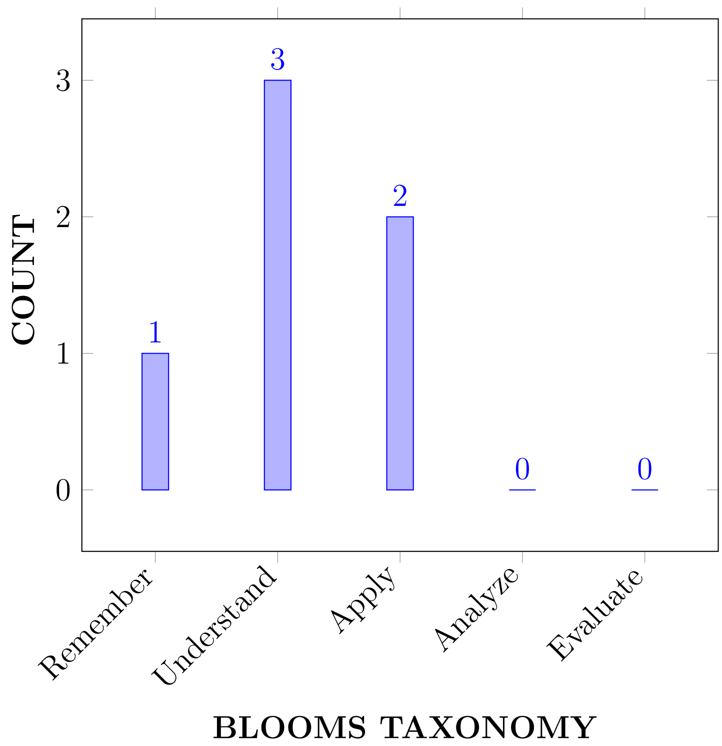
I	Understand and study the effect of fluid properties on a flow system.
II	Apply the concept of fluid pressure, its measurements and applications.
III	Explore the static, kinematic and dynamic behavior of fluids.
IV	Assess the fluid flow and flow parameters using measuring devices.

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	**Classify** the fluids based on Newton's law of viscosity for calculating shear and viscosity of an incompressible fluids.	Understand
CO 3	**Interpret** the principles of manometry and pressure for measuring gauge and differential pressures in fluids.	Understand
CO 4	**Make use of** hydrostatic forces and Archimedes principle for locating the point of application of force on various types of floating and immersed bodies.	Apply
CO 5	**Utilize** the conservation laws in differential forms for determining velocities, pressures and acceleration in a moving liquid.	Apply
CO 6	**Explain** velocity potential, stream function for estimating the possibility of the flow.	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.	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	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.	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	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
CO 2	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.**	4
CO 3	PO 1	Recall the knowledge and principles of **mathematicsand scientific methodology** for estimating various types of pressure in the fluids at rest and transit using **fundamentals of science.**	3
	PO 2	**Identify the problem statement** associated with the given data and **formulate** their cause to **develop the solutions** using the concept of pressure.	3
	PSO 1	Understand the significance of pressurein the design of **Water distribution system**for continuous supply of potable water.	1
CO 4	PO 1	Make use of the principles of hydrostatic forces and Archimedes using **mathematical principles and scientific methodology** and apply those results in analyzing the behaviorof pressure distribution. **(own engineering discipline.)**	3
	PO 3	**Understand the principles** of hydrostatic forces and Archimedes to **investigate** point of application of force on various types of floating and immersed bodies.	2

Course Outcomes	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key competencies matched.
	PO 4	Understanding of Engineering principles such as hydrostatic forces and Archimedes principle to apply them to analyze **key engineering process** like behavior of pressure distribution in liquids.	1
	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.**	2
CO 5	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 6	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**.	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	2	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 3	3	4	-	-	-	-	-	-	-	-	-	-	1	-	-
CO 4	3	-	4	2	-	-	-	-	-	2	-	-	-	-	-
CO 5	2	2	-	3	-	-	-	-	-	-	-	-	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	100	-	-	-	-	-	-	-	-	-	-		-	-	-
CO 2	100	20	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 3	100	50	-	-	-	-	-	-	-	-	-	-	10	-	-
CO 4	100	-	40	20	-	-	-	-	-	50	-	-	-	-	-
CO 5	67	40	-	33	-	-	-	-	-	-	-	-	20	-	-
CO 6	67	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	3	1	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 3	3	2	-	-	-	-	-	-	-	-	-	-	1	-	-
CO 4	3	-	2	1	-	-	-	-	-	2	-	-	-		-
CO 5	3	2	-	1	-	-	-	-	-	-	-	-	1	-	-
CO 6	3	1	-	-	-	-	-	-	-	-	-	-	-	-	-
TOTAL	30	11	2	7	-	-	-	-	-	5	-	-	3	-	-
AVERAGE	3	1	2	1	-	-	-	-	-	3	-	-	1		

XVI ASSESSMENT METHODOLOGY-DIRECT:

CIE Exams	✓	SEE Exams	✓	Seminars	-
Laboratory Practices	-	Student Viva	-	Certification	-
Term Paper	-	Concept Vedio	✓	Open Ended Experiments	✓

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 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 III	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 IV	BOUNDARY LAYER THEORY
	Approximate Solutions of Navier-Stoke's Equations, Boundary layer (BL) – concepts, Prandtl contribution, Characteristics of boundary layer along a thin flat plate, 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 , Magnus effect.
MODULE V	CLOSED CONDUIT FLOW
	Reynolds experiment – Characteristics of Laminar and Turbulent flows. Flow between parallel plates, flow through long pipes, flow through inclined pipes. Laws of Fluid friction – Darcy's equation, minor losses, pipes in series and pipes in parallel. Total energy line and hydraulic gradient line. Pipe network problems, variation of friction factor with Reynolds number – Moody's chart, Water hammer effect.

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 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

COURSE WEB PAGE:

1. https://www.iare.ac.in/?q=courseslist/71

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 system using Fluid Mechanics	-	
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 CO 2	T1: 2.4 R2:1-1.7
5-6	Fluid Pressure: Pressure at a point, Pascal's law.	CO 3 CO 4	T1: 2.6-14 R2:1-1.7
7-8	Measurement of pressure using various mechanical gauges	CO 3 CO 4	T1: 2.15-20 R1:1-1.7
9-10	Single Column Manometer, U -Tube Differential Manometer, Micro manometers.	CO 3 CO 4	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 3 CO 4	T1 – T3 R1 - R3
14-17	Classification of fluid flows with respect to time, space and combination of fluid flows.	CO 5 CO 6	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 5 CO 6	T1: 9.1-5 R2:2-2.8
20-22	Derivation of continuity equations in Cartesian coordinates.	CO 5 CO 6	T1 – T3 R1 - R3
23-26	Surface and body forces; Equations of motion - Euler's equation.	CO 5 CO 6	T2: 9.6-7 R2: 3-3.8

27-30	Bernoulli's equation – derivation and application	CO 5, C06	T2: 4.5
31-32	Approximate Solutions of Navier-Stoke's Equations, Boundary layer (BL) – concepts, Prandtl contribution,	CO 4 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 4 CO 5	T1: 10.1-5 R2: 4-4.8
35-38	Reynolds experiment – Characteristics of Laminar and Turbulent flows. Flow between parallel plates, flow through long pipes, flow through inclined pipes	CO 4	T1: 10.5-7 R2: 4-4.8
39-40	Total energy line and hydraulic gradient line and pipe network problems	CO 4, CO 6	T1: 10.7 R2: 4-4.8
PROBLEM SOLVING/ CASE STUDIES			
1	Problems on Properties of fluid	CO 1 CO2	R2:7.5
2	Problems on Surface tension and Vapour Pressure	CO 1 CO2	R2:7.5
3	Problems on Basic equations of fluid statics	CO 1 CO2	R2:7.5
4	Problems on Pressure Measuring Devices	CO 1 CO2	R2:7.5
5	Problems on Hydrostatic force on submerged surfaces	CO 3 CO 4	R2:7.5
6	Problems on Buoyancy and Stability	CO 3 CO 4	R2:7.5
7	Problems on Liquids in Rigid Body Motion	CO 3 CO 4	R2:7.5
8	Problems on velocity field	CO 5 CO 6	R2:7.5
9	Problems on continuity equations	CO 5 CO 6	R2:7.5
10	Problems on Irrotational Flow,Stream Function and velocity Potential	CO 5 CO 6	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 Boundary layer theory	CO 4	R2:7.5
13	Calculation of Forces exerted by fluid flow on pipe bend; Vortex Flow	CO 4, CO8	R2:7.5
14	Problems on Vonkarmen momentum integral equation	CO 4	R2:7.5
15	Problems on TE and HGL and pipe network analysis	CO 6	R2:7.5
DISCUSSION OF DEFINITION AND TERMINOLOGY			
56	Basic concepts and definitions - important concept and definitions	CO 1	T1: 11.1-7 R2: 11-11.10
57	Fluid statics - important concept and definitions	CO 2	T4: 2.1 -2.2 R2: 13-13.7
58	Fluid kinematics - important concept and definitions	CO 3	T4: 2.3 -2.6 R2: 13-13.7

59	Fluid dynamics - important concept and definitions	CO 4	T4: 2.7 - 2.9 R2: 13-13.7
60	Dimensional analysis - important concept and definitions	CO 5 CO 6	T4: 3.8 -3.10 R2: 19&20
DISCUSSION OF QUESTION BANK			
61	Basic concepts and definitions - important question and solution (Module I)	CO 1	T1: 11.1-7 R2: 11-11.10
62	Fluid statics - important question and solution (Module II)	CO 2	T4: 2.1 -2.2 R2: 13-13.7
63	Fluid kinematics- important question and solution (Module III)	CO 3	T4: 2.3 -2.6 R2: 13-13.7
64	Fluid dynamics - important question and solution (Module IV)	CO 4	T4: 2.7 - 2.9 R2: 13-13.7
65	Dimensional analysis - important question and solution (Module V)	CO 5 CO 6	T4: 3.8 -3.10 R2: 20

Signature of Course Coordinator **HOD,CE**

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

COURSE DESCRIPTION

Department	**CIVIL ENGINEERING**				
Course Title	**DATA STRUCTURES**				
Course Code	ACSC08				
Program	B.Tech				
Semester	III				
Course Type	Core				
Regulation	UG.20				
Course Structure	Theory			Practical	
	Lecture	Tutorials	Credits	Laboratory	Credits
	3	-	3	3	1.5
Course Coordinator	Dr V Sitharamulu, Associate Professor				

I COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites
B.Tech	ACSC01	I	Python Programming

II COURSE OVERVIEW:

The course covers some of the general-purpose data structures and algorithms, and software development. Topics covered include managing complexity, analysis, static data structures, dynamic data structures and hashing mechanisms. The main objective of the course is to teach the students how to select and design data structures and algorithms that are appropriate for problems that they might encounter in real life. This course reaches to student by power point presentations, lecture notes, and lab which involve the problem solving in mathematical and engineering areas.

III MARKS DISTRIBUTION:

Subject	SEE Examination	CIE Examination	Total Marks
Data Structures	70 Marks	30 Marks	100

IV CONTENT DELIVERY / INSTRUCTIONAL METHODOLOGIES:

✓	Power Point Presentations	✓	whiteboard		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 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.
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is given in table.

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

VI COURSE OBJECTIVES:

The students will try to learn:

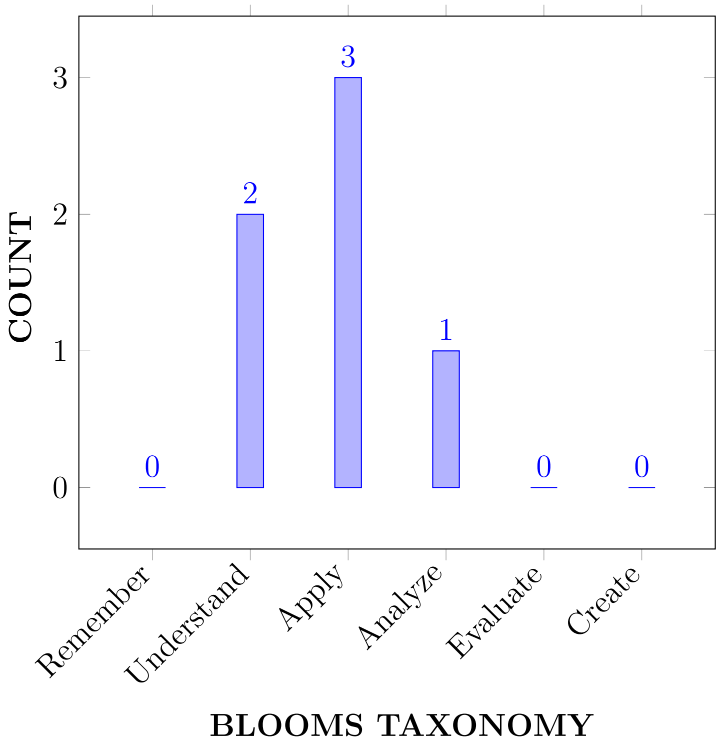
I	To provide students with skills needed to understand and analyze performance trade-offs of different algorithms / implementations and asymptotic analysis of their running time and memory usage.
II	To provide knowledge of basic abstract data types (ADT) and associated algorithms: stacks, queues, lists, tree, graphs, hashing and sorting, selection and searching.
III	The fundamentals of how to store, retrieve, and process data efficiently
IV	To provide practice by specifying and implementing these data structures and algorithms in Python.
V	Understand essential for future programming and software engineering courses.

VII COURSE OUTCOMES:

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

CO 1	**Interpret** the complexity of algorithm using the asymptotic notations.	Understand
CO 2	**Select** appropriate searching and sorting technique for a given problem.	Apply
CO 3	**Construct** programs on performing operations on linear and nonlinear data structures for organization of a data	Apply
CO 4	**Make use of** linear data structures and nonlinear data structures solving real time applications.	Apply
CO 5	**Describe** hashing techniques and collision resolution methods for efficiently accessing data with respect to performance.	Understand
CO 6	**Compare** various types of data structures ; in terms of implementation, operations and performance.	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.

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	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.	2	CIA/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	CIA/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	CIA/SEE

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	CIA/SEE/Open ended Experiments
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	Tech Talk/Concept Videos/Open ended Experiments
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	Tech Talk/Concept Videos/Open ended Experiments

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	CIA/ SEE/ Tech Talk/ Concept Videos
PSO 2	Focus on Improving Performance of Structures with reference to Safety, Serviceability and Sustainable Green Building Technology.	2	CIA/ SEE/ Tech Talk/ Concept Videos
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	CIA/ SEE/ Tech Talk/ Concept Videos

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 matched.
CO1	PO 1	**Understand** (knowledge) the concept of conventional digital communication system and (understand) various types of pulse analog modulation techniques for signals analysis by applying the principles of **mathematics, science,** and **engineering fundamentals**.	3
	PO 2	**Problem Analysis** on different types of algorithms to analyze space and time complexities.	4
	PO 3	**Design the Solutions** for finding space and time complexities of a complex algorithm and representing it by asymptotic notations	2
	PO 10	**Subject matter and speaking style** assessed in explanation of various algorithms, algorithm complexity.	2
	PSO1	**Design and analyze** complex algorithms and specify its space and time complexities and representing it by asymptotic notations for faster processing of data.	3
	PSO3	**Make use of modern** computer tools for finding space and time complexities of a complex algorithm	1
CO 2	PO 1	**Make use** of broad knowledge of searching and sorting techniques for an efficient search from a data structure and optimize the efficiency of other algorithms by applying the knowledge of mathematics, science, Engineering fundamentals.	1
	PO 2	**Problem Analysis** on different types of search sort algorithms to analyze space and time complexities.	5
	PO 3	**Design/Development of Solutions** using appropriate searching and sorting techniques for designing a solution for complex Engineering problems.	2

	PO 5	**Implementation of** different sorting and searching techniques for given problem with the help of computer software	1
	PO 10	**Subject matter and speaking style** assessed in explanation of searching and sorting along with efficiency of searching and sorting techniques in terms of space and time complexity	2
	PO 12	**Keeping current in CSE and advanced engineering concepts** of various searching , sorting and respective time and space complexity by tech talk, concept videos and open ended experiments.	3
	PSO1	**Understand** complex problems and analyzing it and apply appropriate sorting and searching techniques for data processing.	4
	PSO2	**Applying** various selecting and sorting techniques while designing and developing information retrieval systems and its applications	2
	PSO3	**Make use of** various selecting and sorting techniques and extend the knowledge for advance frame works and platforms which are necessary for engineering practices and higher studies or become an entrepreneur.	1
CO 3	PO 1	**Make use of** linear and nonlinear data structures to organize the data in a particular way so to use them in the most effective way by applying the basic knowledge of mathematics, science, engineering fundamentals	2
	PO 2	**Problem analysis:** Organizing the given data in particular way by performing the operations on linear and nonlinear data structures to use the data in the most effective way.	7
	PO 3	**Recognize the** need of linear and nonlinear data structures such as linked list, array, stack and queue by Designing solutions for complex Engineering.	5
	PO 4	**Conduct Investigations** Conduct Investigations of Complex Problems: Ability to apply operations on linear and nonlinear data structures in order to organize the given data in a particular way	4
	PO 5	**Implementation of** Implementation of different operations on linear and nonlinear data structures for given problem with the help of computer software	1
	PO 10	**Subject matter and speaking style** assessed in explanation of linear and nonlinear data structures like linked lists, stacks and queues	2
	PO 12	**Keeping current in** CSE and advanced engineering concepts of linear and nonlinear data structures like linked lists, stacks and queues by tech talk, concept videos and open-ended experiments	3

	PSO1	**Understand** complex problems and analyzing it and apply appropriate operations on linear or nonlinear data structures for Developing the solution.	5
	PSO2	**Applying** various linear or nonlinear data structures while designing and developing information retrieval systems and its applications	2
	PSO3	**Make use of** various linear or nonlinear data structures and extend the knowledge for advance frame works and platforms which are necessary for engineering practices and higher studies or become an entrepreneur.	1
CO 4	PO 1	**Make use of** linear and nonlinear data structures for solving real time applications by applying the basic knowledge of mathematics, science, engineering fundamentals	3
	PO 2	**Problem analysis:**Solving real time applications by performing the operations on linear or nonlinear data structures.	7
	PO 3	**Recognize the** need of linear and nonlinear data structures such as linked list, array, stack and queue for Designing real time applications.	2
	PO 4	**Conduct Investigations of Complex Problems:** Ability to apply operations on linear or nonlinear data structures in order to solve real time applications.	4
	PO 5	**Implementation of** different operations on linear and nonlinear data structures for solving real time applications with the help of computer software	1
	PO 10	**Subject matter and speaking style** assessed in explanation of linear and nonlinear data structures like linked lists, stacks, queues, trees and graphs	2
	PO 12	**Keeping current** in CSE and advanced engineering concepts of linear and nonlinear data structures like linked lists, stacks, queues, trees and graphs by tech talk, concept videos and open-ended experiments for solving real time applications.	3
	PSO1	**Understand** complex problems and analyzing it and apply appropriate operations on linear or nonlinear data structures for solving real time applications.	5
	PSO2	**Applying** various linear or nonlinear data structures while designing and developing information retrieval systems and its applications	1
	PSO3	**Make use of** various linear or nonlinear data structures and extend the knowledge for advance frame works and platforms which are necessary for engineering practices and higher studies or become an entrepreneur.	1

CO 5	PO 1	**Understand** the knowledge of hashing techniques and collision resolution methods and implementing for specified problem domain using knowledge of mathematics, science and engineering fundamentals	1
	PO 3	**Design the Solution** for efficiently accessing data with respect to performance by using hashing techniques and collision resolution methods	2
	PO 5	**Implementation of** hashing techniques and collision resolution methods for efficiently accessing data with respect to performance with the help of computer software	1
	PO 10	**Subject matter and speaking style** assessed in explanation of Hashing, Collision techniques	2
	PSO1	**Understand** complex problems and analyzing it and apply appropriate hashing techniques and collision resolution methods for efficiently accessing data with respect to performance.	4
	PSO2	**Applying** various hashing techniques and collision resolution methods while designing and developing information retrieval systems and its applications	1
	PSO3	**Build** sufficient knowledge hashing techniques and collision resolution methods so that new product can be developed, which leads to become successful entrepreneur in the present market.	1
CO 6	PO 1	**Understand** various types of data structures in terms of implementations and choose appropriate data structure for specified problem domain using knowledge of mathematics, science and engineering fundamentals	3
	PO 2	**Problem Analysis:** Recognize the importance of suitable data structures in checking the efficiency of algorithms used for complex engineering problems.	7
	PO 3	**Design the Solution** complex problems or efficiently accessing data with respect to performance by using hashing techniques and collision resolution methods	5
	PO 4	**Conduct Investigations of Complex Problems:** Ability to apply operations on linear or nonlinear data structures in order to solve real time applications.	4
	PO 5	**Understand** the Implementation of various types of data structures with the help of computer software	1
	PO 10	**Subject matter and speaking** style assessed in explanation of Implementation of various types of data structures.	2
	PO 12	**Keeping current in CSE** and advanced engineering concepts of Implementation of various types of data structures by tech talk, concept videos and open ended experiments	3

	PSO 1	**Understand** complex problems and analyzing it and apply Implementation of various types of data structures.	5
	PSO 2	**Applying** Implementation of various types of data structures while designing and developing information retrieval systems and its applications	1
	PSO 3	**Build** sufficient knowledge Implementation of various types of data structures so that new product can be developed, which leads to become successful entrepreneur in the present market.	1

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

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	12	6	2	2
CO 1	1	4	2	-	-	-	-	-	-	2	-	-	3	-	1
CO 2	1	5	2	-	1	-	-	-	-	2	-	3	4	2	1
CO 3	2	7	5	4	1	-	-	-	-	2	-	3	5	2	1
CO 4	3	7	2	4	1	-	-	-	-	2	-	3	5	1	1
CO 5	1	-	2	-	1	-	-	-	-	2	-	-	4	1	1
CO 6	3	7	5	4	1	-	-	-	-	2	-	3	5	1	1

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	12	2	2	2
CO 1	33.3	40	20	-	-	-	-	-	-	40	-	-	50	-	50
CO 2	33.3	50	20	-	100	-	-	-	-	40	-	25	66.6	100	50
CO 3	66.6	70	50	36.3	100	-	-	-	-	40	-	25	83.3	100	50
CO 4	100	70	20	36.3	100	-	-	-	-	40	-	-	66.6	50	50
CO 5	33.3	-	20	-	100	-	-	-	-	40	-	-	66.6	50	50
CO 6	100	70	50	36.3	100	-	-	-	-	40	-	25	83.3	50	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	**PROGRAM OUTCOMES**												**PSO'S**		
OUTCOMES	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO 1	1	1	1	-	-	-	-	-	-	1	-	-	2	-	2
CO 2	1	2	1	-	3	-	-	-	-	1	-	1	3	3	2
CO 3	3	3	2	1	3	-	-	-	-	1	-	1	3	3	2
CO 4	3	3	1	1	3	-	-	-	-	1	-	1	3	2	2
CO 5	1	-	1	-	3	-	-	-	-	1	-	-	3	2	2
CO 6	3	3	2	1	3	-	-	-	-	1	-	1	3	2	2
TOTAL	**12**	**12**	**8**	**3**	**15**	**-**	**-**	**-**	**-**	**6**	**-**	**4**	**17**	**12**	**12**
AVERAGE	**2.0**	**2.4**	**1.3**	**1.0**	**3.0**	**-**	**-**	**-**	**-**	**1**	**-**	**1**	**2.8**	**2.4**	**2.0**

XVI ASSESSMENT METHODOLOGY DIRECT:

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

XVII ASSESSMENT METHODOLOGY INDIRECT:

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

XVIII SYLLABUS:

MODULE I	**INTRODUCTION TO DATA STRUCTURES, SEARCHING AND SORTING**
	Basic concepts: Introduction to data structures, classification of data structures, operations on data structures; Algorithms Specification ,Recursive algorithms ,Data Abstraction, Performance analysis-time complexity and space complexity, Asymptotic Notation-Big O ,Omega and Theta notations. Introduction to Linear and Non Linear data structures, Searching techniques: Linear search, Binary search; Sorting techniques: Bubble, Selection, Insertion, Quick and Merge Sort and comparison of sorting algorithms
MODULE II	**LINEAR DATA STRUCTURES**
	Stacks: Stack ADT, definition and operations, Implementations of stacks using array, applications of stacks, Arithmetic expression conversion and evaluation; Queues: Primitive operations; Implementation of queues using Arrays, applications of linear queue, circular queue and double ended queue (deque).
MODULE III	**LINKED LISTS**
	Linked lists: Introduction, singly linked list, representation of a linked list in memory, operations on a single linked list; Applications of linked lists: Polynomial representation and sparse matrix manipulation. Types of linked lists: Circular linked lists, doubly linked lists; Linked list representation and operations of Stack, linked list representation and operations of queue
MODULE IV	**NON LINEAR DATA STRUCTURES**
	Trees: Basic concept, binary tree, binary tree representation, array and linked representations, binary tree traversal, binary tree variants, application of trees; Graphs: Basic concept, graph terminology, Graph representations-Adjacency matrix, Adjacency lists, graph implementation, Graph traversals-BFS,DFS, Application of graphs, Minimum spanning trees-Prims and Kruskal algorithms
MODULE V	**BINARY TREES AND HASHING**
	Binary search trees: Binary search trees, properties and operations; Balanced search trees: AVL trees; Introduction to M-Way search trees, B trees; Hashing and collision: Introduction, hash tables, hash functions, collisions, applications of hashing.

TEXTBOOKS

1. Rance D. Necaise, —Data Structures and Algorithms using Python, Wiley Student Edition.

2. Benjamin Baka, David Julian, —Python Data Structures and Algorithms, Packt Publishers, 2017.

REFERENCE BOOKS:

1. S. Lipschutz, —Data Structures , Tata McGraw Hill Education, 1st Edition, 2008.
2. D. Samanta, —Classic Data Structures, PHI Learning, 2nd Edition, 2004.

WEB REFERENCES:

1. http://www.tutorialspoint.com/data-structures-algorithms
2. https://www.geeksforgeeks.org/data-structures/
3. https://www.studytonight.com/data-structures/
4. https://www.coursera.org/specializations/data-structures-algorithms

COURSE WEB PAGE:

1. https://www.iare.ac.in/?q=courses/computer-science-and-engineering-autonomous/datastructures

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	-	https://www.iare.ac.in/?q=courses/computer-science-and-engineering-autonomous/datastructures
CONTENT DELIVERY (THEORY)			
1	Basic concepts: Introduction to Data Structures	CO 3	T1:1.1.3 R2 : 1.2
2	Classification of data structures	CO 3	T1:1.1.3 R2 : 1.4
3	Operations on data Structures	CO 3	T1:1.2
4	Recursive algorithm, Performance Analysis	CO 1	T1:1.2 T1:5.1
5	Searching techniques: Linear search and binary search	CO 2, CO 6	T1:5.1
6	Searching techniques: Fibonacci search and comparison	CO 2, CO 6	T1:5.1
8	Sorting techniques: Bubble sort, selection sort and companding	CO 2 CO 6	R1:14.5

9	Sorting techniques: Insertion sort, Quick sort	CO 2, CO 6,	T1:5.2 R2 : 10.2
10	Merge sort ,comparison of sorting algorithms	CO 4, CO 6	T1:5.2 R2 : 10.2
13	Stacks: Primitive operations, implementation of stacks using Arrays	CO 3, CO 4	T1:7.1
14	Applications of stacks arithmetic expression conversion and evaluation	CO 4, CO 6	T1:7.2
16	Queues: Primitive operations; Implementation of queues using Array	CO 3, CO 4	T1:8.1
17	Applications of linear queue, circular queue	CO 3, CO 4	T1:8.4
18	Double ended queue (deque)l	CO 3, CO 4	R2 : 5.4
19	Linked lists: Introduction, singly linked list, representation of a linked list in memory	CO 3, CO 4	T1:9.1
20	Operations on a single linked list :creation, insertion and deletion	CO 3, CO 4	T1:9.2
21	Applications of linked lists	CO 4,	T1:9.3
22	Operations on a double linked lists :creation, insertion and deletion	CO 3, CO 4	T1:9.4
23	Operations on a double linked lists : deletion ,traversal.	CO 3, CO 4	T1:9.4
24	single linked list :polynomial expression	CO 3, CO 4	T1:9.3
25	single linked list :Sparse matrix manipulation.	CO 3, CO 4	T1:9.3
26	Operations on a Circular linked lists: creation, insertion and deletion	CO 3, CO 4	T1:9
30	Operations on a Circular linked lists: deletion, traversal	CO 3, CO 4	T1:9
31	Linked list representation and operations of Stack	CO 3, CO 4	T1:9.7
32	Linked list representation and operations of queue	CO 3, CO 4	T1:9.8
37	Trees: Basic concept, Tree terminology	CO 3	T1:13.1

CONTENT DELIVERY (THEORY)			
38	Binary tree :Binary Tree properties	CO 3, CO 4	T1:13.1
39	Binary tree representation using array	CO 3, CO 4	T1:13.2
40	Binary tree representation using linked list	CO 3, CO 4	T1:13.2
41	Binary tree traversal, binary tree variants	CO 3, CO 4	T1:13.2
42	Application of trees	CO 4	T1:13.2.3
44	Graphs: Basic concept, graph terminology	CO 3	R2 : 8.2
45	Types of graphs, Representation of graph	CO 3	R2 : 8.2
46	Graph traversals :DFS and BFS, Application of graphs	CO 3	T2:6.2
48	Minimum Spanning Trees-Prims and Kruskal algorithms	CO 4	T1:6.1 T2:5.6
50	Binary search trees, properties	CO 3	T1:13.2.3
51	Binary search trees operations	CO 3	T1:13.2.3
52	AVL trees	CO 3	T1:14.3
53	M- Way search trees, B trees	CO 3	T1:14.3
54	Hashing, Collision	CO 5	R2 : 6.4
7	Problems on linear search, binary search and Fibonacci search.	CO 2	T1:5.1
11	Problems on bubble sort, selection and insertion sort	CO 3, CO 4	T1:5.2 R2 : 10.2
12	Problems on quick and merge sort	CO 3, CO 4	T1:5.2 R2 : 10.2
15	Problems on Arithmetic expression conversion and evaluation	CO 3, CO 4	T1:7.2
27	Problems on single linked list to add, delete element	CO 3, CO 4	T1:9.8
28	Problems on double linked list to add, delete element	CO 3, CO 4	T1:9.8
33	Problems on circular linked list to add, delete element	CO 3, CO 4	T1:9.4
34	Problems on double linked list to add, delete element	CO 3, CO 4	T1:9.3
35	Problems on stack using linked list	CO 3, CO 4	T1:9.7
36	Problems on queue using linked list	CO 3, CO 4	T1:9.8
43	Problems on Binary tree :creation ,insertion and deletion of a node	CO 3, CO 4	T1:13.2
47	Problems on Graph Traversal: DFS and BFS	CO 3, CO 4	T2:6.2

49	Problems on MST: Prim's and Kruskal's	CO 3, CO 4	T1:6.1 T2:5.6
55	Problems on Binary search tree	CO 4	T1:14.3
56	Problems oh hashing	CO 5	R2 : 6.4
DISCUSSION ON DEFINITION AND TERMINOLOGY			
57	Definitions on Data Structures, searching and sorting	CO 1, CO2, CO 3	T1:1 R1:14
58	Definitions on Linear Data Structures	CO 3	T1:7,.T1:8
59	Definitions on Linked Lists	CO 3	T1:9
60	Definitions on Non Linear data Structures	CO 3	T1:7.5
61	Definitions on Binary Trees and Hashing	CO 3, CO 5	T1:14
DISCUSSION ON QUESTION BANK			
62	Module I	CO 1, CO2, CO6	T1:1 R1:14
63	Module II	CO 3, CO 4, CO 6	T1:9
64	Module III	CO 3, CO 4, CO 6	T1:2.5
65	Module IV	CO 3, CO 4, CO 6	T1: 4.1
66	Module V	CO 3, CO 5, CO 6	T1: 5.1

Course Coordinator **HOD,CE**
Dr V Sitharamulu, Associate Professor

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

CIVIL ENGINEERING
COURSE DESCRIPTION

Course Title	**SURVEYING AND GEOMATICS LABORATORY**				
Course Code	ACEC05				
Program	B.Tech				
Semester	III	CE			
Course Type	Core				
Regulation	IARE - UG 20				
Course Structure	Theory			Practical	
	Lecture	Tutorials	Credits	Laboratory	Credits
	-	-	-	3	1.5
Course Coordinator	Mr. A Jagadish Babu, Assistant Professor				

I COURSE OVERVIEW:

The Surveying and Geomatics Laboratory is equipped with the instruments and tools students use throughout the surveying course. Students learn techniques for gathering field data with both traditional and modern instruments. A set of traditional and modern instruments are used, including auto level, theodolite, total station, level rods, tripods, tape measures, chaining pins, and other common surveying tools and ancillary equipments.

II COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites
B.Tech	AHSC02	I	Linear Algebra and Calculus

III MARKS DISTRIBUTION:

Subject	SEE Examination	CIE Examination	Total Marks
Surveying and Geomatics 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:

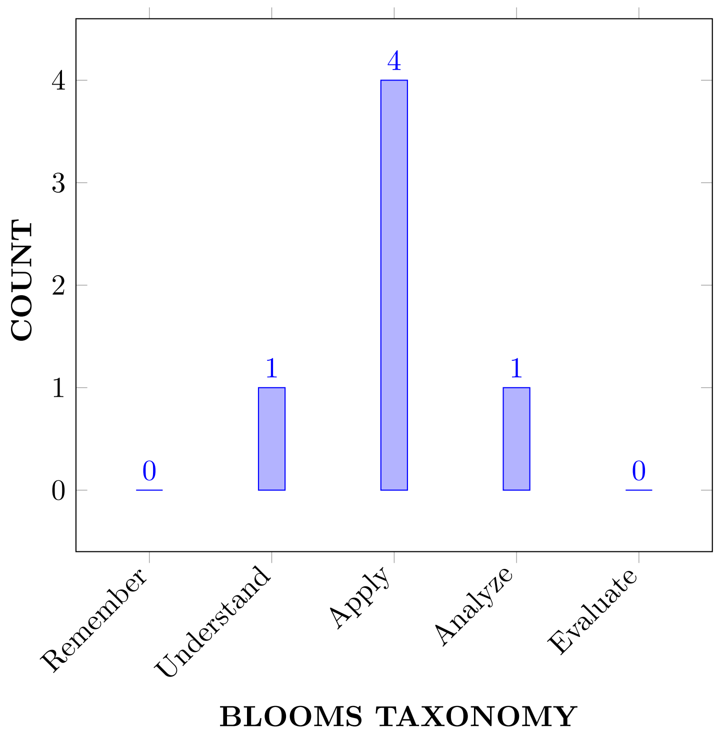
I	The practical knowledge on calculation of an area, volume of an irregular and regular land surface using chains and tapes.
II	The different types of instruments in surveying. Perform levelling and contouring of ground surfaces
III	Mathematics in surveying field to calculate areas and volumes for different projects.
IV	Survey data and design the civil engineering projects.

VII COURSE OUTCOMES:

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

CO 1	**Utilize** the concept of bearing system to measure azimuth and survey lines in filed. .	Apply
CO 2	**Make use of** digital theodolite apparatus to measure vertical and horizontal distances, gradients and elevations.	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** Rankine's curve setting procedure for investigating the suitable path along the alignment and conflict points.	Apply
CO 6	**Distinguish** between Tacheometry and trigonometry surveying for various operating conditions 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.	2	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	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	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.	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	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 (**problem statement**) calibration procedure of compass for (**information and data**) reaching substantiated conclusions by the interpretation of results	3
	PSO 1	Apply (**knowledge**) Design and Supervise Sub-Structures and Super Structures for Residential and Public Buildings, (apply) for tracing station points by applying the **principles of Mathematics, Science and Engineering**	3

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
	PO 5	Understand the (**problem statement**) effects of errors, and mistakes (from the provided information) in solving horizontal, gradients and elevations.	2
	PSO 1	Apply (**knowledge**) Design and Supervise Sub-Structures and Super Structures for Residential and Public Buildings, (apply) for tracing station points by applying the principles of **Mathematics, Science and Engineering**	3
CO 3	PO 1	Summarize (**knowledge**) the plane table surveying and applications of plane table surveying in inaccessible points (understanding) their importance and applicability (apply) in solving (complex) surveying problems by applying the principles of **principles of Mathematics, Science and Engineering**	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**.	3
	PSO 1	Apply (knowledge) Design and Supervise Sub-Structures and Super Structures for Residential and Public Buildings, (apply) for tracing station points by applying the **principles of Mathematics, Science and Engineering.**	3
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 formulate** the longitudinal and cross sectional analysis and similarity parameters for predicting physical parameters that govern the plotting on ground	2
	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 by applying the **principles of Mathematics, Science and Engineering**	3
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

	PO 2	Understand the given **problem statement** and formulate (complex) curve setting by Rankines method for developing various methods of curve setting to investigate the suitable path along the alignment and conflict points and **interpretation** of variations in the results.	2
	PO 5	Make use of **computational and experimental tools** for creating suitable paths and alignment for economical construction of roads and railways.	2
	PSO 1	Apply (knowledge) Design and Supervise Sub-Structures and Super Structures for Residential and Public Buildings, (apply) for illustrating suitable path and alignment by applying the **principles of Mathematics, Science and Engineering**	3
CO 6	PO 1	Apply the knowledge of **Mathematics and Engineering fundamentals** to understand the tacheometric and trigonometric survey to find reduced levels and its applications	2
	PO 2	Using standard stadia diaphragm derive the Tacheometric equation to analyze complex surveying problems with help of **principles of mathematics and engineering sciences.**	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	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-I .
WEEK II	**Survey of an area by chain survey (closed traverse) and plotting**
	Survey of an area by chain survey (closed traverse) and plotting
WEEK III	**Chaining across obstacles**
	Chaining across obstacles.
WEEK IV	**Determine of distance between two inaccessible points with compass**
	Determine of distance between two inaccessible points with 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**
	Radiation method, intersection methods by plane table survey.
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 surveys.
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, 2nd 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	Measurement of an area by chain survey Obtain the direction of a surveying line with a prismatic and surveyors compass.	CO 1	T1: 1.1
2	Chaining across obstacles.	CO 1	T1: 2.1
3	Calculation of distance between two points with compass survey.	CO 1	T2: 3.9
4	Corrections for local attraction by prismatic compass	CO 1	R1: 1.4
5	Radiation method and intersection methods by plane table survey.	CO 3	T1: 5.4
6	An exercise of longitudinal section and cross section and plotting.	CO 4	T1: 6.6
7	Measurement of horizontal angles.	CO 2	R1: 5.4
8	Trigonometric leveling- heights and distance problems.	CO 6	T1: 8.8
9	Heights and distances using principles of tacheometric survey.	CO 6	R1: 9.2
10	Curve setting: different methods.	CO 5	T1: 10.6
11	Determination of an area using total station.	CO 7	R1:7.2
12	Determination of remote height using total station.	CO 7	R1:11.4
13	Calculating distance, gradient and different heights between two inaccessible points using total station.	CO 7	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.A Jagadish Babu, Assistant Professor

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

Course Title	**ENGINEERING GEOLOGY LABORATORY**				
Course Code	ACEC06				
Program	B.Tech				
Semester	III	CE			
Course Type	CORE				
Regulation	IARE - UG20				
Course Structure	Theory			Practical	
	Lecture	Tutorials	Credits	Laboratory	Credits
	-	-	-	2	1
Course Coordinator	Dr. P Sreekanth Reddy, Assistant Professor, CE				

I COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites
-	-	-	-

II COURSE OVERVIEW:
Engineering Geology Laboratory provides a systematic study of the structure and properties of construction materials and their occurrence in different geographical locations. This course also addresses study and selection of different species and improvement of strength competence of the site and design considerations of constructing underground structures.

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 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 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			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:

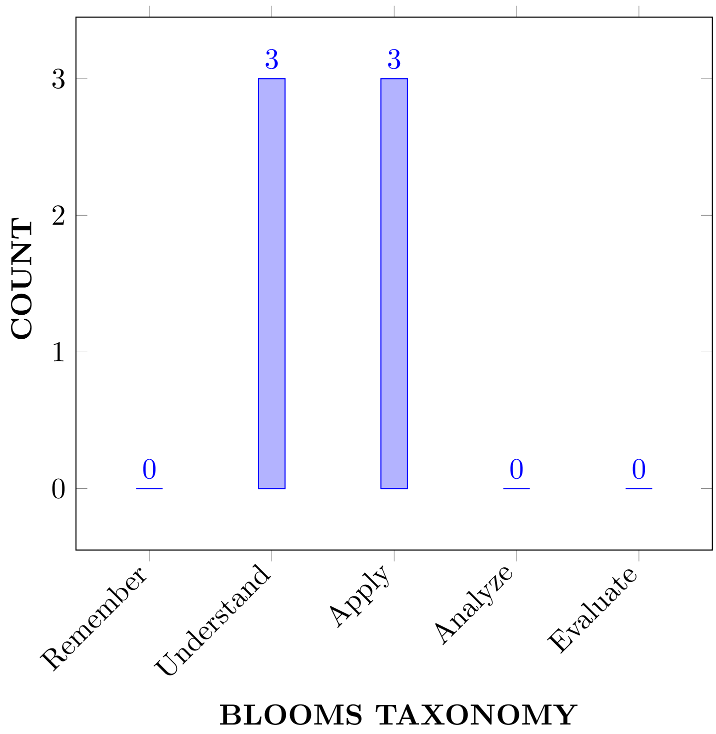
I	Engineering properties of rock and unconsolidated materials in the characterization of geologic sites for construction projects.
II	The statistical collection of geological data and information required for the safe development of civil constructions.
III	The rock engineering concepts and approaches in the design and development of sub surface and underground openings.

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	**Compare** past tectonic settings of an area for evaluation of current structures.	Understand
CO 3	**Interpret** graphs and models used in structural geology for demonstrating stress, strain and tectonics.	Understand
CO 4	**Identification** and study of rock properties using geological selection.	Apply
CO 5	**Apply** the concepts of how minerals form and their uses for identifying the rock forming.	Apply
CO 6	**Apply** the geologic concepts and approaches of rock for engineering projects.	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		Strength	Proficiency Assessed by
PO 1	**Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.	1	LAB PROGRAMS / / 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.	2	LAB PROGRAMS / / CIA/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.	2	LAB PROGRAMS / / CIA/SEE

3 = High; 2 = Medium; 1 = Low

X HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

Program		**Strength**	**Proficiency Assessed by**
PSO 2	Focus on mobile and web applications development and learn the emerging technologies and frameworks in demand with employers and contemporary challenges.	2	LAB PROGRAMS / CIA/SEE

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	PO4	PO4	PO7	PSO1	PSO2	PSO3
CO1	1	1						
CO2	2	2						
CO3	1	2						
CO4			1					
CO5			3					
CO6			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 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 2	Minerals and rocks will get acquainted with **environmental conditions**by natural dynamic processes and their actions.	1
CO 2	PO 1	Explain the significance of **materials knowledge** for civil engineering projects and site selection as well as for the **strength assessment** and others.	2
	PO 2	Explain geological hazard **engineering fundamentals**, mass wasting processes **methodology** and good building stones.	2
CO 3	PO 2	Recall **environmental impact** stratigraphy and **engineering, procurement and construction.**	2
CO 4	PO 4	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
CO 5	PO 4	Recognize **tectonic effects, Geological structures** and their **significance in Civil Engineering.**	3
CO 6	PO 1	**Analyze** the process of Automated Functional Testing Tool using Quick test professional by applying the **knowledge of engineering fundamentals, and an engineering specialization** to the solution of **complex engineering problems.**	3

XV SYLLABUS:

WEEK I	**PHYSICAL PROPERTIES OF MINERALS**
	Study on physical properties and their role in the identification of different minerals
WEEK II	**GROUP OF MINERALS**
	Characterize different group of minerals related to earth geology
WEEK III	**IDENTIFICATION OF SILICA GROUP MINERALS**
	Examine and identify Quartz, Amethyst, Opal in complying with the physical properties
WEEK IV	**IDENTIFICATION OF FELDSPAR GROUP MINERALS**
	Examine and identify Orthoclase, Plagioclase Feldspar in complying with the physical properties.
WEEK V	**IDENTIFICATION OF MINERALS**
	Examine and identify Jasper, Calcite, Graphite; Talc; Muscovite Mica Jasper, Calcite, Graphite; Talc; Muscovite Mica in complying with the physical properties.

WEEK VI	**IDENTIFICATION OF AMPHIBOLE GROUP MINERALS**
	Examine and identify Olivine, Hornblende, Magnetite, Hematite, Corundum, Kyanite, Garnet, Galena, Gypsum in complying with the physical properties.
WEEK VII	**IDENTIFICATION OF IGNEOUS ROCKS**
	Examine and identify Granite, Pegmatite, Dolerite and Basalt rocks in complying with their properties.
WEEK VIII	**IDENTIFICATION OF SEDIMENTARY ROCKS**
	Examine and identify Conglomerate, Sandstone, Limestone and Shale rocks in complying with the physical properties.
WEEK IX	**IDENTIFICATION OF METAMORPHIC ROCKS**
	Examine and identify Marble, Slate, Gneiss and Schist rocks based on their properties
WEEK X	**TOPOGRAPHICAL FEATURES**
	Analyze different topographical features by employing Geological maps.
WEEK XI	**GEOLOGICAL PROBLEMS**
	Geological problems associated with the rock beds and their formations such as Dip, Strike direction.
WEEK XII	**GEOLOGICAL MAPS** Examine and identify different symbols in geological maps that represents the geological features.

TEXTBOOKS

1. Parbin Singh, "Engineering and General Geology, 8th Edition,2010, S K Kataria & Sons.
2. Text Book of Engineering Geology, N. ChennaKesavulu, 2nd Edition 2009, Macmillan Publishers India.

REFERENCE BOOKS:

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

XVI 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 of physical properties of minerals	CO 1,C0 2	T2:2.3
2	Study of different group of minerals	CO 1, CO2	R1:2.6
3	Identification of Quartz, Amethyst, Opal	CO 1, CO2, CO 3, CO 4	T1:2.6
4	Identification of Orthoclase, Plagioclase Feldspar	CO 2, CO 3, CO 4	T2:2.7
5	Identification of Jasper, Calcite, Graphite; Talc; Muscovite Mica	CO 3, CO 4	T2:2.2
6	Olivine, Hornblende, Magnetite, Hematite, Corundum, Kyanite, Garnet, Galena, Gypsum.	CO 2, CO 3	T2:2.26

7	Identification of Granite, Pegmatite, Dolerite and Basalt rocks	CO 4, CO 3	T2:2.26
8	Identification of Conglomerate, Sandstone, Limestone and Shale rocks	CO 3, CO 4	T2:2.3
9	Identification of Marble, Slate, Gneiss and Schist rocks	CO 4	R1:2.6
10	Study of topographical features from Geological maps	CO 4	T1:2.6
11	Dip, Strike direction	CO 4	T2, W2
12	Identification of symbols in maps	CO 3, CO 4	T1, W5

XVII EXPERIMENTS FOR ENHANCED LEARNING (EEL):

S.No	Design Oriented Experiments
1	Demonstrate fundamental knowledge of: the physical and chemical properties of the lithosphere.
2	Study of societal relevance of earth systems.
3	Engineering Geological Diagrams
4	Study of Geological Structures like Faults and Folds
5	Study of Geological Structures like Tilted Bed models and unconformities

Signature of Course Coordinator **HOD,CE**
Dr. P. Sreekanth Reddy, Assistant Professor

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

CIVIL ENGINEERING

COURSE DESCRIPTION

Course Title	**DATA STRUCTURES LABORATORY**				
Course Code	ACSC10				
Program	B.Tech				
Semester	III	CE			
Course Type	Core				
Regulation	IARE - UG 20				
Course Structure	Theory			Practical	
	Lecture	Tutorials	Credits	Laboratory	Credits
	-	-	-	3	1.5
Course Coordinator	Dr. Sitharamulu, Assistant Professor				

I COURSE OVERVIEW:

The course covers some of the general-purpose data structures and algorithms, and software development. Topics covered include managing complexity, analysis, static data structures, dynamic data structures and hashing mechanisms. The main objective of the course is to teach the students how to select and design data structures and algorithms that are appropriate for problems that they might encounter in real life. This course reaches to student by power point presentations, lecture notes, and lab which involve the problem solving in mathematical and engineering areas

II COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites
B.Tech	ACSC02	I	Python Programming Laboratory
B.Tech	ACSC08	III	Data Structures

III MARKS DISTRIBUTION:

Subject	SEE Examination	CIE Examination	Total Marks
Data Structures 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	To provide students with skills needed to understand and analyze performance trade-offs of different algorithms / implementations and asymptotic analysis of their running time and memory usage.

II	To provide knowledge of basic abstract data types (ADT) and associated algorithms: stacks, queues, lists, tree, graphs, hashing and sorting, selection and searching. .
III	The fundamentals of how to store, retrieve, and process data efficiently.
IV	To provide practice by specifying and implementing these data structures and algorithms in Python.
V	Understand essential for future programming and software engineering courses.

VII COURSE OUTCOMES:

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

CO 1	**Identify** appropriate searching technique for efficient retrieval of data stored location. .	Apply
CO 2	**choose** sorting technique to represent data in specified format to to optimize data searching.	Apply
CO 3	**Make use of** stacks and queues representation, operations and their applications to organize specified data	Understand
CO 4	**utilize** linked lists to implement and perform operations for for organizing specified data	Apply
CO 5	**Construct** tree to perform different traversal techniques	Apply
CO 6	**Select** Appropriate graph traversal techniques to visit the vertices of a graph	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 2	**Problem Analysis:** Identify, formulate, review research literature, and analyse complex Engineering problems reaching substantiated conclusions using first principles of mathematics natural sciences, and Engineering sciences	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 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 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 8	**Ethics** Apply ethical principles and commit to professional ethics and responsibilities and norms of the Engineering practice	3	Lab Exercises
PO 9	**Individual and Teamwork** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings	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	4	Lab Exercises

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	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 Super Structures for Residential and Public Buildings, Industrial Structures, Irrigation Structures, Power Houses, Highways, Railways, Airways, Docs and Harbours.	2	Lab Exercises
PSO 2	Focus on Improving Performance of Structures with reference to Safety, Serviceability and Sustainable Green Building Technology.	2	Lab Exercises
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 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	Identify appropriate searching technique for efficient retrieval of data stored location by applying the **principles of Mathematics and Engineering** , **Scientific principles and methodology**,**engineering disciplines to integrate / support study**	3
	PO 2	Identify appropriate searching technique for efficient retrieval of data stored location by applying Problem Analysis **Problem statement and system definition**,**Information and data collection**,**Solution development or experimentation / Implementation**	3
	PO 3	**Identify** appropriate searching technique for efficient retrieval of data stored location by applying **Design/Development of Solutions**	3
	PO 4	Identify**apply**appropriate searching technique for efficient retrieval of data stored location by applying **Conduct Investigations of Complex Problems**	2

	PO 5	Identify**apply**appropriate searching technique for efficient retrieval of data stored location by applying Computer software / simulation packages / diagnostic equipment / technical library resources / literature search toolsl	1
	PO 6	Identify**apply**appropriate searching technique for efficient retrieval of data stored location by applying **reasoning informed by the contextual knowledge**	2
	PO 8	Identify**apply**appropriate searching technique for efficient retrieval of data stored location by applying **ethical principles** and commit to professional **ethics and responsibilities** and norms of the Engineering practice	3
	PO 9	Identify**apply**appropriate searching technique for efficient retrieval of data stored location by applying Function **effectively** as an individual, and as a member or leader to get Ability to work with all levels of people in an organization	3
	PO 10	Identify**apply**appropriate searching technique for efficient retrieval of data stored location by **Communicate effectively** on **complex Engineering activities**	3
	PO 12	Identify**apply**appropriate searching technique for efficient retrieval of data stored location by **Keeping current in CSE and advanced engineering concepts**	3
	PSO 1	Identify appropriate searching technique for efficient retrieval of data stored location in **search engines**	2
	PSO 2	Identify appropriate searching technique for efficient retrieval of data stored location in **mobile and web applications development**	2
	PSO 3	Identify appropriate searching technique for efficient retrieval of data stored location **in shipping real world software, using industry standard tools**	3
CO 2	PO 1	choose sorting technique to represent data in specified format to optimize data searching by applying the **principles of Mathematics and Engineering** , **Scientific principles and methodology**,**engineering disciplines to integrate / support study**	3
	PO 2	choose sorting technique to represent data in specified format to optimize data searching by applying Problem Analysis **Problem statement and system definition**,**Information and data collection**,**Solution development or experimentation / Implementation**	3
	PO 3	**Identify** choose sorting technique to represent data in specified format to optimize data searching by applying **Design/Development of Solutions**	3
	PO 4	**choose** sorting technique to represent data in specified format to optimize data searching by applying **Conduct Investigations of Complex Problems**	2

	PO 5	choose sorting technique to represent data in specified format to optimize data searching by applying Computer software / simulation packages / diagnostic equipment / technical library resources / **literature search toolsl**	1
	PO 6	choose sorting technique to **represent** data in specified format to optimize data searching by applying **reasoning informed by the contextual knowledge**	2
	PO 8	**choose** sorting technique to represent data in specified format to optimize data searching by applying **ethical principles** and commit to professional **ethics and responsibilities** and norms of the Engineering practice	3
	PO 9	choose sorting technique to **represent** data in specified format to optimize data searching by applying Function **effectively** as an individual, and as a member or leader to get Ability to work with all levels of people in an organization	3
	PO 10	choose**Apply** sorting technique to represent data in specified format to optimize data searching by **Communicate effectively** on **complex Engineering activities**	3
	PO 12	**choose** sorting technique to **represent** data in specified format to optimize data searching by **Keeping current in CSE and advanced engineering concepts**	3
	PSO 1	choose**Apply** sorting technique to represent data in specified format to optimize data searching in **search engines**	2
	PSO 2	choose**Apply** sorting technique to represent data in specified format to optimize data searching in **mobile and web applications development**	2
	PSO 3	choose**Apply** sorting technique to represent data in specified format to optimize data searching **in shipping real world software, using industry standard tools**	3
CO 3	PO 1	Make use of stacks and queues representation, operations and their applications to organize specified data by applying the **principles of Mathematics and Engineering** , **Scientific principles and methodology**,**engineering disciplines to integrate / support study**	3
	PO 2	Make use of stacks and queues representation, operations and their applications to organize specified data by applying Problem Analysis **Problem statement and system definition**,**Information and data collection**,**Solution development or experimentation / Implementation**	3
	PO 3	**Identify**, **Make use of** stacks and queues representation, operations and their applications to organize specified data by applying **Design/Development of Solutions**	3

	PO 4	Make use of **Apply**stacks and queues representation, operations and their applications to organize specified data by applying **Conduct Investigations of Complex Problems**	2
	PO 5	Make use of stacks and queues representation, operations and their applications to organize specified data by applying Computer software / simulation packages / diagnostic equipment / technical library resources / **literature search tools**	1
	PO 6	**Make use of** stacks and queues representation, operations and their applications to organize specified data by applying **reasoning informed by the contextual knowledge**	2
	PO 8	Make use of stacks and queues **representation**, operations and their applications to organize specified data by applying **ethical principles** and commit to professional **ethics and responsibilities** and norms of the Engineering practice	3
	PO 9	**Make use of** stacks and queues representation, operations and their applications to organize specified data by applying Function **effectively** as an individual, and as a member or leader to get Ability to work with all levels of people in an organization	3
	PO 10	Make use of stacks and queues representation, **operations and their applications** to organize specified data by **Communicate effectively** on **complex Engineering activities**	3
	PO 12	Make use of stacks and queues **representation**, operations and their applications to organize specified data by **Keeping current in CSE and advanced engineering concepts**	3
	PSO 1	Make use of stacks and queues **representation**, operations and their applications to organize specified data in **search engines**	2
	PSO 2	Make use of stacks and queues **representation**, operations and their applications to organize specified data **mobile and web applications development**	2
	PSO 3	Make use of stacks and queues **representation**, operations and their applications to organize specified data **in shipping real world software, using industry standard tools**	2
CO 4	PO 1	utilize linked lists to implement and perform operations for organizing specified data by applying the **principles of Mathematics and Engineering** , **Scientific principles and methodology**,**engineering disciplines to integrate / support study**	3

	PO 2	utilize linked lists to implement and perform operations for organizing specified data by applying Problem Analysis **Problem statement and system definition**,**Information and data collection**,**Solution development or experimentation / Implementation**	3
	PO 3	utilize**Apply** linked lists to **implement** and perform operations for organizing specified data by applying **Design/Development of Solutions**	3
	PO 4	utilize linked lists to **implement** and perform operations for organizing specified data by applying **Conduct Investigations of Complex Problems**	2
	PO 5	utilize linked lists to implement and perform operations for organizing specified data by applying Computer software / simulation packages / diagnostic equipment / technical library resources / **literature search toolsl**	1
	PO 6	utilize linked lists to implement and perform operations for organizing specified data by applying **reasoning informed by the contextual knowledge**	2
	PO 8	utilize linked lists to **implement** and perform operations for organizing specified data by applying **ethical principles** and commit to professional **ethics and responsibilities** and norms of the Engineering practice	3
	PO 9	utilize **Apply**linked lists to implement and perform operations for organizing specified data by applying Function **effectively** as an individual, and as a member or leader to get Ability to work with all levels of people in an organization	3
	PO 10	utilize linked lists to implement and **perform** operations for organizing specified data by **Communicate effectively** on **complex Engineering activities**	3
	PO 12	utilize**Apply** linked lists to implement and perform operations for organizing specified data by **Keeping current in CSE and advanced engineering concepts**	3
	PSO 1	utilize**Apply** linked lists to implement and perform operations for organizing specified in **search engines**	2
	PSO 2	utilize**Apply** linked lists to implement and perform operations for organizing specified in **mobile and web applications development**	2
	PSO 3	utilize**Apply** linked lists to implement and perform operations for organizing specified **in shipping real world software, using industry standard tools**	2
CO 5	PO 1	Construct tree to perform different traversal techniques by applying the **principles of Mathematics and Engineering** , **Scientific principles and methodology**,**engineering disciplines to integrate / support study**	3

	PO 2	Construct tree to perform different traversal techniques by applying Problem Analysis **Problem statement and system definition**,**Information and data collection**,**Solution development or experimentation / Implementation**	3
	PO 3	Construct**Apply** tree to **perform** different traversal techniques by applying **Design/Development of Solutions**	3
	PO 4	**Construct** tree to perform different traversal techniques by applying **Conduct Investigations of Complex Problems**	2
	PO 5	Construct tree to perform different traversal techniques by applying Computer software / simulation packages / diagnostic equipment / technical library resources / **literature search tools**	1
	PO 6	Construct tree to **perform** different traversal techniquesby applying **reasoning informed by the contextual knowledge**	2
	PO 8	ConstructApply tree to perform different traversal techniques by applying **ethical principles** and commit to professional **ethics and responsibilities** and norms of the Engineering practice	3
	PO 9	Construct tree to perform different traversal techniquesby applying Function **effectively** as an individual, and as a member or leader to get Ability to work with all levels of **people in an organization**	3
	PO 10	Construct tree to **perform** different traversal techniques by **Communicate effectively** on **complex Engineering activities**	3
	PO 12	**Construct** tree to perform different traversal techniques by **Keeping current in CSE and advanced engineering concepts**	3
	PSO 1	Construct tree to **perform** different traversal techniques in **search engines**	2
	PSO 2	Construct tree to **perform** different traversal techniques in **mobile and web applications development**	2
	PSO 3	Construct tree to **perform** different traversal techniques **in shipping real world software, using industry standard tools**	2
CO 6	PO 1	Select Appropriate graph traversal techniques to visit the vertices of a graph by applying the **principles of Mathematics and Engineering** , **Scientific principles and methodology**,**engineering disciplines to integrate / support study**	3
	PO 2	Select Appropriate graph traversal techniques to visit the vertices of a graph by applying Problem Analysis **Problem statement and system definition**,**Information and data collection**,**Solution development or experimentation / Implementation**	3

	PO 3	Select Appropriate graph traversal techniques to visit the vertices of a graph by applying **Design/Development of Solutions**	3
	PO 4	**Select** Appropriate graph traversal techniques to visit the vertices of a graph by applying **Conduct Investigations of Complex Problems**	2
	PO 5	Select Appropriate graph traversal techniques to visit the vertices of a graph by applying Computer software / simulation packages / diagnostic equipment / technical library resources / **literature search tools**	1
	PO 6	**Select** Appropriate graph traversal techniques to visit the vertices of a graph by applying **reasoning informed by the contextual knowledge**	2
	PO 8	**Select** Appropriate graph traversal techniques to visit the vertices of a graph by applying **ethical principles** and commit to professional **ethics and responsibilities** and norms of the Engineering practice	3
	PO 9	**Select** Appropriate graph traversal techniques to visit the vertices of a graph by applying Function **effectively** as an individual, and as a member or leader to get Ability to work with all levels of people in an organization	3
	PO 10	**Select** Appropriate graph traversal techniques to visit the vertices of a graph by **Communicate effectively** on **complex Engineering activities**	3
	PO 12	**Select** Appropriate graph traversal techniques to visit the vertices of a graph by **Keeping current in CSE and advanced engineering concepts**	3
	PSO 1	**Select** Appropriate graph traversal techniques to visit the vertices of a graph in **search engines**	2
	PSO 2	**Select** Appropriate graph traversal techniques to visit the vertices of a graph in **mobile and web applications development**	2
	PSO 3	**Select** Appropriate graph traversal techniques to visit the vertices of a graph **in shipping real world software, using industry standard tools**	2

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

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	3	2	2	3	1	-	1	2	3	-	2	2	1	1
CO 2	1	2	2	2	3	1	-	2	3	3	-	2	1	1	1
CO 3	1	2	2	1	3	1	-	-	2	3	-	2	2	2	-
CO 4	1	2	1	1	3	1	-	-	2	3	-	2	2	1	1

CO 5	1	1	2	1	3	1	-	2	2	3	-	2	2	1	1
CO 6	1	1	2	1	3	1	-	1	3	3	-	2	2	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	**SEARCHING TECHNIQUES**
	Write Python programs 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 implementation Stack and its operations using Arrays. b. Design and implementation Queue and its operations using Arrays
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	**IMPLEMENTATION 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. c. Count the number of nodes in the binary search tree.

TEXTBOOKS

1. Rance D. Necaise, "Data Structures and Algorithms using Python", Wiley Student Edition.
2. Benjamin Baka, David Julian, "Python Data Structures and Algorithms", Packt Publishers, 2017.

REFERENCE BOOKS:

1. Michael H Goldwasser, David Letscher, —Object Oriented Programming in Python‖, Prentice Hall, 1 st Edition, 2007.
2. Yashavant Kanetkar, Aditya Kanetkar, —Let us Python‖, BPB publication, 1st Edition, 2019.
3. Ashok Kamthane, Amit Kamthane, —Programming and Problem Solving with Python‖, McGraw Hill Education (India) Private Limited, 2018.
4. Taneja Sheetal, Kumar Naveen, —Python Programming – A modular approach‖, Pearson, 2017.
5. R Nageswara Rao, —Core Python Programming‖, Dreamtech Press, 2017 Edition.

WEB REFERENCES:

1. https://realpython.com/python3-object-oriented-programming
2. https://python.swaroopch.com/oop.html
3. https://python-textbok.readthedocs.io/en/1.0/Object-Oriented-Programming.html
4. https://www.programiz.com/python-programming/
5. . https://www.geeksforgeeks.org/python-programming-language

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	Searching Techniques	CO 1	T1
2	Sorting Techniques.	CO 2	T1
3	Sorting Techniques	CO 2	T1,T2
4	Implementation of Stack and Queue	CO 3	T1,T2
5	Applications of Stack.	CO 3	T1, W1
6	Implementation of Single Linked List	CO 4	T1,W2
7	Implementation of Circular Single Linked List.	CO 4	T1,W3
8	Implementation of Double Linked List	CO 4	T2,W3
9	Implementation of Stack Using Linked List.	CO 3,CO 4	T2,W2
10	Implementation of Queue Using Linked List	CO 3,CO 4	T2,W5
11	Graph Traversal Techniques.	CO 6	T2,W2
12	Implementation of Binary Search Tree	CO 5	T1,W5

XVI EXPERIMENTS FOR ENHANCED LEARNING (EEL):

S.No	Design Oriented Experiments
1	**Twin vortex formation:** Design a Data Structure SpecialStack that supports all the stack operations like push(), pop(), isEmpty(), isFull() and an additional operation getMin() which should return minimum element from the SpecialStack. All these operations of SpecialStack must be O(1). To implement SpecialStack, you should only use standard Stack data structure and no other data structure like arrays, list, . etc.
2	**Open channel:** In class, we studied binary search trees that do not allow us to insert duplicate elements. However, sometimes we do need to store duplicates. For example, a database of student marks might contain one record for every mark by every student; so if you've taken two courses, there will be two records with the same key (your student number) and different data (your two marks). To accomplish this, we might use a data structure called a "BST with duplicates", or BSTD
3	**Capillary action:** The variable tos in the Stack class is the index of the array element that would be filled the next time push() is called. Modify the code so that tos is the index of the top element actually in use. In other words, tos is to be the index of the top array element occupied by a value that has been "pushed" onto the stack. Write your changes on the code above. Don't forget to fix the comments. You do not need to add preconditions as in part-a.
4	**Buoyancy** Given an adjacency matrix representation of a graph, describe with pseudo code an algorithm that finds a single path, if one exists, between any two different vertices.

5	**Flow through pipes:** There is a garage where the access road can accommodate any number of trucks at one time. The garage is building such a way that only the last truck entered can be moved out. Each of the trucks is identified by a positive integer (a truck-id). Write a program to handle truck moves, allowing for the following commands: a) On-road (truck-id); b) Enter-garage (truck- id); c) Exit-garage (truck-id); d) Show-trucks (garage or road); If an attempt is made to get out a truck which is not the closest to the garage entry, the error message Truck x not near garage door

Signature of Course Coordinator **HOD,IT**
Mrs. K LAXMINARAYANAMMA, Assistant Professor

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

COURSE DESCRIPTION

Department	**CIVIL ENGINEERING**
Course Title	**THEORY OF STRUCTURES**
Course Code	ACEC07
Program	B.Tech
Semester	IV
Course Type	CORE
Regulation	UG-20

Course Structure	Theory			Practical	
	Lecture	Tutorials	Credits	Laboratory	Credits
	3	1	4		

Course Coordinator	Dr.U.Vamsi Mohan, Professor

I COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites
B.Tech	AMEC01	III	Engineering Mechanics
B.Tech	ACEC02	IV	Strength of Materials

II COURSE OVERVIEW:

Theory of Structures deals with deformable solids. It requires basic knowledge of principles of mechanics and knowledge of simple stresses, shear forces and bending moment from engineering mechanics and strength of materials courses and acts as a pre-requisite to the advanced courses on Structural Analysis and Design. This course introduces the concepts of double integration, moment-area and energy methods for finding slopes and deflections in beams and trusses. It also introduces the concepts of Euler's and Rankine's methods for the analysis of columns and struts. Succinctly, the course aims at developing the skill to analyse engineering problems on fixed and continuous beams. Eventually, through this course content, engineers can analyze the response of various structural members under different loading conditions and design the same, satisfying the safety and serviceability conditions.

III MARKS DISTRIBUTION:

Subject	SEE Examination	CIE Examination	Total Marks
Theory 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). 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
10%	Remember
20%	Understand
40%	Apply
30 %	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		Marks	Total Marks
CIA	Continuous Internal Examination – 1 (Mid-term)	10	30
	Continuous Internal Examination – 2 (Mid-term)	10	
	AAT-1	5	
	AAT-2	5	
SEE	Semester End Examination (SEE)	70	70
Total Marks			100

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:

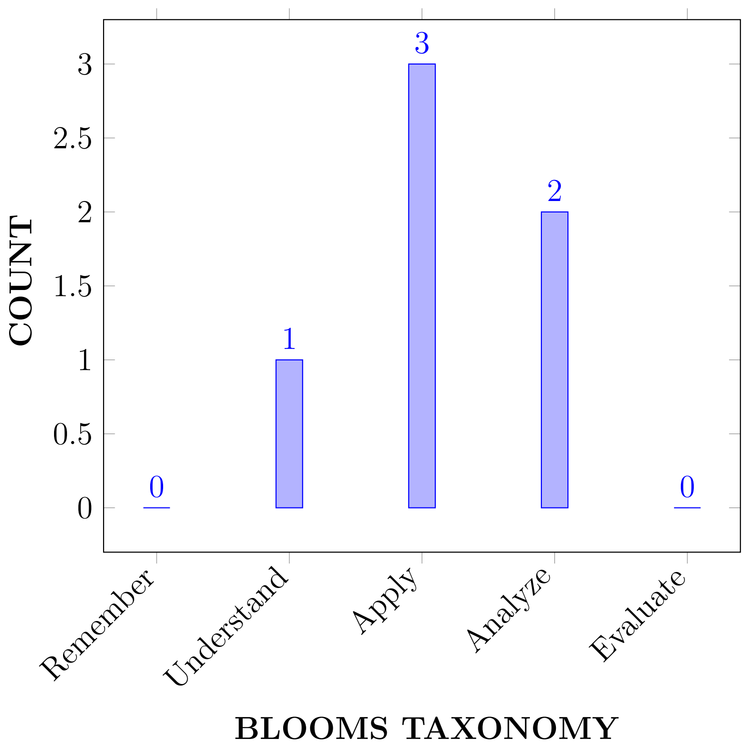
I	The behavior of indeterminate beams, such as propped cantilevers, fixed beams and continuous beams, in response to various applied loads and load combinations including support settlements.
II	The differential equation for slopes and deflections of determinate beams and their behaviour.
III	The concepts of method of joints and sections and Castigliano's theorems for analysing pin-jointed frames
IV	The behaviour of compression members such as columns and struts under axial and eccentric loads.

VII COURSE OUTCOMES:

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

CO 1	**Analyze** propped cantilevers and fixed beams using method of consistent deformation for finding the shear forces and bending moments at various locations and draw shear force and bending moment diagrams	Analyse
CO 2	**Illustrate** the concepts of clapeyron's theorem of three moments for solving problems on continuous beams including sinking of supports.	Understand
CO 3	**Develop** the differential equation for elastic curve for finding slopes and deflections of determinate beams.	Apply
CO 4	**Analyse** the trusses using method of joints and sections for computing member forces	Analyse
CO 5	**Apply** the concepts of energy methods for calculating deflections of simple beams and pin jointed frames.	Apply
CO 6	**Develop** the expressions for critical loads and stresses using Euler's and Rankine's methods for knowing behaviour of columns and struts with different end 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.	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

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 harbours.	2	CIE / 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	Explain the principle of consistent deformation and the principle of super position and solves the problems on propped cantilevers and fixed beams using **knowledge of mathematics and engineering fundamentals**.	2
	PO 2	**Formulate the problem** on propped cantilevers and fixed beams for **development of solution** to find support reactions and moments and analyse **complex engineering problems** with the help of the principles of **mathematics and engineering sciences**	4
	PO 4	**Recognize (knowledge) the behavior** of propped cantilevers and fixed beams, understand the corresponding **context of the engineering knowledge**, and analyse **key parameters** shear force , bending moment and deflections applying consistent deformation and conjugate beam method by incorporating the **systems approach**.	4
CO 2	PO 1	Apply the theorem of three moments and solves the problems on continuous beams to find the support moments **knowledge of mathematics and engineering fundamentals**	2
	PO 2	**Formulate the problem** on continuous beams for **development of solution** to find support moments and analyse **complex engineering problems** with the help of the principles of **mathematics and engineering sciences**	4
	PO 4	**Recognize (knowledge) the behavior** of continuous beams, understand the corresponding **context of the engineering knowledge**, and analyse **key parameters** support moments and reactions applying theorem of three moments by incorporating the **systems approach**.	4
	PSO 1	Understand the theorem of three moments for continuous beams to compute support moments using **mathematical principles and engineering knowledge.**	2

Course Outcomes	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key competencies matched.
CO 3	PO 1	Understand the concept of Macaulay's method, Mohr's theorems and conjugate beam methods for computing the slopes and deflections of beams by making use of **mathematical principles and engineering fundamentals**	2
	PO 2	**Formulate the problem** on different beams for **development of solution** to find deflections and analyse **complex engineering problems** using the principles of **mathematics and engineering sciences**	4
	PO 4	**Recognize (knowledge) the behavior** of beams, understand the corresponding **context of the engineering knowledge**, and analyse **key parameters** slopes and deflections applying Macaulay's method and Mohr's method by incorporating the **systems approach**.	4
	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	Understand the concept of strain energy stored due to external loads and apply the Castigliano's theorem for computing the deflections of the members by making use of **mathematical principles and engineering fundamentals**	2
	PO 2	**Formulate the problem** on pin-jointed frames for **development of solution** to find member forces and analyse **complex engineering problems** using the principles of **mathematics and engineering sciences**	4
	PSO 1	Understand the method of joints and method of sections for calculating member forces in determinate trusses using **mathematical principles and engineering knowledge.**	2
CO 5	PO 2	**Formulate the problem** on pin-jointed frames for **development of solution** to find deflections and analyse **complex engineering problems** using the principles of **mathematics and engineering sciences**	4
	PO 4	**Recognize (knowledge) the behavior** of pin-jointed frames, understand the corresponding **context of the engineering knowledge**, and analyse **key parameters** member forces and deflections applying method of joints and sections and Castigliano's theorem by incorporating the **systems approach**.	4
	PSO 1	Understand the work energy method, virtual work method, Castigliano's theorem for calculating displacements of beams using **mathematical principles and engineering knowledge.**	2

Course Outcomes	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key competencies matched.
CO 6	PO 2	**Formulate the problem** on short and long columns for **development of solution** to find strength and stress distribution and analyse **complex engineering problems** using the principles of **mathematics and engineering sciences**	4
	PO 4	**Recognize (knowledge) the behavior** of columns, understand the corresponding **context of the engineering knowledge**, and analyse **key parameters** crippling load, applying Euler's method and Rankine's method by incorporating the **systems approach**.	4
	PO 10	Illustrate the analysis of different structural elements using complex engineering problems can be solved with help of basic mathematics and engineering sciences.	3
	PO 12	Recognize the need and have sufficient preparation in field of structural engineering to enhance skill and additional efforts for future advancement and life-long learning.	4
	PSO 1	Understand behaviour of columns under axial and eccentric loads and computes critical load using Euler's and Rankine's formulae with the help of **mathematical principles and engineering knowledge.**	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	-	4	-	-	-	-	-	-	-	-	-	-	-
CO 2	2	4	-	4	-	-	-	-	-	-	-	-	2	-	-
CO 3	2	4	-	4	-	-	-	-	-	-	-	-	2	-	-
CO 4	2	4	-	-	-	-	-	-	-	-	-	-	2	-	-
CO 5	-	4	-	4	-	-	-	-	-	-	-	-	2	-	-
CO 6	-	4	-	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	40	-	40	-	-	-	-	-	-	-	-	-	-	-
CO 2	67	40	-	40	-	-	-	-	-	-	-	-	20	-	-
CO 3	67	40	-	40	-	-	-	-	-	-	-	-	20	-	-
CO 4	67	40	-	-	-	-	-	-	-	-	-	-	20	-	-
CO 5	-	40	-	40	-	-	-	-	-	-	-	-	20	-	-
CO 6	-	40	-	40	-	-	-	-	-	60	-	50	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	2	-	2	-	-	-	-	-	-	-	-	-	-	
CO 2	3	2	-	2	-	-	-	-	-	-	-	-	2	-	-
CO 3	3	2	-	2	-	-	-	-	-	-	-	-	2	-	-
CO 4	3	2	-	-	-	-	-	-	-	-	-	-	2	-	-
CO 5	-	2	-	2	-	-	-	-	-	-	-	-	2	-	-
CO 6	-	2	-	2	-	-	-	-	-	3	-	2	2	-	-
TOTAL	12	12	-	10	-	-	-	-	-	3	-	2	2	-	-
AVERAGE	2.8	1.0	-	1	-	-	-	-	-	3	-	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:

	Assessment of mini projects by experts	✓	End Semester OBE Feedback

XVIII SYLLABUS:

MODULE I	**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 and combination of loads, shear force and bending moment diagrams for propped cantilever and fixed beams, effect of sinking of support, effect of rotation of a support.
MODULE II	**CONTINUOUS BEAMS**
	Introduction, 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 III	**DEFLECTIONS OF BEAMS**
	Introduction, Differential equation of deflected beam, Slope and deflection at a point, double integration and Macaulay's methods, determination of slope and deflection for cantilever and simply supported beams subjected to point loads. Uniformly distributed load and uniformly varying load- Mohr's theorems, moment area method, application to simple cases, conjugate beam method, application to simple cases.
MODULE IV	**ANALYSIS OF TRUSSES AND ENERGY METHODS**
	ANALYSIS OF TRUSSES: Definition – Perfect, Deficient and Redundant frames – Methods of Analysis - Analysis of simple trusses by method of joints and method of sections. ENERGY METHODS: Introduction-Strain energy in linear elastic system, expression of strain energy due to axial load, bending moment and shear forces, Castigliano's first theorem, deflections of simple beams and pin jointed trusses.
MODULE V	**COLUMNS AND STRUTS**
	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 formula. Laterally loaded struts, subjected to uniformly distributed and concentrated loads, maximum bending moment and stress due to transverse and lateral loading.

TEXTBOOKS

1. R. K. Bansal, "A Textbook of Strength of Materials", Laxmi Publications (P) Ltd., New Delhi, 2nd Edition, 2007.

2. F. Beer, E. R. Johnston, J. DeWolf, "Mechanics of Materials", Tata McGraw-Hill Publishing Company Ltd., New Delhi, India, 1st Edition, 2008.

3. S. S. Bhavikatti, "Strength of Materials", Vikas Publishing House Pvt. Ltd., New Delhi, 5th Edition, 2013.

REFERENCE BOOKS:

1. B. C. Punmia, Ashok K Jain and Arun K Jain, "Mechanics of Materials", Laxmi Publications Pvt. Ltd., New Delhi, 12th Edition, 2007.
2. R. Subramanian, "Strength of Materials", Oxford University Press, 2nd Edition, 2010.
3. D. S. Prakash Rao, "Strength of Materials A Practical Approach Vol.1", Universities Press (India) Pvt. Ltd., India, 3rd Edition, 2007.
4. J. M. Gere, S.P. Timoshenko, "Mechanics of Materials, SI units edition", CL Engineering, USA, 5th 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 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)			
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**

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

COURSE DESCRIPTION

Department	**CIVIL ENGINEERING**				
Course Title	**PROBABILITY AND STATISTICS**				
Course Code	AHSC08				
Program	B.Tech				
Semester	IV	CE			
Course Type	Foundation				
Regulation	UG-20				
Course Structure	Theory			Practical	
	Lecture	Tutorials	Credits	Laboratory	Credits
	3	1	4	-	-
Course Coordinator	Ms. P Naga Lakshmi Devi, Assistant Professor				

I COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites
10+2	-	-	Fundamentals of Statistics

II COURSE OVERVIEW:

Probability theory is the branch of mathematics that deals with modelling uncertainty. Inferential Statistics and regression analysis together with random variate distributions are playing an exceptional role in designing data driven technology which is familiarly known as data centric engineering. They also have wide variety applications in telecommunications and other engineering disciplines. The course covers advanced topics of probability and statistics with applications. The course includes: random variables, probability distributions, hypothesis testing, confidence intervals, and linear regression. There is an emphasis placed on real-world applications to engineering problems.

III MARKS DISTRIBUTION:

Subject	SEE Examination	CIE Examination	Total Marks
Probability and Statistics	70 Marks	30 Marks	100

IV CONTENT DELIVERY / INSTRUCTIONAL METHODOLOGIES:

✓	Power Point Presentations	✓	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). 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
10%	Remember
30 %	Understand
60%	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		Marks	Total Marks
CIA	Continuous Internal Examination – 1 (Mid-term)	10	30
	Continuous Internal Examination – 2 (Mid-term)	10	
	AAT-1	5	
	AAT-2	5	
SEE	Semester End Examination (SEE)	70	70
Total Marks			100

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:

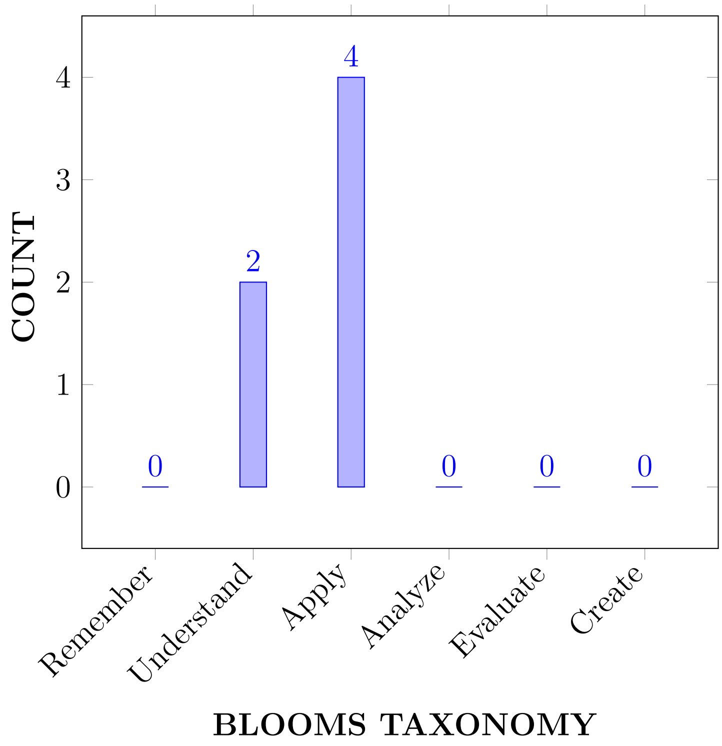
I	The theory of random variables, basic random variate distributions and their applications.
II	The Methods and techniques for quantifying the degree of closeness among two or more variables and the concept of linear regression analysis.
III	The Estimation statistics and Hypothesis testing which play a vital role in the assessment of the quality of the materials, products and ensuring the standards of the engineering process.
IV	The statistical tools which are essential for translating an engineering problem into probability model.

VII COURSE OUTCOMES:

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

CO 1	**Explain** the role of random variables and types of random variables, expected values of the discrete and continuous random variables under randomized probabilistic conditions.	Understand
CO 2	**Interpret** the parameters of random variate Probability distributions such as Binomial, Poisson and Normal distribution by using their probability functions, expectation and variance.	Understand
CO 3	**Apply** Bivariate Regression as well as Correlation Analysis for statistical forecasting.	Apply
CO 4	**Make Use of** estimation statistics in computing confidence intervals, Regression analysis and hypothesis testing.	Apply
CO 5	**Identify** the role of statistical hypotheses, types of errors, confidence intervals, the tests of hypotheses for large samplein making decisions over statistical claims in hypothesis testing	Apply
CO 6	**Identify** the tests of hypothesis for small sample 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.

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	3	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	Seminar/ Conferences/ Research Papers
PO 5	**Modern Tool Usage:** Use research-based knowledge and research methods including design of eConduct investigations of complex problems:xperiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.	3	Assignments/ Discussion

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 (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	Understand the technical uncertainty prevailing in the probabilistic situations with aids of technical literature and quantitatively measure The expected values, variances of the modeled discrete random variables in a systematic approach.	5

Course Outcomes	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key competencies matched.
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 to develop the solution and reaching substantiated conclusions by the interpretation and validation of results through proper documentation	7
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	Understand the technical uncertainty prevailing in the probabilistic situations with aids of technical literature and quantitatively measure The expected values, variances of the modeled discrete random variables in a systematic approach.	5
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 involves the events of uncertainty, Model it with suitable probability distribution and Apply the concepts of discrete or continuous distributions to develop the solution and reaching substantiated conclusions by the interpretation and validation of results through proper documentation	7
	PO 4	Understand the technical uncertainty prevailing in the probabilistic situations with aids of technical literature and quantitatively measure The expected values, variances of the modeled discrete random variables in a systematic approach.	5

Course Outcomes	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key competencies matched.
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	Understand the technical uncertainty prevailing in the probabilistic situations with aids of technical literature and quantitatively measure The expected values, variances of the modeled discrete random variables in a systematic approach.	5
	PO 5	Make Use of R software package a in modeling complex Engineering activities which involves computation of confidence intervals, statistical averages and regression analysis, hypothesis testing.	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	-	-	5	-	-	-	-	-	-	-	-	-	-	-
CO 2	2	7	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 3	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 4	2	-	-	5	-	-	-	-	-	-	-		-	-	-
CO 5	2	7	-	5	-	-	-	-	-	-	-	-	-	-	-
CO 6	2	-	-	5	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	-	-	45.5	-	-	-	-	-	-	-		-	-	-
CO 2	66.7	63.6	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 3	66.7	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 4	66.7	-	-	45.5	-	-	-	-	-	-	-	-	-	-	-
CO 5	66.7	63.6	-	45.5	-	-	-	-	-	-	-	-	-	-	-
CO 6	66.7	-	-	45.5	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	-	-	2	-	-	-	-	-	-	-	-	-	-	-
CO 2	3	3	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 3	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 4	3	-	-	2	-	-	-	-	-	-	-	-	-	-	-
CO 5	3	3	-	2	-	-	-	-	-	-	-	-	-	-	-
CO 6	3	-	-	2	3	-	-	-	-	-	-		-	-	-
TOTAL	18	6	-	8	3	-	-	-	-	-	-	-	-	-	-
AVERAGE	3	3	-	2	3	-	-	-	-	-	-	-	-	-	-

XVI ASSESSMENT METHODOLOGY-DIRECT:

CIE Exams	✓	SEE Exams	✓	Seminars	-
Laboratory Practices	-	Student Viva	-	Certification	-
Term Paper	-	Tech Talk	✓	Concept video	✓
Assignments	-				

XVII ASSESSMENT METHODOLOGY-INDIRECT:

✓	Early Semester Feedback	✓	End Semester OBE Feedback

XVIII SYLLABUS:

MODULE I	**PROBABILITY AND RANDOM VARIABLES**
	Random variables: Basic definitions, discrete and continuous random variables; Probability distribution: Probability mass function and probability density functions; Mathematical expectation.
MODULE II	**PROBABILITY DISTRIBUTION**
	Binomial distribution; Mean and variances of Binomial distribution, Recurrence formula for the Binomial distribution; Poisson distribution: Poisson distribution as a limiting case of Binomial distribution, mean and variance of Poisson distribution, Recurrence formula for the Poisson distribution; Normal distribution; Mean, Variance, Mode, Median, Characteristics of normal distribution.
MODULE III	**CORRELATION AND REGRESSION**
	Correlation: Karl Pearson's Coefficient of correlation, Computation of correlation coefficient, Rank correlation, Repeated Ranks; Properties of correlation. Regression: Lines of regression, Regression coefficient, Properties of Regression coefficient, Angle between two lines of regression.

MODULE IV	**TEST OF HYPOTHESIS – I**
	Sampling: Definitions of population, Sampling, Parameter of statistics, standard error; Test of significance: Null hypothesis, alternate hypothesis, type I and type II errors, critical region, confidence interval, level of significance. One sided test, two-sided test. Large sample test: Test of significance for single mean, Test of significance for difference between two sample means, Tests of significance single proportion and Test of difference between proportions.
MODULE V	**TEST OF HYPOTHESIS – II**
	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; Chi-square test of goodness of fit.

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.

WEB REFERENCES:

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

2. https://toaz.info/32fa2f50-8490-42cf-9e6a-f50cb7ea9a5b

3. http://www.mathworld.wolfram.com

COURSE WEB PAGE:

https://www.youtube.com/playlist?list=PLzkMouYverAJ1gjLBz4sA5O0ymIi01or6

REFERENCE BOOKS:

1. N. P. Bali, "Engineering Mathematics", Laxmi Publications, 9th Edition, 2016.

2. S. C. Gupta, V. K. Kapoor, "Fundamentals of Mathematical Statistics", S. Chand and Co., 10th Edition, 2000.

3. Richard Arnold Johnson, Irwin Miller and John E. Freund, "Probability and Statistics for Engineers", Prentice Hall, 8th Edition, 2013.

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	Probability Basic definitions	CO 1	T2:26.3
3	Probability	CO 1	R2:21.48
4	Axioms of Probability	CO 1	T2:26.6 R2:21.50
5	Conditional Probability	CO 1	T2:26.7 R2:21.51
6	Random Variables	CO 1	T2:26.8
7	Discrete and Continuous random variables	CO 1	T2:26.10
8	Probability distribution	CO 1	T2:26.14 R2:21.55
9	Probability mass function	CO 1	T2:26.15 R2:21.58
10	Probability Density Function	CO 1	T2:26.16 R2:21.61
11	Mathematical Expectation	CO 2	T2:25.12 R2:21.24
12	Binomial Distribution	CO 2	T2:25.16 R2:21.29
13	Mean, Variance and Mode of Binomial Distribution	CO 2	T2:25.14 R2:21.31
14	Expected Frequency of Binomial Distribution	CO 2	T2:25.14 R2:21.33
15	Poisson Distribution	CO 2	R2:21.33
16	Mean, Variance and Mode of Poisson distribution	CO 2	T2:27.2 R2:21.64
17	Expected Frequency of Poisson Distribution	CO 2	T2:27.2
18	Normal distribution – I	CO 2	T2:27.2 R2:21.67

19	Mean and Variance of Normal Distribution	CO 2	T2:27.2
20	Mode and Median of Normal distribution	CO 2	T2:27.3 R2:21.71
21	Normal distribution – II	CO 2	T2:27.4 R2:21.68
22	Correlation	CO 3	T2:27.7 R2:21.74
23	Rank Correlation	CO 3	T2:27.12 R2:21.75
24	Rank Correlation for Repeated Ranks	CO 3	T2:27.8 R2:21.72
25	Regression Lines-I	CO 4	T2:27.8 R2:21.73
26	Regression Lines-II	CO 4	T2:27.14 R2:21.78
27	Regression Lines-III	CO 4	T2:27.19 R2:21.814
28	Sampling distribution – I	CO 5	T2:27.12 R2:21.82
29	Sampling distribution – II	CO 5	T2:27.18 R2:21.82
30	Testing of hypothesis for Large Samples	CO 5	T2:26.15 R2:21.58
31	Test of hypothesis for single mean	CO 5	T2:26.16 R2:21.61
32	Test of hypothesis for difference of means	CO 5	T2:25.14 R2:21.33
33	Test of hypothesis for single proportion	CO 5	R2:21.33
34	Test of hypothesis for difference of proportions	CO 5	T2:27.2 R2:21.64
35	Testing of hypothesis for small samples	CO 6	T2:27.2
36	Student's t-distribution for single mean	CO 6	T2:26.16 R2:21.61
37	Student's t-distribution for difference of means	CO 6	T2:25.12 R2:21.24
38	F-distribution	CO 6	T2:25.16 R2:21.29
39	Chi-Square distribution – I	CO 6	T2:27.14 R2:21.78
40	Chi-Square distribution – II	CO 6	T2:27.19 R2:21.814
41	Chi-Square distribution – III	CO 6	T2:27.12 R2:21.82
PROBLEM SOLVING/ CASE STUDIES			
42	Problems on Probability	CO 1	T2:26.3
43	Problems on Discrete and Continuous random variables	CO 1	R2:21.48

44	Problems on Probability mass function	CO 1	T2:26.6 R2:21.50
45	Problems on Probability density function	CO 1	T2:26.7 R2:21.51
46	Problems on Binomial Distribution	CO 2	T2:26.8
47	Problems on Poisson Distribution	CO 2	T2:26.10
48	Problems on Normal Distribution	CO 2	T2:26.14 R2:21.55
49	Problems on Correlation	CO 3	T2:26.15 R2:21.58
50	Problems on Regression	CO 4	T2:26.16 R2:21.61
51	Problems on Sampling distribution	CO 5	T2:25.12 R2:21.24
52	Problems on Test of hypothesis for single mean and difference of means	CO 5	T2:25.16 R2:21.29
53	Problems on Test of hypothesis for single proportion and difference of proportions	CO 6	T2:25.14 R2:21.31
54	Problems on t-distribution	CO 6	T2:25.14 R2:21.33
55	Problems on F-distribution	CO 6	R2:21.33
56	Problems on Chi-Square distribution	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	Probability and Random variables	CO 2	T2:26.7 R2:21.51
59	Definitions& terminology discussion on correlation and regression.	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.	CO 6	R2:21.33

DISCUSSION OF QUESTION BANK			
62	Question bank discussion on Probability, Random variables and Probability Distributions	CO 1	T2:26.6 R2:21.50
63	Question bank discussion on probability distributions.	CO 2	T2:26.7 R2:21.51
64	Question bank discussion on correlation and regression.	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.	CO 6	R2:21.33

Course Coordinator: **HOD CE**
Ms. P Naga Lakshmi Devi

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

COURSE DESCRIPTION

Department	**CIVIL ENGINEERING**				
Course Title	**HYDRAULICS AND HYDRAULIC MACHINERY**				
Course Code	ACEC08				
Program	B.Tech				
Semester	IV	CE			
Course Type	Core				
Regulation	UG20				
Course Structure	Theory			Practical	
	Lecture	Tutorials	Credits	Laboratory	Credits
	3	-	3	-	-
Course Coordinator	Ms. Durga Sharma , Assistant Professor				

I COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites
B.Tech	AHSC02	I	Linear Algebra and Calculus
B.Tech	AHSC07	II	Mathematical Transform Techniques
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
Fluid Mechanics	70 Marks	30 Marks	100

IV CONTENT DELIVERY / INSTRUCTIONAL METHODOLOGIES:

✓	PPT	✓	Chalk & Talk	✓	Assignments	x	MOOCs
✓	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
40 %	Understand
40 %	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	20	05	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:

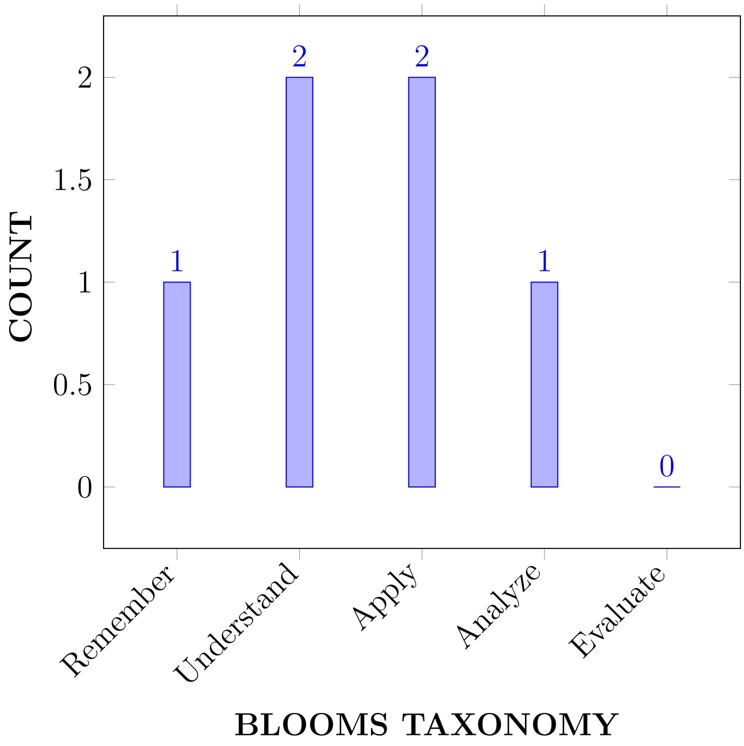
I	The importance of study of open channel flow, to give brief description on different types of flows and channels and hydraulic design principles of channels
II	The fundamentals of Uniform and Non-Uniform flow in open channels and importance of specific energy, critical flow and their applications.
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	**Explain** the differences between lined, unlined canals, and uniform, non – uniform flows for the designing of open channels.	Understand
CO 2	**Summarize** the geometrical properties of the open channels and establish the relationships among them for the designing of the most economical sections.	Understand
CO 3	**Apply** the concept of boundary layer and viscosity theorem to avoid flow separation problems.	Apply
CO 4	**Analyse** the lift and drag forces on different shapes of the objects using various methods applicable for the separation of the boundary layer.	Analyse
CO 5	**Utilize** the Principal of angular momentum for determining effect of hydrodynamic force of jets.	Apply
CO 6	**Explain** working principle of different types of turbines for designing a hydro power plant.	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/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	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.	3	SEE/ CIE, AAT, QUIZ

3 = High; 2 = Medium; 1 = Low

X 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 harbors.	3	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
CO 1	PO 1	**Recall** (knowledge) the various properties of fluids**using the knowledge of mathematics, science and engineering fundamental.**	3
CO 2	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.**	4
CO 3	PO 1	Recall the knowledge and principles of **mathematicsand scientific methodology** for estimating various types of pressure in the fluids at rest and transit using **fundamentals of science.**	3
	PO 2	**Identify the problem statement** associated with the given data and **formulate** their cause to **develop the solutions** using the concept of pressure.	3

	PSO 1	Understand the significance of pressurein the design of **Water distribution system**for continuous supply of potable water.	1
CO 4	PO 1	Make use of the principles of hydrostatic forces and Archimedes using **mathematical principles and scientific methodology** and apply those results in analyzing the behaviorof pressure distribution. **(own engineering discipline.)**	3
	PO 3	**Understand the principles** of hydrostatic forces and Archimedes to **investigate** point of application of force on various types of floating and immersed bodies.	2
	PO 4	Understanding of Engineering principles such as hydrostatic forces and Archimedes principle to apply them to analyze **key engineering process** like behavior of pressure distribution in liquids.	1
	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.**	2
CO 5	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 6	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**.	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	-	-	-	-	-	-	-	-	-	-		-	2	-
CO 2	3	2	-	4	-	-	-	-	-	-	-	-	-	-	-

CO 3	3	4	-	-	-	-	-	-	-	-	-	-	1	-	-
CO 4	3	-	2	1	-	-	-	-	-	3	-	2	-	-	-
CO 5	2	2	-	1	-	-	-	-	-	-	-	-	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	100	-	-	-	-	-	-	-	-	-	-		-	-	-
CO 2	100	40	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 3	100	40	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 4	100	-	20	9	-	-	-	-	-	-	60		-	-	-
CO 5	66.67	20	-	9	-	-	-	-	-	-	-	-	50	-	-
CO 6	66.67	30	18	-	-	-	-	-	-	-	-		-	-	-

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	2	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 3	3	2	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 4	3	-	1	1	-	-	-	-	-	3	-		-	-	-
CO 5	3	1	-	1	-	-	-	-	-	-	-	-	2	-	-
CO 6	3	1	-	-	-	-	-	-	-	-	-		-	-	-
TOTAL	28	11	1	3	-	-	-	-	-	9	-	-	5	-	-
AVERAGE	3	1.5	1	1	-	-	-	-	-	3	-	-	1.7	-	-

XVI ASSESSMENT METHODOLOGY - DIRECT:

CIE Exams	✓	SEE Exams	✓	Seminars	-
Laboratory Practices	-	Student Viva	-	Certification	-
Term Paper	-	Concept Vedio	PO 10 ✓	Open Ended Experiments	PO 10 ✓

XVII ASSESSMENT METHODOLOGY - INDIRECT:

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

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.
3. R. K Bansal, "Fluid mechanics and hydraulic machines", Laxmi publications ltd, 9th Edition, 2011.
4. 2. C. S. P. Ojha, R. Berndtsson and P. N. Chadramouli, "Fluid Mechanics and Machinery", Oxford University Press, 2010.
5. Streeter V. L, Wylie, E.B., "Fluid Mechanics", McGraw-Hill, 9th Edition, 1983.

REFERENCE BOOKS:

1. Ojha CSP, Chandramouli P. N., Berndtsson R., "Fluid Mechanics and Machinery", Oxford University Press, 2010
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.
4. Rathakrishnan. E, "Fundamentals of Fluid Mechanics", Prentice-Hall, 5th Edition, 2007.
5. Som S. K, Biswas. G, "Introduction to fluid mechanics and fluid machines", Tata McGraw-Hill, 2nd Edition, 2004.

WEB REFERENCES:

1. http://nptel.ac.in/courses/112104117/
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	Outcome based education system discussion on hydraulic and hydraulic machinery	-	
CONTENT DELIVERY (THEORY)			
1-2	Types of flows, types of channels, channel characteristics, velocity distribution	CO 1	T1: 1.1-3 R2:1-1.7
3-4	Energy and Momentum correction factors.	CO 1	T1: 2.4 R2:1-1.7
5-6	Chezy‘s, Manning‘s, Basin‘s formulae for uniform flow.	CO 1	T1: 2.6-14 R2:1-1.7
7-8	economical sections, critical flow	CO 1	T1: 2.15-20 R1:1-1.7
9-10	Critical depth, specific energy channel transitions	CO 1	T1: 3.1-.3 R1:2-2.8
11-13	Viscous fluid flow – Boundary conditions – Development of boundary layer .	CO2	T1 – T3 R1 - R3
14-17	Estimation of boundary layer thickness– Displacement thickness, momentum and energy thickness	CO 2	T2: 6.1-5 R1:2-2.8
18-19	Characteristics of boundary layer along a thin flat plate,Vonkarmon momentum integral equation	CO2	T1: 9.1-5 R2:2-2.8
20-22	Laminar and Turbulent Boundary layers separation of BL, control of BL,flow around submerged objects.	CO 3	T1 – T3 R1 - R3

23-26	Hydrodynamic force of jets on stationary, moving plates,jet striking centrally and at tip of symmetrical and unsymmetrical vanes.	CO 3	T2: 9.6-7 R2: 3-3.8
27-30	Jet striking on series of straight and curved vanes.	CO 3	T2: 4.5
31-32	Practical applications of Bernoulli's equation – Venturimeter, orifice meter, pitot tube.	CO 3	T1 – T3 R1 - R3
33-36	Velocity triangles at inlet and outlet, Principle of angular momentum.	CO 3	T1: 10.1-5 R2: 4-4.8
37-38	Classification of hydraulic turbines, Selection of hydraulic turbines	CO 4	T1: 10.5-7 R2: 4-4.8
39-40	Working, design principles of impulse and reaction turbines	CO4	T1: 10.7 R2: 4-4.8
41-42	Draft tube, theory and function efficiency.	CO 4	T1: 11.1-7 R2: 11-11.10
43-44	Layout of hydropower plant.	CO 5	T4: 2.1 -2.2 R2: 13-13.7
44-46	Types of heads and efficiencies.	CO 5	T4: 2.3 -2.6 R2: 13-13.7
47-50	Classification of pumps,work done.	CO 5	T4: 2.7 - 2.9 R2: 13-13.7
51-52	Manometric head.	CO 5	T4: 3.8 -3.10 R2: 19&20
53-55	Minimum starting speed, losses and efficiency,multistage pump,pumps in parallel,performance of pumps	CO 5	T4: 4.1 - 4.6 R2: 19&20
56	Design of centrifugal pumps, NPSH, cavitation in pumps	CO 6	T1: 11.1-7 R2: 11-11.10
57	Dimensional Analysis,dimensionless numbers	CO 6	T4: 2.1 -2.2 R2: 13-13.7
58	Methods of dimensional analysis (Buckingham's pi-Theorem).	CO 6	T4: 2.3 -2.6 R2: 13-13.7
59-60	Concept of similitude – model and prototype	CO 6	T4: 2.7 - 2.9 R2: 13-13.7
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 Boundary layer theory	CO 5	R2:7.5
13	Calculation of Forces exerted by fluid flow on pipe bend; Vortex Flow	CO 5	R2:7.5
14	Problems on Vonkarmen momentum integral equation	CO 6	R2:7.5
15	Problems on TE and HGL and pipe network analysis	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 laws of fluid friction and branching pipe analysis.	CO 6	T1: 8.1
DISCUSSION OF QUESTION BANK			
61	Basic concepts and definitions - important question and solution (Module I)	CO 1	T1: 11.1-7 R2: 11-11.10
62	Fluid statics - important question and solution (Module II)	CO 2	T4: 2.1 -2.2 R2: 13-13.7
63	Fluid kinematics- important question and solution (Module III)	CO 3	T4: 2.3 -2.6 R2: 13-13.7
64	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	**BUILDING MATERIALS PLANNING AND CONSTRUCTION**				
Course Code	ACEC09				
Program	B.Tech				
Semester	IV				
Course Type	CORE				
Regulation	UG20				
Course Structure	Theory			Practical	
	Lecture	Tutorials	Credits	Laboratory	Credits
	3	0	3	-	-
Course Coordinator	Ms. B.Bhavani , Assistant Professor				

I COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites
B.Tech	-	-	-

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 Planning and Construction	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). 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
83.4 %	Understand
0 %	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) and 10 marks for Alternative Assessment Tool (AAT).

Component		Marks	Total Marks
CIA	Continuous Internal Examination – 1 (Mid-term)	10	30
	Continuous Internal Examination – 2 (Mid-term)	10	
	AAT-1	5	
	AAT-2	5	
SEE	Semester End Examination (SEE)	70	70
Total Marks			100

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:

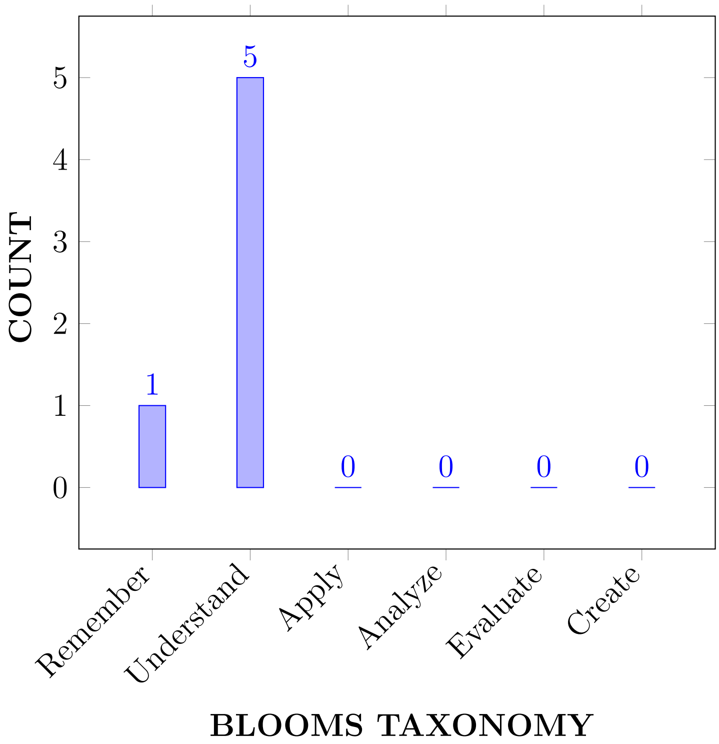
I	The basics of material science and behavior of various building materials used in construction
II	The construction materials required for the assigned work.
III	The procedural knowledge of the simple testing methods of cement, lime and concrete etc.
IV	The requirements and different types of stairs.

VII COURSE OUTCOMES:

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

CO 1	**Recognize** appropriate building materials used for obtaining better performance of structures in the civil engineering applications.	Remember
CO 2	**Identify** the mineral and chemical admixtures for enhancing the strength and durability of concrete mixtures.	Understand
CO 3	**Distinguish** the difference among Galvanized iron, Fiber - reinforcement plastics, steel, wood and aluminum for the construction of doors and windows.	Understand
CO 4	**Select** suitable type of truss, RCC roof, and madras terrace as per structural need for sustaining applied loads successfully.	Understand
CO 5	**Choose** various types of stair cases used in modern construction scenario for improving the accessibility of building floors.	Understand
CO 6	**Outline** building by-laws and standards of building Components for better planning and construction.	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.	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	**Make a use of** (knowledge) the materials those are used in the construction and what are the materials will suite the modern construction one of the material stone know how will get aggregate form rocks by applying the **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	**Interpret** different types of lintels arches and the materials used for construction with the knowledge to **engineering fundamentals related to civil engineering.**	2
	PO 1	**Recognize** the importance of good admixtures selection and stability by **communicating effectively to with engineering community.**	2

Course Outcomes	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key competencies matched.
CO 4	PO 2	**Outline** different types of lintel, arches and the materials which are commonly used in construction to prevent the entry of rainwater inside the building	2
	PSO 1	**Identify** various building materials used in the construction process and its suitability for the building components based on NBC by using engineering fundamentals.	1
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	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 2	2	-	-	-	-	-	-	-	-	-	-	-	1	-	-
CO 3	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 4	2	2	-	-	-	-	-	-	-	-	-	-	1	-	-
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	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 2	66.6	-	-	-	-	-	-	-	-	-	-	-	33.3	-	-
CO 3	66.6	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 4	66.6	20	-	-	-	-	-	-	-	-	-	-	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 5	100	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 6	100	-	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	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 2	3	1	-	-	-	-	-	-	-	-	-	-	1	-	-
CO 3	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 4	3	1	-	-	-	-	-	-	-	-	-	-	1	-	-
CO 5	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 6	3	-	1	-	-	-	-	-	-	-	-	-	1	-	-
TOTAL	18	2	1	-	-	-	-	-	-	-	-	-	3	-	-
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	**ALTERNATIVE MATERIALS AND MASONRY**
	Wood - structure, properties, seasoning of timber; Classification of wood, defects in timber; Alternative materials for wood - galvanized iron, fiber reinforced plastics, steel, aluminum and glass. Masonry - types of masonry, English and Flemish bonds, rubble and ashlars masonry.
MODULE IV	**BUILDING COMPONENTS**
	Lintels, arches, different types of floors-concrete, mosaic, terrazzo floors; Roofs - pitched, flat and curved roofs, leanto-roof, coupled roofs, RCC roofs, madras terrace and shell roofs. Trussed roofs- king and queen post trusses; Foundations: Shallow foundations, spread, combined, strap and mat footings. Stair case: Definitions, technical terms and types of stairs, requirements of good stairs, introduction to geometrical design of stairs, lifts, ramps, elevators and escalators – types and purpose.
MODULE V	**BUILDING PLANNING**
	Building planning - significance, scope, principles of building planning, classification of buildings and building by laws, Introduction to National Building Codes (NBC) – guidelines and regulations

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
OBE DISCUSSION			
1	Course Description on Outcome Based Education (OBE): Course Objectives, Course Outcomes (CO), Program Outcomes (PO) and CO-PO Mapping	-	https://lms.iare.ac.in/index?route=course/details&course_id=73
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 2	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 4	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 4	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 4	T2: 5.3
23-24	Explain the classification of various types of woods. State the properties, seasoning of Timber.	CO 5	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 3	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 5	T2: 5.2
33-34	Describe the properties of wood, aluminum, glass and different types of wood, masonry used in buildings.	CO 5	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 5	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.	CO 5	T1: 7.3
48-49	Design RCC doglegged and open-well stairs.	CO 5	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 flakiness index of coarse aggregate	CO 1	R2:7.5
4	Calculate the consistency limit of cement	CO 2	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	Numerical problems relating to Bernoulli equation.	CO 3	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 1	R2:7.5
12	Dram the grain size distribution curve for fine aggregate	CO 1	R2:7.5
13	Calculate D_{30}, D_{10}, D_{60} for given fine aggregate	CO 1	R2:7.5
14	Determine the grade of fine aggregate using sieve analysis for given sample.	CO 1	R2:7.5
15	Determine the specific gravity of given cement using density bottle.	CO 2	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	R4:5.1
4	Seasoning of timber, English and Flemish bonds, rubble and ashlars masonry	CO 3	T1:7.5
5	Tread, rise, Landing, Offsets, Orientation.	CO 5	T1: 4.1
DISCUSSION OF QUESTION BANK			
1	Stones, Bricks and Aggregates (Module) I	CO 1	R4:2.1
2	Cement and Admixtures (Module II)	CO 2	T4:7.3
3	Alternative Materials and Masonry (Module III)	CO 3	R4:5.1
4	Building Components(Module IV)	CO 4, 5	T1:7.5
5	Building Planning (Module V)	CO 6	T1: 4.1

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	**CONCRETE TECHNOLOGY**
Course Code	ACEC10
Program	B.Tech
Semester	IV
Course Type	Core
Regulation	UG-20

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 20 marks for continuous internal examination (CIE) and 10 marks for Alternative Assessment Tool (AAT).

Component		Marks	Total Marks
CIA	Continuous Internal Examination – 1 (Mid-term)	10	30
	Continuous Internal Examination – 2 (Mid-term)	10	
	AAT-1	5	
	AAT-2	5	
SEE	Semester End Examination (SEE)	70	70
Total Marks			100

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:

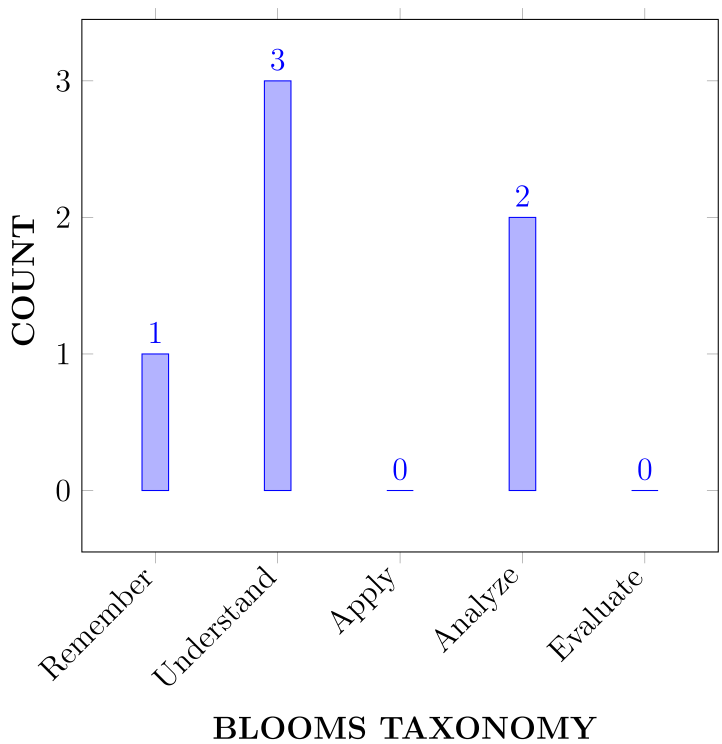
I	The fundamental properties of construction materials such as cement, aggregates and admixtures based on laboratory and filed tests for identifying material quality
II	The factors influencing workability and methods involved in measuring workability of fresh concrete.
III	The importance of water/cement 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
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

Course Outcomes	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key competencies matched.
	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
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

Course Outcomes	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key competencies matched.
	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
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.

REFERENCE BOOKS:

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.

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	**In Outcome-Based Education (OBE), we discussed about course delivery assessment that is planned to achieve stated objectives and outcomes. OBE discussion focuses on measuring student performance i.e. outcomes at different levels. Course outcomes(CO),Program Outcomes(PO)and Program Specific Outcomes(PSO) and also mapping of CO's to PO's PSO's and their attainments are discussed.**	-	

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**

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

CIVIL ENGINEERING

COURSE DESCRIPTION

Course Title	**CONCRETE TECHNOLOGY LABORATORY**				
Course Code	ACEC11				
Program	B.Tech				
Semester	IV	CE			
Course Type	Core				
Regulation	IARE - UG20				
Course Structure	Theory			Practical	
	Lecture	Tutorials	Credits	Laboratory	Credits
	-	-	-	2	1
Course Coordinator	Mr. K. Anand Goud, Assistant Professor				

I COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites
B.Tech	ACEB26	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.

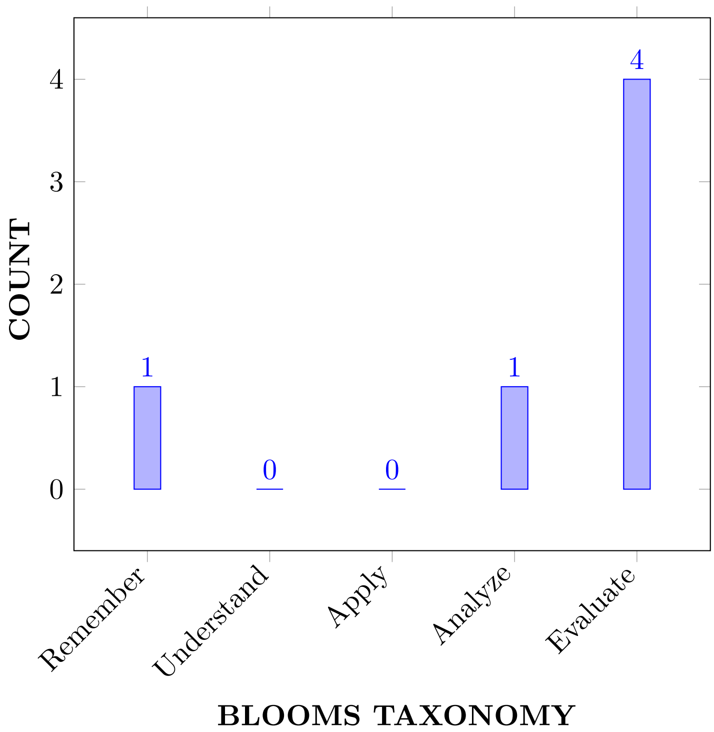
II	The factors influencing workability and methods involved in measuring workability of fresh concrete.
III	The importance of water/cement ratio and its influence on compressive strengths of hardened concrete.
IV	The concept of quality control and design of concrete mix for ensuring quality of concrete.

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 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:

X	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

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 3	R1: 4.3
4	Initial and final setting times of cement.	CO 4	R1: 3.2
5	Specific gravity of cement.	CO 5	R1: 5.4
6	Compressive strength of cement.	CO 6	R3: 6.2
7	Soundness of cement.	CO 7	R3: 7.1

8	Fineness modulus of fine and coarse aggregate.	CO 8	R2: 6.6
9	Bulking of sand.	CO 9	R2: 7.2
10	Workability tests on fresh concrete.	CO 10	R1: 8.1
11	Test for compressive strength of cement concrete.	CO 11	R1:8.4
12	Revision	CO 11	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	**Hydraulics and Hydraulic Machinery Laboratory**				
Course Code	ACEC12				
Program	B.Tech				
Semester	IV	CE			
Course Type	Core				
Regulation	IARE - UG 20				
Course Structure	Theory			Practical	
	Lecture	Tutorials	Credits	Laboratory	Credits
	-	-	-	2	1
Course Coordinator	Ms. Durga Sharma, Assistant Professor				

I COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites
B.Tech	ACEB06	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
Hydraulics 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:

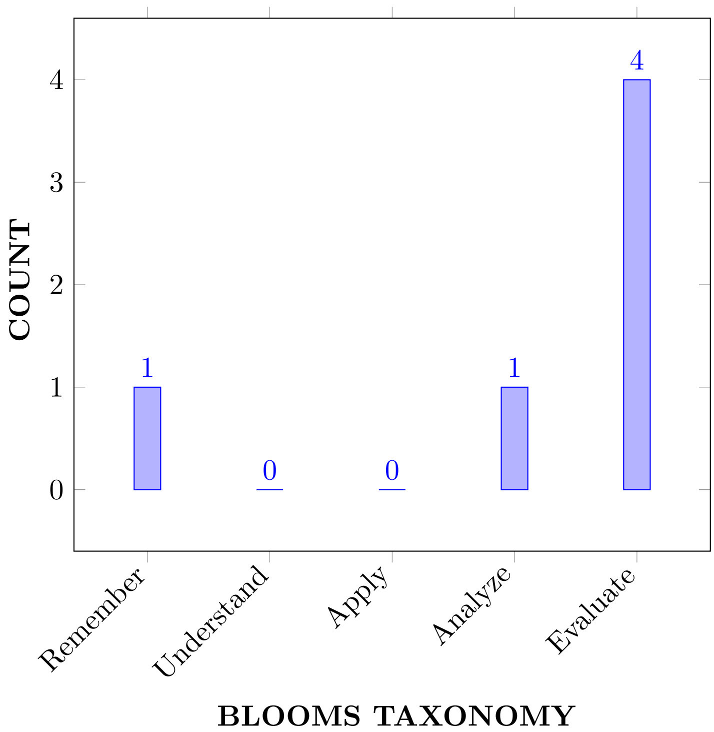
I	Enrich the concept of fluid mechanics and hydraulic machines.
II	Demonstrate the classical experiments in fluid mechanics and hydraulic machinery.
III	Correlate various flow measuring devices such as Venturimeter, orifice meter and notches etc.
IV	Discuss the performance characteristics of turbines 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	66.67	0	0	0	0	0	66.67	0	0	0	0	0	20	0	0
CO 2	66.67	0	0	20	0	0	0	0	0	0	0	0	20	0	66.67
CO 3	66.67	0	0	20	0	0	0	0	0	0	0	0		0	0
CO 4	66.67	0	30	0	0	0	0	0	0	0	0	0	20	0	0
CO 5	66.67	0	20	0	0	0	0	0	0	0	0	0	20	0	0
CO 6	66.67	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**
	Calibration of Venturimeter and Orifice meter
WEEK III	**CALIBRATION OF VENTURIMETER and ORFICEMETER**
	Calibration of Venturimeter and Orifice meter.
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	**STRENGTH OF MATERIALS LABORATORY**				
Course Code	ACEC13				
Program	B.Tech				
Semester	IV	CE			
Course Type	CORE				
Regulation	IARE - UG20				
Course Structure	Theory			Practical	
	Lecture	Tutorials	Credits	Laboratory	Credits
	-	-	-	3	1.5
Course Coordinator	Ms S. R. THAREWAL, 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	AMEC01	II	Engineering Mechanics

III MARKS DISTRIBUTION:

Subject	SEE Examination	CIE Examination	Total Marks
Mechanics of Solids 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
2	2	2	2	2	10

VI COURSE OBJECTIVES:

The students will try to learn:

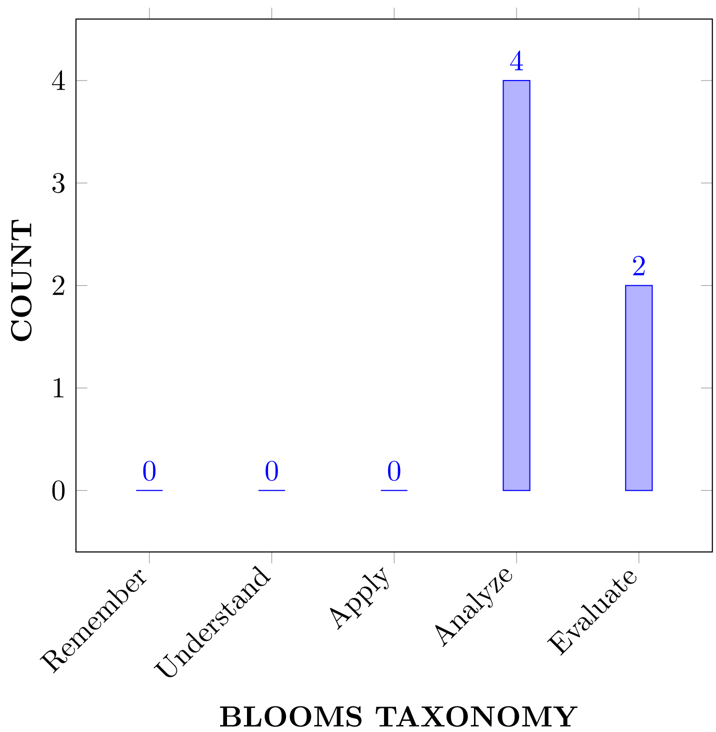
I	The different mechanical properties of different solid engineering materials used in civil engineering applications.
II	The behavior of various material samples under different loads and equilibrium conditions
III	The characterization of materials subjected to tension, compression, shear, torsion, 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:

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

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 using ANSYS

Signature of Course Coordinator **HOD,CE**
Ms. Surbhi Tharewal, Assistant Professor

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

COURSE DESCRIPTION

<table>
<tr><td>Department</td><td colspan="5">CIVIL ENGINEERING</td></tr>
<tr><td>Course Title</td><td colspan="5">ANALYSIS OF STRUCTURES</td></tr>
<tr><td>Course Code</td><td colspan="5">ACEC14</td></tr>
<tr><td>Program</td><td colspan="5">B.Tech</td></tr>
<tr><td>Semester</td><td colspan="5">V</td></tr>
<tr><td>Course Type</td><td colspan="5">CORE</td></tr>
<tr><td>Regulation</td><td colspan="5">UG-20</td></tr>
<tr><td rowspan="3">Course Structure</td><td colspan="3">Theory</td><td colspan="2">Practical</td></tr>
<tr><td>Lecture</td><td>Tutorials</td><td>Credits</td><td>Laboratory</td><td>Credits</td></tr>
<tr><td>3</td><td>1</td><td>4</td><td></td><td></td></tr>
<tr><td>Course Coordinator</td><td colspan="5">Dr.U.Vamsi Mohan, Professor</td></tr>
</table>

I COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites
B.Tech	ACEC07	IV	Theory of Structures

II COURSE OVERVIEW:

The course of Analysis of Structures 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 discusses 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 and design the same satisfying safety and serviceability.

III MARKS DISTRIBUTION:

Subject	SEE Examination	CIE Examination	Total Marks
Analysis 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	✓	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
10%	Remember
20%	Understand
40%	Apply
30 %	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		Marks	Total Marks
CIA	Continuous Internal Examination – 1 (Mid-term)	10	30
	Continuous Internal Examination – 2 (Mid-term)	10	
	AAT-1	5	
	AAT-2	5	
SEE	Semester End Examination (SEE)	70	70
Total Marks			100

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:

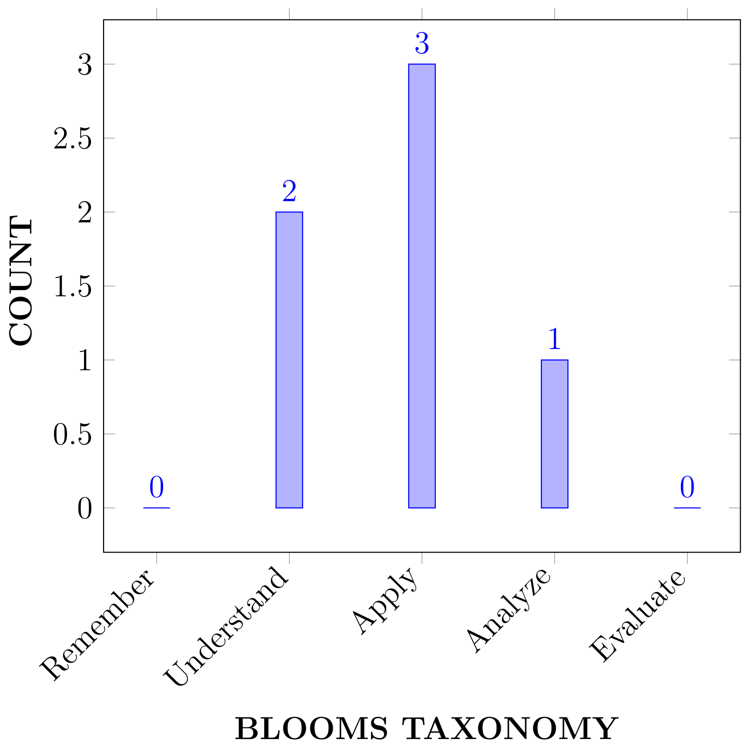
I	The behavior of arches under the action of uniformly distributed loads and concentrated loads.
II	TThe concepts of energy methods for analyzing the components of various industrial structures.
III	The analysis of indeterminate beams and rigid frames by displacement methods for designing framed structures.
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	**Outline** about various types of arches for selecting appropriate arch in field applications.	Understand
CO 2	**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 3	**Apply** the concepts of Castigliano's theorem for analysing indeterminate trusses.	Apply
CO 4	**Analyse** the continuous beams using the concepts of slope-deflection, moment distribution and Kani's methods for design of rigid frames with and without side sway.	Analyse
CO 5	**Summarize** the effects of rolling loads for thorough understanding of the variations in internal forces on bridge girders due to moving vehicular loads.	Understand
CO 6	**Apply** the concept of 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.
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.	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 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	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.	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	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/AAT/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
CO 1	PO 1	Distinguish between arches and selects appropriate arch in various engineering applications using the knowledge of **mathematics and engineering fundamentals**	2
CO 2	PO 1	**Apply the knowledge of Mathematics, Sciences and Engineering fundamentals principles** for estimating the horizontal thrust in arches	2
	PO 2	Determine the secondary stresses in two hinged arches, by **formulating the problem for development of solution** also analyse the **complex engineering problems** using the principles of **mathematics and engineering sciences**.	4
	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 3	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.	2
	PO 2	**Formulates the problem** on indeterminate trusses for **development of solution** to find member forces and **analyse the complex engineering problems** using the **principles of mathematics and engineering sciences.**	5
	PO 4	**Recognize (knowledge) the behavior** of indeterminate trusses, understand the corresponding **context of the engineering knowledge**, and analyse **key parameters** member forces and deflections applying Castigliano's theorem by incorporating the **systems approach**.	4

	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 1	Understand the concept of slope-deflection and moment distribution methods for computing the support moments by making use of **mathematical principles** and **engineering fundamentals**	2
	PO 2	**Formulate the problem** on continuous beams for **development of solution** to find support moments and **analyse the complex engineering problems** using the **principles of mathematics and engineering sciences.**	4
	PO 3	**Investigate and define** the problem of framed structures using **creativity** and in depth understanding of the **principles of mathematics and engineering sciences** and concepts of Kani's method.	3
	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 5	PO 1	**Understand** the concepts of moving loads and their effects on beams and girders by using the principles of **mathematics and engineering fundamentals.**	2
	PO 2	**Formulate** the problem on bridge girders for **development of solution** to draw influence lines for SF, BM and analyse **complex engineering problems** using the **principles of mathematics and engineering sciences**.	4
	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 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	**Data**regarding vehicular traffic **is collected, problem statement is framed and formulates the problem for the development of solution for complex engineering structures** such as bridge girders and truss girders using the concepts of influence line diagrams.	4
	PO 3	**Analyse the complex engineering structures** such as bridge girders using the concepts of moving loads and influence line diagrams.	1

	PO 10	**Illustrate** the analysis of different structural elements using **complex engineering problems** can be solved with help of basic **mathematics and engineering sciences**.	3
	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.**	3
	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

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	4	-	-	-	-	-	-	-	-	-	-	2	-	-
CO 3	2	5	-	4	-	-	-	-	-	-	-	-	2	-	-
CO 4	2	4	3	-	-	-	-	-	-	-	-	-	2	-	-
CO 5	2	4	-	-	-	-	-	-	-	-	-	-	2	-	-
CO 6	3	4	1	-	-	-	-	-	-	3	-	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	66.7	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 2	66.7	40	-	-	-	-	-	-	-	-	-	-	50	-	-
CO 3	66.7	50	-	40	-	-	-	-	-	-	-	-	50	-	-
CO 4	66.7	40	30	-	-	-	-	-	-	-	-	-	50	-	-
CO 5	66.7	40	-	-	-	-	-	-	-	-	-	-	50	-	-
CO 6	100	40	10	-	-	-	-	-	-	60	-	37.5	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	-	-	-	-	-	-	-	-	-	-	-	-	-	
CO 2	3	2	-	-	-	-	-	-	-	-	-	-	2	-	-
CO 3	3	2	-	-	-	-	-	-	-	-	-	-	2	-	-
CO 4	3	2	1	-	-	-	-	-	-	-	-	-	2	-	-
CO 5	3	2	-	-	-	-	-	-	-	-	-	-	2	-	-
CO 6	3	2	1	-	-	-	-	-	-	3	-	1	2	-	-
TOTAL	18	10	2	2	-	-	-	-	-	3	-	1	10	-	-
AVERAGE	3.0	2.0	1	2	-	-	-	-	-	3	-	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:

	Assessment of mini projects by experts	✓	End Semester OBE Feedback

XVIII SYLLABUS:

MODULE I	**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 II	**ANALYSIS OF INDETERMINATE STRUCTURES**
	Indeterminate Structural Analysis, Determination of static and kinematic indeterminacies, Analysis of trusses with up to two degrees of internal and external indeterminacies using Castiglione's theorem

MODULE III	**SLOPE-DEFLECTION AND MOMENT DISTRIBUTION METHOD**
	Introduction- Derivation of slope deflection equation-Application to continuous beams with and without settlement of supports- Analysis of single-bay, single-story, portal frame including side sway. Introduction to moment distribution method - Application to continuous beams with and without settlement of supports - Analysis of single-bay, single-story, portal frame including side sway.
MODULE IV	**KANI'S METHOD**
	Introduction to Kani's method- Rotation factor- Application to continuous beams with and without settlement of supports
MODULE V	**MOVING LOADS AND INFLUENCE LINES**
	Introduction- maximum SF and BM at a given section and absolute maximum S.F. and B.M due to single concentrated load U.D load longer than the span, UDL load shorter than the span, two-point loads with fixed distance between them and several point loads – Equivalent uniformly distributed load– Focal length. Definition of influence line for SF, Influence line for BM– load position for maximum SF at a section– Load position for maximum BM at a section- Point loads, UDL longer than the span, UDL shorter than the span

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			
	Discussion on OBE		
CONTENT DELIVERY (THEORY)			
1	Introduction to arches, types of arches, comparison between three hinged and two hinged arches, Linear arch, Eddy's theorem	CO 1	T1: 16.1, R1: 7.1
2	Geometrical properties of parabolic and circular arch. Equation of parabolic arch.	CO 1	T1: 16.4, R1: 7.2

3	Analysis of three hinged parabolic arches. Determination of normal thrust and radial shear. Numerical Examples.	CO 1	T1: 16.4, R1: 7.3
4	Numerical Examples on three hinged parabolic arches.	CO 1	T1: 16.1
5	Analysis of three hinged circular arch. Numerical examples	CO 1	T1: 16.5
6	Numerical examples on circular arches.	CO 1	T1: 16.5, R1: 7.4
7	Introduction to two hinged arches.	CO 1	T1:16.6, R1: 7.1
8	Analysis of two hinged parabolic arches. Analysis of two hinged circular arches.	CO 1	T1:16.7, R1: 7.1
9	Analysis of two hinged parabolic arches. Problems on secondary stresses in two hinged arches.	CO 1	T1:16.10
10	Problems on secondary stresses in two hinged arches due to temperature and elastic shortening of rib.	CO 1	T1:16.10-16.13
11	Introduction to Indeterminate structures. Difference between determinate and indeterminate structures. Energy principles – Castigliano's theorem. Degree of static indeterminacy or degree of redundancy. Degree of kinematic indeterminacy	CO 2	T1:14.1
12	Degree of indeterminacy of pin jointed plane frames. Degree of kinematic indeterminacy of beams and frames.	CO 2	T1: 14.1
13	Analysis of trusses with degree of external redundancy one. Procedure. Numerical Examples.	CO 2	T1:Ex.14.1, 14.2
14	Analysis of trusses with degree of internal redundancy one. Procedure. Numerical Examples.	CO 3	T1: 14.3, R1: 10.3
15	Stresses due to error in length – Temperature stresses. – Numerical Example.	CO 3	T1:14.4, R1:10.5
16-17	Analysis of trusses with degree of redundancy two. Procedure. Numerical Examples.	CO 3	R1:10.7
18	Introduction to slope-deflection method. Slope-deflection equations, and procedure. Introduction to Fixed end moments	CO 4	T1:9.1, R 1:7.6.3
19	Fixed end moments due to symmetric point load and eccentric point load. Numerical Examples	CO 4	R2:1.3-11
20	Fixed end moments due to UDL , UVL and a couple. Numerical Examples	CO 4	R2:1.4-14
21	Fixed end moments due to rotation and sinking of supports. Numerical Examples	CO 4	R2:1.7-20

22	Analysis of continuous beams with and without sinking of supports by slope-deflection method. Numerical Examples.	CO 4	T1: 9.3
23-24	Numerical Examples on analysis of continuous beams by Slope deflection method	CO 4	T1: 9.4
25	Introduction to Moment distribution method. Carry over factor, absolute stiffness and relative stiffness, distribution factor.	CO 4	T1: 10.2
26	Analysis of continuous beams with and without sinking of supports by moment distribution method. Procedure. Numerical Examples.	CO 4	T1: 10.1
27	Numerical Examples on analysis of continuous beams by moment distribution method.	CO 4	T1: 10.5
28-29	Analysis of rigid jointed frames with and without sway by slope deflection method. Numerical examples	CO 4	T1: 9.9
30	Analysis of rigid jointed frames with and without sway by moment distribution method. Numerical examples.	CO 4	T1: 10.9
31	Introduction to Kani's method. Rotation factor . Displacement factor. Rotation Contributions.	CO 4	T1: 28.1
32	Procedure for analysis of continuous beams with and without sinking of supports by Kani's method. Numerical Examples.	CO 4	T1: 28.2
33-35	Numerical Examples on analysis of continuous beams by moment distribution method	CO 4	T1:10.4, R1: 28.3
36	Introduction to moving or rolling loads and influence lines. Effect of moving loads on Shear force and bending moment at a given section.	CO 5	T1: 1.1-03
37	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 5	T1: 1.2
38	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 5	T1: 1.4
39	Equivalent uniformly distributed load – Focal length.- Numerical Examples.	CO 5	T1: 1.8-47
40-41	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
42-43	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
44-45	Numerical Examples on Rolling loads and Influence lines.	CO 6	T1: 63, R1: 5.5

PROBLEM SOLVING/ CASE STUDIES			
1	Numerical examples on three hinged and two hinged arches	CO 1, CO 2	T1:3.4 R1: 20.4
2	Numerical examples on three hinged and two hinged arches	CO 1, CO 2	T1:2.7 R1: 20.7
3	Numerical examples on three hinged and two hinged arches	CO 1, CO 2	T1:6.8 R1: 12.4 – 12.6
4	Numerical examples on Castigliano's theorem for analysing indeterminate trusses	CO 3	T1:6.8 R1: 12.4 – 12.6
5	Numerical examples on Castigliano's theorem for analysing indeterminate trusses	CO 3	T1:6.9 R1: 13.1 – 13.6
6	Numerical examples on Castigliano's theorem for analysing indeterminate trusses	CO 3	T1:5.1,5.2 R1: 14.1 – 14.3
7	Numerical examples on slope-deflection and moment distribution methods for analysing continuous beams and rigid frames	CO 4	T1:10.17
8	Numerical examples on slope-deflection and moment distribution methods for analysing continuous beams and rigid frames	CO 4	T2:9.1 R1: 15.3 – 15.6
9	Numerical examples on slope-deflection and moment distribution methods for analysing continuous beams and rigid frames	CO 4	T2:9.1 R1: 15.3 – 15.6
10	Numerical examples on Kani's method for analysing continuous beams	CO 4	T2:12
11	Numerical examples on Kani's method for analysing continuous beams	CO 4	T2:13
12	Numerical examples on rolling loads and influence lines	CO 5, CO 6	T2:9.2
13	Numerical examples on rolling loads and influence lines	CO 5, CO 6	T1:4.8 R1: 17.1 – 17.3
14	Numerical examples on rolling loads and influence lines	CO 5, CO 6	T1:4.14 R1: 17.4 – 17.6
15	Numerical examples on rolling loads and influence lines	CO 5, CO 6	T2:11
DISCUSSION OF DEFINITION AND TERMINOLOGY			
1	Definitions and terminology from Module-I	CO 1, CO 2	T1: 3.1 – 3.10 R1: 20.1 – 20.7
2	efinitions and terminology from Module-II	CO 3	T1:6.1 – 6.8 R1: 12.1 – 12.6
3	Cefinitions and terminology from Module-III	CO 4	T2:9.1 R1: 15.3 – 15.6
4	efinitions and terminology from Module-IV	CO 4	T2:13
5	efinitions and terminology from Module-V	CO 5, CO 6	T1:4.8 – 4.10 R1: 17.1 – 17.6
DISCUSSION OF QUESTION BANK			
1	Module I	CO 1, CO 2	T1: 3.1 – 3.10 R1: 20.1 – 20.7

2	Module II	CO 3	T1:6.1 – 6.8 R1: 12.1 – 12.6
3	Module III	CO 4	T2:9.1 R1: 15.3 – 15.6
4	Module IV	CO 4	T2:13
5	Module V	CO 5, CO 6	T1:4.8 – 4.10 R1: 17.1 – 17.6

Signature of Course Coordinator **HOD, CE**

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

COURSE DESCRIPTION

Department	**CIVIL ENGINEERING**				
Course Title	HYDROLOGY AND WATER RESOURCES ENGINEERING				
Course Code	ACECI5				
Program	BTECH				
Semester	V				
Course Type	CORE				
Regulation	UG-20				
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	AMEC01	II	Engineering Mechanics
B.Tech	ACEC03	IV	Fluid Mechanics

II COURSE OVERVIEW:

Hydrology and water resources engineering is concerned with quantitative study of the hydrological cycle on and below the earth surface. This course deals with supply and feed for surface, sub-surface water bodies, methods of irrigation and their challenges in water table management and improving crop production. Further, the knowledge of the course is useful for designing innovative systems and equipment for planning, development and management of water resources.

III MARKS DISTRIBUTION:

Subject	SEE Examination	CIE Examination	Total Marks
Hydrology and Water Resources Engineering	70 Marks	30 Marks	100

IV CONTENT DELIVERY / INSTRUCTIONAL METHODOLOGIES:

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

V EVALUATION METHODOLOGY:

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50%	Understand
34%	Apply
16%	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		Marks	Total Marks
CIA	Continuous Internal Examination – 1 (Mid-term)	10	30
	Continuous Internal Examination – 2 (Mid-term)	10	
	AAT-1	5	
	AAT-2	5	
SEE	Semester End Examination (SEE)	70	70
Total Marks			100

Continuous Internal Examination (CIE):
Two CIE exams shall be conducted at the end of the 8th and 16th 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:

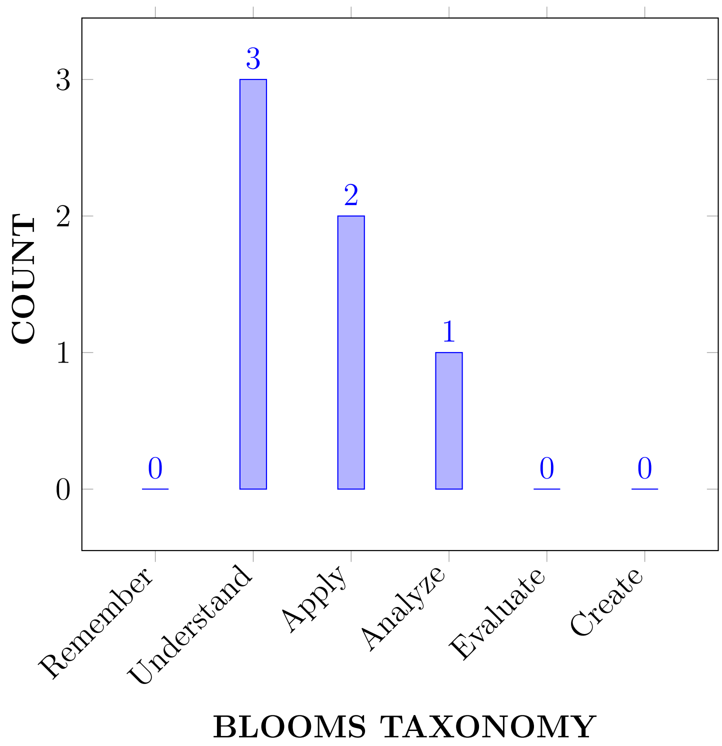
I	The fundamentals of hydrological cycle on and below the surface of the earth.
II	The concept of ground water engineering and analytical techniques in ground water flow
III	The principles of irrigation types, methods and design-discharge required based on canal networks.
IV	The construction of hydraulic 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 and its measurement for evolving the effects of hydrology.	Understand
CO 2	**Summarize** the factors effecting the rate of evaporation and infiltration for reducing the water loss in the environment	Understand
CO 3	**Develop** a unit hydrograph based on stream flow data for preventing hydraulic system flood problems.	Apply
CO 4	**Illustrate** the geological formations capable of storing and transporting groundwater and radial movement for improving the yield of water table in the aquifers.	Understand
CO 5	**Identify** the basic requirements of irrigation and various techniques to supply water improving the production of crops.	Apply
CO 6	**Classify** the various hydraulic structures such as, dams, spillways and canals on the basic of hydraulic design Considerations for Storing and transporting water efficiently and economically.	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/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.	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.	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 mathematical principles and methodology**	2
	PO 7	Understand the cycle of water, **environmental** effects on hydrological cycle with their **socio-economical effect**.	2
CO 2	PO 1	Recall the components and process of hydrological cycle based on **scientific mathematical principles and methodology**	2
	PO 7	Understand the cycle of water, **environmental** effects on hydrological cycle with their **socio-economical effect**.	2
CO 3	PO 2	Understand the given **problem statement, formulation and model** for **developing the solution** of hydrographs to estimate flood flow.	4
	PO 3	**Understand** and **Investigate** the runoff problem by taking **all aspects of the problem** into consideration and **including the environmental risks**.	4
CO 4	PO 1	Choose the suitable geological formations which is capable of storing and transmitting the groundwater for water table development with the **scientific mathematical principles and methodology**	2
	PO 2	Understand the given **problem statement, formulate and model** for developing the solution for groundwater yielding in aquifers.	4
	PSO 1	Define the geological formations which suitable aquifer where the groundwater table development with the **help of geological survey and exploration, soil investigation, engineering codes of practices**.	4

Course Outcomes	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key competencies matched.
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, mathematical principles and methodology**.	2
	PO 2	Understand the given **problem statement, formulate and model** for **developing the solution** of canals to estimate flood flow.	4
	PO 4	**Understanding of 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
	PO 7	Understand (knowledge) the function of the dam to obtain valuable outputs with the **socio economics, political and environment**.	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	2	-	-	-	-	-	2	-	-	-	-	-	-	-	-
CO 3	-	4	4	-	-	-	-	-	-	-	-	-	-	-	-
CO 4	2	4	-	-	-	-	-	-	-	-	-	-	4	-	-
CO 5	-	-	-	4	-	-	-	-	-	-	-	-	-	-	-
CO 6	2	4	-	3	-	-	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	67	-	-	-	-	-	67	-	-	-	-	-	-	-	-

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	-	40	40	-	-	-	-	-	-	-	-	-	-	-	-
CO 4	67	40	-	-	-	-	-	-	-	-	-	-	40	-	-
CO 5	-	-	-	78	-	-	-	-	-	-	-	-	-	-	-
CO 6	67	40	-	67	-	-	100	-	-	-	-	-	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	3	-	-	-	-	-	3	-	-	-	-	-	-	-	-
CO 3	-	2	2	-	-	-	-	-	-	-	-	-	-	-	-
CO 4	3	2	-	-	-	-	-	-	-	-	-	-	2	-	-
CO 5	-	-	-	3	-	-	-	-	-	-	-	-	-	-	-
CO 6	3	2	-	-	-	-	3	-	-	-	-	-	2	3	-
TOTAL	12	6	2	3	-	-	6	-	-	-	-	-	4	3	-
AVERAGE	3	2	1	3	-	-	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:

MODULE I	**HYDROLOGICAL CYCLE AND PRECIPITATION**
	Introduction to hydrologic cycle, Water – budget equation. Precipitation - forms of precipitation, characteristics of precipitation in India, measurement of precipitation, rain gauge network, mean precipitation over an area, Depth-Area-Duration (DAD) relationships, maximum intensity/depth-duration-frequency relationship, Probable Maximum Precipitation (PMP), rainfall data in India.
MODULE II	**ABSTRACTIONS FROM PRECIPITATION**
	Evaporation process, evaporimeters, analytical methods of evaporation estimation, reservoir evaporation and methods for its reduction, evapotranspiration, measurement of evapotranspiration, evapotranspiration equations, Potential evapotranspiration, actual evapotranspiration, infiltration, infiltration capacity, measurement of infiltration.
MODULE III	**SURFACE AND SUB – SURFACE RUNOFF**
	Surface Runoff - Runoff volume, SCS – CN method of estimating runoff volume, flow – duration curve, flow- mass curve, hydrograph, factors affecting runoff hydrograph, components of hydrograph, base flow separation, effective rainfall, and unit hydrograph. Sub – surface runoff - forms of subsurface water, saturated formation, aquifer properties, geologic formations of aquifers, well hydraulics: steady state flow in wells, equilibrium equations for confined and unconfined aquifers, aquifer tests.
MODULE IV	**WATER WITHDRAWLS AND DISTRIBUTION SYSTEMS**
	Water requirement of crops-Crops and crop seasons in India, cropping pattern, duty and delta; Quality of irrigation water; Soil-water relationships, root zone soil water, consumptive use, irrigation requirement, frequency of irrigation; Methods of applying water to the fields: surface, sub-surface, sprinkler and trickle /drip irrigation. Canal systems – Design of channels – Kennedy's and Lacey's theory of regime channels.
MODULE V	**DAMS AND SPILLWAYS**
	Dams - Gravity dams - forces on gravity dams, causes of failure, stress analysis, elementary and practical profile. Embankment dams - Classification, design considerations. Arch and buttress dams. Spillways - components of spillways, types of gates for spillway crests. Reservoirs - Types, capacity of reservoirs, yield of reservoir, selection of suitable site for reservoirs.

TEXTBOOKS

1. Jayarami Reddy, "Engineering hydrology", McGraw Hill Education, 4th Edition, 2017.
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.

REFERENCE BOOKS:

1. V. P. Singh, "Elementary hydrology", PH1 publications, 1st Edition, 1991.
2. Dr. G. Venkata Ramana, "Water Resources Engineering-I", Academic Publishing Company, 1st Edition,2012.

3. D. K. Majumdar, "Irrigation Water Management – Principles and Practice", Prentice Hall of India, 2nd Edition, 2014.

WEB REFERENCES:

1. https://nptel.ac.in/courses/105/104/105104103/
2. https://https://www.youtube.com/watch?v=MUiLSMabDhc
3. guides.lib.vt.edu/subject,guides/cee/environmental,water,engineering
4. https://books.google.co.in/books?isbn=0470460644
5. https://www.elsevier.com/journals/advances,in,water,resources/0309,1708

E-TEXTBOOKS:

1. https://www.civilenggforall.com/p/water,resources,engineering.html
2. https://books.askvenkat.com/water,resources,engineering,1,textbook,pdf
3. https://www.amazon.in/Water,Resources,Engineering,Larry,Mays/dp/047
4. https://www.respwritunac.hatenablog.com/entry/2016/05/20/044146

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, Course Outcomes, Course Objectives		
CONTENT DELIVERY (THEORY)			
2	Understand the hydrological cycle, their components and water budget equation	CO 1	T2: 4.2-4.5
3-4	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 2	T2: 4.5

15	Reservoir evaporation and methods of reduction.	CO 2	T1: 2.4-2.7
16	Understand the evapotranspiration, measurement of evapotranspiration and their equations.	CO 2	T1: 2.8-2.9
17	Explain the Potential evapotranspiration, actual evapotranspiration	CO 2	T1: 2.10
18-19	Infiltration, Infiltration capacity and factors affecting infiltration Measurement of infiltration	CO 2	T2: 4.16
20-21	Explain the Surface runoff and runoff volume, estimation of runoff volume by SCS-CN method	CO 3	T2:4.17-4.19
22	Flow-duration-curve, flow-mass curve, hydrograph and factors affecting hydrograph.	CO 3	T1: 3.4-3.5
23	Components of hydrograph, base flow separation, effective rainfall, and unit hydrograph.	CO 3	T2:4.20-4.22
24	Sub – surface runoff - forms of subsurface water, saturated formation	CO 4	T2: 5.2-5.3
25-26	Aquifer properties, geologic formations of aquifers, well hydraulics	CO 4	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 5	T2: 13.1, 14.3-14.9
37-38	Dams - Gravity dams - forces on gravity dams, causes of failure, stress analysis, elementary and practical profile	CO 6	T2: 7.1-7.4, 8.2-8.21
39-40	Embankment dams - Classification, design considerations. Arch and buttress dams	CO 6	T2: 9.1-9.7
41-42	Spillways - components of spillways, types of gates for spillway crest	CO 6	T2:11.1-11.4
43	Reservoirs - Types, capacity of reservoirs	CO 6	T2:6.1-6.2
44-45	Yield of reservoir, selection of suitable site for reservoirs.	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 2	T1.4.2-4.10
5	Calculate the evapotranspiration using empirical methods	CO 2	T1.4.2-4.10
6	Calculate an infiltration capacity and its indices	CO 2	T1.4.2-4.10
7	Draw Hydrographs using ordinates given with respective time duartion	CO 3	T1.4.2-4.10
8	Draw an Unit hydrograph from DRH ordinates using required formula	CO 3	T1.4.2-4.10
9	Calculate surface runoff using rational formula and other required formula r	CO 3	T2:5.2-5.7
10	Estimate an aquifer discharge using equilibrium equations for confined and unconfined aquifer	CO 4	T2:5.2-5.7
11	Design the canal alignment methods using Kennedy's and Lacey's theory	CO 5	T2:9.1-9.7
12	Calculate the Consumptive use and discharge applied for the irrigation using required formulas,	CO 5	T2:9.1-9.7
13	Calculate the forces acting on the gravity dam	CO 6	T2:11.1-11.4 R3:12.34-12.36
14	Calculate the forces acting on the embankment dam	CO 6	T2:11.1-11.4 R3:12.34-12.36
15	Calculate the reservoir capacity using the required formulas	CO 6	T2:11.1-11.4 R3:12.34-12.36
DISCUSSION OF DEFINITION AND TERMINOLOGY			
1	Introduction to hydrologic cycle, Water – budget equation. Precipitation - forms of precipitation, characteristics of precipitation in India, measurement of precipitation, rain gauge network, mean precipitation over an area, Depth-Area-Duration (DAD) relationships, maximum intensity/depth-duration-frequency relationship, Probable Maximum Precipitation (PMP), rainfall data in India.	CO 1	T2: 4.2-4.13
2	Evaporation process, evaporimeters, analytical methods of evaporation estimation, reservoir evaporation and methods for its reduction, evapotranspiration, measurement of evapotranspiration, evapotranspiration equations, Potential evapotranspiration, actual evapotranspiration, infiltration, infiltration capacity, measurement of infiltration.	CO 2	T1.4.2-4.10

3	Surface Runoff - Runoff volume, SCS – CN method of estimating runoff volume, flow – duration curve, flow- mass curve, hydrograph, factors affecting runoff hydrograph, components of hydrograph, base flow separation, effective rainfall, and unit hydrograph. Sub – surface runoff - forms of subsurface water, saturated formation, aquifer properties, geologic formations of aquifers, well hydraulics: steady state flow in wells, equilibrium equations for confined and unconfined aquifers, aquifer tests.	CO 3, CO 4	T2:5.2-5.7
4	Water requirement of crops-Crops and crop seasons in India, cropping pattern, duty and delta; Quality of irrigation water; Soil-water relationships, root zone soil water, consumptive use, irrigation requirement, frequency of irrigation; Methods of applying water to the fields: surface, sub-surface, sprinkler and trickle/ drip irrigation. Canal systems – Design of channels – Kennedy's and Lacey's theory of regime channels.	CO 5	T2:9.1-9.7
5	Dams - Gravity dams - forces on gravity dams, causes of failure, stress analysis, elementary and practical profile. Embankment dams - Classification, design considerations. Arch and buttress dams. Spillways - components of spillways, types of gates for spillway crests. Reservoirs - Types, capacity of reservoirs, yield of reservoir, selection of suitable site for reservoirs.	CO 6	T2:11.1-11.4 R3:12.34-12.36
DISCUSSION OF QUESTION BANK			
1	Introduction to hydrologic cycle, Water – budget equation. Precipitation - forms of precipitation, characteristics of precipitation in India, measurement of precipitation, rain gauge network, mean precipitation over an area, Depth-Area-Duration (DAD) relationships, maximum intensity/depth-duration-frequency relationship, Probable Maximum Precipitation (PMP), rainfall data in India.	CO 1	T2: 4.2-4.13
2	Evaporation process, evaporimeters, analytical methods of evaporation estimation, reservoir evaporation and methods for its reduction, evapotranspiration, measurement of evapotranspiration, evapotranspiration equations, Potential evapotranspiration, actual evapotranspiration, infiltration, infiltration capacity, measurement of infiltration.	CO 2	T1.4.2-4.10
3	Surface Runoff - Runoff volume, SCS – CN method of estimating runoff volume, flow – duration curve, flow- mass curve, hydrograph, factors affecting runoff hydrograph, components of hydrograph, base flow separation, effective rainfall, and unit hydrograph. Sub – surface runoff - forms of subsurface water, saturated formation, aquifer properties, geologic formations of aquifers, well hydraulics: steady state flow in wells, equilibrium equations for confined and unconfined aquifers, aquifer tests.	CO 3, CO 4	T2:5.2-5.7

4	Water requirement of crops-Crops and crop seasons in India, cropping pattern, duty and delta; Quality of irrigation water; Soil-water relationships, root zone soil water, consumptive use, irrigation requirement, frequency of irrigation; Methods of applying water to the fields: surface, sub-surface, sprinkler and trickle/ drip irrigation. Canal systems – Design of channels – Kennedy's and Lacey's theory of regime channels.	CO 5	T2:9.1-9.7
5	Dams - Gravity dams - forces on gravity dams, causes of failure, stress analysis, elementary and practical profile. Embankment dams - Classification, design considerations. Arch and buttress dams. Spillways - components of spillways, types of gates for spillway crests. Reservoirs - Types, capacity of reservoirs, yield of reservoir, selection of suitable site for reservoirs.	CO 6	T2:11.1-11.4 R3:12.34-12.36

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	**Reinforced concrete structures design and drawing**				
Course Code	ACECI6				
Program	B.Tech				
Semester	V				
Course Type	Core				
Regulation	UG20				
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	AMEB03	III	Engineering Mechanics
B.Tech	ACEB07	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
17%	Remember
33 %	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) and 10 marks for Alternative Assessment Tool (AAT).

Component		Marks	Total Marks
CIA	Continuous Internal Examination – 1 (Mid-term)	10	30
	Continuous Internal Examination – 2 (Mid-term)	10	
	AAT-1	5	
	AAT-2	5	
SEE	Semester End Examination (SEE)	70	70
Total Marks			100

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:

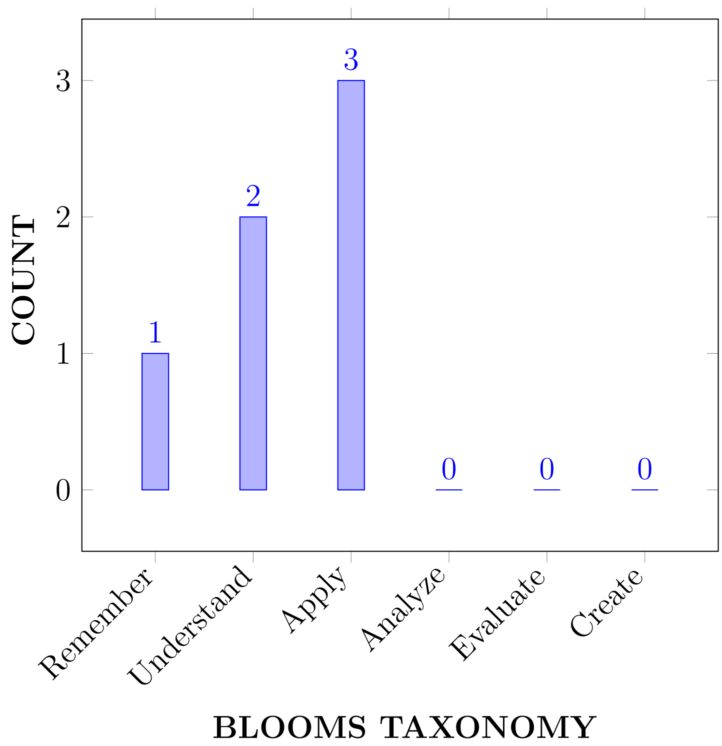
I	The basic design concepts for reinforced concrete structures starting with historical development to the latest limit state theory.
II	The Indian Standard codal provisions and refreshing the bending and shear theory.
III	The behavior of reinforced concrete components and systems subjected to gravity 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	**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 2	**Recall** basic concepts of singly reinforced, doubly reinforced, T, L beam, material stress–strain curves, and safety factors to know the properties of concrete structure..	Remember
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	**Solve** design of reinforced concrete slab sections as per IS: 456–2000 for obtaining the reinforcement details in load bearing members.	Apply
CO 5	**Develop** the concept of Axial loading uni-axial and bi-axial bending of vertically loaded members to obtain reinforcement details.	Apply
CO 6	**Design** reinforcement structural sections for isolated, Combined footing and staircase for obtaining the 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.

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 / 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 modelling to complex Engineering activities with an understanding of the limitations	2	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	-	-	-	-	-	-	-	-	-	2	-	-
CO 5	2	2	2	-	1	-	-	-	-	-	-	-	2	-	-
CO 6	2	2	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	66.6	30	10	-	-	-	-	-	-	-	-	-	-	-	-
CO 2	-	20	10	-	-	-	-	-	-	-	-	-	-	-	-
CO 3	-	20	10	-	-	-	-	-	-	-	-	-	-	-	-
CO 4	66.6	20	10	-	-	-	-	-	-	-	-	-	20	-	-
CO 5	66.6	20	20	-	100	-	-	-	-	-	-	-	20	-	-
CO 6	66.6	20	20	-	100	-	-	-	-	-	-	-	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≤ 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	1	1	-	-	-	-	-	-	-	-	-	-	-	-
CO 2	-	1	1	-	-	-	-	-	-	-	-	-	-	-	-
CO 3	-	1	1	-	-	-	-	-	-	-	-	-	-	-	-
CO 4	3	1	1	-	-	-	-	-	-	-	-	-	1	-	-
CO 5	3	1	1	-	3	-	-	-	-	-	-	-	1	-	-
CO 6	3	1	1	-	3	-	-	-	-	-	-	-	1	-	-
TOTAL	12	6	6	-	6	-	-	-	-	-	-	-	3	-	-
AVERAGE	3	1	1	-	2	-	-	-	-	-	-	-	1	-	-

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:

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

XVIII SYLLABUS:

MODULE I	INTRODUCTION TO LIMIT STATE DESIGN
	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 AND STAIRCASE
	Design of footing: Isolated (square and rectangular) and combined footings. Design of staircase.

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			
	Discussion on outcome based education		
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 2	T2: 3.4, R1: 4.1
17-19	Design of doubly reinforced beams, design of T beam sections and L beam sections	CO 2	T2: 3.4, R1: 4.1
20-22	Design of doubly reinforced beams, design of T beam sections and L beam sections	CO 2	T2: 3.4, R1: 4.1
23-25	Design of doubly reinforced beams, design of T beam sections and L beam sections	CO 2	T2: 3.4, R1: 4.1
17	Analysis and Design of section for shear and torsion	CO 3	T2: 3.4
26-27	Concept of bond, anchorage and development length	CO 3	T2: 10.17
28	Problems on development length	CO 3	T2: 4.2
22	Understand deflection limits in IS: 456–2000	CO 3	T2: 5.1
29-30	Problems on one-way slabs, design and concept of two-way slabs.	CO 4	T2: 5.2
31-32	Problems on Two-way slabs	CO 4	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 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	Module I	CO 1,2	R4:2.1
2	Module II	CO 3	T4:7.3
3	Module III	CO 4	R4:5.1
4	Module IV	CO 5	T1:7.5
5	Module V	CO 6	T1:4.1

Signature of Course Coordinator **HOD,CE**
Ms. B.Veeralaxmi , Assistant Professor

I A R E
EDUCATION FOR LIBERATION

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

COURSE DESCRIPTION

Department	**Civil Engineering**				
Course Title	**Business Economics and Financial Analysis**				
Course Code	AHSC13				
Program	B.Tech				
Semester	V				
Course Type	Core				
Regulation	UG-20				
Course Structure	Theory			Practical	
	Lecture	Tutorials	Credits	Laboratory	Credits
	3	-	3	-	-
Course Coordinator	Dr.M.Sindu,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). 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).

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	AAT-2	5	
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Concept Video	Tech-talk	Complex Problem Solving
40%	40%	20%

VI COURSE OBJECTIVES:

The students will try to learn:

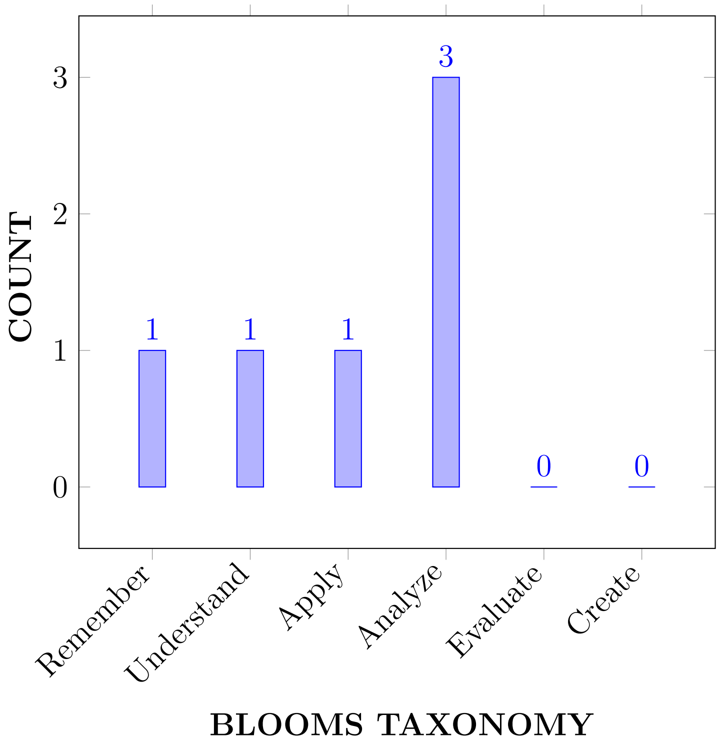
I	The concepts of business economics and demand analysis helps in optimal decision making in business environment
II	The functional relationship between Production and factors of production and able to compute breakeven point to illustrate the various uses of breakeven analysis.
III	The features, merits 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 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 2	**Problem analysis:** Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.	2	CIE/Quiz/AAT
PO 8	**Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice	1	Seminar/ Conferences
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	Assignments/ Discussion
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	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	**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

Course Outcomes	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key competencies matched.
	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
	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

Course Outcomes	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key competencies matched.
	PO 11	**Illustrate**the accounting methods and procedures and accounting principles to manage the financial aspects in a project.	8

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	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	-	-	-	-

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	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	-	-	-	-

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	-	-	-	-	-	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	-	-	-	-

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	7	7	-	-	-	-	-	10	8	-	-	-	-	-	-
AVERAGE	2.3	2.3	-	-	-	-	-	2.5	2	-	2.5	-	-	-	-

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&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.

REFERENCE BOOKS:

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.

WEB REFERENCES:

1. https://courses.lumenlearning.com/boundless-marketing/chapter/demand-analysis/
2. https://theintactone.com/2019/10/01/me-u3-topic-2-cost-output-relationship-in-short-run-long-run-cost-curves/
3. https://corporatefinanceinstitute.com/resources/knowledge/modeling/break-even-analysis/
4. https://corporatefinanceinstitute.com/resources/knowledge/economics/market-structure/#: :text=The%20four%20popular%20types%20of,monopoly%20market%2C%20and%20mo
5. https://www.vedantu.com/commerce/various-forms-of-business-organisations
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/
8. https://www.iedunote.com/write-accounting-ledger
9. https://opentextbc.ca/principlesofaccountingv1openstax/chapter/prepare-a-trial-balance/
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

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 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,MBA**
Dr. M Sindu, Associate Professor

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

COURSE DESCRIPTION

Department	**CIVIL ENGINEERING**					
Course Title	**REMOTE SENSING AND GIS**					
Course Code	ACEC17					
Program	B.Tech					
Semester	V					
Course Type	ELECTIVE					
Regulation	UG-20					
Course Structure	Theory			Practical		
	Lecture	Tutorials	Credits	Laboratory	Credits	
	3	-	3	-	-	
Course Coordinator	Mr. B. Suresh, Assistant Professor					

I COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites
B.Tech	ACEC01	III	Surveying and Geomatics

II COURSE OVERVIEW:

GIS and remote sensing techniques have become indispensable and potential tools for solving problems in civil engineering. Data from remote sensing mostly correlate spatial data to their attributes making them useful in this field. Different themes such as geology, terrain, drainage, and hydrology can be extracted by the use of remote sensing.Places, where remote sensing in technology is mostly used, include sanitation, urban growth, new road alignment, and irrigation project design. GIS and remote sensing data are mostly used to develop models by integrating socio-economic, demographic and information on natural resources.

III MARKS DISTRIBUTION:

Subject	SEE Examination	CIE Examination	Total Marks
Remote Sensing and GIS	70 Marks	30 Marks	100

IV CONTENT DELIVERY / INSTRUCTIONAL METHODOLOGIES:

✓	Power Point Presentations	✓	Chalk & Talk	✓	Assignments	x	MOOC
✓	Open Ended Experiments	✓	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
50%	Remember
33.33%	Understand
16.66%	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) and 10 marks for Alternative Assessment Tool (AAT).

Component		Marks	Total Marks
CIA	Continuous Internal Examination – 1 (Mid-term)	10	30
	Continuous Internal Examination – 2 (Mid-term)	10	
	AAT-1	5	
	AAT-2	5	
SEE	Semester End Examination (SEE)	70	70
Total Marks			100

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:

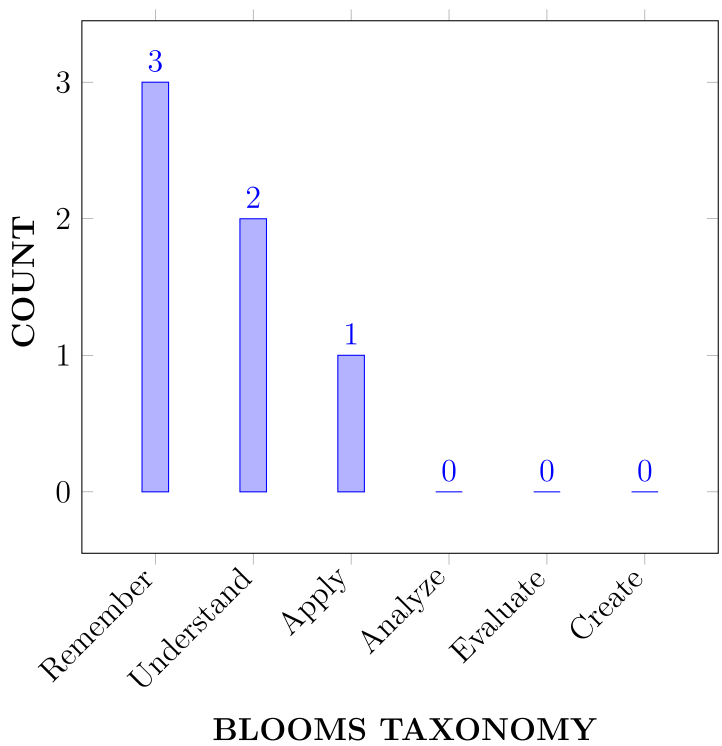
I	The Photogrammetric techniques, concepts and components of Photogrammetry.
II	The basic concepts and principles of various components of remote sensing and its applications.
III	The concept of Geographical Information System (GIS), coordinate system, GIS Data and its types.
IV	The data management systems in GIS and its practical applications in the field of Civil Engineering.

VII COURSE OUTCOMES:

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

CO 1	**Recall** the importance of aerial photogrammetry, flight planning and Stereoscopy for preparing 3D geographical maps.	Remember
CO 2	**Relate** the fundamentals of stereoscopy concept for adding third coordinate to the image pair.	Remember
CO 3	**Interpret** the electromagnetic spectrum, remote sensing data acquisition on platforms and sensors for studying energy interactions with earth surface and atmosphere and to provide base maps.	Understand
CO 4	**List** the basic components and data input to GIS for collecting GIS data using appropriate data collection technique.	Remember
CO 5	**Summerize** the data base management systems for storing and managing GIS data using suitable data management system.	Understand
CO 6	**Utilize** the GIS and remote sensing data for assessing the water resources applications.	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.
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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 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:** 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 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	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
CO 1	PO 1	Recall the geometry of aerial photogrammetry and stereoscopy concepts to create basic 3D maps by using **knowledge of mathematics and engineering fundamentals.**	2
	PSO 1	Use the basic maps prepared by aerial photogrammetry to **supervise irrigation structures.**	1
CO 2	PO 1	Use the stereoscopy concepts to create basic 3D maps by using **knowledge of mathematics and engineering fundamentals.**	2
CO 3	PO 1	Analyze the interaction of electromagnetic spectrum with different objects to know the physical and chemical properties by **using knowlwdge of mathematics and science.**	2
	PO 4	Prepare remote sensing maps to differentiate physical and chemical properties of objects by **analyzing and interpreting the remote sensing data.**	2
CO 4	PO 1	Understand the basic components and data input to collect GIS data of a location by **applying the knowledge of earth sciences.**	1
	PO 4	Select the appropriate method to collect and represent the GIS data by **analyzing different GIS inputs methods.**	1
CO 5	PO 1	Understand the GIS data management systems for storing and managing GIS data of a location by **applying knowledge of earth sciences.**	1
	PO 4	Select the appropriate data management system for managing GIS data by **analyzing different GIS management systems.**	1
CO 6	PO 4	Assess the flood and drought impact of an area by using **reaserch based knowledge.**	1
	PO 7	Analyze the present and past data of remoe sensing and GIS to assess environmental impact of that loaction and understand the **need for sustainable developement.**	1
	PSO 1	Use the integrated remote sensing and GIS data to **supervise irrigation structures.**	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	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 3	2	-	-	2	-	-	-	-	-	-	-	-	-	-	-
CO 4	1	-	-	1	-	-	-	-	-	-	-	-	-	-	-
CO 5	1	-	-	1	-	-	-	-	-	-	-	-	-	-	-
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	67	-	-	-	-	-	-	-	-	-	-	-	10	-	-
CO 2	67	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 3	67	-	-	18	-	-	-	-	-	-	-	-	-	-	-
CO 4	33	-	-	9	-	-	-	-	-	-	-	-	-	-	-
CO 5	33	-	-	9	-	-	-	-	-	-	-	-	-	-	-
CO 6	-	-	-	9	-	-	33	-	-	-	-		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

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	-	-	-	-	-	-	-	-	-	-	-
CO 4	1	-	-	1	-	-	-	-	-	-	-	-	-	-	-
CO 5	1	-	-	1	-	-	-	-	-	-	-	-	-	-	-
CO 6	-	-	-	1	-	-	1	-	-	-	-	-	1	-	-
TOTAL	11	-	-	4	-	-	1	-	-	-	-	-	2	-	-
AVERAGE	2	-	-	1	-	-	1	-	-	-	-	-	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:

✓	Early Semester Feedback	✓	End Semester OBE Feedback
✓	Assessment of activities / Modelling and Experimental tools in Engineering by Experts		

XVIII SYLLABUS:

MODULE I	**INTRODUCTION TO PHOTOGRAMMETRY**
	Principles and types of aerial photograph, geometry of vertical aerial photograph, Scale and Height measurement on single vertical aerial photograph, Height measurement based on relief displacement, Fundamentals of stereoscopy, fiducially points, parallax measurement using fiducially line.
MODULE II	**REMOTE SENSING**
	Basic concepts and foundation of remote sensing – elements involved in remote sensing, electromagnetic spectrum, remote sensing terminology and units. Energy resources, energy interactions with earth surface features and atmosphere, resolution, sensors and satellite visual interpretation techniques, basic elements, converging evidence, interpretation for terrain evaluation, spectral properties of water bodies, introduction to digital data analysis.
MODULE III	**GEOGRAPHIC INFORMATION SYSTEM AND TYPES OF DATA REPRESENTATION**
	Introduction, History of GIS, GIS definition and terminology, GIS categories, components of GIS, fundamental operations of GIS, A theoretical framework for GIS. Data collection and input overview, data input and output. Keyboard entry and coordinate geometry procedure, manual digitizing and scanning, Raster GIS, Vector GIS.
MODULE IV	**GIS DATA MANAGEMENT**
	Introduction, Data base management systems, functions and components of data base management system, GIS data file management, Database Models - Hierarchical Database Models, Network Systems, Relational Database Models. Storage of GIS data.
MODULE V	**WATER RESOURCES APPLICATIONS**
	Land use/Land cover in water resources, Surface water mapping and inventory, Rainfall – Runoff relations and runoff potential indices of watersheds, Flood and Drought impact assessment and monitoring, Watershed management for sustainable development and Watershed characteristics.

TEXTBOOKS

1. Remote Sensing and GIS by B.Bhatta, Oxford University Press,New Delhi.

2. Fundamentals of remote sensing by Gorge Joseph , Universities press, Hyderabad.

REFERENCE BOOKS:

1. LRA Narayana, "Remote Sensing and its applications", University Press 1999.
2. S.Kumar, "Basics of Remote Sensing and GIS", Laxmi Publications.
3. Tsung Chang, "GIS", TMH Publications and Co.
4. M.Anji Reddy, "Remote Sensing and GIS", B.S. Pubiliications, New Delhi.

WEB REFERENCES:

1. https://nptel.ac.in/courses/105/103/105103193/

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			
1	Discussion on outcome based education		
CONTENT DELIVERY (THEORY)			
2	Understand the Principles and types of aerial photograph	CO 1	T2: 1.1-1.5, T1: 4.1
3	Understand Geometry of vertical aerial photograph	CO 1	T2: 1.1-1.5, T1: 4.1
4	Calculate Scale and Height measurement on single vertical aerial photograph	CO 1	T2: 1.1-1.5, T1: 4.1
5	Understand height measurement based on relief displacement	CO 1	T2: 1.1-1.5, T1: 4.1
6	Understand fundamentals of stereoscopy	CO 2	T2: 1.1-1.5, T1: 4.1
7	Examine parallax measurement	CO 2	T2: 1.1-1.5, T1: 4.1
8	Understand he importance of fiducially points	CO 1,2	T2: 1.1-1.5, T1: 4.1
9	Recall Parallax measurement using fiducially line.	CO 2	T2: 1.1-1.5, T1: 4.1
10	Understand basic concepts of Remote sensing	CO 3	T2: 1.1-1.5, T1: 4.1
11	Explain elements involved in remote sensing.	CO 3	T2: 1.1-1.5, T1: 4.1
12	Understand electromagnetic spectrum.	CO 3	T2: 1.1-1.5, T1: 4.1
13	Examine energy interactions with earth surface features and atmosphere.	CO 3	T2: 1.1-1.5, T1: 4.1

14	Relate Satellite visual interpretation techniques.	CO 3	T2: 1.1-1.5, T1: 4.1
15	Summerize interpretation for terrain evaluation.	CO 3	T2: 1.1-1.5, T1: 4.1
16	Understand spectral properties of water bodies.	CO 3	T2: 1.1-1.5, T1: 4.1
17	Introduction to digital data analysis	CO 5	T2: 1.1-1.5, T1: 4.1
18	Introduction, History of GIS.	CO 4	T2: 1.1-1.5, T1: 4.1
19	Summerize GIS categories	CO 4	T2: 1.1-1.5, T1: 4.1
20	Understand components of GIS.	CO 4	T2: 1.1-1.5, T1: 4.1
21	Understand fundamental operations of GIS.	CO 4	T2: 1.1-1.5, T1: 4.1
22	Theoretical framework for GIS.	CO 4	T2: 1.1-1.5, T1: 4.1
23	Data collection and input overview.	CO 4	T2: 1.1-1.5, T1: 4.1
24	Keyboard entry and coordinate geometry procedure.	CO 4	T2: 1.1-1.5, T1: 4.1
25	Manual digitizing and scanning.	CO 4	T2: 1.1-1.5, T1: 4.1
26	Understand Raster GIS	CO 4	T2: 1.1-1.5, T1: 4.1
27	Understand Vector GIS	CO 4	T2: 1.1-1.5, T1: 4.1
28	Introduction data base management systems.	CO 5	T2: 1.1-1.5, T1: 4.1
29	Summerize data base management systems functions	CO 5	T2: 1.1-1.5, T1: 4.1
30	GIS data file management	CO 5	T2: 1.1-1.5, T1: 4.1
31	Hierarchical Database Models	CO 5	T2: 1.1-1.5, T1: 4.1
32	Understand network Systems of GIS.	CO 5	T2: 1.1-1.5, T1: 4.1
33	Relational Database Models	CO 5	T2: 1.1-1.5, T1: 4.1
34	Land use/Land cover in water resources	CO 6	T2: 1.1-1.5, T1: 4.1
35	Surface water mapping and inventory	CO 6	T2: 1.1-1.5, T1: 4.1
36	Rainfall – Runoff relations and runoff potential indices of watersheds.	CO 6	T2: 1.1-1.5, T1: 4.1

37	Flood and Drought impact assessment	CO 6	T2: 1.1-1.5, T1: 4.1
38	Flood and Drought impact monitoring	CO 6	T2: 1.1-1.5, T1: 4.1
39	Watershed management for sustainable development	CO 6	T2: 1.1-1.5, T1: 4.1
40	Watershed characteristics	CO 6	T2: 1.1-1.5, T1: 4.1
PROBLEM SOLVING/ CASE STUDIES			
1	Numerical Examples on Terrestrial photogrammetry	CO 1	R2:7.5
2	Numerical Examples on geometry of aerial photograph.	CO 1	R2:7.5
3	Numerical Examples on determining scale of a vertical photograph.	CO 1	R2:7.5
4	Numerical Examples on measuring height of an object in vertical photograph.	CO 2	R2:7.5
5	Numerical Examples on determining scale of a tilted photograph.	CO 2	R2:7.5
6	Numerical Examples on measuring height of an object in tilted photograph.	CO 2	R2:7.5
7	Numerical Examples on Relief displacement in vertical photograph	CO 3	R2:7.5
8	Numerical Examples on Relief displacement in tilted photograph.	CO 3	R2:7.5
9	Numerical Examples on Stereoscopy.	CO 3	R2:7.5
10	Numerical Examples on parallax error	CO 4	R2:7.5
11	Numerical Examples on Electromagnetic spectrum.	CO 4	R2:7.5
12	Numerical Examples on Rainfall – Runoff relations.	CO 5	R2:7.5
13	Numerical Examples on runoff potential indices	CO 5	R2:7.5
14	Numerical Examples on Land use/Land cover in water resources.	CO 6	R2:7.5
15	Numerical Examples on Flood and Drought impact.	CO 6	R2:7.5
DISCUSSION OF DEFINITION AND TERMINOLOGY			
1	Definitions and terminology of electromagnetic spectrum.	CO 1 2	R4:2.1
2	Definitions and terminology of remote sensing.	CO 3	R4:2.1
3	Definitions and terminology of GIS.	CO 4	R4:2.1
4	Definitions and terminology from Data base management systems	CO 5	R4:2.1
5	Definitions and terminology from data input and output.	CO 6	R4:2.1

DISCUSSION OF QUESTION BANK			
1	Introduction of photogrammetry	CO 1,2	R4:2.1
2	Remote sensing	CO 3	T4:7.3
3	Geographic information system and types of data representation	CO 4	R4:5.1
4	GIS Data Management	CO 5	T1:7.5
5	Water resources applications	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

COURSE DESCRIPTION

Department	**Civil Engineering**				
Course Title	**Advanced Material Testing Laboratory**				
Course Code	ACEC22				
Program	B.Tech				
Semester	V	CE			
Course Type	Core				
Regulation	IARE - UG20				
Course Structure	Theory			Practical	
	Lecture	Tutorials	Credits	Laboratory	Credits
	-	-	-	3	1.5
Course Coordinator	Mr. Gude Ramakrishna, Associate Professor				

I COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites
B.Tech	ACEC10	IV	Concrete Technology
B.Tech	ACEC11	IV	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
Advanced Material Testing 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.

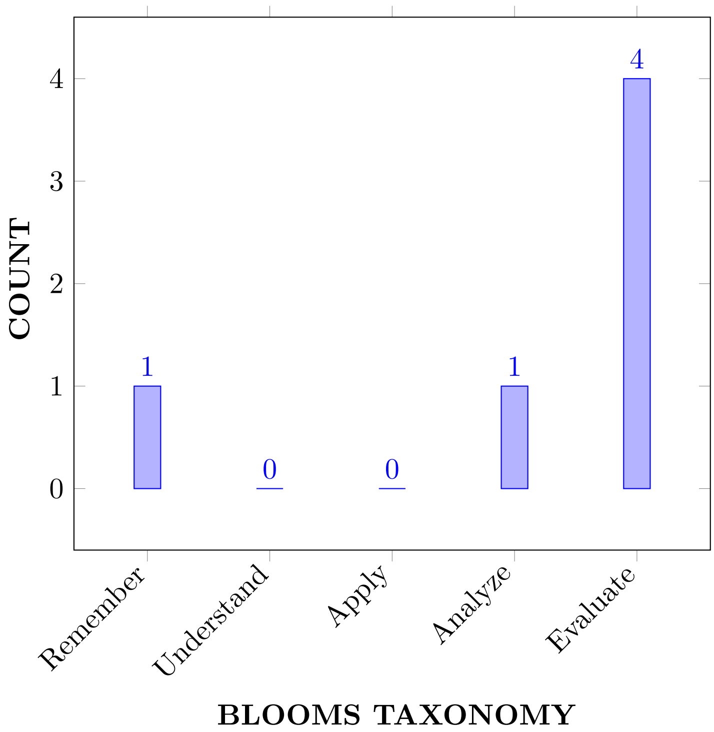
II	The factors influencing workability and methods involved in measuring workability of self compacting concrete.
III	The importance of water/cement ratio and its influence on compressive strengths of hardened concrete.
IV	The concept of quality control and design of concrete mix with various admixtures 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 and workability 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 1	R1: 2.4
2	Study of gradation charts of aggregates.	CO 3	R2: 4 2
3	Study of bulking of sand.	CO 2	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. Gude Ramakrishna, Associate Professor

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

CIVIL ENGINEERING
COURSE DESCRIPTION

Department	CIVIL ENGINEERING				
Course Title	ADVANCED SURVEYING LABORATORY				
Course Code	ACEC21				
Program	B.Tech				
Semester	V				
Course Type	Laboratory				
Regulation	UG-20				
Course Structure	Theory			Practical	
	Lecture	Tutorials	Credits	Laboratory	Credits
	-	-	-	3	1.5
Course Coordinator	Mr. B Suresh , Assistant Professor				

I COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites	Credits
UG	ACEC05	III	Surveying and Geomatics Laboratory	1.5

II 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 distances, tracing 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 measuring inaccessible distances, remote elevation and distances by collecting and evaluating data such as horizontal distances, vertical distances,slopes and elevations

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	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 of surveys 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.

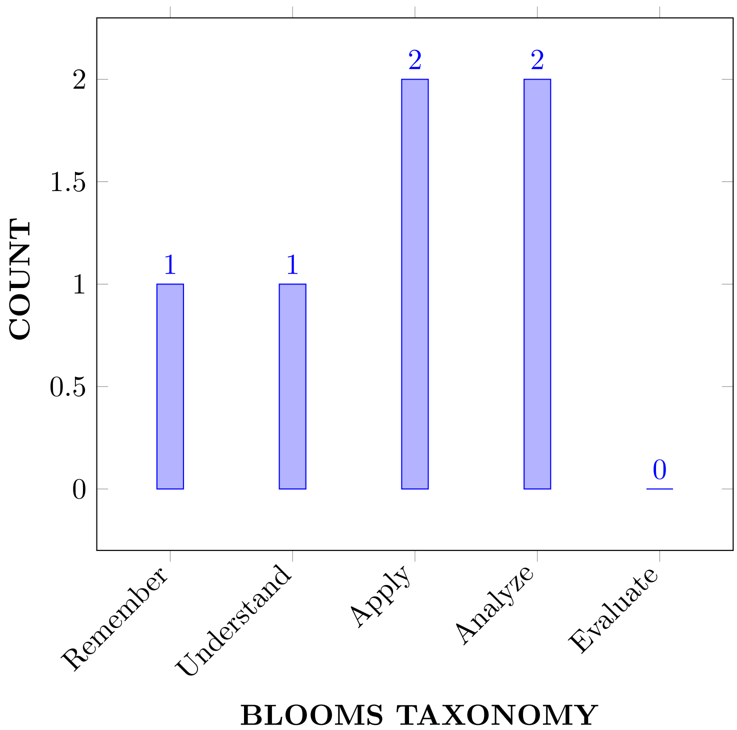
III	The measurement of alteration works, detecting land use and land cover, creating base maps for visual reference.

VII COURSE OUTCOMES:

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

CO 1	**Recall** the concept of traversing in theodolite for measuring horizontal and vertical angles	Remember
CO 2	**Demonstrate** trigonometric leveling for locating inaccessible heights and distances.	Understand
CO 3	**Identify** the suitable repetition and reiteration methods in theodolite survey for tracing out the centering point on ground.	Apply
CO 4	**Examine** the reduced levels using leveling apparatus for illustrating longitudinal section and cross section and plotting.	Analyze
CO 5	**Examine** contours for investigating the suitable path along the alignment at conflict points.	Analyze
CO 6	**Utilize** the concept of remote elevation and remote distance in total station at various operating conditions and data record keeping.	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:** 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
PO 5	**Modern Tool Usage:** Create, select, and apply appropriate techniques, resources, and modern Engineering and IT tools including prediction and modeling to complex Engineering activities with an understanding of the limitations	3	Lab Exercises
PO 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

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 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 by applying the **Scientific 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	3

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.	3
	PO 9	Recall the fundamental of plane table surveying and understand the concept of orientation resection and radiation **demonstrate and instruct on effective teamwork** which helps the **ability to work with all levels of people.**	3
CO 4	PO 1	Recognize (knowledge) the importance and application (apply) of leveling, in solving (complex) problems associated with leveling by applying the **Scientific 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 in the **demonstration and instruction on effective teamwork** with the **ability to work with all levels of people**	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**for **Engineering, procurement and construction** through standard **codes of practices**	3
CO 5	PO 1	Apply the basic conservation laws for various curves setting in surveying by using **Scientific and 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** for **Engineering, procurement and construction** through standard **codes of practices**	3

CO 6	PO 2	Using standard stadia diaphragm derive the Tacheometric equation to **identify problem** and **Interpretate** complex survey problems with help of **opportunity identification.**	3
	PO 5	Understand the given problem statement and apply the appropriate techniques of advances **Computer simulation packages** for the analysis of electronic distance measurements and similarity parameters for predicting physical parameters that govern the plotting on ground technically	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 5	PO9	PSO 1
CO 1	3	3			
CO 2	3				
CO 3		3		3	
CO 4	3		1	3	3
CO 5	3				3
CO 6		3	1		

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
	3	10	10	11	1	5	3	3	12	5	12	8	10	3	3
CO 1	100	30	-	-	-	-	-	-	-	-	-		-	-	-
CO 2	100	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 3	-	30	-	-	-	-	-	-	25	-	-	-	-	-	-
CO 4	100	-	-	-	100	-	-	-	25	-	-		30	-	-
CO 5	100	-	-	-	-	-	-	-	-	-	-	-	30	-	-
CO 6	-	30	-	-	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

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		
	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	-	-	-	-	-	-	1	-	-	-	-	-	-
CO 4	3	-	-	-	3	-	-	-	1	-	-	-	1	-	-
CO 5	3	-	-	-	-	-	-	-	-	-	-	-	1	-	-
CO 6	-	1	-	-	3	-	-	-	-	-	-		-	-	-
TOTAL	12	3	-	-	6	-	-	-	2	-	-	-	2	-	-
AVERAGE	3	1	-	-	3	-	-	-	1	-	-	-	1	-	-

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

XVI 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. Anderson, James 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.

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 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

XVIII 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

COURSE DESCRIPTION

Department	**CIVIL ENGINEERING**				
Course Title	**ESTIMATION, COSTING AND VALUATION**				
Course Code	ACEC26				
Program	B.Tech				
Semester	VI				
Course Type	ELECTIVE				
Regulation	UG-20				
Course Structure	Theory			Practical	
	Lecture	Tutorials	Credits	Laboratory	Credits
	3	-	3	-	-
Course Coordinator	Mr. R.Suresh Kumar, Assistant Professor				

I COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites
B.Tech	ACEC01	III	Surveying and Geomatics
B.Tech	ACEC09	IV	Building Materials – Planning and Construction

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
Engineering Economics, Estimation And Costing	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	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
10%	Remember
40%	Understand
40%	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) and 10 marks for Alternative Assessment Tool (AAT).

Component		Marks	Total Marks
CIA	Continuous Internal Examination – 1 (Mid-term)	10	30
	Continuous Internal Examination – 2 (Mid-term)	10	
	AAT-1	5	
	AAT-2	5	
SEE	Semester End Examination (SEE)	70	70
Total Marks			100

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:

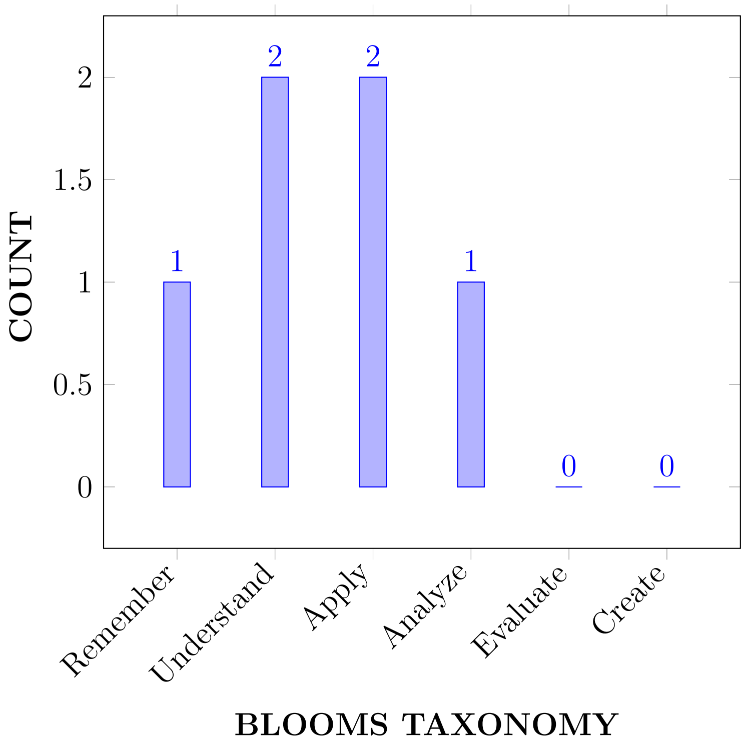
I	The importance and fundamentals of estimation and costing for measuring quantities of construction materials using traditional methods involved in project works.
II	The basic concept of earth work related to roads and canals for estimating earth work quantity using sectional area methods.
III	The concept 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.
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		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	-	-	-	-	-	-	-	-	-	-		20		-
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	-	-	-	-	-	-	-	-	-	-	-	1		-
CO 5	3	1	-	-	-	1	-	-	-	-	-	-	1		-
CO 6	3	-	-	-	3	-	-	-	-	-	-	1	-	-	3
TOTAL	18	3	-	-	6	3	-	-	-	-	-	1	3	-	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	-
Techtalk	✓				

XVII ASSESSMENT METHODOLOGY-INDIRECT:

✓	Early Semester Feedback	✓	End Semester OBE Feedback

XVIII SYLLABUS:

MODULE I	**ESTIMATION OF GENEREAL ITEMS IN BUILDINGS**
	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.
MODULE II	**EARTHWORKS**
	Introduction to earth works, earthwork calculations for roads and canals.

MODULE III	**RATE ANALYSIS AND CONTRACTS**
	Rate analysis - Working out data for various items of work over head. Rate analysis, contingent charges. Contracts, types of contracts, contract documents, conditions of contract.
MODULE IV	**BAR BENDING SCHEDULE**
	Reinforcement bar bending and bar requirement schedules.
MODULE V	**VALUATION**
	Valuation of buildings, standard specifications for different items of building construction. Need for tendering, process of tendering in construction, tendering models and strategies, prequalification of bidders, documents forming a BID, agreements and bonds in tendering process.

TEXT BOOKS:

1. B. N. Dutta, "Estimating and Costing", UBS publishers, 2000.
2. G. S. Birdie., "Estimating and Costing", Dhanpat Rai publications, 1988.
3. S. C. Rangwala, Estimating And Costing, Charotar Publishing House, 2002.

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 REFERENCE :

1. https://onlinecourses.swayam2.ac.in/nou20_cs11/preview
2. https://en.wikipedia.org/wiki/Estimation
3. https://theconstructor.org/practical-guide/quality-control/

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, 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
45	Centre line Method for a two roomed 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	Introduction to earth works, earthwork calculations 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. Contracts, types of contracts, contract documents, conditions of contract	CO 3	T1:4.5, T2: 5.4, R3: 7.3
4	Reinforcement bar bending and bar requirement schedules.	CO 4	T1:4.5, T2: 5.4, R3: 7.3
5	Valuation of buildings, standard specifications for different items of building construction. Need for tendering, process of tendering in construction, tendering models and strategies, prequalification of bidders, documents forming a BID, agreements and bonds in tendering process.	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	Introduction to earth works, earthwork calculations 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. Contracts, types of contracts, contract documents, conditions of contract.	CO 3	R4:5.1
4	Reinforcement bar bending and bar requirement schedules.	CO 4	T1:7.5
5	Valuation of buildings, standard specifications for different items of building construction. Need for tendering, process of tendering in construction, tendering models and strategies, prequalification of bidders, documents forming a BID, agreements and bonds in tendering process.	CO 6	T1: 4.1

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	ACEC24				
Program	B.Tech				
Semester	VI				
Course Type	Core				
Regulation	UG-20				
Course Structure	Theory			Practical	
	Lecture	Tutorials	Credits	Laboratory	Credits
	3	1	4		
Course Coordinator	Dr.M. Madhusudhan Reddy, Assistant Professor				

I COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites
B.Tech	AMEC01	II	Engineering Mechanics
B.Tech	ACEC04	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). 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
30%	Remember
50 %	Understand
20 %	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) and 10 marks for Alternative Assessment Tool (AAT).

Component		Marks	Total Marks
CIA	Continuous Internal Examination – 1 (Mid-term)	10	30
	Continuous Internal Examination – 2 (Mid-term)	10	
	AAT-1	5	
	AAT-2	5	
SEE	Semester End Examination (SEE)	70	70
Total Marks			100

Continuous Internal Examination (CIE):
Two CIE exams shall be conducted at the end of the 8th and 16th 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:

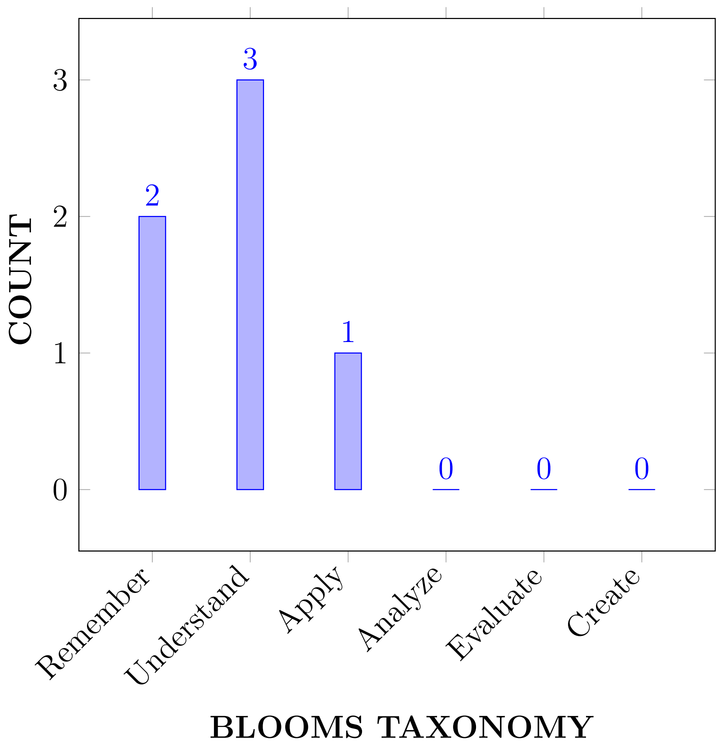
I	The fundamental knowledge on soils, importance in the design and construction process of massive structures.
II	The laboratory, field tests conducted on soils to identify the better ground to construction.
III	The methods employed for soil properties prediction, soil layers and its applications
IV	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	**List out** the procedure of soil formation, soil structure, clay mineralogy and index proportion for classifying the soil types.	Understand
CO 2	**Demonstrate** the concepts of permeability and seepage flow net for estimating 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. for estimating intensity of pressure on soil.	Understand
CO 4	**Relate** the effect of compaction and consolidation pressures for estimating the total settlement, 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 AND COMPACTION**
	Boussinesqs and Westergards theories for point load, uniformly loaded circular and rectangular areas, pressure bulb, variation of vertical stress under point load along vertical and horizontal plane, Newmarks 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	Clay mineralogy and adsorbed water, Mass volume relationship	CO 1	T4: 6.5-6.12, R2:3.3
4	Clay mineralogy and adsorbed water, Mass volume relationship	CO 1	T4: 6.5-6.12, R2:3.3
5	Relative density, Index properties of soils: grain sizes analysis	CO 1	T4:.3.15-3.16, T4:.3.3
6	Relative density, Index properties of soils: grain sizes analysis	CO 1	T4:.3.15-3.16, T4:.3.3

7	Index properties of soils: grain sizes analysis, Sieve and hydrometer method of analysis	CO1	T4: 3.8-3.9 R2:3.5
8	Index properties of soils: grain sizes analysis, Sieve and hydrometer method of analysis	CO1	T4: 3.8-3.9 R2:3.5
9	Consistency limit and indices of soil	CO1	R2:3.6
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	Flow of water through soil	CO2	T4: 8.9-8.10
14	Flow of water through soil	CO2	T4: 8.9-8.10
15	Permeability and factors effecting, laboratory determination of coefficient of permeability	CO 2	T4: 8.6-8.7
16	Permeability and factors effecting, laboratory determination of coefficient of permeability	CO 2	T4: 8.6-8.7
17	Permeability of layered systems	CO2	T4: 8.9-8.10,
18	Permeability of layered systems	CO2	T4: 8.9-8.10,
19	Seepage through soils –total, neutral and effective stresses quick sand conditions	CO2	T4: 9.11-9.12
20	Seepage through soils –total, neutral and effective stresses quick sand conditions	CO2	T4: 9.11-9.12
21	Seepage through soils.	CO2	T4: 9.11-9.12
22	Seepage through soils.	CO2	T4: 9.11-9.12
23	Flow nets, characteristics and uses	CO2	T4: 9.4-9.5
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	Newmark's influences chart	CO3	T4:11.3-11.9
28	Newmark's influences chart	CO3	T4:11.3-11.9
29	Compaction- mechanism of compaction	CO4	T4:14.1-14.4
30	Compaction- mechanism of compaction	CO4	T4:14.1-14.4

31	Factors effecting compaction of soils properties	CO4	T4:14.8-14.9
32	Factors effecting compaction of soils properties	CO4	T4:14.8-14.9
33	Effect of compaction on soil properties	CO4	T4:14.8-14.9
34	Effect of compaction on soil properties	CO4	T4:14.8-14.9
35	Field compaction equipment, Compaction control	CO4	T4:14.13-14.1
36	Field compaction equipment, Compaction control	CO4	T4:14.13-14.1
37	Consolidation –stress history of clay, e-p and e- log pcurves	CO5	T4:12.1-12.2
38	Consolidation –stress history of clay, e-p and e- log pcurves	CO5	T4:12.1-12.2
39	Magnitude and rates of 1-d consolidation	CO5	T4:12.4-12.5
40	Magnitude and rates of 1-d consolidation	CO5	T4:12.4-12.5
41	Terzaghi's theory, shear strength of soils –Mohr and Coulomb failure theories	CO6	T4:13.1-13.2
42	Terzaghi's theory, shear strength of soils –Mohr and Coulomb failure theories	CO6	T4:13.1-13.2
43	Types of laboratory strength test, Shear strength of sands	CO6	T4:13.23-13.24
44	Types of laboratory strength test, Shear strength of sands	CO6	T4:13.23-13.24
45	Strength test based on drainage conditions, Critical void ratio of clay, Liquefaction and shear strength of clay	CO6	T4:13.22
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	Soil formation, clay mineralogy and soil structure, moisture content, weight-volume relationships	CO 1	R1
2	Neutral effective stress and	CO2	R1
3	Compaction, factors affecting compaction, effects of compaction on soil properties	CO3 & CO4	R1
4	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	CO5	T 1&2, R1
5	Importance of shear strength, Mohr‘s-Coulomb failure theories	CO6	R1
DISCUSSION OF QUESTION BANK			
1	Grain size analysis, sieve analysis, principle of hydrometer method, consistency limits and indices, I.S. classification of soils.	CO1	R1
2	Permeability of layered soils. Total, neutral and effective stress, upward & downward seepage through soils, quick sand condition, flow nets: characteristics and uses.	CO2	T 1&2, R1
3	Boussinesqs and Westergards theories for point load, uniformly loaded circular and rectangular areas,pressure bulb, variation of vertical stress under point load along vertical and horizontal plane	CO 3 & CO4	T 1&2,
4	Types of compressibility, immediate settlement, primary consolidation and secondary consolidation, stress history of clay	CO 5	T 1&2,
5	Importance of shear strength, Mohr‘s-Coulomb failure theories, types of laboratory tests for strength parameters, strength tests based on drainage conditions,	CO 6	T 1&2,

Signature of Course Coordinator **HOD**

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

COURSE DESCRIPTION

Department	CIVIL ENGINEERING				
Course Title	TRANSPORTATION ENGINEERING				
Course Code	ACEC25				
Program	B.TECH				
Semester	VI				
Course Type	CORE				
Regulation	UG-20				
Course Structure	Theory			Practical	
	Lecture	Tutorials	Credits	Laboratory	Credits
	3	1	4	-	-
Course Coordinator	Mr. V.Suryaprakash Reddy, Assistant Professor				

I COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites
B.Tech	ACEC01	III	Surveying and Geomatics
B.Tech	ACEC10	IV	Concrete Technology

II COURSE OVERVIEW:

Road networks are vital parts of the infrastructure for ensuring safe and efficient public mobility and supply chain. 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 to Design and maintenance of highways as per IRC standards. This course also focuses on devoloping 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	x	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 20 marks for continuous internal examination (CIE) and 10 marks for Alternative Assessment Tool (AAT).

Component		Marks	Total Marks
CIA	Continuous Internal Examination – 1 (Mid-term)	10	30
	Continuous Internal Examination – 2 (Mid-term)	10	
	AAT-1	5	
	AAT-2	5	
SEE	Semester End Examination (SEE)	70	70
Total Marks			100

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:

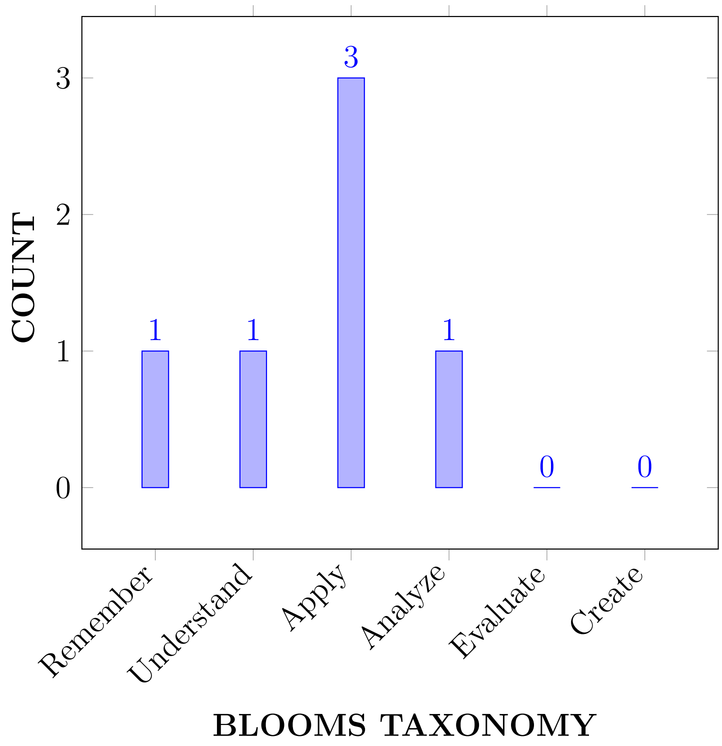
I	Understand the highway planning process and carry out surveys involved in planning and highway alignment.
II	Remember various geometric elements involved in design of highways and expressway.
III	Understand the various traffic studies and to implement traffic regulation and control measures.
IV	Understand the engineering properties of pavement materials used in highway construction
V	Understand the factors affecting design and performance of flexible and rigid pavements as per IRC.

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	**Analyze** 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	**Elucidate** the mechanical properties of pavement construction materials for enhancing serviceability and durability of highway pavements.	Understand
CO 6	**Analyze** the stresses induced in rigid pavements considered for designing, CC pavements to improve their performance.	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.	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

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
	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

Course Outcomes	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key competencies matched.
	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
	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
	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

Course Outcomes	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key competencies matched.
	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
	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	-	-	-	-	-	-	-	-	-	-		5	-	-
CO 2	1	-	-	2	-	-	-	-	-	-	-		-	2	-
CO 3	1	-	2	2	-	-	-	-	-	-	-		-	-	-
CO 4	1	-	2	2	-	-	-	-	-	-	-		-	-	-
CO 5	-	-	2	2	-	-	-	-	-	-	-	-	5	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	-	-	-	-	-	-	-	-	-	-	-	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	-	-	-	-	-	-	-	-	50	66.6	-
CO 6	-	-	-	18.1	-	-	-	-	-	-	-	-	-	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	-	-	-	-	-	-	-	-	-	-	-	2	-	-
CO 2	1	-	-	1	-	-	-	-	-	-	-	-	-	3	-
CO 3	1	-	1	1	-	-	-	-	-	-	-		-	-	-
CO 4	1	-	1	1	-	-	-	-	-	-	-		-	-	-
CO 5	-	-	1	1	-	-	-	-	-	-	-	-	2	3	-
CO 6	-	-	-	1	-	-	-	-	-	-	-	-	-	3	-
TOTAL	4	-	3	5	-		-	-	-	-	-	-	4	9	
AVERAGE	1	-	1	1	-	-	-	-	-	-	-		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**
	Classification of roads, road development in India, Current road projects in India, highway alignment, factors affecting alignment, Engineering surveys, drawing and reports, highway project
MODULE II	**GEOMETRIC DESIGN OF HIGHWAYS**
	Introduction, highway cross section elements, sight distance elements, stopping sight distance, overtaking sight distance and intermediate sight distance, design of horizontal alignment; design of vertical alignment; design of intersections.
MODULE III	**TRAFFIC ENGINEERING AND CONTROL**
	Traffic Characteristics, traffic engineering studies, traffic flow and capacity, traffic regulation and control. Design of parking facilities; highway lighting and Accident studies: causes and measures
MODULE IV	**PAVEMENT MATERIALS**
	Materials used in Highway Construction- Soils, Stone aggregates, bituminous binders, bituminous paving mixes; Portland cement and cement concrete: desirable properties, tests, requirements for different types of pavements

MODULE V	**DESIGN OF PAVEMENTS**
	Introduction; flexible pavements, factors affecting design and performance; stresses in flexible pavements; design of flexible pavements as per IRC; rigid pavements- components and functions; factors affecting design and performance of CC pavements; stresses in rigid pavements; design of concrete pavements as per IRC; problems

TEXTBOOKS

1. Khanna, S.K., Justo, C.E.G and Veeraragavan, A, 'Highway Engineering', Revised 10 th Edition, Nem Chand & Bros, 2017.
2. Partha Chakraborty, Principles Of Transportation Engineering, PHI Learning, 2017
3. 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, 7^{th} Edition, 2009.

WEB REFERENCES:

1. http://www.nptelvideos.in/2012/11/introduction-to-transportation.html
2. http://www.nptelvideos.com/civil_engineering/transportation_engineering_video_lectures.php
3. https://nptel.ac.in/courses/105105107/
4. https://nptel.ac.in/courses/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	Classification of roads	CO 1	T1:2.4 T2:11.2
2	Road development in India	CO 1	T1:2.10
3	Road development in India	CO 1	T1:2.10

4	Current road projects in India	CO 1	T1:3.10
5	Highway alignment	CO 1	T1:3.1
6	Highway alignment	CO 1	T1:3.1
7	Factors affecting alignment	CO 1	T1:3.1.2
8	Engineering surveys	CO 1	T1:3.2
9	Drawing and reports, highway project	CO 1	T1:3.4.2
10	Drawing and reports, highway project	CO 1	T1:3.4.2
11	Introduction, highway cross section elements	CO 2	T1:16.6.2
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 flow and capacity	CO 3	T1:5.2.3 R2:4.1
23	Traffic regulation and control	CO 4	T1:5.3.2 T3:17.1
24	Design of parking facilities	CO 4	T1:5.5 T2:6.3
25	Highway lighting	CO 4	T1:5.6
26	Accident studies: causes and measures	CO 4	T1:5.2.1
27	Accident studies: causes and measures	CO 4	T1:5.2.1
28	Materials used in Highway Construction- Soils	CO 5	T1:6.1.1
28	Stone aggregates	CO 5	T1:6.2
29	Bituminous binders, bituminous paving mixes	CO 5	T1:6.3
30	Bituminous binders, bituminous paving mixes	CO 5	T1:6.3
31	Portland cement and cement concrete	CO 5	T1:6.2
32	Desirable properties, tests of materials	CO 5	T1:6.3
33	Desirable properties, tests of materials	CO 5	T1:6.3
34	Requirements for different types of pavements	CO 6	T1:7.1.1
35	Introduction of flexible pavements	CO 6	T1:7.2
36	Factors affecting design and performance	CO 6	T1:6.3 R2:1.1
37	Stresses in flexible pavements	CO 6	T1:7.3

38	Design of flexible pavements as per IRC	CO 6	T1:7.3.1 R2:6.1
39	Design of flexible pavements as per IRC	CO 6	T1:7.3.1 R2:6.1
40	Introduction of Rigid pavements, components and functions	CO 6	T1:4.1 R1:6.5
41	Components and functions of Rigid pavements	CO 6	T1:4.1 R1:6.5
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	Design of concrete pavements as per IRC; problems	CO 6	T1:7.4.5 R1:6.10
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	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

Signature of Course Coordinator **HOD CE**

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

COURSE DESCRIPTION

Department	Mechanical Engineering					
Course Title	Industrial Management					
Course Code	AMEC34					
Program	B.Tech					
Semester	VI					
Course Type	OPEN ELECTIVE					
Regulation	UG-20					
Course Structure	Theory			Practical		
	Lecture	Tutorials	Credits	Laboratory	Credits	
	3	0	3	0	0	
Course Coordinator	Dr A NAVEEN KRISHNA, ASSISTANT PROFESSOR					

I COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites
B.Tech	Nil	Nil	Nil

II COURSE OVERVIEW:

The industrial management prepares engineers to design, improve, install, and operate the integrated systems of people, materials, and facilities needed by industry, commerce, and society. Industrial engineers solve problems that arise in the management of systems, applying the principles of engineering science, product/service and process design, work analysis, human factors principles, and operations research.The focus of this course is how to improve processes or design things that are more efficient and waste less money, time, raw resources, man-power and energy while following safety standards and regulations

III MARKS DISTRIBUTION:

Subject	SEE Examination	CIE Examination	Total Marks
Industrial Management	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
%	Remember
%	Understand
%	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		Marks	Total Marks
CIA	Continuous Internal Examination – 1 (Mid-term)	10	30
	Continuous Internal Examination – 2 (Mid-term)	10	
	AAT-1	5	
	AAT-2	5	
SEE	Semester End Examination (SEE)	70	70
Total Marks			100

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:

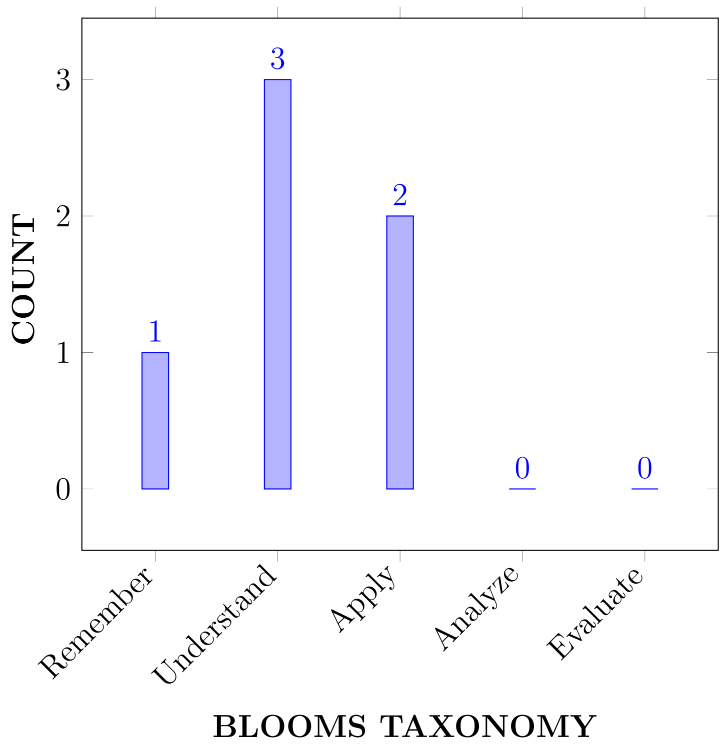
I	Organization principles and management
II	The production planning and control procedures and types
III	The work study procedures and quality concepts to enhance more productivity
IV	The significant exposure on some maintenance practices in industry for consistent productivity

VII COURSE OUTCOMES:

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

CO 1	**Understand the** basic principles of organization structure for efficient management	Remember
CO 2	**Calculate the** work content of a specific job for employees of any organization	Understand
CO 3	**Understand** the methods used by the organization for effective inventory management	Apply
CO 4	**Develop** a sound knowledge of the supply chain management in today's business environment	Understand
CO 5	**Understand the** concepts underlying statistical quality control techniques and apply those concepts to the design and management of quality control processes in industries	Understand
CO 6	**Develop skills required for** demand planning and forecasting and apply those Techniques/Models for demand planning and management	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.
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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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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/QUIZ
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/AAT/QUIZ
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/QUIZ
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/AAT/QUIZ
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.	2	CIE/AAT/QUIZ

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 Advanced Structural Analysis and Project Management Software for creating Modern Avenues to succeed as an Entrepreneur, Pursue Higher Studies and Career Paths.	1	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	Recognize (knowledge) the importance of principles of management in organization structure by applying the principles of mathematics, science and Engineering fundamentals.	3
CO 2	PO 2	A good knowledge in various methods of work study to solve engineering Problems by using appropriate work study techniques for a specific real world problems.	2
CO 3	PO 4	A good knowledge in various inventory control models to design solutions to complex engineering problems by using appropriate techniques.	1
CO 4	PO 11	Knowledge of Quality control methods help in solving various management relevant problems by applying quality management principles.	1
CO 5	PO 12	Advanced Knowledge of forecasting techniques is useful for solving industry relevant problems	2
CO 6	PSO 3	Make use of Project Management Software for creating Modern Avenues to succeed as an Entrepreneur, Pursue Higher Studies and Career Paths.	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	3	-	-	-	-	-	-	-	-	-	-	4	-	-	1
CO 2	3	5	-	3	-	-	-	-	-	-	-	4	-	-	1
CO 3	3	5	-	4	-	-	-	-	-	-	2	4	-	-	1
CO 4	3	5	-	4	-	-	-	-	-	-	2	4	-	-	1
CO 5	3	5	-	4	-	-	-	-	-	-	-	4	-	-	1
CO 6	3	5	-	4	-	-	-	-	-	-	2	4	-	-	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	-	-	-	-	-	-	-	-	-	-	50	-	-	-
CO 2	100	50	-	27.3	-	-	-	-	-	-	-	50	-	-	-
CO 3	100	50	-	36.4	-	-	-	-	-	-	25	50	-	-	-
CO 4	100	50	-	36.4	-	-	-	-	-	-	25	50	-	-	-
CO 5	100	50	-	36.4	-	-	-	-	-	-	-	50	-	-	-
CO 6	100	50	-	36.4		-	-	-	-	-	25	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	-	-	-	-	-	-	-	-	-	-	2	-	-	1
CO 2	3	2	-	1	-	-	-	-	-	-	-	2	-	-	1
CO 3	3	2	-	1	-	-	-	-	-	-	1	2	-	-	1
CO 4	3	2	-	1	-	-	-	-	-	-	1	2	-	-	1
CO 5	3	2	-	1	-	-	-	-	-	-	-	2	-	-	1
CO 6	3	2	-	1	-	-	-	-	-	-	1	2	-	-	1
TOTAL	18	10	-	5	-	-	-	-	-	-	3	12	-	-	6
AVERAGE	3.0	2.0	-	1.0	-	-	-	-	-	-	1.0	2	-	-	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	**CONCEPTS OF INDUSTRIAL MANAGEMENT**
	Principles of management- Growth of management thought, Functions of management, Principles of organization, Types of organization and committees
MODULE II	**WORK STUDY**
	Concept of productivity, Method Study - Basic steps in method study, Process charts, Diagrams, Principles of motion economy, Micro motion study, Therbligs, SIMO chart. Work Measurement - Stop watch procedure of time study, Performance rating, allowances, Work sampling, Simple problems.
MODULE III	**INVENTORY CONTROL**
	Inventory Control: Inventory, Cost, Deterministic Models and Introduction to Supply Chain Management
MODULE IV	**QUALITY CONTROL**
	Quality Control: Process control, SQC, Control charts, Single, Double and Sequential Sampling, Introduction to TQM
MODULE V	**DEMAND FORECASTING AND COST ESTIMATION**
	Demand Forecasting and cost Estimation: Characteristics of Forecasts, Forecasting Horizons, Steps to Forecasting, Forecasting Methods, Seasonal Adjustments, Forecasting Performance Measures, Cost Estimation, Elements of cost, Computation of Material Variances Break-Even Analysis

TEXTBOOKS

1. O.P. Khanna, "Industrial Engineering and Management", Khanna Publishers.
2. T.R. Banga and S.C.Sarma, "Industrial Engineering and Management Science", Khanna Publishers.

REFERENCE BOOKS:

1. Ralph M Barnes, "Motion and Time Study", John Willey Sons Work Study lLO.
2. Ernest J McCormick, "Human factors in Engineering Design", TMH.

WEB REFERENCES:

1. https://nptel.ac.in/courses/110107141

COURSE WEB PAGE:

https://akanksha.iare.ac.in/index?route=course/indexcategory$_id = 14$

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 CO-PO mapping		
CONTENT DELIVERY (THEORY)			
UNIT I			
2	Introduction	CO1	T1: 1.1-1.5
3	Introduction to Industrial Management	CO1	T2: 1.1-1.5
4	Management Philosophy	CO1	T2: 1.1-1.5
5	Functions of Management	CO1	T2: 1.1-1.5
6	Principles of Organizations	CO1	T2: 1.1-1.5
7	Types of Organization	CO1	T2: 1.1-1.5
8	Organization Structure	CO1	T2: 1.1-1.5
9	Organization Committees	CO1	T2: 1.1-1.5
UNIT II			
10	Concept of Productivity	CO2	T2: 1.1-1.5
11	Work Study-Introduction	CO2	T2: 1.1-1.5
12	Basics steps in Method Study	CO2	T2: 1.1-1.5
13	Process Charts and Diagrams	CO2	T2: 1.1-1.5
14	Principles of Motion Economy	CO2	T2: 1.1-1.5
15	Micro Motion Study	CO2	T2: 1.1-1.5
16	Therbligs, SIMO chart	CO2	T2: 1.1-1.5
17	Work Measurement-Stopwatch	CO2	T2: 1.1-1.5
18	Performance rating and Allowance	CO2	T2: 1.1-1.5
19	Work sampling	CO2	T2: 1.1-1.5
UNIT III			
20	Introduction-Inventory control	CO3	T2: 1.1-1.5
21	Classification of inventory	CO3	T2: 1.1-1.5
22	Inventory costs	CO3	T2: 1.1-1.5
23	Inventory Methods	CO3	T2: 1.1-1.5
24	Assumptions of basic EOQ	CO3	T2: 1.1-1.5
25	Derivation of Basic EOQ model	CO3	T2: 1.1-1.5
26	Deterministic models	CO3	T2: 1.1-1.5
27	Supply chain management	CO3	T2: 1.1-1.5
28	Framework of supply chain management	CO3	T2: 1.1-1.5
UNIT IV			
29	Quality control-Introduction	CO4	T2: 1.1-1.5
30	Process control	CO4	T2: 1.1-1.5
31	Statistical quality control	CO4	T2: 1.1-1.5

32	Control charts	CO4	T2: 1.1-1.5
33	Single sampling	CO4	T2: 1.1-1.5
34	Double sampling	CO4	T2: 1.1-1.5
35	Introduction to Total Quality Management	CO4	T2: 1.1-1.5
UNIT V			
36	Introduction to forecasting	CO5	T2: 1.1-1.5
37	Characteristics of Forecasts	CO5	T2: 1.1-1.5
38	Forecasting Horizons	CO5	T2: 1.1-1.5
39	Forecasting methods	CO5	T2: 1.1-1.5
40	Seasonal adjustments	CO5	T2: 1.1-1.5
41	Forecasting Performance Measures	CO5	T2: 1.1-1.5
42	Cost Estimation	CO5	T2: 1.1-1.5
43	Elements of Cost	CO5	T2: 1.1-1.5
44	Break even analysis	CO5	T2: 1.1-1.5
45	Break even computation	CO5	T2: 1.1-1.5
PROBLEM SOLVING/ CASE STUDIES			
1	Organization structure	CO 1	R2:7.5
2	Functions of management	CO 1	R2:7.5
3	Functions of management	CO 1	R2:7.5
4	Process charts in steel industry	CO 2	R2:7.5
5	Micro motion study in small scale industry	CO 2	R2:7.5
6	Time study measurement	CO 2	R2:7.5
7	Stop watch procedure	CO 2	R2:7.5
8	Performance rating	CO 2	R2:7.5
9	Work sampling	CO 2	R2:7.5
10	Inventory control	CO 3	R2:7.5
11	Basic EOQ models	CO 3	R2:7.5
12	Total inventory cost	CO 3	R2:7.5
13	Control charts	CO 4	R2:7.5
14	Sequential sampling	CO 4	R2:7.5
15	Forecasting methods	CO 5	R2:7.5
16	Break even analaysis	CO 5	R2:7.5
DISCUSSION OF DEFINITION AND TERMINOLOGY			
1	Introduction to principles of management	CO 1	R4:2.1
2	Concept of productivity	CO 2	R4:2.1
3	Inventory control and costs	CO 3	R4:2.1
4	Quality control and statistical quality control	CO 4	R4:2.1
5	Forecasting analysis and types	CO 5	R4:2.1
DISCUSSION OF QUESTION BANK			
1	Module I: Principles of management	CO 1,2, 3	R4:2.1
2	Module II: Work study	CO 4,11	T4:7.3
3	Module III: Inventory control	CO 6,7	R4:5.1
4	Module IV: Quality control	CO 8,11	T1:7.5

5	Module V: Demand forecasting	CO 9,10, 11	T1: 4.1

Signature of Course Coordinator **HOD,**

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

COURSE DESCRIPTION

Department	**CIVIL ENGINEERING**				
Course Title	**STEEL STRUCTURES DESIGN AND DRAWING**				
Course Code	ACEC23				
Program	B.Tech				
Semester	VI				
Course Type	CORE				
Regulation	IARE - UG20				
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	ACEC07	IV	Theory of Structures
B.Tech	ACEC14	V	Analysis of Structures
B.Tech	ACEC16	V	Reinforced Concrete Structures Design and Drawing

II COURSE OVERVIEW:

Steel structures design 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
Steel Structures Design and Drawing	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	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. Initial two modules one question from each module will be no choice, rest three modules, two full questions with "either" or "choice" will be drawn. 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
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) and 10 marks for Alternative Assessment Tool (AAT).

<table>
<tr><th colspan="2">Component</th><th>Marks</th><th>Total Marks</th></tr>
<tr><td rowspan="4">CIA</td><td>Continuous Internal Examination – 1 (Mid-term)</td><td>10</td><td rowspan="4">30</td></tr>
<tr><td>Continuous Internal Examination – 2 (Mid-term)</td><td>10</td></tr>
<tr><td>AAT-1</td><td>5</td></tr>
<tr><td>AAT-2</td><td>5</td></tr>
<tr><td>SEE</td><td>Semester End Examination (SEE)</td><td>70</td><td>70</td></tr>
<tr><td colspan="3">Total Marks</td><td>100</td></tr>
</table>

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:

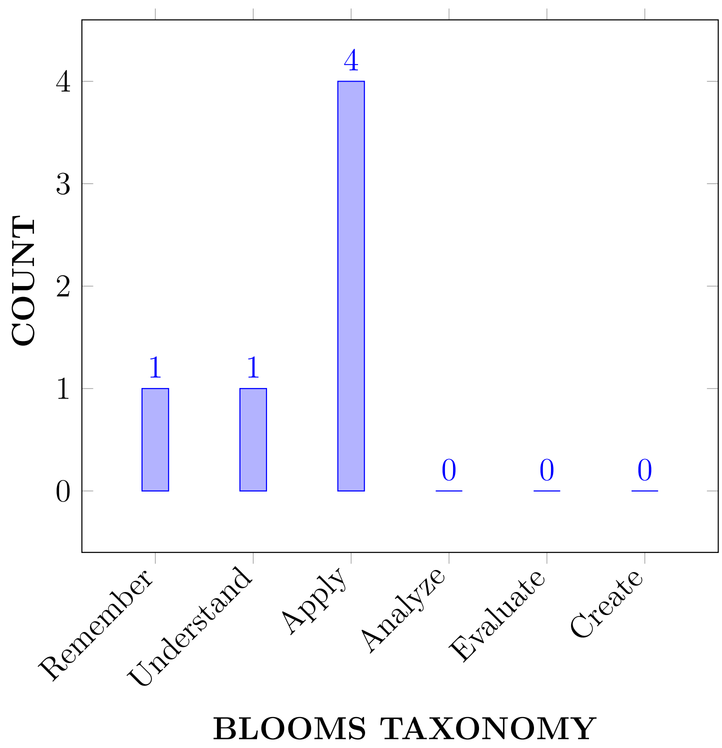
I	The concepts of limit state design and the behaviour of structural steel used in design and its properties.
II	The design of structural elements necessary for creating efficient and economic steel structures.
III	The design and drawing of multi storeyed industrial and residential structures including 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.
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 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.	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	✓	✓	✓	✓	-	-	-	-	-	-	-	-	✓	-	-

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	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
	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

Course Outcomes	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key competencies matched.
	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
	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

Course Outcomes	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key competencies matched.
	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.	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	-	-	-	-	-	-	-	-	-	-	-	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	-	-

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

XVII ASSESSMENT METHODOLOGY-INDIRECT:

	Assessment of mini projects by experts	✓	End Semester OBE Feedback

XVIII SYLLABUS:

MODULE 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, efficiency of joint, prying action, design of tension members, design strength of members.
MODULE II	**COMPRESSION MEMBERS**
	Design of compression members, buckling class, slenderness ratio, strength design, laced columns, battened columns, slab base.
MODULE 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.
MODULE IV	**ECCENTRIC CONNECTIONS**
	Design of eccentric connections with brackets, beam end connections, web angles, design of truss joints.
MODULE V	**PLATE GIRDERS**
	Design of plate girders, optimum depth, design of main section, design of end bearing stiffness and intermediate stiffness. Connection between web and flange.

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: R1:
OBE DISCUSSION			
1	Course Objectives, Course Outcomes, Program Outcomes and 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	Understand loads and combinations loading wind loads on roof trusses.	CO 1	T1:10.2 R1: 1.6
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	Evaluate the bolted connections and efficiency of joint.	CO 3	T1: 11.10 -11.11

11	Evaluate the bolted 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	Understand the design of tension members and design strength of members.	CO 4	T1: 3.10 R1: 3.1 – 3.5
14	Understand the design of tension members and design strength of members.	CO 4	T1: 3.10 R1: 3.1 – 3.5
15	Understand the design of tension members and design strength of members.	CO 4	T1: 3.10 R1: 3.1 – 3.5
16	Understand the design of compression members, buckling class, slenderness ratio.	CO 4	T1: 5.1-5.3 T3: 6.1 – 6.5
17	Understand the design of compression members, buckling class, slenderness ratio.	CO 4	T1: 5.1-5.3 T3: 6.1 – 6.5
18	Understand the design of compression members, buckling class, slenderness ratio.	CO 4	T1: 5.1-5.3 T3: 6.1 – 6.5
19	Understand the strength design, laced and battened columns.	CO 4	T1: 5.4-5.9 R1: 4.1 – 4.8
20	Understand the strength design, laced and battened columns.	CO 4	T1: 5.4-5.9 R1: 4.1 – 4.8
21	Understand the design of column base, and slab base.	CO 4	T1: 5.11-5.13 R1: 9.3
22	Understand the design of column base, and slab base.	CO 4	T1: 5.11-5.13 R1: 9.3
23	Understand the design of beams, plastic moment.	CO 4	T1: 6.1-6.4 R1: 5.1 – 5.4
24	Understand the design of beams, plastic moment.	CO 4	T1: 6.1-6.4 R1: 5.1 – 5.4
25	Analyse the bending and shear strength laterally supported beams.	CO 4	T1: 6.5-6.12 T2: 6.1 – 6.4
26	Analyse the bending and shear strength laterally supported beams.	CO 4	T1: 6.5-6.12 T2: 6.1 – 6.4
27	Understand the design, built up sections, large plates web buckling.	CO 4	T1: 6.12 R1: 5.5 – 5.8
28	Understand the design, built up sections, large plates web buckling.	CO 4	T1: 6.12 R1: 5.5 – 5.8
29	Understand the design, built up sections, large plates web buckling.	CO 4	T1: 6.12 R1: 5.5 – 5.8
30	Analyse the crippling and deflection of beams, design of purlin.	CO 4	T1: 12.6 T3: 7.12 – 7.15
31	Analyse the crippling and deflection of beams, design of purlin.	CO 4	T1: 12.6 T3: 7.12 – 7.15
32	Understand the design of eccentric connections with brackets.	CO 5	T1: 11.3-11.4 T2: 10.1 – 10.9
33	Understand the design of eccentric connections with brackets.	CO 5	T1: 11.3-11.4 T2: 10.1 – 10.9
34	Analyse the beam end connections, web angle and design of truss joints.	CO 5	T1: 7.1-7.3

35	Analyse the beam end connections, web angle and design of truss joints.	CO 5	T1: 7.1-7.3
36	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
37	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
38	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
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	Understand the design of end bearing stiffness and intermediate stiffness.	CO 6	T1: 7.6 R1: 7.4 – 7.6
41	Understand the design of end bearing stiffness and intermediate stiffness.	CO 6	T1: 7.6 R1: 7.4 – 7.6
42	Understand the design of end bearing stiffness and intermediate stiffness.	CO 6	T1: 7.6 R1: 7.4 – 7.6
43	Analyze the Connection between web and flange.	CO 6	T1: 7.6-7.8
44	Analyze the Connection between web and flange.	CO 6	T1: 7.6-7.8
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.	CO 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 3,4	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
	DISCUSSION OF QUESTION BANK		
1	Desingn of bolted joints and design of tension members	CO 1,2,3	R1:1.1 - 1.6
2	Design of columns, struts, builtup sections, laced and battened column and design of slab base	CO 3,4	T1:5.1 - 5.13
3	Design of laterally supported and laterally unsupported beams, design for web buckling, design for web crippling	CO 3,4	T1 6.1-6.12
4	Design of eccentric conections, bracket connection type - I, bracket connections type - II, beam column connections, stiffened and unstiffened connections	CO 5	T1:7.1 - 7.3
5	Design of main section, plate girder, end bearing stiffeners, intermediate stiffeners	CO 6	T1: 7.1 - 7.8

Signature of Course Coordinator **HOD,CE**

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

CIVIL ENGINEERING

COURSE DESCRIPTION

Course Title	**Geotechnical Engineering Laboratory**				
Course Code	ACEC32				
Program	B.Tech				
Semester	VI	CE			
Course Type	Core				
Regulation	UG20				
Course Structure	Theory			Practical	
	Lecture	Tutorials	Credits	Laboratory	Credits
	-	-	-	3	1.5
Course Coordinator	Dr. M. Madhusudhan Reddy, Assistant Professor				

I COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites
B.Tech	ACEC04	III	Engineering Geology

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:

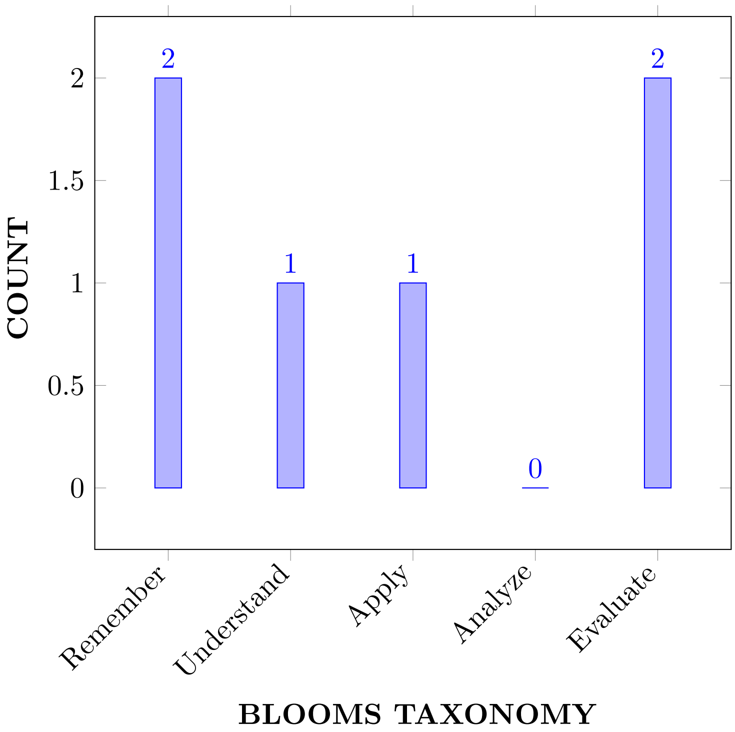
I	The concept behind the soil formation, type soil and the relationships between the soil mass and volume of voids and enables the students to perform moisture content, specific gravity and atterberg limits.
II	The procedure for soil classification through grain size distribution and classification of 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	3	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 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	3	2	-	3	-	-	-	-	-	-	2	3	-

XV ASSESSMENT METHODOLOGY DIRECT:

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

XVI ASSESSMENT METHODOLOGY INDIRECT:

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

XVII SYLLABUS:

WEEK I	**DETERMINATION OF MOISTURE CONTENT OF SOILS**
	To determine the natural moisture content of the given soil sample.
WEEK II	**DETERMINATION OF SPECIFIC GRAVITY OF SOILS**
	Determine the specific gravity of soil fraction passing 4.75 mm I.S sieve by density bottle
WEEK III	**DETERMINATION OF ATTERBERG'S LIMITS OF SOILS**
	To determine liquid limit, plastic limit, shrinkage limit, classify the soil and to find flow index and toughness index
WEEK IV	**DETERMINATION OF FIELD DENSITY- CORE CUTTER AND SAND REPLACEMENT METHOD**
	To determine the relative density of given coarse grained material
WEEK V	**GRAIN SIZE ANALYSIS OF SOILS**
	To determine the mass density of soils by core cutter method and replacement method
WEEK VI	**PERMEABILITY OF SOIL: CONSTANT AND VARIABLE HEAD TEST**
	To classify the coarse grained soils based on sieve analysis
WEEK VII	**DETERMINATION OF OMC AND MDD OF SOIL USING COMPACTION TEST**
	To determine coefficient of permeability of given soil sample at desired density by a suitable method.
WEEK VIII	**DETERMINATION OF CALIFORNIA BEARING RATIO OF SOILS**
	To determine the optimum moisture content and maximum dry density of a soil by proctor test.
WEEK IX	**DETERMINATION OF CONSOLIDATION PARAMETERS IN SOILS**
	To determine the California bearing ratio by conducting a load penetration test in the laboratory.
WEEK X	**DETERMINATION OF UNCONFINED COMPRESSION STRENGTH IN SOILS**
	To determine the settlements due to primary consolidation of soil by conducting one dimensional test.
WEEK XI	**DETERMINATION OFSHEAR PARAMETERS USING TRIAXIAL COMPRESSION TEST**
	To determine the unconfined compressive strength of cohesive soil sample and its sensitivity.
WEEK XII	**DETERMINATION OFSHEAR PARAMETERS USING DIRECT SHEAR TEST**
	To determine shear strength parameter i.e. angle of shearing resistance and cohesion of a given soil sample.
WEEK XIII	**DETERMINATION OF SHEAR PARAMETERS USING VANE SHEAR TEST**
	To determine shear strength parameters of the given soil sample at known density and moisture content by direct shear test.

TEXTBOOKS

1. Das, B M. —Soil Mechanics Laboratory Manual‖, 2021. Engineering Press at OUP, 2001.
2. Kalinski, Michael E. —Soil Mechanics: Lab Manual‖, John Wiley & Sons, 2nd Edition, 2011.
3. Ventura Tejeda, Fernando R. "Soil Mechanics Laboratory Manual." (2020).

REFERENCE BOOKS:

1. Das, B M., and N Sivakugan. Fundamentals of geotechnical engineering. Cengage Learning, 2016.
2. Murthy, V. N. S. Geotechnical engineering: principles and practices of soil mechanics and foundation engineering. CRC press, 2002.

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: 816-818
3	Determination of water content of soil solids oven drying and Pycnometer method.	CO 1	T2,R2: 819-821
4	Determination of in-situ density by core cutter and sand replacement method	CO 2	R3:
5	Grain size analysis	CO 2	R1
6	Determination of liquid limit of fine soil by Casagrande apparatus	CO 2	T2, R1
7	Determination of maximum dry density and optimum moisture content by Standard Proctor compaction method	CO 4	R1
8	Determination of co-efficient of permeability by Constant head	CO 3	R2
9	Determination of co-efficient of permeability by variable head method	CO 3	R2
10	Determination of liquid limit of fine soil by Cone Penetration Method	CO 3	T1
11	Determination of shear parameters by Direct shear test of soil	CO 5	R2
12	Determination of unconfined compressive strength of soil	CO 6	R1
13	Vane Shear Test	CO 6	R2

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**

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

Course Title	**Transportation Engineering Laboratory**				
Course Code	ACEC33				
Program	B.Tech				
Semester	VI	CE			
Course Type	CORE				
Regulation	IARE - UG20				
Course Structure	Theory			Practical	
	Lecture	Tutorials	Credits	Laboratory	Credits
	-	-	-	3	1.5
Course Coordinator	Mr. V.Suryaprakash Reddy, Assistant Professor				

I COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites	Credits
UG	ACEC11	IV	Concrete Technology Laboratory	1

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 to construction 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 Laboratory	70 Marks	30 Marks	100

IV DELIVERY / INSTRUCTIONAL METHODOLOGIES:

✓	Probing Further Experiments (last)	✓	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-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			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:

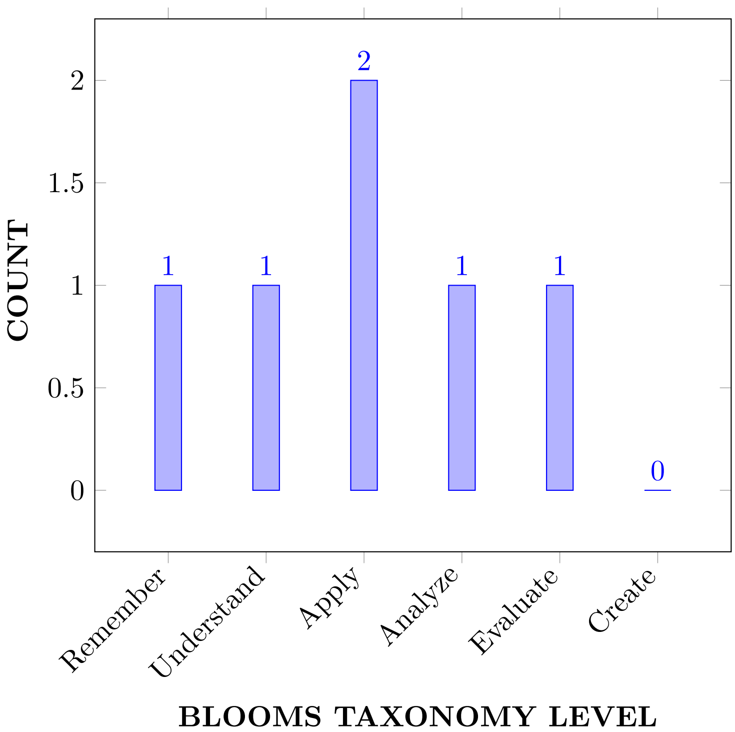
I	Identify the properties and behavior of highway material for different loading patterns.
II	Demonstrate tests on transportation materials like aggregate, bitumen, sand etc. and check their Suitability.
III	Understand the properties of cement by conducting setting time, specific gravity and compressive 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 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	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

X HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

Program		Strength	Proficiency Assessed by
PSO 1	Understand, analyze, design and supervise sub-structures and superstructures of 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

XI JUSTIFICAT IONS 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

3 = High; 2 = Medium; 1 = Low

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

COURSE OUTCOMES	PROGRAM OUTCOMES				Program Specific Outcomes
	PO 1	PO 2	PO 5	PO 9	PSO 1
CO 1	2	3			
CO 2	2	3			
CO 3	2		2		
CO 4	2				2
CO 5	2		2	2	
CO 6	2		2		2

3 = High; 2 = Medium; 1 = Low

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	66.0	100	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CO 2	66.0	100	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CO 3	66.0	0.0	0.0	0.0	66.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	0.0
CO 4	66.0	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	66.0	0.0	0.0
CO 5	66.0	0.0	0.0	0.0	66.0	0.0	0	0.0	66.0	0.0	0.0	0.0	0.0	0	0.0
CO 6	66.0	0.0	0.0	0.0	66.0	0.0	0	0.0	0.0	0.0	0.0	0.0	66.0	0	0.0

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		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO 1	3	3	0	0	0	0	0	0	0	0	0	0.0	0	0	0
CO 2	3	3	0	0	0	0	0	0	0	0	0	0.0	0	0	0
CO 3	3	0	0	0	3	0	0	0	0	0	0	0.0	0	0	0
CO 4	3	0	0	0	0	0	0	0	0	0	0	0.0	3	0	0
CO 5	3	0	0	0	3	0.0	0	0	3	0	0.0	0.0	0	0	0
CO 6	3	0	0	0	3	0.0	0	0	0	0	0	0.0	3	0	0.0
TOTAL	18	6	-	-	9	-	-	-	3	-	-	-	6	-	-
AVERAGE	6	2	-	-	3	-	-	-	-	-	-	-	2	-	-

XV ASSESSMENT METHODOLOGY DIRECT:

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

XVI ASSESSMENT METHODOLOGY INDIRECT:

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

XVII SYLLABUS:

<table>
<tr><td>WEEK 1</td><td>INTRODUCTION TO TRANSPORTATION LABORATORY – I</td></tr>
<tr><td></td><td>Testing of pavement material used for construction in day-to-day activities as per Indian standards test to perform the following objectives.
1. To calculate the Bulking of sand using by adding various percent of moisture
2. To calculate aggregate shape and size by using flakiness index and Elongation index
3. To Calculate the bitumen elongation by using ductility apparatus</td></tr>
<tr><td>WEEK 2</td><td>AGGREGATE CRUSHING STRENGTH TEST</td></tr>
<tr><td></td><td>Testing of coarse aggregate to assess the strength by using aggregate crushing test to perform the following objectives.
1. To calculate the dry weight of aggregate sample passing through 12.5mm sieve and retained on 10mm sieve.
2. To calculate the weight of the portion of crushed material passing through 2.36mm sieve.
3. To calculate the aggregate crushing values by using w1&w2.</td></tr>
<tr><td>WEEK 3</td><td>AGGREGATE IMPACT TEST</td></tr>
<tr><td></td><td>Evaluate the toughness of aggregate and resistance of the aggregates to fracture under repeated impacts using impact test to perform the following objectives.
1. To calculate the dry weight of aggregate sample passing through 12.5mm sieve and retained on 10mm sieve.
2. To calculate the weight of the portion of crushed material (by giving 25 blows) passing through 2.36mm sieve.
3. To calculate the aggregate impact values.</td></tr>
</table>

WEEK 4	**SPECIFIC GRAVITY AND WATER ABSORPTION TEST**
	Evaluate the strength and quality of the material by using specific gravity test to perform the following objectives. 1. To calculate dry weight of aggregate and weight of equal volume of water. 2. To calculate apparent specific gravity by using dry weight of aggregate and weight of equal volume of water excluding air. 3. To calculate percentage of weight of water absorbed in terms of oven dried weight of aggregate.
WEEK 5	**ABRASION AND ATTRITION TEST OF COARSE AGGREGATES**
	Testing of aggregate for the measure of toughness and abrasion resistance such as crushing degradation and disintegration to perform the following objectives. 1. To calculate the initial weight and remaining weight of aggregate that passes through 75 micron after attrition test. 2. To calculate the initial weight and weight of aggregates after abrasion test which is coarser than 2.36mm IS Sieve. 3. To calculate the percentage wear of aggregates for different proportions.
WEEK 6	**SHAPE TESTS OF COARSE AGGREGATES**
	Testing of aggregate for the measure of flakiness and elongation to perform the following objectives. 1. To determine the flakiness and elongation of aggregate used for concrete applications. 2. To calculate the indices of aggregate of flakiness for each fraction 3. To calculate the shape test of aggregate on each fraction of elongation
WEEK 7	**PENETRATION AND DUCTILITY TEST OF BITUMINOUS MATERIALS**
	Evaluate the hardness or softness of the bitumen material by using penetration and ductility to perform the following objectives. 1. To determine the suitability of bitumen for its use in road construction. 2. To calculate the penetration of weight of bitumen on different IS codes. 3. To understand the quality of bitumen is mor important test for penetration and ductility

WEEK 8	**SOFTENING POINT OF BITUMEN MATERIALS**
	Evaluate the hardness or softness of the bitumen material by using penetration and ductility to perform the following objectives. 1. To determine the suitability of bitumen for its use in road construction. 2. To calculate the penetration of weight of bitumen on different IS code. 3. To determine Bitumen is mor important test for penetration and ductility
WEEK 9	**FLASH AND FIRE POINT TEST OF BITUMEN MATERIALS**
	Evaluate the measure of bitumen at critical temperatures gradually at rise of melting of Flash point and fire point to perform the following objectives. 1. To determine the flash and Fire point of bitumen 2. To calculate the significant of Flash point of bitumen material at different temperature. 3. To calculate the fire point of bitumen on different parameter
WEEK 10	**NORMAL CONSISTENCY OF FINENESS OF CEMENT**
	Testing of cement for the measure of consistency on quality of cement at different penetrations to perform the following objectives. 1. To determine the suitability of cement for its use in construction. 2. To calculate the Fineness of cement at different intervals 3. To calculate the consistency of cement on addition of water at different parameters.
WEEK 11	**INITIAL SETTING TIME AND FINAL SETTING TIME OF CEMENT**
	Testing of Cement for the measure of quality of cement at different setting times to perform the following objectives. 1. To determine the setting time of cement for its use in construction 2. To calculate the initial setting and final setting time of cement. 3. To calculate the setting time of cement for different grade of cement.
WEEK 12	**SPECIFIC GRAVITY AND SOUNDNESS OF CEMENT**
	Evaluate the measure of fineness of cement for specific gravity and soundness of material at different conditions to perform the following objectives. 1. To calculate the specific gravity of cement of given sample(w1) 2. To determine the soundness of cement as per Indian Standards 3. To calculate the hydration of cement at different temperature.

WEEK 13	**COMPRESSIVE STRENGTH OF CEMENT**
	Testing of Cement for the measure of strength and quality by using compressive strength To perform the following objectives 1. To determine the compressive strength of cement at 7 days 2. To calculate the compressive strength of cement for the different proportions. 3. To calculate the strength of cement for OPC&PPC
WEEK 14	**BULKING OF FINE AGGREGATES**
	Evaluate the measure of aggregate of moisture content of volume of aggregate to perform the following objectives 1. To calculate the bulking of fine aggregate of different properties. 2. To determine the role of bulking of sand in concrete. 3. To calculate the moisture content of fine aggregate for different limits .

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.
3. ParthaChakraborty, —Principles Of Transportation Engineering‖, PHI Learning, 2017.

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.

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 Transportation Laboratory – I	CO1, CO 5	T1:2.1.5 T2:2.3
2	Aggregate Crushing Strength Test	CO1, CO 5	T2:2.1.5 R1:2.6
3	Aggregate Impact Test	CO 1,CO 4, CO 5, CO 6	T1:2.6 R3:3.6.5
4	Specific Gravity and Water Absorption Test	CO 2, CO 4	T2:2.7 R2:2.18

5	Abrasion and Attrition Test of Coarse Aggregates	CO 2, CO 3	T2:2.22 R3:3.1.1
6	Shape Test of Coarse aggregates	CO 2, CO 6	T1:2.5.1 T2:2.25
7	Penetration and Ductility Test of Bituminous Materials	CO 3, CO 5	T2:2.26 R3:2.55
8	Softening Point of Bitumen Materials	CO 3, CO 6	T2:2.3 R3:2.6
9	Flash and Fire Point Test of Bitumen Materials	CO 3, CO 6	T2:2.3 R1:2.6
10	Normal Consistency of Fineness of Cement	CO 4, CO 6	T1:2.6
11	Initial Setting Time and Final Setting Time of Cement	CO 4, CO 6	T2:2.7 R1:2.18
11	Specific Gravity and Soundness of Cement	CO 4, CO 5	T2:2.9 R1:2.19
13	Compressive Strength of Cement	CO 5, CO 6	T2:2.11 R1:2.21
14	Bulking of fine Aggregate	CO 5, CO 6	T2:2.2 R1:2.29

XIX EXPERIMENTS FOR ENHANCED LEARNING (EEL):

S.No	Design Oriented Experiments
1	Design of Porous conrete 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.

Signature of Course Coordinator **HOD,CE**

ANNEXURE - I

KEY ATTRIBUTES FOR ASSESSING PROGRAM OUTCOMES

PO Number	NBA Statement / Key Competencies Features (KCF)	No. of KCF's
PO 1	Apply the knowledge of mathematics, science, Engineering fundamentals, and an Engineering specialization to the solution of complex Engineering problems **(Engineering Knowledge).** Knowledge, understanding and application of 1. Scientific principles and methodology. 2. Mathematical principles. 3. Own and / or other engineering disciplines to integrate / support study of their own engineering discipline.	3
PO 2	Identify, formulate, review research literature, and analyse complex Engineering problems reaching substantiated conclusions using first principles of mathematics natural sciences, and Engineering sciences (**Problem Analysis).** 1. Problem or opportunity identification 2. Problem statement and system definition 3. Problem formulation and abstraction 4. Information and data collection 5. Model translation 6. Validation 7. Experimental design 8. Solution development or experimentation / Implementation 9. Interpretation of results 10. Documentation	**10**
PO 3	Design solutions for complex Engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and Environmental considerations (**Design/Development of Solutions).** 1. Investigate and define a problem and identify constraints including environmental and sustainability limitations, health and safety and risk assessment issues 2. Understand customer and user needs and the importance of considerations such as aesthetics 3. Identify and manage cost drivers 4. Use creativity to establish innovative solutions	**10**

	5. Ensure fitness for purpose for all aspects of the problem including production, operation, maintenance and disposal 6. Manage the design process and evaluate outcomes. 7. Knowledge and understanding of commercial and economic context of engineering processes 8. Knowledge of management techniques which may be used to achieve engineering objectives within that context 9. Understanding of the requirement for engineering activities to promote sustainable development 10. Awareness of the framework of relevant legal requirements governing engineering activities, including personnel, health, safety, and risk (including environmental risk) issues	
PO 4	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 (**Conduct Investigations of Complex Problems).** 1. Knowledge of characteristics of particular materials, equipment, processes, or products 2. Workshop and laboratory skills 3. Understanding of contexts in which engineering knowledge can be applied (example, operations and management, technology development, etc.) 4. Understanding use of technical literature and other information sources Awareness of nature of intellectual property and contractual issues 5. Understanding of appropriate codes of practice and industry standards 6. Awareness of quality issues 7. Ability to work with technical uncertainty 8. Understanding of engineering principles and the ability to apply them to analyse key engineering processes 9. Ability to identify, classify and describe the performance of systems and components through the use of analytical methods and modeling techniques 10. Ability to apply quantitative methods and computer software relevant to their engineering discipline, in order to solve engineering problems 11. Understanding of and ability to apply a systems approach to engineering problems.	**11**
PO 5	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 **(Modern Tool Usage).** 1. Computer software / simulation packages / diagnostic equipment / technical library resources / literature search tools.	**1**

PO 6	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 (**The Engineer and Society).** 1. Knowledge and understanding of commercial and economic context of engineering processes 2. Knowledge of management techniques which may be used to achieve engineering objectives within that context 3. Understanding of the requirement for engineering activities to promote sustainable development 4. Awareness of the framework of relevant legal requirements governing engineering activities, including personnel, health, safety, and risk (including environmental risk) issues 5. Understanding of the need for a high level of professional and ethical conduct in engineering.	**5**
PO 7	Understand the impact of the professional Engineering solutions in societal and Environmental contexts, and demonstrate the knowledge of, and need for sustainable development (**Environment and Sustainability).** Impact of the professional Engineering solutions (Not technical) 1. Socio economic 2. Political 3. Environmental	**3**
PO 8	Apply ethical principles and commit to professional ethics and responsibilities and norms of the Engineering practice (**Ethics).** 1. Comprises four components: ability to make informed ethical choices, knowledge of professional codes of ethics, evaluates the ethical dimensions of professional practice, and demonstrates ethical behavior. 2. Stood up for what they believed in 3. High degree of trust and integrity	**3**
PO 9	Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings (**Individual and Teamwork).** 1. Independence 2. Maturity – requiring only the achievement of goals to drive their performance 3. Self-direction (take a vaguely defined problem and systematically work to resolution) 4. Teams are used during the classroom periods, in the hands-on labs, and in the design projects. 5. Some teams change for eight-week industry oriented Mini-Project, and for the seventeen -week design project.	**12**

	6. Instruction on effective teamwork and project management is provided along with an appropriate textbook for reference 7. Teamwork is important not only for helping the students know their classmates but also in completing assignments. 8. Students also are responsible for evaluating each other's performance, which is then reflected in the final grade. 9. Subjective evidence from senior students shows that the friendships and teamwork extends into the Junior years, and for some of those students, the friendships continue into the workplace after graduation 10. Ability to work with all levels of people in an organization 11. Ability to get along with others 12. Demonstrated ability to work well with a team	
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).** "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**
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 (**Project Management and Finance).** 1. Scope Statement 2. Critical Success Factors 3. Deliverables 4. Work Breakdown Structure 5. Schedule 6. Budget 7. Quality 8. Human Resources Plan 9. Stakeholder List 10. Communication 11. Risk Register 12. Procurement Plan	**12**

PO 12	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 (**Life - Long Learning).** 1. Project management professional certification / MBA 2. Begin work on advanced degree 3. Keeping current in CSE and advanced engineering concepts 4. Personal continuing education efforts 5. Ongoing learning – stays up with industry trends/ new technology 6. Continued personal development 7. Have learned at least 2-3 new significant skills 8. Have taken up to 80 hours (2 weeks) training per year	**8**

KEY ATTRIBUTES FOR ASSESSING PROGRAM SPECIFIC OUTCOMES

PO Number	NBA Statement / Key Competencies Features (KCF)	No. of KCF's
PSO1	Design and supervise sub-structures and superstructures for residential and public buildings, industrial structures, irrigation structures, powerhouses, highways, railways, airways, docks and harbours. 1. Structural design and materials knowledge. 2. Quantitative building survey and quality assurance. 3. Environmental impact and remediation measures. 4. Water treatment and distribution systems. 5. Traffic study and design of pavements. 6. Strength assessment and retrofitting techniques. 7. Codes of practices. 8. Soil investigation and design of sub-structures. 9. Engineering, procurement and construction. 10. Geological survey and exploration.	**10**
PSO2	Focus on improving performance of structures with reference to safety and serviceability, and sustainable green building technology. 1. Sustainable green building technology. 2. Performance improvement of structural components. 3. Safety and serviceability of structure and research.	**3**
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. Project management and contracts. 2. Advanced analysis and project management software-based Entrepreneurship and Higher studies. 3. Customer and user needs fulfilment with advanced software.	**3**

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

COURSE DESCRIPTION

Department	**CIVIL ENGINEERING**				
Course Title	**FOUNDATION ENGINEERING**				
Course Code	ACEC35				
Program	B.Tech				
Semester	VII				
Course Type	Core				
Regulation	UG20				
Course Structure	Theory			Practical	
	Lecture	Tutorials	Credits	Laboratory	Credits
	3	-	3	-	-
Course Coordinator	Dr. M. Madhusudhan Reddy, Assistant Professor				

I COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites
B.Tech	ACEC04	III	Engineering Geology
B.Tech	ACEC24	VI	Geotechnical Engineering

II COURSE OVERVIEW:

Civil Engineers are required to construct structures on the soil. The loads coming onto these structures, along with the self-weight, have to be safely transmitted to the soil beneath it. A geotechnical engineer must be able to design a footing in such a way that soil below it will not fail there will not be any excessive settlements in the soil. This course enables students to design a shallow and deep foundation, analyze the stability of slopes, and check the stability of retaining walls and embankments against failure. Through this course content engineers can design the foundation for safety and serviceability.

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:

Each theory 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). Student's performance in a course shall be judged by taking into account the results of CIA and SEE together. Below table shows the typical distribution of weightage for CIA and SEE.

Table: Assessment pattern for Theory Courses

Component		Marks	Total Marks
CIA	Continuous Internal Examination – 1 (Mid-term)	10	30
	Continuous Internal Examination – 2 (Mid-term)	10	
	Tech talk / Quiz – 1 and Quiz – 2	5	
	Concept video / Alternative Assessment Tool (AAT)	5	
SEE	Semester End Examination (SEE)	70	70
Total Marks			100

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 modules 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 emphasis on the questions is broadly based on the following criteria:

50%	To test the objectiveness of the concept
50%	To test the analytical skill of the concept OR to test the application skill of the concept

Continuous Internal Assessment (CIA):
For each theory course the CIA shall be conducted by the faculty / teacher handling the course. 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). **Two CIE Tests are Compulsory** and sum of the two tests, along with the scores obtained in the quizzes (average of Quiz – 1 and Quiz – 2) / AAT shall be considered for computing the final CIA of a student in a given course.
The CIE Tests/quizzes/AAT shall be conducted by the course faculty with due approval from the HOD. Advance notification for the conduction of Quiz/AAT is mandatory and the responsibility lies with the concerned course faculty.

Continuous Internal Examination (CIE):

Two CIE exams shall be conducted at the end of the 8th and 16th 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. The valuation and verification of answer scripts of CIE exams shall be completed within a week after the conduct of the Examination.

Quiz – Online Examination:
Two Quiz exams shall be conducted along with CIE in online mode for 5 marks each, consisting of 10 short answers questions (Definitions and Terminology) and 10 multiple choice questions (having each question to be answered by tick marking the correct answer from the choices (commonly four) given against it. Such a question paper shall be useful in testing of knowledge, skills, application, analysis, evaluation and understanding of the students. Average of two quiz examinations shall be considered.

Alternative Assessment Tool (AAT):
In order to encourage innovative methods while delivering a course, the faculty members are encouraged to use the Alternative Assessment Tool (AAT). This AAT enables faculty to design own assessment patterns during the CIA. The AAT enhances the autonomy (freedom and flexibility) of individual faculty and enables them to create innovative pedagogical practices. If properly applied, the AAT converts the classroom into an effective learning centre.

The AAT may include tech talk, tutorial hours/classes, seminars, assignments, term paper, open ended experiments, concept videos, partial reproduction of research work, oral presentation of research work, developing a generic tool-box for problem solving, report based on participation in create-a-thon, makea-thon, code-a-thon, hack-a-thon conducted by reputed organizations / any other. etc.

However, it is mandatory for a faculty to obtain prior permission from the concerned HOD and spell out the teaching/assessment pattern of the AAT prior to commencement of the classes.

VI COURSE OBJECTIVES:

The students will try to learn:

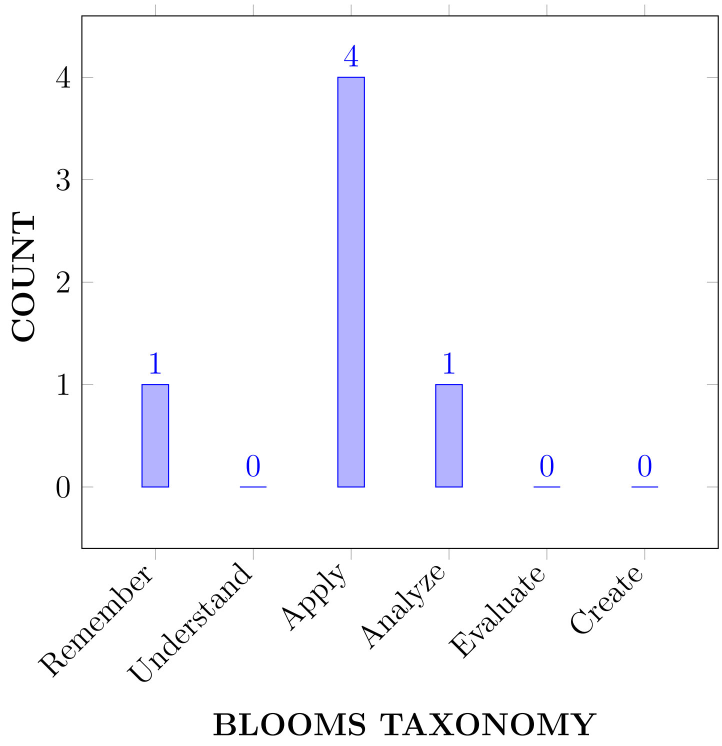
I	The various methods of soil exploration and field tests on soil, planning and preparation of soil investigation programme.
II	The stability of infinite and finite slopes
III	At rest, Active and Passive earth pressures of soil & analyze the stability of retaining wall against sliding, overturning and bearing capacity failures
IV	The bearing capacity of shallow and deep foundation from theoretical & field tests.

VII COURSE OUTCOMES:

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

CO 1	**Select** comprehensive soil exploration and sampling utilizing various methods, resulting in accurate soil characterization for informed engineering decision-making.	Remember
CO 2	**Analyze** the stability of infinite and finite earth slopes using various methods ensuring the determination of appropriate factor of safety and effective slope stability measures.	Analyze
CO 3	**Utilize** theoretical principles and analytical methods to proficiently analyze and design retaining walls	Apply
CO 4	**Apply** sound engineering principles to design and analyze shallow and deep foundations.	Apply
CO 5	**Apply** comprehensive knowledge of pile foundations to design and analyze shallow and deep foundations.	Apply
CO 6	**Apply** principles of analysis and design to expertly build wells of various shapes, integrating components, and adhering to IRC guidelines.	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,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	✓	-	-	✓	-	-	-	-	-	-	-	-	✓	-	-
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 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

Course Outcomes	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key competencies matched.
	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
	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	-	-
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:

	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.
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. https://akanksha.iare.ac.in/index?route=course/details&courseid=180

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 5	T 1,2 & R 1, 2
24	Shallow Foundation design methods	CO 5	T 1,2 & R 1, 2
25	Shallow Foundations design methods using IS codes	CO 5	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 5	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	Soil Explorations	CO 1	T 2,3 & R 1
2	Slope Stability	CO 1,2	T 2,3 & R 2, 3
3	Earth Pressure Theories and Retaining Walls	CO 3	T 2,3 & R 2, 3
4	Shallow and Deep Foundations	CO 4	T 2,3 & R 2, 3
5	Well Foundation Applications.	CO 6	T 2,3 & R 2, 3

Signature of Course Coordinator **HOD, CE**

Dr. M . Madhusudhan Reddy, Assistant Professor

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

COURSE DESCRIPTION

Department	**CIVIL ENGINEERING**					
Course Title	**GROUND IMPROVEMENT TECHNIQUES**					
Course Code	ACEC47					
Program	B.Tech					
Semester	VII					
Course Type	Elective					
Regulation	UG20					
Course Structure	Theory			Practical		
	Lecture	Tutorials	Credits	Laboratory	Credits	
	3	-	3	-	-	
Course Coordinator	Ms.B.Bhavani, Assistant Professor					

I COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites
B.Tech	ACEC24	VI	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
16.6%	Remember
83.4 %	Understand
0 %	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) and 10 marks for Alternative Assessment Tool (AAT).

Component		Marks	Total Marks
CIA	Continuous Internal Examination – 1 (Mid-term)	10	30
	Continuous Internal Examination – 2 (Mid-term)	10	
	AAT-1	5	
	AAT-2	5	
SEE	Semester End Examination (SEE)	70	70
Total Marks			100

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:

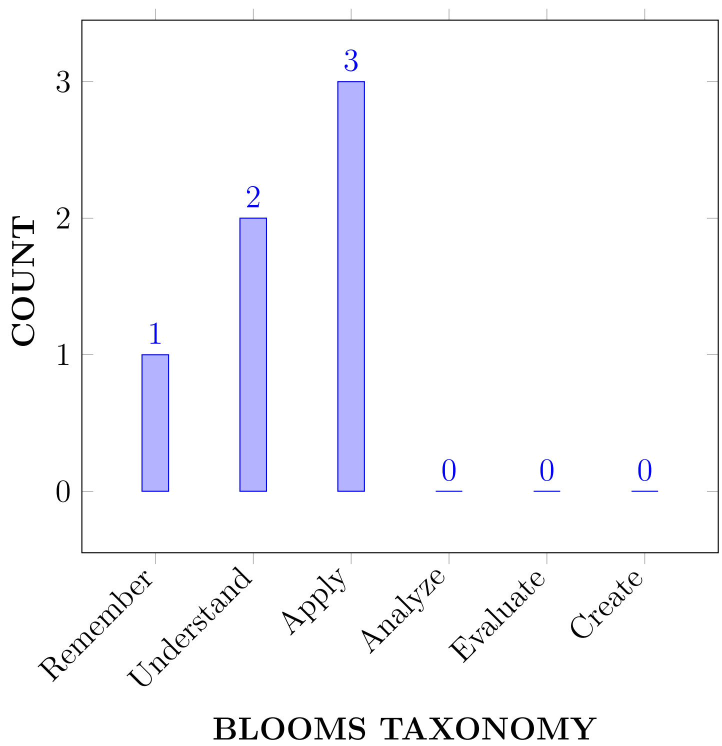
I	The importance and fundamentals of Ground improvement techniques for measuring field parameters by using traditional and modern methods involved in civil construction.
II	The mechanical methods and suitable equipment to proliferate the ground for making the soil to withstand all the loads acting on 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 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.	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
	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

Course Outcomes	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key competencies matched.
	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	-	-

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	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:

MODULE-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.
MODULE-II	**MECHANICAL MODIFICATION**
	Deep compaction techniques, blasting, vibro compaction, dynamic tamping and compaction piles.
MODULE-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.
MODULE-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.
MODULE-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 Description on Outcome Based Education (OBE): Course Objectives, Course Outcomes (CO), Program Outcomes (PO) and CO-PO Mapping	-	https://lms.iare.ac.in
CONTENT DELIVERY (THEORY)			
1	Introduction to ground modification	CO 1	T1:11.1
2	Introduction to ground modification	CO 1	T1:11.1
3	Need and objectives of ground modification techniques.	CO 1	T1:11.4
4	Need and objectives of ground modification techniques.	CO 1	T1:11.4
5	Identification of soil types.	CO 1	T1:16.6
6	Identification of soil types.	CO 1	T1:16.6
7	In Situ and laboratory tests to characterize problematic soils.	CO 1	T1:13.1
8	In Situ and laboratory tests to characterize problematic soils.	CO 1	T1:13.1
9	Mechanical, hydraulic, physic-chemical methods of ground Improvement techniques.	CO 1	R1:13.15
10	Mechanical, hydraulic, physic-chemical methods of ground Improvement techniques.	CO 1	R1:13.15
11	Electrical, Thermal methods, and their applications of ground Modification.	CO 1	T1:13.3 R1:15.5
12	Introduction to mechanical modification	CO 2	T1:13.8
13	Analyzing Deep Compaction techniques	CO 2	T1:13.9
14	Analyzing Deep Compaction techniques	CO 2	T1:13.9
15	Blasting vibro- compaction	CO 2	T1:14.3
16	Blasting vibro- compaction	CO 2	T1:14.3
17	Objectives and techniques of hydraulic modification	CO 3	T1:15.9
18	Objectives and techniques of hydraulic modification	CO 3	T1:15.9
19	Traditional dewatering methods and their choice	CO 3	T1:15.5
20	Traditional dewatering methods and their choice	CO 3	T1:15.5
21	Design of dewatering system	CO 3	T1:15.6
22	Design of dewatering system	CO 3	T1:15.6
23	Electro-osmosis technique.	CO 3	T1:15.8
24	Electro-osmosis technique.	CO 3	T1:15.8
25	Electro kinetic dewatering technique.	CO 3	T1:16.9
26	Filtration technique used in geo-synthetics.	CO 4	T1:16.5
27	Preloading the vertical drains.	CO 4	T1:16.3

28	Preloading the vertical drains.	CO 4	T1:16.3
29	Shotcreting and Guniting Technology.	CO 5	T1:17.22
30	Shotcreting and Guniting Technology.	CO 5	T1:17.22
31	Modification at depth by grouting.	CO 5	T1:17.22
32	Modification at depth by grouting.	CO 5	T1:17.22
33	Crack grouting and compaction grouting.	CO 5	T1:19.3
34	Crack grouting and compaction grouting.	CO 5	T1:19.3
35	Jet grouting technique, Thermal modification, Ground freezing.	CO 5	T1:19.6.1
36	Jet grouting technique, Thermal modification, Ground freezing.	CO 5	T1:19.6.1
37	Modification by inclusions and confinement.	CO 6	R2:19.6.2
38	Modification by inclusions and confinement.	CO 6	R2:19.6.2
39	Soil reinforcement and grid reinforced soil.	CO 6	R2:21.6.2
40	Soil reinforcement and grid reinforced soil.	CO 6	R2:21.6.2
41	Physical and Chemical Modification of admixtures.	CO 5	R2:22.6.3
42	Physical and Chemical Modification of admixtures.	CO 5	R2:22.6.3
43	Reinforced soils, grid soils	CO 6	T1:17.4
44	Reinforced soils, grid soils	CO 6	T1:17.4
45	Rock bolting and soil nailing	CO 6	R2:17.2.1
46	Rock bolting and soil nailing	CO 6	R2:17.2.1
PROBLEM SOLVING/ CASE STUDIES			
1	Identification of soil types	CO 1	T1: 5.1-5.4 R2: 5.1-5.5
2	In situ and laboratory tests	CO 1	T1: 6.1-6.8 R2: 6.1-6.4
3	Compaction factor test sieve analysis.	CO 1	T1: 7.1-7.6
4	Index properties tests.	CO 3	T1: 5.2; 6.2
5	Permeability tests	CO 1	T2: 6.3 R4: 10.6
6	Hydraulic methods	CO 1	T2: 6.3 R4: 10.7
7	Application of GIT methods	CO 1	T2: 6.2 R4: 10.3-10.5
8	Deep compaction techniques.	CO 2	T2: 14.7-14.8
9	Dynamic tamping.	CO 2	T2: 26.5-26.10 R4: 3 - 5
10	Compaction piles	CO 2	T3: 10.2-10.8
11	Electro-osmosis, electro kinetic dewatering	CO 3	T1: 14.1-14.3
12	Filtration, drainage and seepage control	CO 4	T2: 14.4-14.6
13	Types of geosynthetics-I.	CO 4	T3: 3.1-3.12 R1: 8.1-8.7
14	Application of GIT methods	CO 5	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, 2, 3	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 1, 2, 3	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 4, 5, 6	T3: 10.2-10.8 T4: 14.7-14.8 R4: 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 4, 5, 6	T3: 10.2-10.8 T4: 14.1-14.3 T4: 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 4, 5, 6	T3: 2.1-3.12 R4: 7.1-7.6, 8.1-8.7
DISCUSSION OF QUESTION BANK			
1	Module I	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	Module II	CO 2	T1: 6.1-6.8 R2: 6.1-6.4
3	Module III	CO 3, 4	T2: 10.2-10.8
4	Module IV	CO 5	T1: 10.2-10.8 T2: 14.1-14.3
5	Module V	CO 6	T2: 2.1-3.12 R2: 7.1-7.6, 8.1-8.7

Signature of Course Coordinator **HOD,CE**

INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

Dundigal, Hyderabad - 500 043

COURSE DESCRIPTION

Department	**CIVIL ENGINEERING**				
Course Title	**PRESTRESSED CONCRETE STRUCTURES**				
Course Code	ACEC40				
Program	B.Tech				
Semester	VII				
Course Type	PROFESSIONAL ELECTIVE				
Regulation	IARE - UG 20				
Course Structure	Theory			Practical	
	Lecture	Tutorials	Credits	Laboratory	Credits
	3	-	3	-	-
Course Coordinator	Dr Venu M, Professor				

I COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites
B.Tech	ACEC16	V	Reinforced Concrete Structures Design and Drawing
B.Tech	ACEC23	VI	Steel Structures Design and Drawing

II COURSE OVERVIEW:

A prestressed concrete structure is different from a conventional reinforced concrete structure due to the application of an initial load on the structure prior to its use. In prestressed concrete high strength concrete and high strength steel are combined such that the full section is effective in resisting tension and compression. This is an active combination of the two materials. This subject provides students an understanding and ability to analyse and design prestressed concrete structural elements. The primary topics includes the concept and principles of prestressing, methods of prestressing concrete, stress limits, losses of prestress, selection of section, serviceability and strength requirements. Students will also be able to complete analysis and design procedure of simply supported prestressed concrete non-composite and composite beams.

III MARKS DISTRIBUTION:

Subject	SEE Examination	CIE Examination	Total Marks
Prestressed Concrete Structures	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	x	Videos
x	Others						

V EVALUATION METHODOLOGY:

Each theory 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). Student's performance in a course shall be judged by taking into account the results of CIA and SEE together. Below table shows the typical distribution of weightage for CIA and SEE.

Table: Assessment pattern for Theory Courses

Component		Marks	Total Marks
CIA	Continuous Internal Examination – 1 (Mid-term)	10	30
	Continuous Internal Examination – 2 (Mid-term)	10	
	Tech talk / Quiz – 1 and Quiz – 2	5	
	Concept video / Alternative Assessment Tool (AAT)	5	
SEE	Semester End Examination (SEE)	70	70
Total Marks			100

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 modules 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 emphasis on the questions is broadly based on the following criteria:

50%	To test the objectiveness of the concept
50%	To test the analytical skill of the concept OR to test the application skill of the concept

Continuous Internal Assessment (CIA):
For each theory course the CIA shall be conducted by the faculty / teacher handling the course. 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). **Two CIE Tests are Compulsory** and sum of the two tests, along with the scores obtained in the quizzes (average of Quiz – 1 and Quiz – 2) / AAT shall be considered for computing the final CIA of a student in a given course.
The CIE Tests/quizzes/AAT shall be conducted by the course faculty with due approval from the HOD. Advance notification for the conduction of Quiz/AAT is mandatory and the responsibility lies with the concerned course faculty.

Continuous Internal Examination (CIE):

Two CIE exams shall be conducted at the end of the 8th and 16th 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. The valuation and verification of answer scripts of CIE exams shall be completed within a week after the conduct of the Examination.

Quiz – Online Examination:
Two Quiz exams shall be conducted along with CIE in online mode for 5 marks each, consisting of 10 short answers questions (Definitions and Terminology) and 10 multiple choice questions (having each question to be answered by tick marking the correct answer from the choices (commonly four) given against it. Such a question paper shall be useful in testing of knowledge, skills, application, analysis, evaluation and understanding of the students. Average of two quiz examinations shall be considered.

Alternative Assessment Tool (AAT):
In order to encourage innovative methods while delivering a course, the faculty members are encouraged to use the Alternative Assessment Tool (AAT). This AAT enables faculty to design own assessment patterns during the CIA. The AAT enhances the autonomy (freedom and flexibility) of individual faculty and enables them to create innovative pedagogical practices. If properly applied, the AAT converts the classroom into an effective learning centre.

The AAT may include tech talk, tutorial hours/classes, seminars, assignments, term paper, open ended experiments, concept videos, partial reproduction of research work, oral presentation of research work, developing a generic tool-box for problem solving, report based on participation in create-a-thon, makea-thon, code-a-thon, hack-a-thon conducted by reputed organizations / any other. etc.

However, it is mandatory for a faculty to obtain prior permission from the concerned HOD and spell out the teaching/assessment pattern of the AAT prior to commencement of the classes.

VI COURSE OBJECTIVES:

The students will try to learn:

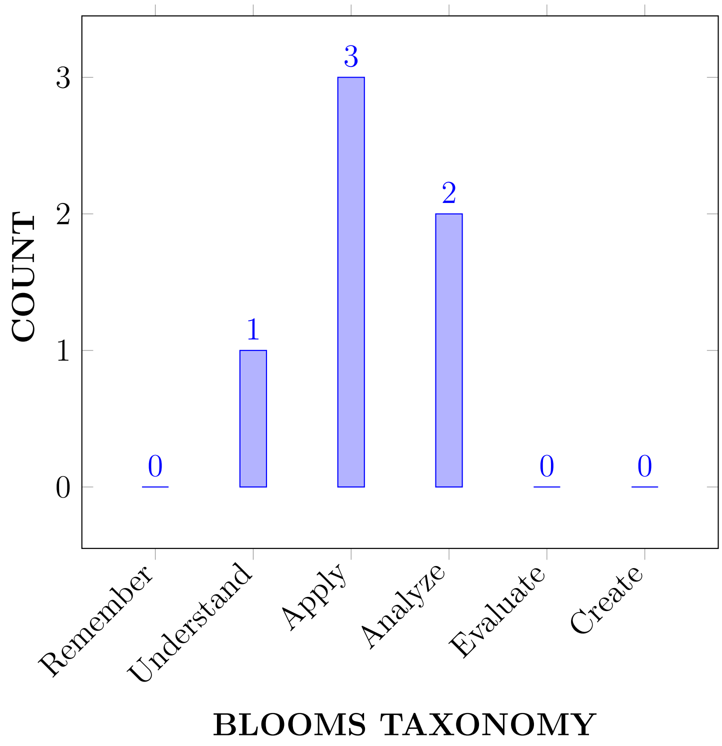
I	The concepts of prestressed concrete structures and the behaviour of these structures subjected to loads for the design purpose.
II	The design of structural elements necessary for creating efficient and economic prestressed concrete structures.
III	The design and drawing of multi storeyed industrial 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	**Explain** the concept of methods of pre and post tensioning and the systems of prestressing for the designing of prestressed concrete structural elements.	Understand
CO 2	**Estimate** the losses in the prestress and post tensioned members for the efficient design of prestressed concrete structures.	Analyse
CO 3	**Analyse** prestressed concrete structural elements subjected to flexure for the design purpose.	Analyse
CO 4	**Design** prestressed concrete structural elements subjected to shear using Indian standard code method.	Apply
CO 5	**Apply** the concepts of transfer of prestress in pre and post tensioned members through bond for effective utilisation of prestressing force.	Apply
CO 6	**Design** the composite prestressed concrete structural elements subjected to flexure and shear for designing multi storied structures..	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	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 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.	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	Understand the concepts methods of pre and post tensioning and the systems of prestressing by applying the principles of **mathematics, and engineering fundamentals**.	2
	PSO 1	Understand the basic concepts of methods of pre and post tensioning and the systems of prestressing using **structural design** concepts for the design purpose.	1
CO2	PO 1	Calculate the losses in the prestress and post tensioned members by applying the principles of **mathematics and engineering fundamentals**.	2
	PO 2	Analyse the losses in prestress and post tensioned members to know the design forces using the structural analysis concepts, **formulate and state a problem, and develop solution and document the results**.	4
	PSO 1	Understand the loss estimation in the prestressed members based on Indian standards using structural **design; strength assessment; materials knowledge** their applications in **engineering construction** of steel structures.	4

Course Outcomes	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key competencies matched.
CO 3	PO 1	Understand the different loads to be considered and design process of prestressed and post tensioned structural elements by applying the principles of **mathematics and engineering fundamentals**.	2
	PO 2	Analyse the prestressed and post tensioned structural elements 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 prestressed and post tensioned structural elements for the factored forces for safety and serviceability.	1
	PO 4	Understand the appropriate is codes and **engineering knowledge** for the design of prestressed and post tensioned structural elements 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 prestressed and post tensioned structural elements based on Indian standards for the **structural design; strength assessment; materials knowledge** their applications in **engineering construction** of prestressed and post tensioned structural elements.	4
CO 4	PO 1	Understand the different loads to be considered and design process of prestressed and post tensioned structural elements by applying the principles of **mathematics and engineering fundamentals**.	2
	PO 2	Analyse the prestressed and post tensioned structural elements 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 prestressed and post tensioned structural elements for the factored forces for safety and serviceability.	1
	PO 4	Understand the appropriate IS codes and **engineering knowledge** for the design of prestressed and post tensioned structural elements 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 prestressed and post tensioned structural elements based on Indian standards for the **structural design; strength assessment; materials knowledge** their applications in **engineering construction** of prestressed and post tensioned structural elements.	4

Course Outcomes	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key competencies matched.
CO 5	PO 1	Understand the concepts of transfer of prestressed and post tensioned force by bond, transmission length by applying the principles of **mathematics and engineering fundamentals**.	2
	PO 2	Transfer of prestress in the prestressed and post tensioned structural elements using the structural analysis concepts, **formulate and state a problem, and develop solution and document the results**.	4
	PO 3	**Design** the prestressed and post tensioned structural elements for the factored forces for safety and serviceability.	1
	PO 4	Understand the appropriate IS codes and **engineering knowledge** for the design of prestressed and post tensioned structural elements by **Identifying problem, classify problem and describe problem and quality issues** associated with the given problem in different conditions.	5
	PSO 1	Understand the concepts of transfer of prestressed and post tensioned force by bond, transmission length based on Indian standards for the **structural design; strength assessment; materials knowledge** their applications in **engineering construction** of prestressed and post tensioned sections.	4
CO 6	PO 1	Understand the different loads to be considered and design process of composite prestressed concrete structural elements 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 composite prestressed concrete structural elements for the factored forces for safety and serviceability.	1
	PO 4	Understand the appropriate is codes and **engineering knowledge** for the design of composite prestressed concrete structural elements 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 composite prestressed concrete structural elements based on Indian standards for the **structural design; strength assessment; materials knowledge** their applications in **engineering construction** of concrete structural elements.	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	-	-	-	-	-	-	-	-	-	-	-	1	-	-
CO 2	2	4	-	-	-	-	-	-	-	-	-	-	4	-	-
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	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10.0	0.0	0.0
CO 2	66.7	40.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	40.0	0.0	0.0
CO 3	66.7	40.0	10.0	45.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	40.0	0.0	0.0
CO 4	66.7	40.0	10.0	45.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	40.0	0.0	0.0
CO 5	66.7	40.0	10.0	45.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	40.0	0.0	0.0
CO 6	66.7	40.0	10.0	45.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	40.0	0.0	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	-	-
CO 2	3	2	-	-	-	-	-	-	-	-	-	-	2	-	-
CO 3	3	2	1	2	-	-	-	-	-	-	-	-	2	-	-
CO 4	3	2	1	2	-	-	-	-	-	-	-	-	2	-	-
CO 5	3	2	1	2	-	-	-	-	-	-	-	-	2	-	-
CO 6	3	2	1	2	-	-	-	-	-	-	-	-	2	-	-
TOTAL	18	10	4	8									11		
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	-	Concept Video	✓	Open Ended Experiments	-
Assignments	-	Tech talk	✓		

XVII ASSESSMENT METHODOLOGY-INDIRECT:

	Assessment of mini projects by experts	✓	End Semester OBE Feedback

XVIII SYLLABUS:

MODULE I	**INTRODUCTION**
	Historic development- General principles of pre-stressing pre-tensioning and post tensioning- Advantages and limitations of Prestressed concrete- General principles of PSC- Classification and types of pre-stressing Materials- high strength concrete and high tensile steel their characteristics. Methods and Systems of prestressing: Pre-tensioning and Post-tensioning methods and systems of prestressing like Hoyer system, Magnel Blaton system, Freyssinet system and Gifford- Udall System- Lee McCall system.
MODULE II	**LOSSES OF PRE-STRESS**
	Loss of pre-stress in pre-tensioned and post-tensioned members due to various causes like elastic shortage of concrete, shrinkage of concrete, creep of concrete, relaxation of stress in steel, slip in anchorage, frictional losses.
MODULE III	**FLEXURE**
	Analysis of sections for flexure, beams pre-stressed with straight, concentric, eccentric, bent and parabolic tendons- stress diagrams, Elastic design of PSC beams of rectangular and I section Kern line, Cable profile and cable layout. Shear: General Considerations, Principal tension and compression, improving shear resistance of concrete by horizontal and vertical pre-stressing and by using inclined or parabolic cables, Analysis of rectangular and I beam for shear, Design of shear reinforcements- Bureau of Indian Standards (BIS) Code provisions.
MODULE IV	**TRANSFER OF PRE-STRESS IN PRE-TENSIONED MEMBERS**
	Transmission of pre-stressing force by bond, Transmission length, Flexural bond stresses, IS code provisions, Anchorage zone stresses in post tensioned members, stress distribution in End block, Analysis by Guyon, Magnel, Zielinski and Rowe's methods, Anchorage zone reinforcement, BIS Provisions.
MODULE V	**COMPOSITE BEAMS AND DEFLECTIONS**
	Different Types: Propped and Unpropped, stress distribution, Differential shrinkage, Analysis of composite beams, General design considerations. Deflections: Importance of control of deflections, Factors influencing deflections, short term deflections of uncracked beams, prediction of longtime deflections, BIS code requirements.

TEXTBOOKS

1. N. Krishna Raju, "Pre-stressed Concrete", Tata McGraw Hill Book Education Pvt. Ltd, 6th Edition, 2018.

2. N. Rajagopalan, "Prestressed Concrete", Alpha Science International Ltd, 2nd edition, 2005.

REFERENCE BOOKS:

1. T.Y. Lin and Burn, "Design of Pre-stress Concrete Structures", John Wiley, New York.
2. S. Ramarnrutham, "Prestressed Concrete", Dhanpat Rai & Sons, Delhi.

WEB REFERENCES:

1. https://nptel.ac.in/courses/105106118
2. https://odp.inflibnet.ac.in/index.php/module_details?course=prestressed%20concrete %20structures&source=swayam&subsource=NPTEL

COURSE WEB PAGE:

1. https://akanksha.iare.ac.in/index?route=course/details&course_id=366

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	Course Objectives, Course Outcomes, Program Outcomes and CO-PO Mapping		
CONTENT DELIVERY (THEORY)			
2	Historic development of pre-stressing technology, general principles of pre-tensioning and post-tensioning	CO1	T1: 1 R1: 1.1
3	Historic development of pre-stressing technology, general principles of pre-tensioning and post-tensioning	CO1	T1: 1 R1: 1.1
4	Advantages and limitations of pre-stressed concrete, General principles of PSC, classifications and types of pre-stressing Materials - high strength concrete and high tensile steel	CO 1	T1: 1.2 R1:1.1
5	Advantages and limitations of pre-stressed concrete, General principles of PSC, classifications and types of pre-stressing Materials - high strength concrete and high tensile steel	CO 1	T1: 1.2 R1:1.1
6	Characteristics, Methods and Systems of pre-stressing.	CO 1	T1: 1.5 R1:1.2
7	Characteristics, Methods and Systems of pre-stressing.	CO 1	T1: 1.5 R1:1.2
8	Pre-tensioning and Post-tensioning methods.	CO 2	T1: 2.1-2.2 R1:3.1-3.4
9	Systems of pre-stressing like Hoyer system, Magnel Blaton system, Freyssinet system and Gifford- Udall System- Lee McCall system	CO 2	T1: 4.1-4.2 R1:3.4-3.7

10	Systems of pre-stressing like Hoyer system, Magnel Blaton system, Freyssinet system and Gifford- Udall System- Lee McCall system	CO 2	T1: 4.1-4.2 R1:3.4-3.7
11	Nature of loss of prestress, Loss of prestress in pre-tensioned and post-tensioned members due to elastic deformation, shrinkage and creep.	CO 2	T1: 3.1-3.2 R1:4.1-4.6
12	Nature of loss of prestress, Loss of prestress in pre-tensioned and post-tensioned members due to elastic deformation, shrinkage and creep.	CO 2	T1: 3.1-3.2 R1:4.1-4.6
13	Loss of prestress due to Relaxation of stress in steel	CO 2	T1: 4.1-4.2 R1:4.7-4.9
14	Loss of prestress due to Relaxation of stress in steel	CO 2	T1: 4.1-4.2 R1:4.7-4.9
15	Loss of prestress due to Relaxation of stress in steel	CO 2	T1: 4.1-4.2 R1:4.7-4.9
16	Slip in anchorage, frictional losses.	CO 3	T1: 4.3-4.4 R1:4.10-4.13
17	Slip in anchorage, frictional losses.	CO 3	T1: 4.3-4.4 R1:4.10-4.13
18	Slip in anchorage, frictional losses.	CO 3	T1: 4.3-4.4 R1:4.10-4.13
19	Slip in anchorage, frictional losses.	CO 3	T1: 4.3-4.4 R1:4.10-4.13
20	FLEXURE - Analysis of sections for flexure, beams prestressed with straight, concentric, eccentric, bent and parabolic tendons	CO 3	T1: 4.4-4.5 R1:5.1-5.4
21	FLEXURE - Analysis of sections for flexure, beams prestressed with straight, concentric, eccentric, bent and parabolic tendons	CO 3	T1: 4.4-4.5 R1:5.1-5.4
22	FLEXURE - Analysis of sections for flexure, beams prestressed with straight, concentric, eccentric, bent and parabolic tendons	CO 3	T1: 4.4-4.5 R1:5.1-5.4
23	Stress diagrams- Elastic design of PSC beams of rectangular and I section, Kern line	CO 3	T1: 4.6-4.7 R1:5.5-5.8
24	Stress diagrams- Elastic design of PSC beams of rectangular and I section, Kern line	CO 3	T1: 4.6-4.7 R1:5.5-5.8
25	Stress diagrams- Elastic design of PSC beams of rectangular and I section, Kern line	CO 3	T1: 4.6-4.7 R1:5.5-5.8
26	Cable profile and cable layout.	CO 3	T1: 5.1-5.2 R1:5.9
27	Cable profile and cable layout.	CO 3	T1: 5.1-5.2 R1:5.9
28	SHEAR: General Considerations, Principal tension and compression	CO 3	T1: 5.3-5.4 R1:7.1-7.3
29	SHEAR: General Considerations, Principal tension and compression	CO 3	T1: 5.3-5.4 R1:7.1-7.3
30	SHEAR: General Considerations, Principal tension and compression	CO 3	T1: 5.3-5.4 R1:7.1-7.3

31	Analysis of rectangular and I beam for shear	CO 4	T1: 6.1- 6.2 R1:7.4-7.6
32	Analysis of rectangular and I beam for shear	CO 4	T1: 6.1- 6.2 R1:7.4-7.6
33	Design of shear reinforcements- Bureau of Indian Standards (BIS) Code provisions.	CO 4	T1: 6.3-6.4 R1:7.7-7.8
34	Design of shear reinforcements- Bureau of Indian Standards (BIS) Code provisions.	CO 4	T1: 6.3-6.4 R1:7.7-7.8
35	Improving shear resistance of concrete by horizontal and vertical prestressing and by using inclined or parabolic cables	CO 4	T1: 6.4-6.5 R1:8.1-8.2
36	Transmission of prestressing force by bond as per IS code provisions.	CO 4	T1: 7.1-7.2 R1:8.3-8.4
37	Transmission length, Flexural bond stresses	CO 4, CO 5	T1: 8.1-8.2 R1:8.5
38	Transmission length, Flexural bond stresses	CO 4, CO 5	T1: 8.1-8.2 R1:8.5
39	Anchorage zone stresses in post tensioned members, stress distribution in End block	CO 5	T1: 8.2-8.3 R1:7.7
40	Analysis by Guyon, Magnel, Zielinski and Rowe's methods, Anchorage zone reinforcement, BIS Provisions	CO 5	T1: 5.2-5.3 R1:7.8
41	Composite Beams: Different Types, Propped and Unpropped, stress distribution.	CO 6	T1: 5.3-5.4 R1:5.5-5.6
42	Differential shrinkage-, Analysis of composite beams- General design considerations.	CO 6	T1: 4.5-4.6 R1:5.7-5.8
43	Importance of control of deflections, Factors influencing deflections	CO 6	T1: 8.1-8.2 R1:10.2-10.5
44	Short term deflections of uncracked beams and Problems.	CO 6	T1: 8.3-8.4 R1:10.6
45	Prediction of long-term deflections, BIS code requirements	CO 6	T1: 8.5-8.6 R1:10.7
PROBLEM SOLVING/ CASE STUDIES			
1	Loss of prestress in pre-tensioned and post-tensioned members due to elastic deformation, shrinkage and creep.	CO 3	T1: 11.10 -11.11
2	Loss of prestress due to Relaxation of stress in steel	CO 3	T1: 3.10-3.12
3	Analysis of sections for flexure, beams prestressed with straight, concentric, eccentric, bent and parabolic tendons.	CO 4, CO 5	T1: 3.10 R1: 3.1 – 3.5
4	Stress diagrams- Elastic design of PSC beams of rectangular and I section, Kern line.	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	Cable profile and cable layout	CO 4	T1: 5.4-5.9 R1: 4.1 – 4.8
7	Analysis of rectangular and I beam for shear.	CO 4	T1: 5.4-5.9 R1: 4.1 – 4.8

8	Design of shear reinforcements	CO 4	T1: 5.4-5.9 R1: 4.1 – 4.8
9	Transmission length, Flexural bond stresses	CO 4	T1: 5.11-5.13 R1: 9.3
10	Anchorage zone stresses in post tensioned members, stress distribution in End block.	CO 4	T1: 6.1-6.11
11	Analysis by Guyon, Magnel, Zielinski and Rowe's methods for Anchorage zone reinforcement.	CO 4, CO 5	T1: 6.12 R1: 5.5 – 5.8
12	Analysis of composite beams for differential shrinkage	CO 4, CO 5	T1: 6.5-6.12
13	Short term deflections of uncracked beams	CO 5	T1: 11.3-11.4
14	Long term deflections of uncracked beams	CO 6	T1: 7.4-7.8 R1: 7.1 – 7.3
15	Analysis of stresses in PSC members subjected to external loads.	CO 6	T1: 7.6 R1: 7.4 – 7.6
DISCUSSION OF DEFINITION AND TERMINOLOGY			
1	General principles of PSC- Classification and types of pre-stressing Materials- high strength concrete and high tensile steel their characteristics. Methods and Systems of prestressing: Pre-tensioning and Post-tensioning methods	CO 1,2,3	R1:1.1 - 1.6
2	Loss of pre-stress in pre-tensioned and post-tensioned members due to various causes like elastic shortage of concrete, shrinkage of concrete, creep of concrete, relaxation of stress in steel, slip in anchorage, frictional losses.	CO 3	T1:5.1 - 5,13
3	Analysis of sections for flexure and shear, beams pre-stressed with straight, concentric, eccentric, bent and parabolic tendons- stress diagrams, Elastic design of PSC beams of rectangular and I section Kern line, Cable profile and cable layout.	CO 3	T1 6.1-6.12
4	Transmission of pre-stressing force by bond, Transmission length, Flexural bond stresses, IS code provisions, Anchorage zone stresses in post tensioned members, stress distribution in End block, Analysis by Guyon, Magnel, Zielinski and Rowe's methods, Anchorage zone reinforcement, BIS Provisions.	CO 5	T1:7.1 - 7.3
5	Propped and Unpropped, stress distribution, Differential shrinkage, Analysis of composite beams, General design considerations. Deflections: Importance of control of deflections, Factors influencing deflections, short term deflections.	CO 6	T1: 7.1 - 7.8
DISCUSSION OF QUESTION BANK			
1	Analysis of stresses in PSC members subjected to external loads.	CO 1,2,3	R1:1.1 - 1.6

2	Loss of pre-stress in pre-tensioned and post-tensioned members due to various causes like elastic shortage of concrete, shrinkage of concrete, creep of concrete, relaxation of stress in steel, slip in anchorage, frictional losses.	CO 3,4	T1:5.1 - 5.13
3	Analysis of sections for flexure and shear, beams pre-stressed with straight, concentric, eccentric, bent and parabolic tendons- stress diagrams, Elastic design of PSC beams of rectangular and I section Kern line, Cable profile and cable layout.	CO 3,4	T1 6.1-6.12
4	Transmission of pre-stressing force by bond, Transmission length, Flexural bond stresses, IS code provisions, Anchorage zone stresses in post tensioned members, stress distribution in End block.	CO 5	T1:7.1 - 7.3
5	Propped and Unpropped, stress distribution, Differential shrinkage, Analysis of composite beams, General design considerations. Deflections: Importance of control of deflections, Factors influencing deflections, short term deflections	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	**REHABILITATION & RETROFITTING OF STRUCTURES**				
Course Code	ACEC51				
Program	B.Tech				
Semester	VII				
Course Type	Core				
Regulation	UG-20				
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	ACEC10	IV	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). 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
33.3 %	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) and 10 marks for Alternative Assessment Tool (AAT).

Component		Marks	Total Marks
CIA	Continuous Internal Examination – 1 (Mid-term)	10	30
	Continuous Internal Examination – 2 (Mid-term)	10	
	AAT-1	5	
	AAT-2	5	
SEE	Semester End Examination (SEE)	70	70
Total Marks			100

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:

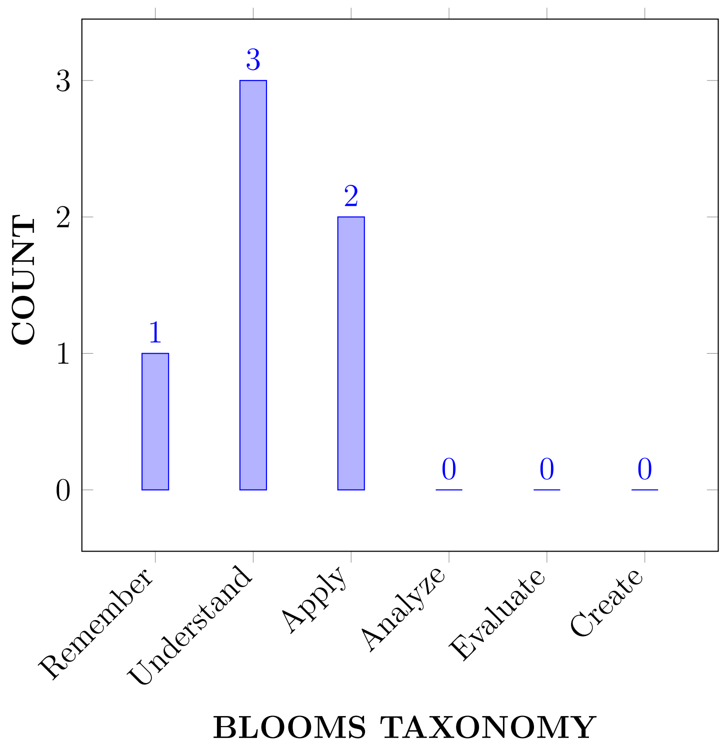
I	The basic concepts of degradation, damage grades in civil structures for evaluating Structural performance by using rehabilitation and retrofitting methods.
II	The knowledge on structural maintenance, repairs and rehabilitation for obtaining assessment of damage in construction failure.
III	The mechanism 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	**PO'S PSO'S**	**Justification for mapping (Students will be able to)**	**No. of key competencies matched.**
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	-
CO 5	-	-	-	1	3	-	-	-	-	-	-	-	-	-	-
CO 6	-	-	-	1	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
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:

MODULE- 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.
MODULE- 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.
MODULE- 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.
MODULE- 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.

MODULE- 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	Deterioration of structures.	CO 1	T2:2.2.2
4	Causes for deterioration of structures	CO 1	T2:2.2.2 R3:3.7
5	Mechanism of damage	CO 1	T2:2.2.2
6	types of damage.	CO 1	T1:8.1

7	damage under accidental loads	CO 1	T1:7.1 R2: 1.2
8	damage under cyclic loads	CO 1	T2:3.2.3 R2: 1.3
9	cracking in structures	CO 2	T2:4.2.3
10	cracking in structures	CO 2	T2:4.5.2
11	evaluation of damage	CO 2	T2:4.7.9
12	Defibitions of Maintenance, repair and rehabilitation	CO 2	T2:5.2.1 R2: 6.4
13	facets of maintenance	CO 3	T2:5.4
14	importance of maintenance	CO 3	T2:5.5.3
15	various aspects of inspection.	CO 3	T2:6.2.2
16	Assessment procedure for evaluating a damaged structure.	CO 3	R1:2.5 R2: 8.2
17	Diagnosis of construction failures.	CO 3	R2:2.2.5 R2: 9.2
18	Corrosion damage of reinforced concrete	CO 3	R3:5.6.2
19	methods of corrosion protection	CO 3	R3:5.4.8 R2: 9.6
20	corrosion inhibitors	CO 4	T2:8.1.2
21	corrosion resistant steels	CO 4	T2:8.3.5 R2: 5.3
22	cathodic protection	CO 4	T2:8.5
23	rust eliminators	CO 4	T2:8.9.2
24	Causes of deterioration of concrete	CO 4	T2:9.2 R3: 4.6
25	Causes of deterioration of steel, masonry and timber structures	CO 5	T2:9.5.3
26	surface deterioration	CO 6	T2:9.6.2
27	efflorescence,	CO 6	T2:9.7.5 R3: 8.12
28	causes and preventive measures.	CO 6	T2:9.6.2
29	coatings for embedded steel and set concrete.	CO 6	T2:9.6.2
30	Special concrete and mortar	CO 6	T2:9.6.2
31	concrete chemicals	CO 6	T2:9.6.2
32	polymer concrete.	CO 6	T2:9.6.2
33	sulphurinfiltrated concrete	CO 6	T2:9.6.2
34	ferro cement	CO 6	T2:9.6.2
35	fiber reinforced concrete	CO 6	T2:9.6.2
36	methods of repair in concrete	CO 6	T2:9.6.2
37	methods of repair in steel, masonry and timber structures	CO 6	T2:9.6.2

38	Gunite and shotcrete, epoxy injection	CO 6	T2:9.6.2
39	Strengthening of existing structures	CO 6	T2:9.6.2
40	repairs to overcome low member strength, deflection	CO 6	T2:9.6.2
41	repairs to overcome cracking, chemical disruption	CO 6	T2:9.6.2
42	weathering, wear, fire, leakage, marine exposure	CO 6	T2:9.6.2
43	use of non-destructive testing techniques for evaluation	CO 6	T2:9.6.2
44	load testing of structure	CO 6	T2:9.6.2
45	demolition of structures using engineered and non-engineered techniques	CO 6	T2:9.6.2
46	case studies	CO 6	T2:9.6.2
PROBLEM SOLVING / CASE STUDIES			
1	Rehabilitation and Retrofitting of Structures.	CO 1	T2:26.3 R2: 3.1
2	Damage of structures	CO 1	T1:8.1
3	Mechanism of damage and types of damage.	CO 1	T2:2.2.2
4	Facets of maintenance	CO 2	T2:26.3 R2: 3.1
5	various aspects of inspection.	CO 2	T2:26.3 R2: 3.1
6	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	Different causes and preventive measures of surface deterioration and efflorescence.	CO 3	T2:26.3 R2: 3.1
9	different methods of repairs in concrete, steel, masonry and timber structures.	CO 4	T2:26.3 R2: 3.1
10	strengthening techniques for existing structures.	CO 4	T2:26.3 R2: 3.1
11	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	Gunite and shotcrete, epoxy injection	CO 5	T2:26.3 R2: 3.1
14	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 5,6	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 5, 6	T1: 4.1

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

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

COURSE DESCRIPTION

<table>
<tr><td>Department</td><td colspan="5">CIVIL ENGINEERING</td></tr>
<tr><td>Course Title</td><td colspan="5">ENVIRONMENTAL ENGINEERING</td></tr>
<tr><td>Course Code</td><td colspan="5">ACEC34</td></tr>
<tr><td>Program</td><td colspan="5">B.Tech</td></tr>
<tr><td>Semester</td><td colspan="5">VII</td></tr>
<tr><td>Course Type</td><td colspan="5">CORE</td></tr>
<tr><td>Regulation</td><td colspan="5">UG20</td></tr>
<tr><td rowspan="3">Course Structure</td><td colspan="3">Theory</td><td colspan="2">Practical</td></tr>
<tr><td>Lecture</td><td>Tutorials</td><td>Credits</td><td>Laboratory</td><td>Credits</td></tr>
<tr><td>3</td><td>1</td><td>4</td><td>-</td><td>-</td></tr>
<tr><td>Course Coordinator</td><td colspan="5">Mr. R. Suresh Kumar , Assistant Professor</td></tr>
</table>

I COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites
B.Tech	ACEC15	V	Hydrology and Water Resources Engineering

II COURSE OVERVIEW:

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 MARKS DISTRIBUTION:

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

IV CONTENT DELIVERY / INSTRUCTIONAL METHODOLOGIES:

<table>
<tr><td>✓</td><td>Power Point Presentations</td><td>✓</td><td>Chalk & Talk</td><td>✓</td><td>Assignments</td><td>x</td><td>MOOC</td></tr>
<tr><td>x</td><td>Open Ended Experiments</td><td>x</td><td>Seminars</td><td>x</td><td>Mini Project</td><td>✓</td><td>Videos</td></tr>
<tr><td>x</td><td colspan="7">Others</td></tr>
</table>

V EVALUATION METHODOLOGY:

Each theory 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). Student's performance in a course shall be judged by taking into account the results of CIA and SEE together. Table-7 shows the typical distribution of weightage for CIA and SEE.

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		Marks	Total Marks
CIA	Continuous Internal Examination – 1 (Mid-term)	10	30
	Continuous Internal Examination – 2 (Mid-term)	10	
	Tech talk / Quiz – 1 and Quiz – 2	5	
	Concept video / Alternative Assessment Tool (AAT)	5	
SEE	Semester End Examination (SEE)	70	70
Total Marks			100

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 modules 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 emphasis on the questions is broadly based on the following criteria:

50%	To test the objectiveness of the concept
50%	To test the analytical skill of the concept OR to test the application skill of the concept

Continuous Internal Examination (CIE):
Two CIE exams shall be conducted at the end of the 8th and 16th 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. The valuation and verification of answer scripts of CIE exams shall be completed within a week after the conduct of the Examination.

Quiz - Online Examination
Two Quiz exams shall be conducted along with CIE in online mode for 5 marks each, consisting of 10 short answers questions (Definitions and Terminology) and 10 multiple choice questions (having each question to be answered by tick marking the correct answer from the choices (commonly four) given against it. Such a question paper shall be useful in testing of knowledge, skills, application, analysis, evaluation and understanding of the students. Average of two quiz examinations shall be considered

Alternative Assessment Tool (AAT)
In order to encourage innovative methods while delivering a course, the faculty members are encouraged to use the Alternative Assessment Tool (AAT). This AAT enables faculty to design own assessment patterns during the CIA. The AAT enhances the autonomy (freedom and flexibility) of individual faculty and enables them to create innovative pedagogical practices. If properly applied, the AAT converts the classroom into an effective learning centre.

The AAT may include tech talk, tutorial hours/classes, seminars, assignments, term paper, open ended experiments, concept videos, partial reproduction of research work, oral presentation of research work, developing a generic tool-box for problem solving, report based on participation in create-a-thon, makea-thon, code-a-thon, hack-a-thon conducted by reputed organizations / any other. etc. However, it is mandatory for a faculty to obtain prior permission from the concerned HOD and spell out the teaching/assessment pattern of the AAT prior to commencement of the classes.

VI COURSE OBJECTIVES:

The students will try to learn:

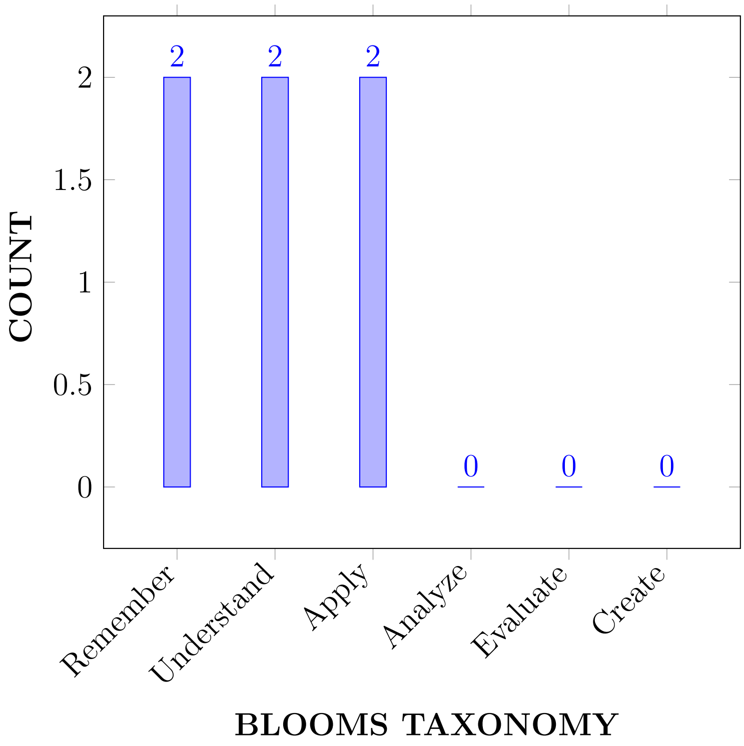
I	The quality and quantity of drinking water standards and know the demand of water for a particular community
II	The basic standards of water and study the procedure for determination
III	The conventional process of water and waste water treatment methods, and know the distribution system

VII COURSE OUTCOMES:

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

CO 1	**Identify** the importance of water demand including types of demand according to population forecasts for supplying the water to meet the public needs.	Remember
CO 2	**Illustrate** the general layout of various units in waste water treatment plant and tratment process to remove the large suspended particles from waste water and for reuse.	Apply
CO 3	**List** out the various concepts of conservancy and water carriage systems for arranging the pipe line system to transfer the sewage and storm water to treatment plant.	Remember
CO 4	**Discuss** the need for the ultimate disposal of sewage and dilution to allow human and industrial effluents to be disposed of without damage to the natural environment.	Understand
CO 5	**Discover** the waste water treatment process via primary sedimentation and secondary sedimentation for removing the suspended particle from the collected waste water.	Understand
CO 6	**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 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.

Program Outcomes	
PO 10	**Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO 11	**Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO 12	**Life-Long Learning:** Recognize the need for and having the preparation and ability to engage in independent and life-long learning in the broadest context of technological change

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

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
PSO 2	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):

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 (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
	PO 2	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
	PO 3	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
	PSO 1	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
	PSO 2	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
CO 2	PO 1	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, science.**	3
	PO 3	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

Course Outcomes	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key competencies matched.
	PO 4	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
	PSO 1	Understand the concept of various water distribution systems including the distribution patterns using **engineering fundamentals** for quality supply of water	1
CO 3	PO 1	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
	PO 2	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
	PO 4	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
	PSO 2	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
CO 4	PO 1	Understand the necessity of waste water treatment and ultimate disposal of sewage then develop the water carriage system to sewer system and hence understand the design concept of sewer, sewer appurtenances and manhole using **engineering principles, fundamentals in mathematics and structural engineering concepts.**	3
	PO 3	Understand the necessity of waste water treatment and lay out including general outline of various units in a waste water treatment plant with design concept using **structural engineering design concept, concrete technology approaches, fundamentals in mathematics and engineering principles.**	4
	PSO 1	Understand the necessity of providing the screeners in sewage treatment plant and design the appropriate screeners using **engineering fundamentals**	1

Course Outcomes	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key competencies matched.
CO 5	PO 1	Understand the necessity of waste water treatment and importance of screening since 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
	PO 3	Understand the necessity of waste water 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
	PSO 1	Understand the necessity of waste water 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 grounds and eggshells will settle out of the waste. Therefore, understand the design concept of grit chamber using **engineering fundamentals and standard design codes**	2
CO 6	PO 1	Understand the importance of oxidation ponds and sludge digestion tanks including design approaches using the **knowledge of mathematics, science and engineering fundamentals.**	3
	PO 3	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
	PO 4	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
	PSO 2	Understand the importance of drying bed and concept of sludge disposal by drying using fundamental of **engineering principles**	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	3	1	3	-	-	-	-	-	-	-	-	-	1	2	-
CO 2	3	-	2	2	-	-	-	-	-	-	-	-	1	-	-
CO 3	3	4	-	3	-	-	-	-	-	-	-	-	-	3	-
CO 4	3	-	4	-	-	-	-	-	-	-	-	-	1	-	-

CO 5	3	-	1	-	-	-	-	-	-	-	-	-	2	-	-
CO 6	3	-	2	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	100	10	30	-	-	-	-	-	-	-	-	-	10	66.6	-
CO 2	100	-	20	18.1	-	-	-	-	-	-	-	-	10	-	-
CO 3	100	40	-	27.7	-	-	-	-	-	-	-		-	100	-
CO 4	100	-	40	-	-	-	-	-	-	-	-		10	-	-
CO 5	100	-	10	-	-	-	-	-	-	-	-	-	20	-	-
CO 6	100	-	20	27.7	-	-	-	-	-	-	-	-	-	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	2	-
CO 2	3	-	1	1	-	-	-	-	-	-	-	-	1	-	-
CO 3	3	1	-	1	-	-	-	-	-	-	-	-	-	3	-
CO 4	3	-	2	-	-	-	-	-	-	-	-	-	1	-	-
CO 5	3	-	1	-	-	-	-	-	-	-	-	-	1	-	-
CO 6	3	-	1	1	-	-	-	-	-	-	-	-	-	1	-
TOTAL	18	2	6	3	-	-	-	-	-	-	-	-	4	6	-
AVERAGE	3	1	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:

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

XVIII SYLLABUS:

MODULE I	**WATER QUALITY, DEMAND ANDSUPPLY**
	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, methods and layouts.
MODULE II	**WATER TREATMENT AND DISTRIBUTION**
	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 pipe lines, pump house.
MODULE III	**SEWAGE TREATMENT AND DISPOSAL**
	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, 168 — P a g e 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.
MODULE IV	**WASTEWATER TREATMENT**
	Lay out and general outline of various units in a waste water 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.
MODULE V	**DESIGN AND WORKING OF TREATMENT UNITS**
	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 waste water, self-purification of rivers, sewage farming.

TEXTBOOKS

1. Peavy, Howard S., Donald R. Rowe, and George Tchobanoglous. Environmental engineering. Vol. 2985. New York: 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. Punmia B.C, Ashok Jain Arun Jain, "Water Supply Engineering", Laxmi Publications, Pvt. Ltd., New Delhi, 2004.

REFERENCE BOOKS:

1. Garg, Santosh Kumar. Water Supply Engineering: Environmental Engineering. Khanna, 1992.

2. Modi, P. N. Sewage 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/Environmental_book.pdf
2. https://www.sanfoundry.com/best-reference-books-btech-environmental-engineering/

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 Environemtal Engineering subject		
CONTENT DELIVERY (THEORY)			
2	Introduction to Environmental Engineering & water quality, demand and supply	CO 1	T 2,3
3	Importance and Necessity for Planned Water Supplies	CO 1	T 2,3 & R 1
4	Need for Protected Water Supply	CO 1	T 2,3 & R 1
5	Various Types of Water Demands	CO 1	T 2,3 & R 1
6	Per Capita Demand	CO 1	T 2,3 & R 1
7	Factors Affecting Per Capita Demand	CO 1	T 2,3 & R 1
8	Variations in Demand	CO 1	T 2,3 & R 1
9	Population forecasting Methods and Problems	CO 1, 2	T 2,3 & R 1

10	Geometrical increase Method	CO 1	T 2,3 & R 1
11	Surface Source and Surface Source for Water	CO 1	T 2,3 & R 1
12	Intakes for collecting surface water	CO 1	T 2,3 & R 1
13	Introduction to water treatment and distribution	CO 2	T 2,3 & R 2, 3
14	Treatment unit flow diagram	CO 2	T 2,3 & R 2, 3
15	The Location of Treatment Plant	CO 2	T 2,3 & R 2, 3
16	Screening	CO 2	T 2,3 & R 2, 3
17	Sedimentation	CO 2	T 2,3 & R 2, 3
18	Design aspects of sedimentation tanks	CO 2	T 2,3 & R 2, 3
19	Sedimentation aided with coagulation	CO 2	T 2,3 & R 2, 3
20	Distribution systems, types of layouts of distribution systems	CO 2	T 2,3 & R 2, 3
21	Design of distribution systems, Hardy Cross and equivalent pipe methods and service reservoirs	CO 2	T 2,3 & R 2, 3
22	Introduction to sewage treatment and disposal	CO 2	T 1,2 & R 1, 2
23	Direct discharge of sewage	CO 2	T 1,2 & R 1, 2
24	Definitions of some common terms used in the sanitary engineering	CO 2	T 1,2 & R 1, 2
25	Methods of domestic waste water disposal	CO 2	T 1,2 & R 1, 2
26	Sewerage Systems	CO 3	T 1,2 & R 1, 2
27	Design of sewers, shapes and materials and sewer appurtenances manhole	CO 4	T 1,2 & R 1, 2
28	Ultimate disposal of sewage, sewage farming, dilution.	CO 4	T 1,2 & R 1, 2
29	Introduction Wastewater Treatment	CO 4	T 1,2 & R 1,3
30	Lay out and general outline of various units in a waste water treatment plant	CO 2 & 5	T 1,2 & R 1,3
31	Primary treatment process and design of screens	CO 5	T 1,2 & R 1,3
32	Grit chambers	CO 5	T 1,2 & R 1,3
33	Skimming tanks	CO 5	T 1,2 & R 1,3

34	Sedimentation tanks	CO 2, 5	T 1,2 & R 1,3
35	Principles and design of biological treatment	CO 5	T 1,2 & R 1,3
36	Trickling filters	CO 2, 5	T 1,2 & R 1,3
37	Introduction to design and working of treatment units	CO 2, 5	T 1,2 & R 1,3
38	Construction and design of oxidation ponds	CO 6	T 1,2 & R 1,3
39	sludge digestion tanks design	CO 6	T 1,2 & R 1,3
40	Factors effecting the design of oxidation ponds, design of digestion tank, sludge disposal by drying	CO 6	T 1,2 & R 1,3
41	Septic tanks working principles and design-soak pits	CO 6	T 1,2 & R 1,3
42	Ultimate disposal of waste water, self-purification of rivers and sewage farming	CO 4 & 6	T 1,2 & R 1,3
PROBLEM SOLVING/ CASE STUDIES			
1	Problems on population forecasts	CO 1	T 2,3 & R 1
2	Problems on domestic water demand	CO 1	T 2,3 & R 1
3	Problems based on per capita demand	CO 1	T 2,3 & R 1
4	Problems based variations in demand	CO 1	T 2,3 & R 1
5	Problems on sedimentation analysis	CO 2	T 2,3 & R 2, 3
6	Problems on uniform settling velocity	CO 2	T 2,3 & R 2, 3
7	Examples on coagulation, flocculation and clarifier design	CO 2, 5	T 2,3 & R 2, 3
8	Problems on design of filters	CO 4	T 2,3 & R 2, 3
9	Types of layouts of distribution systems and Problems design of distribution systems	CO 1, 3	T 2,3 & R 2, 3
10	Problems on sewage and storm water estimation	CO 3	T 1,2 & R 1, 2
11	Problems on B.O.D. and C.O.D. equations	CO 3	T 1,2 & R 1, 2
12	Problems on design of sewers, appurtenances manhole and inverted siphon	CO 5	T 1,2 & R 1, 2
13	Examples on catch basins, flushing tanks, ejectors, pumps and pump houses	CO 5	T 1,2 & R 1, 2
14	Problems of on oxidation ponds design	CO 6	T 1,2 & R 1,3

15	Problems of on digestion tank design and soak pits	CO 6	T 1,2 & R 1,3
DISCUSSION OF DEFINITION AND TERMINOLOGY			
1	Brief note on Per ca1pita demand, Domestic water demand, Industrial demand and Institution and commercial demand	CO 1	T 2,3 & R 1
2	Analysis on coagulation, flocculation filtration Hardy Cross and equivalent pipe methods	CO 2 & 5	T 2,3 & R 2, 3
3	Basic definitions on Basic Refuse garbage sullage sewage storm water sanitary sewage and sewers	CO 3 & 4	T 2,3 & R 2, 3
4	Over view on screens, grit chambers, skimming tanks and sedimentation tanks	CO 5	T 2,3 & R 2, 3
5	Brief note on oxidation ponds, sludge digestion tanks and their purposes	CO 6	T 2,3 & R 2, 3
DISCUSSION OF QUESTION BANK			
1	Protected water supply, population forecasts, design period, water demand and types of demand	CO 1	T 2,3 & R 1
2	Design of distribution systems, Hardy Cross and equivalent pipe methods	CO 1 & 2	T 2,3 & R 2, 3
3	Conservancy and water carriage systems and B.O.D. and C.O.D. equations	CO 3 & 4	T 2,3 & R 2, 3
4	Design of screens, grit chambers, skimming tanks-sedimentation tanks-principles	CO 5	T 2,3 & R 2, 3
5	Design of oxidation ponds and sludge digestion tanks	CO 6	T 2,3 & R 2, 3

Signature of Course Coordinator **HOD-CE**

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

COURSE DESCRIPTION

Department	**CIVIL ENGINEERING**				
Course Title	**CONSTRUCTION ENGINEEERING AND MANAGEMENT**				
Course Code	ACEC36				
Program	B.Tech				
Semester	VII				
Course Type	Core				
Regulation	UG-20				
Course Structure	Theory			Practical	
	Lecture	Tutorials	Credits	Laboratory	Credits
	3	0	3	-	-
Course Coordinator	Mr.S.Selvaprakash , Assistant Professor				

I COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites
-	-	-	-

II COURSE OVERVIEW:

This course deals with the designing, planning, construction, and management of infrastructures such as roads, bridges, airports, railroads, buildings, dams, and other projects. This course helps to know the implementation of safety aspects and to know different legal aspect and its provisions during the execution of civil engineering project. This course addresses the modern construction materials, techniques and effective construction management practices.This course also focuses on the resources management efficiently for successful completion of construction projects.

III MARKS DISTRIBUTION:

Subject	SEE Examination	CIE Examination	Total Marks
Construction Engineering and Management	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 20 marks for continuous internal examination (CIE) and 10 marks for Alternative Assessment Tool (AAT).

Component		Marks	Total Marks
CIA	Continuous Internal Examination – 1 (Mid-term)	10	30
	Continuous Internal Examination – 2 (Mid-term)	10	
	AAT-1	5	
	AAT-2	5	
SEE	Semester End Examination (SEE)	70	70
Total Marks			100

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:

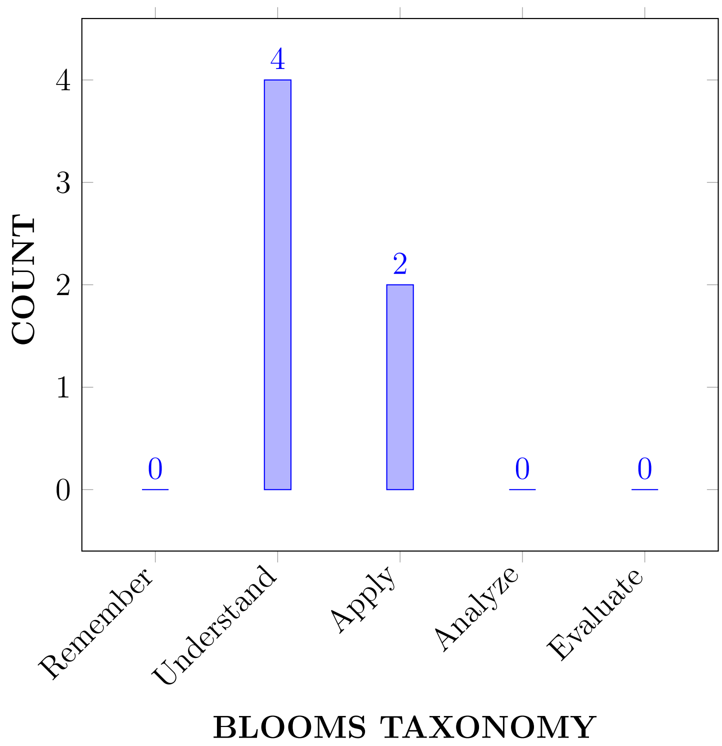
I	The construction project schedules, documents for planning and management of construction processes.
II	The various types of planning tools like bar chart, CPM networks and PERT analysis.
III	The different methods of project delivery, roles and responsibilities of all constituencies involved in the design and construction process.
IV	The various types of construction contracts, their legal aspects and provisions.

VII COURSE OUTCOMES:

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

CO 1	**Explain** Various management Principles for Planning, decision making and improve the leadership qualities.	Understand
CO 2	**Apply** CPM AND PERT techniques for detailed construction planning and excuation of various projects.	Apply
CO 3	**Illustrate** the planning and organization at site layout for controlling manpower, inventory and procurment.	Understand
CO 4	**Apply** line of balance of techniques for Resource aggregation and allocation	Apply
CO 5	**Makeuse** BIM techniques in project management for Controlling Quality and safety of constructed structures .	Understand
CO 6	**Explain** The various cost involed in construction projects for preparing proper contracts and tender documents.	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
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 9	**Individual and team work**: unction effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.	3	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.	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 2	Focus on improving performance of structures with reference to safety and serviceability and sustainable green building technology	2	Quiz / 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	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	Explain the knowledge and **principals of Planning and decision making** to improve the leadership qualities using the knowledge of **science and engineering fundamentals.**	2
	PO 9	Analyze **Individual and team work** the engineering problems Function effectively as an individual, and as a member or leader **organisation and human relations.**	4
	PO 11	Understanding **Management process** the engineering and management principles **for an various difffrent industry organisation and management.**	3
CO 2	PO 1	Explain **Stages of Project planning, pre-tender and pre construction planning** to improve the roughcost estimation quantities using the knowledge of **science and engineering fundamentals.**	3
	PO 2	Understand the given **problem statement and identify to formulate**complex engineering problems related to Construction **translate the information** in to the model and prototype system from the provided information and data, **solutions**based on the functionality of CPM and PERT Technquies **validate** the condition of construction in reaching substantiated conclusions by **interpretation** of results.	6
	PO 5	Create the Modern tool usage of planning and schedulling **PERT Chart Software** and ensure its **for the purpose of all aspects of the problem including Cost, labour and maintenance** of construction.	1
	PO 11	Understanding **Project planning and scheduling** the engineering in diffrents methods are used in **CPM and PERT METHODS**	3

Course Outcomes	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key competencies matched.
	PSO 3	Make use of project management sofware **GANNT CHART Project planning and schedulling**	3
CO 3	PO 1	Determine various planning engineering and organizing construction sites and resources are **site layout, materials, equipment, resources sheduling , sources of funds, documentation at site** in construction	3
	PO 9	Analyze **Individual and team work** the engineering problems in construction planning due to **environment affect individual owner and project leader.**	4
	PO 11	Define **cost of materials , labour and equipment** in diffrents construction of building	3
CO 4	PO 1	Identify the labour, materials how much quantity used in construction **daily labour report and perodic progress reports engineering fundamentals** uses of materials.	3
	PO 5	Create the Modern tool usage of project management **BIM Software** and ensure its for the purpose of all aspects of the problem including **Quality and safety maintenance** of Constructed structures.	1
	PO 11	Makeuse of **quality and safety of materials** given project monitoring and control construction of building	3
	PSO 3	Make use of project management sofware **BIM BUILDING INFORMATION MODELLING**	3
CO 5	PO 1	Develop a construction costs and contracts engineering problems related to real world applications along with enhanced performance with minimum affordability principles of **engineering fundamentals and** their **integration and support with other engineering disciplines Mathematics.**	2
	PO 9	Analyze **Individual and team work** the construction of projects main important **cost of construction and contracts of building**	4
	PO 11	Develop most economical for **improving the construction costs structures**with day by day **classification of costs for labor, material, machines**	3
	PSO 2	Focus on improving performance of structures **safety serviceability and sustainability of construction cost**	3
CO 6	PO 1	Explain **Stages of Project construction contarct and tender** to improve the roughcost estimation quantities using the knowledge of **science and engineering fundamentals.**	3
	PO 9	Analyze **Individual and team work** the construction of projects main important **contarcts and tender**	4

Course Outcomes	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key competencies matched.
	PO 11	Develop most economical for **improving the construction costs structures** year of cost **tender and contracts**	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	-	3	-	-	-	-
CO 2	3	6	-	-	1	-	-	-	-	-	3	-	-	-	3
CO 3	3	-	-	-	-	-	-	-	9	-	3	-	-	-	-
CO 4	3	-	-	-	1	-	-	-	-	-	3		-	-	3
CO 5	2	-	-	-	-	-	-	-	4	-	3	-	-	2	-
CO 6	3	-	-	-	-	-	-	-	4	-	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	0.0	0.0	0.0	0.0	0.0	0.0	0.0	33.3	0.0	30.0	0.0	0.0	0.0	0.0
CO 2	100	60.0	0.0	0.0	100	0.0	0.0	0.0	0.0	0.0	30.0	0.0	0.0	0.0	100
CO 3	100	0.0	0.0	0.0	0.0	0.0	0.0	0.0	75.0	0.0	30.0	0.0	0.0	0.0	0.0
CO 4	100	0.0	0.0	0.0	100	0.0	0.0	0.0	0.0	0.0	30.0	0.0	0.0	0.0	100
CO 5	66.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	33.3	0.0	30.0	0.0	0.0	100	0.0
CO 6	100	0.0	0.0	0.0	0.0	0.0	0.0	0.0	33.3	0.0	30.0	0.0	0.0	0.0	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	2	-	-	-	-	-	-	-	1	-	1	-	-	-	-
CO 2	3	2	-	-	3	-	-	-	-	-	1	-	-	-	3
CO 3	3	-	-	-	-	-	-	-	3	-	1	-	-	-	-
CO 4	3	-	-	-	3	-	-	-	-	-	1	-	-	-	3
CO 5	2	-	-	-	-	-	-	-	1	-	1	-	-	3	-

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 6	3	-	-	-	-	-	-	-	1	-	1	-	-	-	-
TOTAL	16	2	-	-	6	-	-	-	6	-	-	-	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	**ORGANISATION AND HUMAN RELATIONS**
	Management process, Roles, managementtheories, Social responsibilities, planning and strategic management strategy implementation. Decision making: tools and techniques, Organizational structure. Human resource management, motivation performance leadership.
MODULE II	**CONSTRUCTION PROJECT PLANNING**
	Stages of project planning: pre-tender planning, preconstruction planning, detailed construction planning, roleof client and contractor, Networks: basic terminology, types of precedence relationships, preparation of CPMnetworks: activity on link and activity on node representation, computation of float values, critical and semicritical paths, calendaring networks. PERTAssumptions underlying PERT analysis.
MODULE III	**PLANNING AND ORGANIZING CONSTRUCTION SITE AND RESOURCES**
	Site: site layout including enabling structures, developing site organization, Documentation at site; Manpower: planning, organizing, staffing, motivation; Materials: concepts of planning, procurement and inventory control; Equipment: basic concepts of planning and organizing; Funds: cash flow, sources of funds; Histograms and S-Curves. Earned Value; Resource SchedulingBar chart, line of balance technique, resource constraints and conflicts; resource aggregation, allocation, smoothening and leveling.
MODULE IV	**PROJECT MONITORING & CONTROL**

	Supervision, record keeping, periodic progress reports, periodical progress meetings. Updating of plans: purpose, frequency and methods of updating, Basics of Modern Project management systems such as Lean Construction; Use of Building Information Modelling (BIM) in project management; Quality control: concept of quality, quality of constructed structure, use of manuals and checklists for quality control, role of inspection, basics of statistical quality control. Safety and Health.
MODULE V	**CONSTRUCTION COSTS & CONTRACTS**
	Make-up of construction costs; Classification of costs, time-cost trade-off in construction projects, time and cost overruns and corrective measures. Contract, Types of contract, contract document, specification, important conditions of contract, tender and tender document.

TEXTBOOKS

1. Ghalot, P.S., Dhir,D. M., Construction Planning and Management, Wiley Eastern Limiled,1992.
2. Chitkara,K K., Construction Project Management. Tata McGraw Hill Publishing Co, Ltd., New Delhi, 1998.
3. Punmia,B. C., Project Planning and Control with PERT and CPM, Laxmi Publications, new deIhi,1987.

REFERENCE BOOKS:

1. Sengupta, Guha, —Construction Management And Planning‖. Tata McGraw-Hill Inc, 1994.
2. George J.Ritz , —Total Construction Project Management‖, McGraw-Hill Inc, 1994.

WEB REFERENCES:

1. https://nptel.ac.in/courses/105106149

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	Management process	CO 1	T1: 1.8-1.9, T1: 2.28-2.28.2
3	Roles, management theories,	CO 1	T1: 1.13-1.1

4	Social responsibilities	CO 1	T1:2.1-2.6, T1: 2.18, R2:5.1
5	planning and strategic management	CO 1	T1: 5.1-5.3
6	strategy implementation.	CO 1	T1: 5.4-5.5
7	Decision making: tools and techniques	CO 1	T1: 3.2-3.4, R2:6.3
8	Organizational structure.	CO 1	T1: 3.7-3.9
9	Human resource management, motivation performance leadership.	CO 1	T1: 3.15-3.18, R2:6.5
10	Stages of project planning: pre-tender planning	CO 2	T1:3.26-3.27, T1:3.19-3.20, T2 :3.50
11	detailed construction planning, role of client	CO 1	T2 :3.6-3.7, R1:7.1
12	contractor, Networks in construction planning	CO 1	T2:3.8-3.9
13	types of precedence relationships,	CO 2	T2:3.9-3.11, R1:7.5
14	preparation of CPMnetworks	C02	T2: 6.1-6.4, R2:7.2
15	activity on link and activity on node representation	CO 2	T1:6.3-6.36
16	computation of float values	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	critical and semicritical paths,	CO 2	T1: 6.4-6.5, R1:8.5
19	calendaring networks	CO 2	T1: 6.7.1-6.7.7.15
20	PERTAssumptions underlying PERT analysis.	CO 2	T1: 6.7-6.8
21	Site: site layout including enabling structures	CO 3	T1: 4.2-4.3
22	developing site organization	CO 3	T1: 7.2, R1:8.6

23	Documentation at site; Manpower: planning, organizing	CO 3	T1: 7.3, R1:8.8
24	Documentation at site; staffing, motivation;	CO 3	T1: 7.4
25	Materials: concepts of planning, procurement	CO 3	T1: 7.6, R1:9.1.4
26	shrinkage, types of shrinkage	CO3	T1: 7.8
27	Equipment: basic concepts of planning and organizing;	CO 3	T1: 7.7 R2:9.2.1
28	Funds: cash flow, sources of funds; Histograms and S-Curves	CO 3	T1: 7.8 R1: 6.8-6.9
29	Earned Value; Resource Scheduling	CO 3	T1: 10.1-10.2, R1:4.2.3
30	Bar chart, line of balance technique	CO 3	T1:10.7-10.9
31	resource constraints and conflicts methods	CO3	T1:10.8-10.11, R1: 10.1-10.2
32	resource aggregation, allocation, smoothening and leveling.	CO 3	T1:8.1-8.3
33	Supervision, record keeping, periodic progress reports	CO 4	T1:8.1.1-8.1.4
34	periodical progress meetings. Updating of plans	CO 4	T1:8.2
35	frequency and methods of updating	CO 4	T1:8.3
36	Use of Building Information Modelling (BIM) in project management	CO 4	T1:11.3
37	Quality control: concept of quality, quality of constructed structure	CO 4	R1:9.2
38	use of manuals and checklists for quality control,	CO 4	R1:11.5
39	role of inspection, basics of statistical quality control	CO 4	R1:11.5-11.7
40	Safety and Health.	CO 4	T1:11.9
41	Make-up of construction costs;	CO 5	T1:11.13
42	Classification of costs, time-cost trade-off in construction projects	CO 5	T1:11.13
43	time and cost overruns and corrective measures.	CO 6	T1:11.13
44	Contract, Types of contract, contract document	CO 6	T1:11.13
45	specification, important conditions of contract, tender and tender document	CO 6	T1:11.13

PROBLEM SOLVING/ CASE STUDIES			
1	Contractual Perspective for BIM Utilization in US Construction Projects	CO 4	T1:11.13-11.14
2	Design the concrete Comparative Analysis of Safety Climate in the Chinese, Australian, and Indonesian Construction Industries	CO 4	R2:14.2-14.3
3	Job Quality and Construction Workers' Mental Health: Life Course Perspective	CO 3	R2:14.15
4	Understanding Sustainability in Off-Site Construction Management: State of the Art and Future Directions	CO 3	R1:12.8
5	Reinforcement Learning in Construction Engineering and Management	CO 1	T1:12.10
6	Influencing Factors of Early Termination for PPP Projects Based on Multicase Grounded Theory."	CO 1	R1:12.10.2
7	Blockchain Technology in the Construction Industry: Current Status, Challenges, and Future Directions."	CO 5	R1:12.13
8	DAssessing Project Contingency Reserves with the Expected Cost Overrun Risk Measure	CO 6	R1:12.13.2
9	BIM Critical-Success Factors in the Design Phase and Risk Management: Exploring Knowledge and Maturity Mediating Effect."	CO 4	R2:16.1-16.9
10	How International Construction Arbitrators Make Their Decisions: Status of Commercial Norms and International Construction Law."	CO 6	T1:13.1-13.4
DISCUSSION OF DEFINITION AND TERMINOLOGY			
1	Organisation and human relations	CO 1	R1:12.8
2	construction project planning	CO 2	T1:12.10
3	planning and organizing constuction site and resources	CO 3	R1:12.10.2
4	project monitoring and control	CO 4	R2:14.2-14.3
5	construction costs	CO 5	R2:14.2-14.3
6	Tender and contarcts	CO 6	R2:14.2-14.3

DISCUSSION OF QUESTION BANK			
1	Organisation and human relations	CO 1	R1:12.8
2	construction project planning	CO 2	T1:12.10
3	planning and organizing constuction site and resources	CO 3	R1:12.10.2
4	project monitoring and control	CO 4	R2:14.2-14.3
5	construction costs	CO 5	R2:14.2-14.3
6	Tender and contarcts	CO 6	R2:14.2-14.3

Signature of Course Coordinator **HOD,CE**

Mr. S.Selvaprakash, Assistant Professor

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

Department	CIVIL ENGINEERING				
Course Title	ADVANCE STRUCTRAL DESIGN LABORTARY				
Course Code	ACEC44				
Program	B.Tech				
Semester	VII	CE			
Course Type	Core				
Regulation	IARE - UG20				
Course Structure	Theory			Practical	
	Lecture	Tutorials	Credits	Laboratory	Credits
	-	-	-	3	1.5
Course Coordinator	Mr. Gude Ramakrishna, Associate Professor				

I COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites
-	-	-	-

II 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.

III MARKS DISTRIBUTION:

Subject	SEE Examination	CIE Examination	Total Marks
Advance Structural Design 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.

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. **Programming Based**

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

VI COURSE OBJECTIVES:

The students will try to learn:

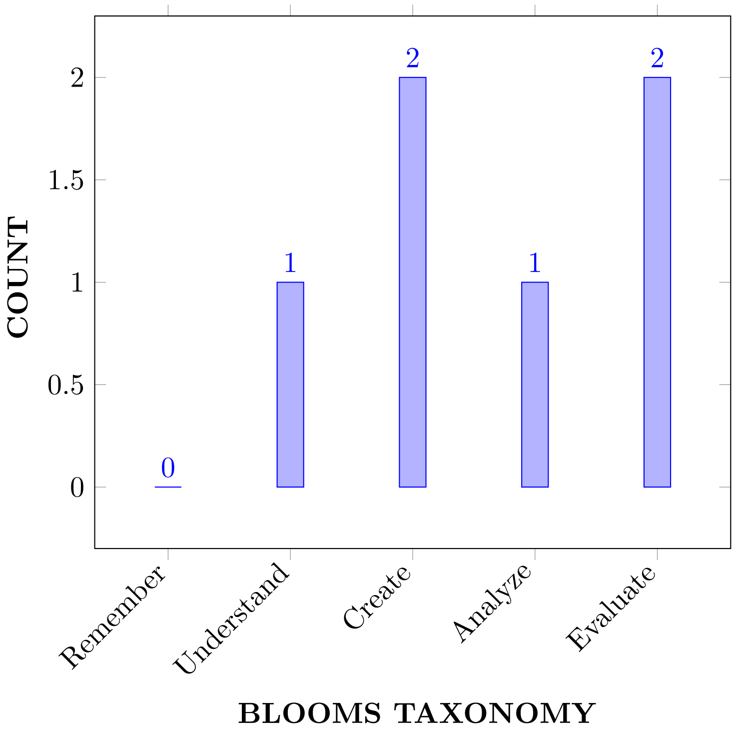
I	Study the basic elements with different loading type and supports with the aid of STAAD Pro software.
II	Analyze and design 2D Frame and multi-storey buildings with different load sets.
III	Synthesize steel structures with truss elements subjected to lateral load.
IV	Analysis and design of different types footing.

VII COURSE OUTCOMES:

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

CO 1	**Describe** the software usages and produce structural drawing for structural members.	Understand
CO 2	**Explain** the procedure to design the beams in STAAD Pro.	Analyze
CO 3	**Design** of structural elements/components, application to multistoried building .	Create
CO 4	**Assess** the wind loads to design structural members as per STAAD Pr.	Evaluate
CO 5	**Explain** and design plane frame and truss subjected to different type of loading .	Analyze
CO 6	**Design** detailing and estimations of RC structural members like Footings.	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.
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.	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	Guest Lectures
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	Software

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.	3	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	Apply the knowledge and **principals of mathematics** to engineering problems using the knowledge of **science and engineering fundamentals.**	2
	PSO 1	Explain the procedure to prepare structural members 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 preparation of drawings using the knowledge of **science and engineering fundamentals**.	2

	PO 3	Determine the accuracy of structural member **investigation** and ensure its **fitness for the purpose of all aspects of operation and maintenance** of concrete structures.	2
	PO 5	**Select and apply appropriate techniques** for determining and**understanding the limitations**.implemented to solve programs for complex engineering activities.	1
	PSO 1	Select suitability of structural member 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 preparation of STAAD pro software 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 using the knowledge of **science and engineering fundamentals.**	2
	PO 3	Determine the accuracy of structural member **investigation** and ensure its **fitness for the purpose of all aspects of operation and maintenance** of concrete structures.	3
	PO 5	**Select and apply appropriate techniques** for preparation of STAAD pro software by **understanding the limitations**	1
	PSO 1	Explain the procedure to prepare structural members of residential and public buildings with **materials knowledge** and ensure **quality assurance**.	5
CO 5	PO 3	Determine the accuracy of structural member **investigation** and ensure its **fitness for the purpose of all aspects of operation and maintenance** of concrete structures.	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 accuracy of structural member **investigation** and ensure its **fitness for the purpose of all aspects of operation and maintenance** of concrete structures.	2

	PSO 1	Select suitability of structural member by testing their fineness based on **structural design and material knowledge** for **strength assessment**.	2

XII 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	
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	

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	66.7	0.0	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	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

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	3	0	0	0	0	0	3	0	0	0	0	0	1	0	0
CO 2	3	0	1	0	3	0	0	0	0	0	0	0	1	0	0
CO 3	0	0	1	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	2	0	0
CO 5	0	0	1	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	1	0	0
TOTAL	13	0	2	0	3	0	6	0	0	0	0	0	4	0	0
AVERAGE	3	0	1	0	3	0	3	0	0	0	0	0	1	0	0

XV ASSESSMENT METHODOLOGY DIRECT:

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

XVI ASSESSMENT METHODOLOGY INDIRECT:

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

XVII SYLLABUS:

WEEK I	**INTRODUCTION TO STAAD PRO**
	Introduction and commands.
WEEK II	**ANALYSIS OF CONTINUOUS BEAM**
	Analysis of continuous beam for different loads.
WEEK III	**ANALYSIS OF SINGLE STOREY FRAME**
	Analysis of single frame.
WEEK IV	**ANALYSIS OF MULTI-STOREY FRAME**
	Analysis of multistoried frame.
WEEK V	**DESIGN OF MULTI-STOREY FRAME**
	Design of multi storied frame for different loads.
WEEK VI	**ANALYSIS OF MULTI-STOREYED BUILDING**
	Analysis of multi storied building.
WEEK VII	**DESIGN OF MULTI-STOREYED BUILDING**
	Design of multistoried building.
WEEK VIII	**WIND LOAD ANALYSIS ON RCC BUILDING**
	Wind load analysis for 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 AND DESIGN OF TRAPEZODIAL FOOTING**
	Analysis and design of trapezoidal footing.

TEXTBOOKS

1. Vargis, "Concrete Structures, Theory & Practice", S. Chand and Co,2004.
2. Neelam Sarma, "Reinforced Concrete Structures Design", Tata McGraw Hill,2004.

REFERENCE BOOKS:

1. Laboratory Manual on structural design lab, CBS Publishers Pvt. Ltd., New Delhi, 2nd Edition, 2013.
2. Punimia —Design of concrete structures , Tata McGraw Hill Education, 2012.

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 and commands.	CO 1	R1: 2.4
2	Analysis of continuous beam for different loads.	CO 3	R2: 4 2
3	Analysis of single frame .	CO 2	R1: 4.3
4	Analysis of multistoried frame.	CO 3	R1: 3.2
5	Design of multi storied frame for different loads.	CO 3	R1: 5.4
6	Analysis of multi storied building.	CO 4	R3: 6.2
7	Design of multistoried building.	CO 2	R3: 7.1
8	Wind load analysis for RCC Building.	CO 4	R2: 6.6
9	Analysis and design of steel truss.	CO 5	R2: 7.2
10	Analysis and design of isolated footing.	CO 5	R1: 8.1
11	Analysis and design of combined footing.	CO 6	R1:8.4
12	Analysis and design of trapezoidal footing.	CO 6	R1:7.3, R2: 8.1

XIX EXPERIMENTS FOR ENHANCED LEARNING (EEL):

S.No	Design Oriented Experiments
1	Structural design laboratory focuses on the elemental technology development of structural design.
2	Advanced methods for the design of structures considering both loading and strength aspects of design.

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	**GROUND IMPROVEMENT TECHNIQUES**				
Course Code	ACEC47				
Program	B.Tech				
Semester	VIII				
Course Type	Professional Elective-5				
Regulation	UG20				
Course Structure	Theory			Practical	
	Lecture	Tutorials	Credits	Laboratory	Credits
	3	-	3	-	-
Course Coordinator	Mr.Gude Ramakeishna , Assistant Professor				

I COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites
B.Tech	ACEC24	VI	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
16.6%	Remember
33.4%	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) and 10 marks for Alternative Assessment Tool (AAT).

Component		Marks	Total Marks
CIA	Continuous Internal Examination – 1 (Mid-term)	10	30
	Continuous Internal Examination – 2 (Mid-term)	10	
	AAT-1	5	
	AAT-2	5	
SEE	Semester End Examination (SEE)	70	70
Total Marks			100

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:

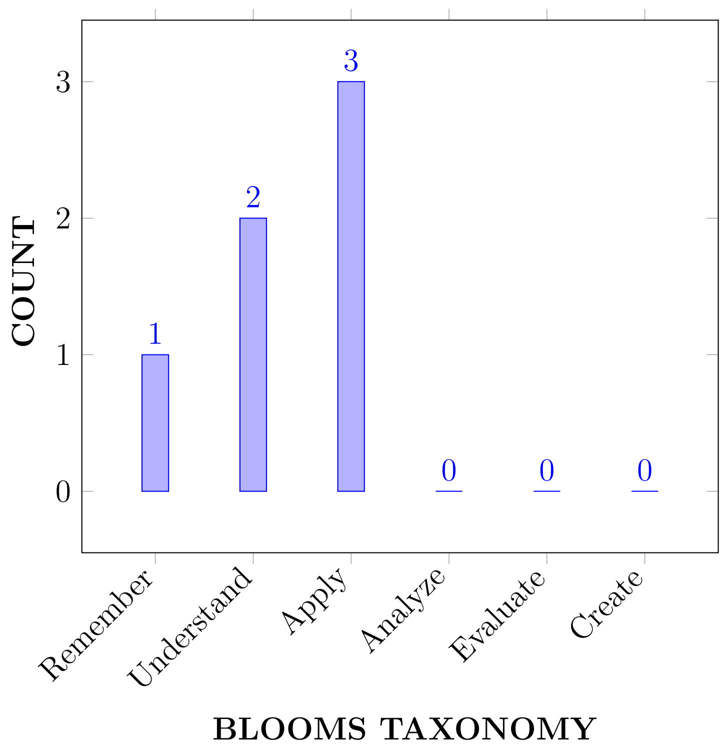
I	The importance and fundamentals of Ground improvement techniques for measuring field parameters by using traditional and modern methods involved in civil construction.
II	The mechanical methods and suitable equipment to proliferate the ground for making the soil to withstand all the loads acting on 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 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.	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
	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

Course Outcomes	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key competencies matched.
	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	-	-

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	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:

MODULE-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.
MODULE-II	**MECHANICAL MODIFICATION**
	Deep compaction techniques, blasting, vibro compaction, dynamic tamping and compaction piles.
MODULE-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.
MODULE-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.
MODULE-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 Description on Outcome Based Education (OBE): Course Objectives, Course Outcomes (CO), Program Outcomes (PO) and CO-PO Mapping	-	https://lms.iare.ac.in
CONTENT DELIVERY (THEORY)			
1	Introduction to ground modification	CO 1	T1:11.1
2	Introduction to ground modification	CO 1	T1:11.1
3	Need and objectives of ground modification techniques.	CO 1	T1:11.4
4	Need and objectives of ground modification techniques.	CO 1	T1:11.4
5	Identification of soil types.	CO 1	T1:16.6
6	Identification of soil types.	CO 1	T1:16.6
7	In Situ and laboratory tests to characterize problematic soils.	CO 1	T1:13.1
8	In Situ and laboratory tests to characterize problematic soils.	CO 1	T1:13.1
9	Mechanical, hydraulic, physic-chemical methods of ground Improvement techniques.	CO 1	R1:13.15
10	Mechanical, hydraulic, physic-chemical methods of ground Improvement techniques.	CO 1	R1:13.15
11	Electrical, Thermal methods, and their applications of ground Modification.	CO 1	T1:13.3 R1:15.5
12	Introduction to mechanical modification	CO 2	T1:13.8
13	Analyzing Deep Compaction techniques	CO 2	T1:13.9
14	Analyzing Deep Compaction techniques	CO 2	T1:13.9
15	Blasting vibro- compaction	CO 2	T1:14.3
16	Blasting vibro- compaction	CO 2	T1:14.3
17	Objectives and techniques of hydraulic modification	CO 3	T1:15.9
18	Objectives and techniques of hydraulic modification	CO 3	T1:15.9
19	Traditional dewatering methods and their choice	CO 3	T1:15.5
20	Traditional dewatering methods and their choice	CO 3	T1:15.5
21	Design of dewatering system	CO 3	T1:15.6
22	Design of dewatering system	CO 3	T1:15.6
23	Electro-osmosis technique.	CO 3	T1:15.8
24	Electro-osmosis technique.	CO 3	T1:15.8
25	Electro kinetic dewatering technique.	CO 3	T1:16.9
26	Filtration technique used in geo-synthetics.	CO 4	T1:16.5
27	Preloading the vertical drains.	CO 4	T1:16.3

28	Preloading the vertical drains.	CO 4	T1:16.3
29	Shotcreting and Guniting Technology.	CO 5	T1:17.22
30	Shotcreting and Guniting Technology.	CO 5	T1:17.22
31	Modification at depth by grouting.	CO 5	T1:17.22
32	Modification at depth by grouting.	CO 5	T1:17.22
33	Crack grouting and compaction grouting.	CO 5	T1:19.3
34	Crack grouting and compaction grouting.	CO 5	T1:19.3
35	Jet grouting technique, Thermal modification, Ground freezing.	CO 5	T1:19.6.1
36	Jet grouting technique, Thermal modification, Ground freezing.	CO 5	T1:19.6.1
37	Modification by inclusions and confinement.	CO 6	R2:19.6.2
38	Modification by inclusions and confinement.	CO 6	R2:19.6.2
39	Soil reinforcement and grid reinforced soil.	CO 6	R2:21.6.2
40	Soil reinforcement and grid reinforced soil.	CO 6	R2:21.6.2
41	Physical and Chemical Modification of admixtures.	CO 5	R2:22.6.3
42	Physical and Chemical Modification of admixtures.	CO 5	R2:22.6.3
43	Reinforced soils, grid soils	CO 6	T1:17.4
44	Reinforced soils, grid soils	CO 6	T1:17.4
45	Rock bolting and soil nailing	CO 6	R2:17.2.1
PROBLEM SOLVING/ CASE STUDIES			
1	Identification of soil types	CO 1	T1: 5.1-5.4 R2: 5.1-5.5
2	In situ and laboratory tests	CO 1	T1: 6.1-6.8 R2: 6.1-6.4
3	Compaction factor test sieve analysis.	CO 1	T1: 7.1-7.6
4	Index properties tests.	CO 3	T1: 5.2; 6.2
5	Permeability tests	CO 1	T2: 6.3 R4: 10.6
6	Hydraulic methods	CO 1	T2: 6.3 R4: 10.7
7	Application of GIT methods	CO 1	T2: 6.2 R4: 10.3-10.5
8	Deep compaction techniques.	CO 2	T2: 14.7-14.8
9	Dynamic tamping.	CO 2	T2: 26.5-26.10 R4: 3 - 5
10	Compaction piles	CO 2	T3: 10.2-10.8
11	Electro-osmosis, electro kinetic dewatering	CO 3	T1: 14.1-14.3
12	Filtration, drainage and seepage control	CO 4	T2: 14.4-14.6
13	Types of geosynthetics-I.	CO 4	T3: 3.1-3.12 R1: 8.1-8.7
14	Application of GIT methods	CO 5	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, 2, 3	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 1, 2, 3	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 4, 5, 6	T3: 10.2-10.8 T4: 14.7-14.8 R4: 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 4, 5, 6	T3: 10.2-10.8 T4: 14.1-14.3 T4: 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 4, 5, 6	T3: 2.1-3.12 R4: 7.1-7.6, 8.1-8.7
DISCUSSION OF QUESTION BANK			
1	Introduction to Ground Modification 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 Inclusion and Confinement	CO 6	T2: 2.1-3.12 R2: 7.1-7.6, 8.1-8.7

Signature of Course Coordinator **HOD,CE**

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

COURSE DESCRIPTION

<table>
<tr><td>Department</td><td colspan="5">CIVIL ENGINEERING</td></tr>
<tr><td>Course Title</td><td colspan="5">REHABILITATION & RETROFITTING OF STRUCTURES</td></tr>
<tr><td>Course Code</td><td colspan="5">ACEC51</td></tr>
<tr><td>Program</td><td colspan="5">B.Tech</td></tr>
<tr><td>Semester</td><td colspan="5">VIII</td></tr>
<tr><td>Course Type</td><td colspan="5">Core</td></tr>
<tr><td>Regulation</td><td colspan="5">UG-20</td></tr>
<tr><td rowspan="3">Course Structure</td><td colspan="3">Theory</td><td colspan="2">Practical</td></tr>
<tr><td>Lecture</td><td>Tutorials</td><td>Credits</td><td>Laboratory</td><td>Credits</td></tr>
<tr><td>3</td><td>-</td><td>3</td><td>-</td><td>-</td></tr>
<tr><td>Course Coordinator</td><td colspan="5">Mr. A. Rajesh, Assistant Professor</td></tr>
</table>

I COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites
B.Tech	ACEC10	IV	Concrete Technology

II COURSE OVERVIEW:

The main purpose 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 covers the 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. Some of the applications of this course are restoring the structural integrity and performance,modifying the geometry, configuration, or functionality of existing structures to suit changing needs or demands.

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:

<table>
<tr><td>✓</td><td>Power Point Presentations</td><td>✓</td><td>Chalk & Talk</td><td>✓</td><td>Assignments</td><td>x</td><td>MOOC</td></tr>
<tr><td>x</td><td>Open Ended Experiments</td><td>x</td><td>Seminars</td><td>x</td><td>Mini Project</td><td>x</td><td>Videos</td></tr>
<tr><td>x</td><td colspan="7">Others</td></tr>
</table>

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 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).

<table>
<tr><th colspan="2">Component</th><th>Marks</th><th>Total Marks</th></tr>
<tr><td rowspan="4">CIA</td><td>Continuous Internal Examination – 1 (Mid-term)</td><td>10</td><td rowspan="4">30</td></tr>
<tr><td>Continuous Internal Examination – 2 (Mid-term)</td><td>10</td></tr>
<tr><td>AAT-1</td><td>5</td></tr>
<tr><td>AAT-2</td><td>5</td></tr>
<tr><td>SEE</td><td>Semester End Examination (SEE)</td><td>70</td><td>70</td></tr>
<tr><td colspan="3">Total Marks</td><td>100</td></tr>
</table>

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:

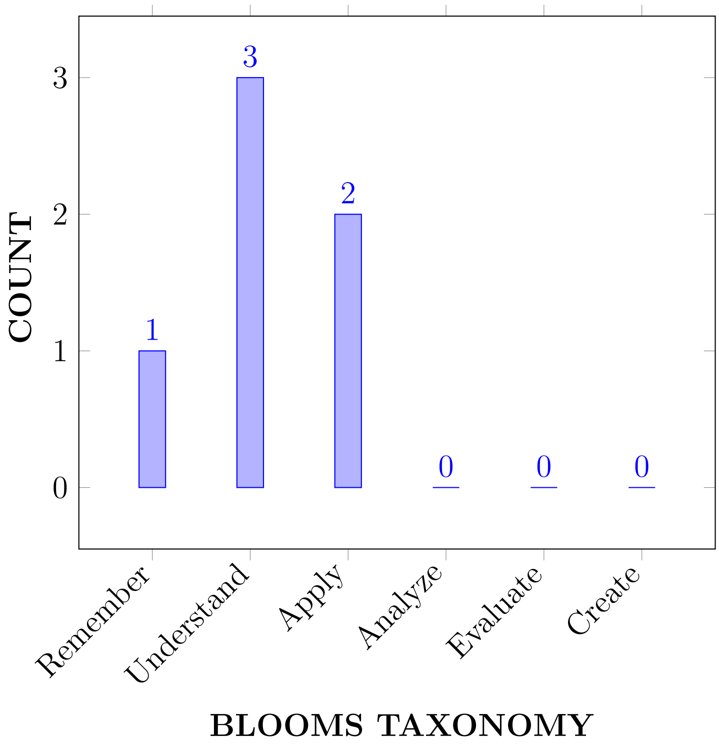
I	The basic concepts of degradation, damage grades in civil structures for evaluating Structural performance by using rehabilitation and retrofitting methods.
II	The knowledge on structural maintenance, repairs and rehabilitation for obtaining assessment of damage in construction failure.
III	The mechanism 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.
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, 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
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	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of key competencies matched.
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≤ 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	1	-	-	-	-	-	-	-	-	-	-	2	-	-
CO 2	-	-	1	1	-	-	-	-	-	-	-	-	1	3	-
CO 3	3	1	-	1	-	-	-	-	-	-	-	-	2	3	-
CO 4	1	-	1	-	3	-	-	-	-	-	-	-	-	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:

MODULE- 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.
MODULE- 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.
MODULE- 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.

MODULE- 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.
MODULE- 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	Deterioration of structures.	CO 1	T2:2.2.2

4	Causes for deterioration of structures	CO 1	T2:2.2.2 R3:3.7
5	Mechanism of damage	CO 1	T2:2.2.2
6	types of damage.	CO 1	T1:8.1
7	damage under accidental loads	CO 1	T1:7.1 R2: 1.2
8	damage under cyclic loads	CO 1	T2:3.2.3 R2: 1.3
9	cracking in structures	CO 2	T2:4.2.3
10	cracking in structures	CO 2	T2:4.5.2
11	evaluation of damage	CO 2	T2:4.7.9
12	Defibitions of Maintenance, repair and rehabilitation	CO 2	T2:5.2.1 R2: 6.4
13	facets of maintenance	CO 3	T2:5.4
14	importance of maintenance	CO 3	T2:5.5.3
15	various aspects of inspection.	CO 3	T2:6.2.2
16	Assessment procedure for evaluating a damaged structure.	CO 3	R1:2.5 R2: 8.2
17	Diagnosis of construction failures.	CO 3	R2:2.2.5 R2: 9.2
18	Corrosion damage of reinforced concrete	CO 3	R3:5.6.2
19	methods of corrosion protection	CO 3	R3:5.4.8 R2: 9.6
20	corrosion inhibitors	CO 4	T2:8.1.2
21	corrosion resistant steels	CO 4	T2:8.3.5 R2: 5.3
22	cathodic protection	CO 4	T2:8.5
23	rust eliminators	CO 4	T2:8.9.2
24	Causes of deterioration of concrete	CO 4	T2:9.2 R3: 4.6
25	Causes of deterioration of steel, masonry and timber structures	CO 5	T2:9.5.3
26	surface deterioration	CO 6	T2:9.6.2
27	efflorescence,	CO 6	T2:9.7.5 R3: 8.12
28	causes and preventive measures.	CO 6	T2:9.6.2
29	coatings for embedded steel and set concrete.	CO 6	T2:9.6.2
30	Special concrete and mortar	CO 6	T2:9.6.2
31	concrete chemicals	CO 6	T2:9.6.2
32	polymer concrete.	CO 6	T2:9.6.2
33	sulphurinfiltrated concrete	CO 6	T2:9.6.2

34	ferro cement	CO 6	T2:9.6.2
35	fiber reinforced concrete	CO 6	T2:9.6.2
36	methods of repair in concrete	CO 6	T2:9.6.2
37	methods of repair in steel, masonry and timber structures	CO 6	T2:9.6.2
38	Gunite and shotcrete, epoxy injection	CO 6	T2:9.6.2
39	Strengthening of existing structures	CO 6	T2:9.6.2
40	repairs to overcome low member strength, deflection	CO 6	T2:9.6.2
41	repairs to overcome cracking, chemical disruption	CO 6	T2:9.6.2
42	weathering, wear, fire, leakage, marine exposure	CO 6	T2:9.6.2
43	use of non-destructive testing techniques for evaluation	CO 6	T2:9.6.2
44	load testing of structure	CO 6	T2:9.6.2
45	demolition of structures using engineered and non-engineered techniques	CO 6	T2:9.6.2
46	case studies	CO 6	T2:9.6.2
PROBLEM SOLVING / CASE STUDIES			
1	Rehabilitation and Retrofitting of Structures.	CO 1	T2:26.3 R2: 3.1
2	Damage of structures	CO 1	T1:8.1
3	Mechanism of damage and types of damage.	CO 1	T2:2.2.2
4	Facets of maintenance	CO 2	T2:26.3 R2: 3.1
5	various aspects of inspection.	CO 2	T2:26.3 R2: 3.1
6	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	Different causes and preventive measures of surface deterioration and efflorescence.	CO 3	T2:26.3 R2: 3.1
9	different methods of repairs in concrete, steel, masonry and timber structures.	CO 4	T2:26.3 R2: 3.1
10	strengthening techniques for existing structures.	CO 4	T2:26.3 R2: 3.1
11	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	Gunite and shotcrete, epoxy injection	CO 5	T2:26.3 R2: 3.1

14	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 5,6	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 5, 6	T1: 4.1

Signature of Course Coordinator **HOD,CE**
Mr. A. Rajesh, Assistant Professor

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

COURSE DESCRIPTION

Department	**CIVIL ENGINEERING**				
Course Title	**SOFT SKILLS AND INTERPERSONAL COMMUNICATION**				
Course Code	AHSC15				
Program	B.TECH				
Semester	VIII				
Course Type	OPEN ELECTIVE				
Regulation	UG-20				
Course Structure	Theory			Practical	
	Lecture	Tutorials	Credits	Laboratory	Credits
	3		3	-	-
Course Coordinator	Mr. Washim Sajjad, Assistant Professor				

I COURSE PREREQUISITES

Level	Course Code	Semester	Prerequisites
IB.Tech	AHSC01	I	Basic principles of soft skills and concepts of functional syntacticalities.

II COURSE OVERVIEW

The objectives of Soft Skills and Interpersonal Communication Skills are to give each student a realistic perspective of work and work expectations. It helps formulate problem solving skills and also it guides students in making appropriate responsible decisions. Besides, it creates a desire to fulfill individual goals, and to educate students about productive thinking, self-defeating emotional impulses, and self- defeating behaviors.

III MARKS DISTRIBUTION:

Subject	SEE Examination	CIE Examination	Total Marks
Soft skills and Interpersonal communication	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	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): 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
80%	Understand
20%	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) and 10 marks for Alternative Assessment Tool (AAT).

Component		Marks	Total Marks
CIA	Continuous Internal Examination – 1 (Mid-term)	10	30
	Continuous Internal Examination – 2 (Mid-term)	10	
	AAT-1	5	
	AAT-2	5	
SEE	Semester End Examination (SEE)	70	70
Total Marks			100

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.

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:

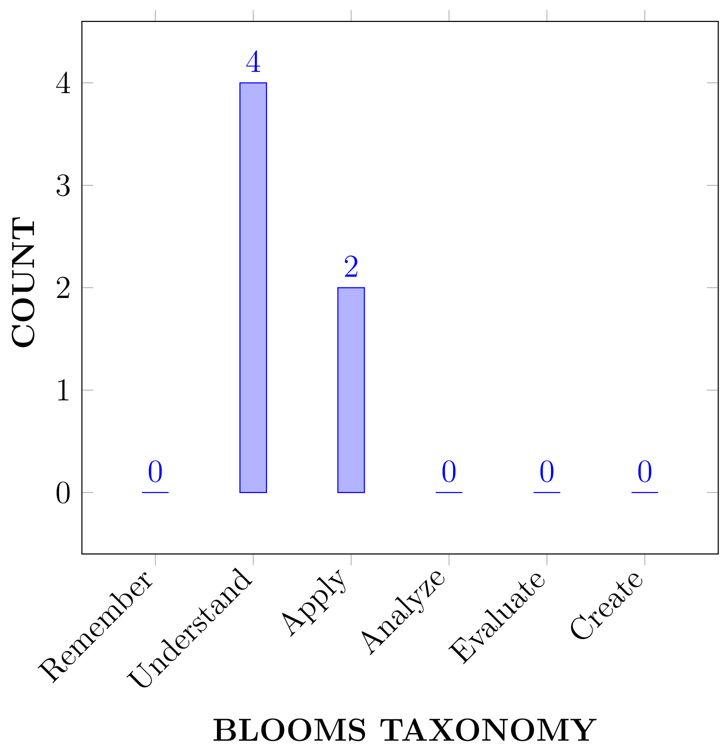
I	Effective communication skills in both spoken and written languages.
II	Well-rounded personalities with a mature outlook, enabling them to function effectively in various formal and informal situations.
III	Self-confidence by mastering inter-personal skills, team management skills, and leadership skills.
IV	Productive presentation skills that provide an advantage when interacting with people at all levels.

VII COURSE OUTCOMES:

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

CO 1	**Apply** soft skills in the development of personality and use them in their daily life.	Apply
CO 2	**Relate** how to listen actively and respond productively to others.	Understand
CO 3	**Classify** the correct usage of English grammar in reading, writing and speaking.	Understand
CO 4	**Demonstrate** the significance of verbal and non-verbal communication in academic and non-academic platforms.	Understand
CO 5	**Explain** some of the strategies and challenges for developing effective speaking skills and they can be applied to enhance reading skills for understanding the content of advanced-level textbooks and all types of written data.	Understand
CO 6	**Develop** various written communication strategies of cover letter writing, resume writing, E-mail writing and report writing.	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.
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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
PO8	**Ethics:**Apply ethical principles and commit to professional ethics and responsibilities and norms of the Engineering practice (Ethics). 1. **Comprises four components: ability to make informed ethical choices, knowledge of professional codes of ethics, evaluates the ethical dimensions of professional practice, and demonstrates ethical behavior.** 2. **Stood up for what they believed in** 3. **High degree of trust and integrity**	3	Seminar/ Conferences/ Quiz/ AAT Assignments/ Discussion
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. 1. **Clarity (Writing)** 2. **Grammar/Punctuation (Writing)** 3. **References (Writing)** 4. **Speaking (Oral)** 5. **Subject Matter (Oral)**	3	Seminar/ Conferences/ Quiz/ AAT Assignments/ Discussion

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 8	Identify the basic **professional ethics** of ethical choices, codes of ethics, professional practice, and ethical behaviour with special respect to the usage of soft skills and personality development. Besides, students are designed to **stand up for what they believed in** and they are encouraged to maintain a **high degree of trust and integrity.**	3
CO 2	PO 10	Understand the nuances of spoken communication with **clarity**. Recognize correct **grammatical** structures, vocabulary, and language patterns used by proficient speakers, thereby enhancing their own **speaking** proficiency.	5
CO 3	PO 10	Interpret how proper **grammar** contributes to clear communication, both in **written** and **oral** contexts and also demonstrate the apt applicability of different rules of grammar in **oral** presentations with **clarity.**	5
CO 4	PO 8	Infer the essential roles of verbal and nonverbal communication in expressing **ethical choices, discussing codes of ethics, evaluating ethical dimensions, demonstrating ethical behavior, standing up for beliefs, and maintaining trust and integrity within professional contexts.**	3
CO 4	PO10	Extend the knowledge on **subject matter** with appropriate **clarity** using with proper **grammatical** structures in both areas of **speaking** and **written** communication practices.	5

Course Outcomes	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key competencies matched.
CO 5	PO 8	Extend effective speaking skills while applying ethical principles and committing to professional ethics in the field of engineering.	3
CO 5	PO 10	Understand how strong speaking skills play a crucial role in the ability to articulate complex ideas clearly and concisely, enabling effective communication about intricate engineering activities with both the engineering community and society at large.	5
CO 6	PO 10	Classify different **oral** and **written** communication strategies through systematic order and also recognize appropriate method in order to understand the writer's point of view with **clarity** while **reading** and practices proper **grammatical** functionalities to understand different **subject matters.**	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	-	-	-	-	-	-	-	3	-	-	-	-	-	-	-
CO 2	-	-	-	-	-	-	-	-	-	5	-	-	-	-	-
CO 3	-	-	-	-	-	-	-	-	-	5	-	-	-	-	-
CO 4	-	-	-	-	-	-	-	3	-	5	-	-	-	-	-
CO 5	-	-	-	-	-	-	-	3	-	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	-	100	-	-	-	-	-
CO 5	-	-	-	-	-	-	-	100	-	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	-	3	-	-	-	-	-
CO 5	-	-	-	-	-	-	-	3	-	3	-	-	-	-	-
CO 6	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-
TOTAL								9		15			-	-	-
AVERAGE								3		3			-	-	-

XVI ASSESSMENT METHODOLOGY-DIRECT:

CIE Exams	✓	SEE Exams	✓	Seminars	✓
Laboratory Practices	-	Student Viva	-	Certification	-
Term Paper	✓	10 Minutes Video	✓	Open Ended Experiments	✓
Assignments	✓				

XVII ASSESSMENT METHODOLOGY-INDIRECT:

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

XVIII SYLLABUS:

MODULE I	**SOFT SKILLS**
	Soft Skills: An Introduction – Definition and significance of soft skills; Process, Importance and application of soft skills, discovering the self; setting goals; positivity and motivation: developing positive thinking and attitude
MODULE II	**EFFECTIVENESS OF SOFT SKILLS**
	Developing interpersonal relationships through effective soft skills; Define Listening, Speaking, Reading and Writng skills; Barriers to Listening, Speaking, Reading and Writing; Essential formal writing skills; Public Speaking: Skills, Methods, Strategies and Essential tips for effective public speaking.
MODULE III	**ORAL AND AURAL SKILLS**
	Sounds of English vowels sounds and consonant sounds, Word Accent and connected speech- contractions, questions tags, Listening for information, Taking notes while listening to lectures (use of Dictionary). Group Discussion: Importance, Planning, Elements, Skills, Effectively disagreeing, Initiating

MODULE IV	**VERBAL AND NON-VERBAL COMMUNICATION**
	Interpersonal communication-verbal and nonverbal etiquette; Body language, grapevine, Postures, Gestures, Facial expressions, Proximity; Conversation skills, Critical thinking, Teamwork, Group Discussion, Impact of Stress; Measurement and Management of Stress
MODULE V	**WRITTEN COMMUNICATION**
	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. Raman Meenakshi, Upadhyay Shalini (2017). Soft Skills: Key to Success in Workplace and Life. Cengage India Private Limited, Noida.

2. Handbook of English for Communication (Prepared by Faculty of English, IARE)

REFERENCE BOOKS:

1. Dorch, Patricia. What Are Soft Skills? New York: Execu Dress Publisher, 2013.

2. Klaus, Peggy, Jane Rohman & Molly Hamaker. —The Hard Truth about Soft Skill, London: HarperCollins E-books, 2007.

3. Kamin, Maxine. Soft Skills Revolution: A Guide for Connecting with Compassion for Trainers, Teams, and Leaders. Washington, DC: Pfeiffer & Company, 2013.

4. Stein, Steven J. & Howard E. Book. —The EQ Edge: Emotional Intelligence and Your Success Canada: Wiley & Sons, 2006

5. Suresh Kumar. English for Success. Cambridge University Press IndiaPvt.Ltd.2010.

6. Dorling Kindersley. Communication Skills & Soft Skills - An Integrated Approach. India Pvt. Ltd. 2013.

WEB REFERENCES:

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

2. www.edufind.com

3. www.myenglishpages.com

4. http://grammar.ccc.comment.edu

5. http://owl.english.prudue.edu

E-TEXT BOOKS:

1. http://bookboon.com/en/communication-ebooks-zip

2. http://www.bloomsbury-international.com/images/ezone/ebook/writing-skills-pdf.pdf

3. http://learningenglishvocabularygrammar.com/files/idiomsandphraseswith meaningsandexamplespdf.pdf

4. http://www.robinwood.com/Democracy/General Essays/CriticalThinking.pdf

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)		T1:06.06
CONTENT DELIVERY (THEORY)			
2	Introduction of soft skills	CO1	T1:06.09
3	Significance of soft skills..	CO1	T1:09.10
4	Process, importance and application of soft skills..	CO1	T1:08:05
5	Discovering one's self-qualities.	CO1	T1:06:02
6	Setting up goals	CO1	T1:04:74
7	Positivity and motivation.	CO1	T1:01:08
8	Developing one's positive thinking and attitude	CO 1	T1:03:01
9	Developing interpersonal relationships through soft skills..	CO2	T1:06:05
10	Significance of listening skills.	CO 2	T1:02:09
11	Significance of speaking skills.	CO 4	T1:26:11
12	Significance of reading skills..	CO 5	T1:46:08
13	Significance of writing skills.	CO 6	T1:16:20
14	Barriers to listening and speaking.	CO 2	T1:13:43
15	Barriers to reading and writing.	CO 5	T1:40:51
16	Essentials of formal writing skills.	CO 6	T1:19:07
17	Developing public speaking skills.	CO4	T1:69:62
18	Methods, strategies of public speaking..	CO 4	T1:5:05
19	Essential tips for effective public speaking.	CO4	T1:46:05
20	Introduction to sounds of vowels and consonants.	CO 4	T1:09:18
21	Contractions and questions tags.	CO 3	T1:07:14
22	Listening for information.	CO 1	T1:32:96
23	Taking notes while listening to lectures.	CO 3	T1:55:21
24	Group discussion and its importance.	CO 2	T1:14:25
25	Planning, elements, skills, effectively, disagreeing, initiating.	CO 2	T1:08:08
26	Developing interpersonal communication skills.	CO4	T1:22:74
27	The role of verbal and nonverbal etiquettes in one's career.	CO1	T1:32:36
28	Significance of body language,	CO 1	T1:78:12
29	Grapevine communication.	CO4	T1:01:08
30	Developing critical thinking.	CO4	T1:04:18
31	Conversation skills at formal and informal situations. .	CO4	T1:06:08
32	The power of group discussion and the role of a team work.	CO4	T1:03:22
33	Impact of stress; measurement and management of stress.	CO4	T1:89:01
34	Significance and effectiveness of writing.	CO 6	T1:01:04
35	Organizing principles of paragraphs in documents;	CO 4	T1:74:32
36	Writing introduction and conclusion	CO 1	T1:25:10
37	Techniques for writing precisely;	CO 6	T1:09:07

38	Letter writing; Formal and Informal letter writing;	CO 6	T1:60:31
39	Rules of E-mail writing.	CO 6	T1:22:12
40	Strategies of report writing.	CO 6	T1:01:01
41	Persuasive writing techniques.	CO 6	T1:01:02
PROBLEM SOLVING/ CASE STUDIES			
42	Soft skills can help someone come out of difficult situations and ensure reassurance along with reliability. think critically and answer	CO 1	R2:7.5
43	Will not hard skills suffice the requirement needed in a corporate setup without soft skills?	CO 1	R2:7.5
44	Do you think soft skills are communication skills? If so, give your reasons	CO 1	R2:7.5
45	Describe the way interpersonal communication can influence the psychological health of individuals with examples.	CO 1	R2:7.5
46	What do you mean by 'assumption' in the communication process and explain with a real -life example?	CO 1	R2:7.5
47	Explain with examples the self-fulfillment and happiness of productive interpersonal communication skills.	CO 1	R2:7.5
48	Explain the importance of learning the sounds of English language for fluent and confident communication.	CO 3	R2:7.5
49	Mispronunciation of English words may lead to miscommunication and misconception. Elaborate with the help of an example.	CO 3	R2:7.5
50	Throw light on word stress which is pivotal for proper differentiation of sounds.	CO 3	R2:7.5
51	Differentiate between verbal and non-verbal communication	CO 4	R2:7.5
52	Classify non-verbal skills and explain the various skills that are important	CO 4	R2:7.5
53	Write down advantages of non-verbal skills	CO 4	R2:7.5
54	What is the meaning of thesis focus? Explain in detail.	CO 6	R2:7.5
55	What do you understand by organization?	CO 6	R2:7.5
56	Support and Elaboration is an extension and development of the topic/subject/ thesis. Comment.	CO 6	R2:7.5
DISCUSSION OF DEFINITION AND TERMINOLOGY			
57	Definition and terminology of soft skills	CO 1	T1:69:08
58	Definition and terminology of contractions	CO 3	T1:65:66
59	Definition and terminology of question tags	CO 3	T1:42:03
60	Definition and terminology of verbal and nonverbal communication	CO 4	T1:78:78
61	Definition and terminology of self discovery	CO 1	T1:09:01

DISCUSSION OF QUESTION BANK			
62	Module I - Soft skills and interpersonal communication	CO 1	R4:2.1
63	Module II - Effectiveness of soft skills	CO 2	T4:7.3
64	Module III - Oral and aural skills	CO 3,4	R4:5.1
65	Module IV - Verbal and nonverbal communication	CO 5	T1:7.5
66	Module V - Interpersonal communication	CO 6	T1: 4.1

Signature of Course Coordinator **HOD**

Mr. Washim Sajjad. Assistant Professor.