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

COURSE DESCRIPTION

Department	**CIVIL ENGINEERING**				
Course Title	**ENGLISH**				
Course Code	AHSB01				
Program	B. Tech				
Semester	I				
Course Type	Foundation				
Regulation	R-18				
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 (Table 2), with 20 marks for Continuous Internal Examination (CIE), 05 marks for Quiz and 05 marks for Alternative Assessment Tool in table

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	Complex Problem Solving
40%	40%	20%

VI COURSE OBJECTIVES:

The students will try to learn:

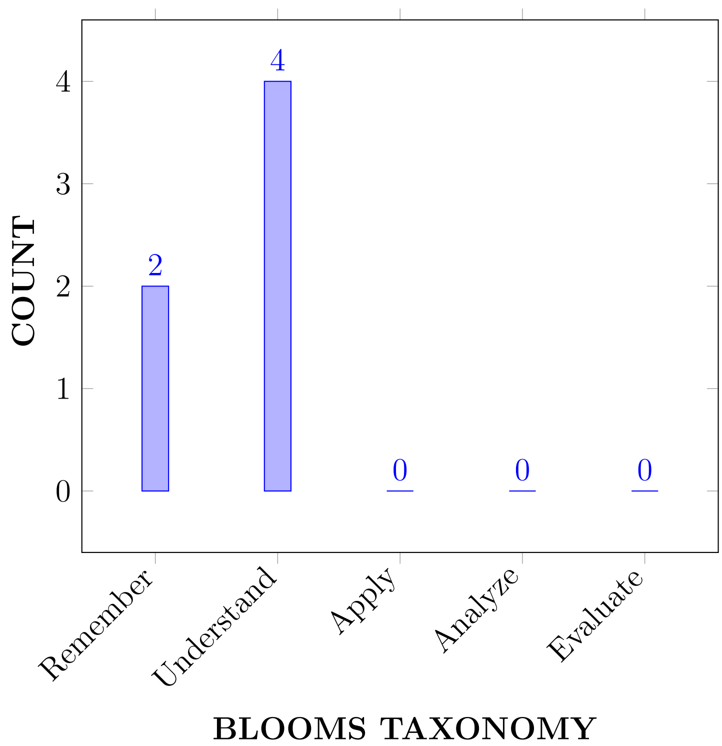
I	Communicate in an intelligible English pronunciation to meet the global standards.
II	Effectively use of four language skills (listening skill, speaking skill, reading skill and writing skill) in day-to-day affairs.
III	A critical aspect of speaking and reading for interpreting in-depth meaning between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

VII COURSE OUTCOMES:

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

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

COURSE KNOWLEDGE COMPETENCY LEVEL



VIII PROGRAM OUTCOMES:

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

IX HOW PROGRAM OUTCOMES ARE ASSESSED:

PROGRAM OUTCOMES		Strength	Proficiency Assessed by
PO 10	**Communication :** Communicate effectively on complex Engineering activities with the Engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions (Communication). "Students should demonstrate the ability to communicate effectively in writing / Orally." 1. Clarity (Writing); 2. Grammar/Punctuation (Writing); 3. References (Writing); 4. Speaking Style (Oral); 5. Subject Matter (Oral).	5	Seminar/ Conferences/ Research Papers IE/AAT / Discussion

3 = High; 2 = Medium; 1 = Low

X HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

PROGRAM SPECIFIC OUTCOMES		Strength	Proficiency Assessed by
PSO 1	Understand, analyze, design and supervise sub-structures and superstructures for residential and public buildings, industrial structures, irrigation structures, powerhouses, highways, railways, airways, docks and harbors.	-	-
PSO 2	Focus on broad knowledge of aeronautical engineering in innovative, dynamic challenging environment for design and development of new products.	-	-
PSO 3	Make use of advanced software for creating modern avenues to succeed as an entrepreneur or to pursue higher studies.	-	-

3 = High; 2 = Medium; 1 = Low

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

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

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	PO 1	PO 2	PO 3	PO 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 1	Discuss the heeds of functional grammar and punctuation tools in speaking and writing by generating the clarity of an audio text.	5
CO 2	PO 10	Illustrate essential aspects of grammar as well as punctuation marks for speaking or writing towards a discussion on a topic to give the clarity.	5
CO3	PO 10	Choose suitable grammatical structures and punctuation marks at speaking and writing areas maintaining clarity at professional platform.	5
CO4	PO 10	Interpret the grammatical knowledge and punctuation marks systematically towards providing the clarity in speaking and writing.	5
CO 5	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 6	T1:103.103
38	Introduction to informal letters.	CO 5	TI:105.108
39	Introduction to formal letters.	CO 5	TI:109.110
40	Introduction of email writing and formal and informal emails.	CO 5	TI:111.112
41	Significance of Report Writing.	CO 6	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 6	TI:100,102
55	Logical bridges and Verbal bridges in writing.	CO 6	TI:102,104
56	Soft skills and Interpersonal Communication.	CO 6	TI:102,104
DISCUSSION OF DEFINITION AND TERMINOLOGY			
57	Soft skills and Interpersonal Communication.	CO 1	TI 8,9
58	Language acquisition is a process.	CO 1	TI: 11,12
59	Communication.	CO 1	TI: 14,16
60	Time management.	CO 3	TI:9,10
61	Stress management.	CO 3	TI:9,10
DISCUSSION OF QUESTION BANK			
62	Soft Skills for difficult situations in terms of reassurance and reliability.	CO 3	TI:9,10
63	Verbal and non-verbal communication.	CO 2	TI: 34,35

64	Honesty, Respect, Self-Control and Accountability their role in building long lasting interpersonal skills?	CO 3	TI: 9,10
65	Etiquette and manners. Its importance in social, personal and professional communication.	CO 2	TI: 9,10
66	Problem solving and decision making.	CO 3	TI: 9,10

Signature of Course Coordinator **HOD CE**

INSTITUTE OF AERONAUTICAL ENGINEERING
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Dundigal, Hyderabad - 500 043

COURSE DESCRIPTION

Department	**CIVIL ENGINEERING**				
Course Title	**LINEAR ALGEBRA AND CALCULUS**				
Course Code	AHSB02				
Program	B.Tech				
Semester	I				
Course Type	Foundation				
Regulation	R - 18				
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
-	-	-	-

II COURSE OVERVIEW:

The course focuses on more advanced Engineering Mathematics topics which provide with the relevant mathematical tools required in the analysis of problems in engineering and scientific professions. The course includes types of Matrices and its applications, maxima and minima of functions of several variables, solutions of higher order ordinary differential equations, multiple integrals and vector calculus. The mathematical skills derived from this course form a necessary base to analytical and design concepts encountered in the program.

III MARKS DISTRIBUTION:

Subject	SEE Examination	CIE Examination	Total Marks
Linear Algebra and Calculus	70 Marks	30 Marks	100

IV CONTENT DELIVERY / INSTRUCTIONAL METHODOLOGIES:

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

V EVALUATION METHODOLOGY:

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

Semester End Examination (SEE): The SEE is conducted for 70 marks of 3 hours duration. The syllabus for the theory courses is divided into FIVE modules and each module carries equal weightage in terms of marks distribution. The question paper pattern is as follows. Two full questions with ”either” or ”choice” will be drawn from each module. Each question carries 14 marks. There could be a maximum of two sub divisions in a question.

The expected percentage of cognitive level of the questions is broadly based on the criteria given in Table: 1.

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), 05 marks for Quiz and 05 marks for Alternative Assessment Tool (AAT).

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

Continuous Internal Examination (CIE):

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

Quiz - Online Examination

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

Alternative Assessment Tool (AAT)

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

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

VI COURSE OBJECTIVES:

The students will try to learn:

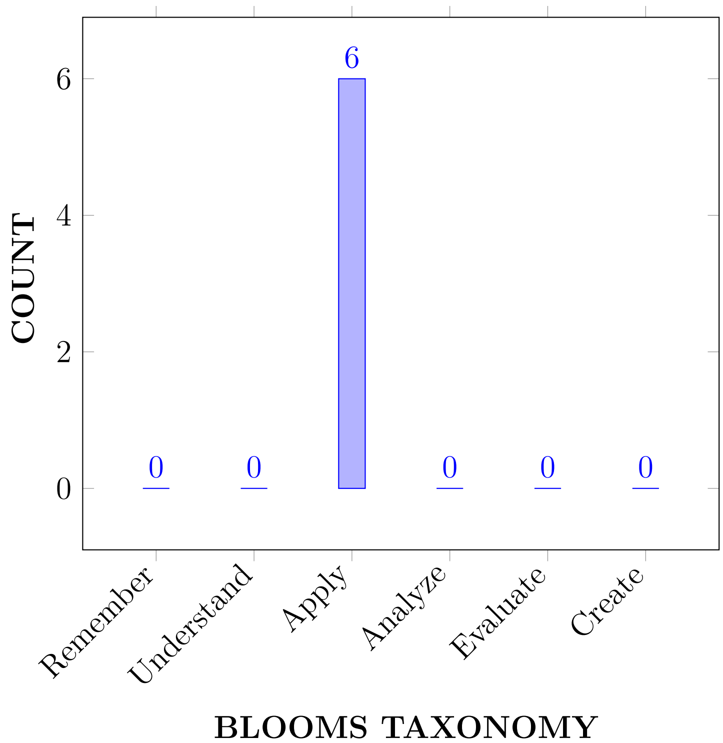
I	Apply and solve linear system of equations by using elementary transformations.
II	Determine the maxima and minima of functions of several variables by using partial differential coefficients.
III	Apply second and higher order linear differential equations to solve electrical circuits.
IV	Apply multiple integration to evaluate mass, area and volume of the plane.
V	Apply gradient, divergence and curl to evaluate the integration over a vector field.

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	**Make use of** Eigen values, Eigen vectors for developing modal, Spectral matrices and Cayley Hamilton for powers of the matrix.	Apply
CO 3	**Utilize** the mean–value theorems and partial derivatives in estimating the extreme values for functions of several variables.	Apply
CO 4	**Solve** the Second and higher order linear differential equations with constant coefficients by using substitution method and method of variation of parameters.	Apply
CO 5	**Apply** the definite integral calculus to a function of two or more variable in calculating the area of solid bounded regions.	Apply
CO 6	**Calculate** scalar and vector point function, line, surface, volume integral for bounded regions.	Apply

COURSE KNOWLEDGE COMPETENCY LEVEL



VIII PROGRAM OUTCOMES:

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

IX HOW PROGRAM OUTCOMES ARE ASSESSED:

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

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	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	**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 diagonally equivalent matrix of given matrix involved in the **complex engineering problems modeled by matrices** with help of Eigen values and Eigen vectors **(principles of mathematics).**	2
	PO 2	**Model** the **problem into matrices** and apply the concepts of Eigen values and Eigen vectors along with **basic principles of mathematics** to **develop the solution.**	5
CO 3	PO 1	**Explain** the mean–value theorems for the single variable functions and extreme values apply them in the **complex engineering problems** modeled by functions of single variables **with their geometrical interpretation and partial derivatives (principles of mathematics).**	2
CO 4	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 **(principles of mathematics)**.	2
	PO 2	**Model** the **problems** with the help of ordinary differential equations and analyze them using substitution method along with **basic principles of mathematics** to **develop the solution** with the help of method of variation of parameters **(principles of mathematics)**	5
CO 5	PO 1	**Apply** the definite integral calculus to a function of two or more variable in **for the complex engineering problems** modeled by given calculating the area of solid bounded regions. **(principles of mathematics).**	2
	PO 2	**Model** the **problem** in to definite integral expansion for the problem using **formulation** of two or more variable along with **basic principles of mathematics** to **develop the solution.**	5
CO 6	PO 1	**Calculate** the scalar and vector point function, line, surface, volume integral for **complex engineering problems** by using **(principles of mathematics).**	2
	PO 2	**Model** the **problem in to vector function** and **then build** the vector function for **develop the solution** and **solve** them in various situations with **basic principles of mathematics.**	5

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

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

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	67	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 2	67	50	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 3	67	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 4	67	50	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 5	67	50	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 6	67	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		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO 1	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 2	3	2	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 3	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 4	3	2	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 5	3	2	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 6	3	2	-	-	-	-	-	-	-	-	-	-	-	-	-
TOTAL	18	8	-	-	-	-	-	-	-	-	-	-	-	-	-
AVERAGE	3	2	-	-	-	-	-	-	-	-	-	-	-	-	-

XVI ASSESSMENT METHODOLOGY-DIRECT:

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

XVII ASSESSMENT METHODOLOGY-INDIRECT:

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

XVIII SYLLABUS:

MODULE I	**THEORY OF MATRICES AND LINEAR TRANSFORMATIONS**
	Real matrices: Symmetric, skew-symmetric and orthogonal matrices; Complex matrices: Hermitian, Skew-Hermitian and unitary matrices; Elementary row and column transformations; Rank of a matrix: Echelon form and normal form; Inverse by Gauss-Jordan method; Cayley-Hamilton theorem: Statement, verification, finding inverse and powers of a matrix; Linear dependence and independence of vectors; Eigen values and Eigen vectors of a matrix and Properties (without proof); Diagonalization of matrix by linear transformation.
MODULE II	**FUNCTIONS OF SINGLE AND SEVERAL VARIABLES**
	Mean value theorems: Rolle's theorem, Lagrange's theorem, Cauchy's theorem-without proof; Functions of several variables: Partial differentiation, chain rule, total derivative, Euler's theorem, functional dependence, Jacobian, maxima and minima of functions of two variables without constraints and with constraints; Method of Lagrange multipliers.
MODULE III	**HIGHER ORDER LINEAR DIFFERENTIAL EQUATIONS AND THEIR APPLICATIONS**
	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,Applications to electrical circuits.
MODULE IV	**MULTIPLE INTEGRALS**
	Double and triple integrals; Change of order of integration. Transformation of coordinate system; Finding the area of a region using double integration and volume of a region using triple integration.
MODULE V	**VECTOR CALCULUS**
	Scalar and vector point functions; Definitions of Gradient, divergent and curl with examples; Solenoidal and irrotational vector point functions; Scalar potential function; Line integral, surface integral and volume integral; Vector integral theorems: Green's theorem in a plane, Stoke's theorem and Gauss divergence theorem without proofs.

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.
4. Dr. M Anita, Engineering Mathematics-I, Everest Publishing House, Pune, First Edition, 2016.

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 2	T2:7.1 R1:7.4
15	Applications of Cayley – Hamilton: Finding Inverse and Powers of a Matrix	CO 2	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 3	T3-2.5 R1:2.8
18	Mean Value Theorems:2: Lagrange's Theorem	CO 3	T3-2.5 R1:2.8
19	Mean Value Theorems:3: Cauchy's Theorem	CO 3	T3-2.5 R1:2.8
20	Functions of Several Variables: Partial Differentiation	CO 3	T3-2.5 R1:2.8
21	Jacobian Transformations	CO 3	T3-2.61 R1:2.10
22	Functional Dependence	CO 3	T1-7.1 R2:7.5
23	Maxima and Minima of Functions with Two Variables	CO 3	T3-2.61 R1:2.10
24	Maxima and Minima of Functions with Three Variables	CO 3	T1-7.1 R2:7.6
25	Application Method of Lagrange Multipliers	CO 3	T1-7.1 R2:7.7
26	Method of Lagrange Multipliers	CO 3	T3-2.5 R1:2.8
27	Linear Differential Equations of Second and Higher Order with Constant Coefficients	CO 4	T3-2.5 R1:2.8
28	Linear Differential Equations of Second and Higher Order with Constant Coefficients	CO 4	T3-2.5 R1:2.8
29	Non-Homogeneous term of the type F (X) = e^{ax}	CO 4	T3-2.5 R1:2.8
30	Non-Homogeneous term of the type F (X) = Sinax , Cosax	CO 4	T2-7.1 R1:7.4
31	Non-Homogeneous term of the type F (X) = X^n	CO 4	T2:7.1 R1:7.4
32	Non-Homogeneous term of the type F (X) = e^{ax}v(X)	CO 4	T2:7.1 R1:7.4
33	Method of Variation of Parameters	CO 4	T3-2.9 R1:2.1
34	Double Integrals	CO 5	T3-2.61 R1:2.10

35	Triple Integrals	CO 5	T1-7.1 R2:7.5
36	Change of order of integrations Cartesian and polar form	CO 5	T3-2.61 R1:2.10
37	Transformation of Coordinate System to Evaluate Double Integral	CO 5	T1-7.1 R2:7.6
38	Surface Area of field	CO 6	T3-2.61 R1:2.10
39	Volume of Field	CO 6	T1-7.1 R2:7.5
40	Green's Theorem	CO 6	T3-2.61 R1:2.10
41	Stokes' Theorem	CO 6	T1-7.1 R2:7.6
PROBLEM SOLVING/ CASE STUDIES			
42	Rank of the Matrix	CO 1	T2:32.1 R1:4.2
43	Eigen Values and Eigen Vectors	CO 2	T2:32.1 R1:4.3
44	Cayley Hamilton Theorem	CO 2	T2:32.1 R1:4.3
45	Spectral Matrix by Linear Transformation.	CO 2	T2-7.1 R1:7.4
46	Jacobian Transformation in Cartesian and Polar Forms	CO 3	T2-7.1 R1:7.4
47	Functional Relationship.	CO 3	T2:7.1 R1:7.4
48	Critical Points.	CO 3	T2:7.1 R1:7.4
49	Non-Homogeneous Differential Equations.	CO 4	T3-2.5 R1:2.8
50	Second Order Non-Homogeneous Differential Equations by Method of Variation of Parameters.	CO 4	T3-2.5 R1:2.8
51	Double Integrals	CO 5	T3-2.61 R1:2.10
52	Triple Integrals	CO 5	T1-7.1 R2:7.5
53	Change of order of integrations Cartesian and polar form	CO 5	T3-2.61 R1:2.10
54	Surface Area of field	CO 6	T3-2.61 R1:2.10
55	Green's Theorem	CO 6	T3-2.61 R1:2.10
56	Stokes' Theorem	CO 6	T1-7.1 R2:7.6
DISCUSSION OF DEFINITION AND TERMINOLOGY			
57	Real, Complex Matrices and Rank of a Matrix	CO 1,2	T3-2.5 R1:2.8

58	Mean value theorems, Jacobian transformations, functionally dependent and independent	CO 3	T3-2.5 R1:2.8
59	Higher order differential equations	CO 4	T3-2.5 R1:2.8
60	Multiple Integrals	CO 5	T3-2.5 R1:2.8
61	Vector Calculus	CO 6	T3-2.5 R1:2.8
DISCUSSION OF QUESTION BANK			
62	Theory of matrices and linear transformations	CO 1,CO 2	T2:7.1 R1:7.4
63	Functions of Several Variables	CO 3	T3-2.5 R1:2.8
64	Higher order differential equations	CO 4	T2:32.1 R1:4.3
65	Multiple Integrals	CO 5	T3-2.5 R1:2.8
66	Vector Calculus	CO 6	T3-2.5 R1:2.8

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

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

COURSE DESCRIPTION

Department	**CIVIL ENGINEERING**				
Course Title	**BASIC ELECTRICAL AND ELECTRONCIS ENGINEERING**				
Course Code	AEEB04				
Program	B.Tech				
Semester	III	CE			
Course Type	Foundation				
Regulation	IARE - R18				
Course Structure	Theory			Practical	
	Lecture	Tutorials	Credits	Laboratory	Credits
	3	1	4	-	-
Course Coordinator	Ms.B Navothna, Assistant Professor				

I COURSE PRE-REQUISITES:

Level	**Course Code**	**Semester**	**Prerequisites**
-	-	-	-

II COURSE OVERVIEW:

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

III MARKS DISTRIBUTION:

Subject	**SEE Examination**	**CIE Examination**	**Total Marks**
Basic Electrical and Electronics Engineering	70 Marks	30 Marks	100

IV CONTENT DELIVERY / INSTRUCTIONAL METHODOLOGIES:

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

V EVALUATION METHODOLOGY:

The course will be evaluated for a total of 100 marks, with 30 marks for Continuous Internal Assessment (CIA) and 70 marks for Semester End Examination (SEE). Out of 30 marks allotted for CIA during the semester, marks are awarded by taking average of two 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
0%	Remember
67%	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), 05 marks for Quiz and 05 marks for Alternative Assessment Tool (AAT).

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

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

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

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

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

VI COURSE OBJECTIVES:

The students will try to learn:

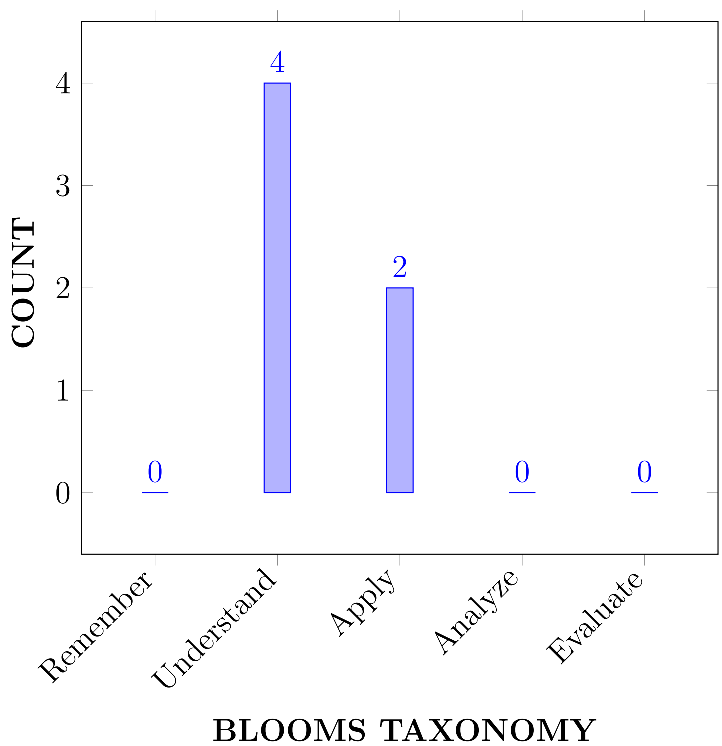
I	Understanding of the basic elements encountered in electric networks, and operation of measuring instruments.
II	The construction and working principle of DC generator, DC motor, andtypes of DC machines based on field excitation method.
III	Analyze the characteristics of alternating quantities and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

VII COURSE OUTCOMES:

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

CO 1	**Solve** complex electrical circuits by applying network reduction techniques for reducing into a simplified circuit.	Apply
CO 2	**Differentiate** the working of moving iron and moving coil type instruments for computing electrical qunatities using suitable instrument.	Understand
CO 3	**Demonstrate** the construction, principle and working of DC machines for their performance analysis.	Understand
CO 4	**Illustrate** alternating quantities of sinusoidal waveform and working , construction of single phase transformers,induction motors, alternators for analysis of AC waveforms and AC machines.	Understand
CO 5	**Apply** the PN junction characteristics for the doide applications such as switch and rectifier.	Apply
CO 6	**Extend** the biasing techniques for bipolar and uni-polar transistor amplifier circuits considering stability condition for establishing a proper operating point.	Understand

COURSE KNOWLEDGE COMPETENCY LEVEL



VIII PROGRAM OUTCOMES:

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

IX HOW PROGRAM OUTCOMES ARE ASSESSED:

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

3 = High; 2 = Medium; 1 = Low

X HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

PROGRAM SPECIFIC OUTCOMES		Strength	Proficiency Assessed by
PSO 1	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.	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**	Recollect the concept of electricity is described through scientific principles, importance Kirchhoff laws in relation with law of conservation of energy and charge circuits are explained using mathematical principles and various source transformation techniques are adopted for solving complex circuits.	3
	PO 2	Derive standard expressions for equivalent resistances, inductances and capacitance by using series-parallel networks i.e mathematical calculations.	1

Course Outcomes	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key competencies matched.
	PSO 1	Solve complex electrical circuits by applying basic circuit concepts by using computer programs.	1
CO 2	PO 1	Understand the working principles of indicating instruments and classify types based on construction engineering disciplines.	3
CO 3	PO 1	The principle of operation and characteristics of DC machines are explained by applying engineering fundamentals including device physics.	3
CO 4	PO 1	Understand about alternating quantities of an AC signal and working of single phase transformers,induction motors and alternators using engineering principles and mathematical equations.	3
	PSO 1	Develop equivalent circuit of single phase transformer referred to both sides by developing computer programs.	1
CO 5	PO 1	Outline of materials and brief description of formation of semi-conductor devices by using basic fundamentals of science and engineering.	3
	PO 2	Recognize (knowledge) the working and characteristics of diode and understand application which is rectifier circuit using engineering knowledge, and types of rectifiers.	3
CO 6	PO 1	List out various transistor configurations and discuss their working using principles of science and mathematical principles.	3
	PO 2	Explain the concept of biasing and load lines and their applicability in solving problems and working of transistors as switch and amplifier.	3

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

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

XIV PERCENTAGE OF KEY COMPETENCIES FOR CO – PO/ PSO

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	100	10	-	-	-	-	-	-	-	-	-	-	25	-	-
CO 2	100	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 3	100	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 4	100	-	-	-	-	-	-	-	-	-	-	-	25	-	-
CO 5	100	25	-	-	-	-	-	-	-	-	-		-	-	-
CO 6	100	25	-	-	-	-	-	-	-	-	-		-	-	-

XV COURSE ARTICULATION MATRIX (PO / PSO MAPPING):

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

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

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	3	1	-	-	-	-	-	-	-	-	-	-	1	-	-
CO 2	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 3	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 4	3	-	-	-	-	-	-	-	-	-	-	-	1	-	-
CO 5	3	1	-	-	-	-	-	-	-	-	-		-	-	-
CO 6	3	1	-	-	-	-	-	-	-	-	-		-	-	-
TOTAL	**18**	**3**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**2**	**0**	**0**
AVERAGE	**3**	**0.5**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0.3**	**0**	**0**

XVI ASSESSMENT METHODOLOGY-DIRECT:

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

XVII ASSESSMENT METHODOLOGY-INDIRECT:

	Assessment of mini projects by experts	✓	End Semester OBE Feedback

XVIII SYLLABUS:

MODULE I	**ELECTRICCIRCUITS,ELECTROMAGNETISM AND INSTRUMENTS**
	Electrical Circuits: Basic definitions, types of elements, Ohm's Law, resistive networks, inductive networks, capacitive networks, Kirchhoff's Laws, series, parallel circuits and star delta transformations, simple problems, Faradays law of electromagnetic induction; Instruments: Basic principles of indicating instruments, permanent magnet moving coil and moving iron instruments.
MODULE II	**DC MACHINES**
	DC Machines: Principle of operation of DC generator, EMF equation, principle of operation of DC motors, torque equation, types of DC machines, applications, three point starter.
MODULE III	**ALTERNATING QUANTITIES AND AC MACHINES**
	Alternating Quantities: Sinusoidal AC voltage, average and RMS values, form and peak factor, concept of three phase alternating quantity; Transformer: Principle of operation, EMF equation, losses, efficiency and regulation. Three Phase Induction Motor: Principle of operation, slip, slip torque characteristics, efficiency, applications; Alternator: Principle of operation, EMF Equation, efficiency, regulation by synchronous impedance method.
MODULE IV	**SEMICONDUCTOR DIODE AND APPLICATIONS**
	Semiconductor Diode: P-N Junction diode, symbol, V-I characteristics, half wave rectifier, full wave rectifier, bridge rectifier and filters, diode as a switch, Zener diode as a voltage regulator.
MODULE V	**BIPOLAR JUNCTION TRANSISTOR AND APPLICATIONS**
	Bipolar junction: Working principle of transistors, DC characteristics, CE, CB, CC configurations, biasing, load line, applications.

TEXTBOOKS

1. A Chakrabarti, "Circuit Theory", Dhanpat Rai Publications, 6thEdition,2004.
2. K S Suresh Kumar, "Electric Circuit Analysis", Pearson Education, 1stEdition,2013.
3. WillianmHayt, Jack E Kemmerly S M Durbin, "Engineering Circuit Analysis", Tata McGraw Hill, 7thEdition,2010.
4. R L Boylestad, Louis Nashelsky, "Electronic Devices and Circuits", PEI / PHI, 9th Edition, 2006.
5. 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/aeronautical-engineering-autonomous/basic-electrical-and-electronics-engineering

XIX COURSE PLAN:

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

S.No	Topics to be covered	CO's	Reference
OBE DISCUSSION			
	Discussion on mapping COs with POs. (OBE)		
1	Course Description on Outcome Based Education (OBE): Course Objectives, Course Outcomes (CO), Program Outcomes (PO) and CO - PO Mapping	-	-
CONTENT DELIVERY (THEORY)			
2	Electrical Circuits: Basic definitions, Types of elements	CO 1	T1-5.2 to 5.3
3	Ohm's Law, Kirchhoff Laws	CO 1	T1-5.4 to 5.5
4	Series, parallel circuits	CO 1	T1-5.5 to 5.8
5	Derivation for Star-delta and delta-star transformations	CO 1	T1-5.8 to 5.9
6	Mesh analysis and Nodal Analysis	CO 1	T1-5.11 to 5.12
7	Working of moving iron type instruments	CO 2	T1-5.14 to 5.15
8	Working of moving coil type inst0ruments	CO 2	T1-5.16 to 5.16
9	Principle of operation for DC generators	CO 3	R2-7.1 to 7.2
10	Construction and EMF equation for DC generators	CO 3	R2-7.4
11	Types of DC generators	CO 3	R2-7.3
12	Principle of operation for DC motors	CO 3	R2-7.3.1 to 7.3.2
13	Back EMF, torque equation for DC motors	CO 3	R2-7.3.3 to 7.3.6
14	Types of DC motors	CO 3	R2-7.6
15	Losses and efficiency for DC generators, motors	CO 3	T1-13.1 to 13.3
16	Principle of operation for Single Phase Transformers	CO 4	T1-13.1 to 13.3
17	Construction and EMF equation for Single Phase Transformers	CO 4	T1-13.5 to 13.6

18	Types of transformers and turns ratio	CO 4	T1-13.6 to 13.7
19	Operation of transformer under no load	CO 4	T1-13.7 to 13.9
20	Operation of transformer under on load	CO 4	T1-13.8
21	Equivalent circuit for Transformers	CO 4	T1-17.1 to 17.2
21	Phasor diagrams of transformer	CO 4	T1-17.3 to 17.4
22	Losses of Transformers	CO 4	T1-17.6 to 17.7
23	Efficiency of Transformers	CO 4	T1-13.11
24	Regulation for Transformers	CO 4	T1-13.12
25	Three Phase Induction motor: Principle of operation	CO 4	T1-13.13
26	slip, slip -torque characteristics	CO 4	T1-13.14
27	Alternators: Introduction, principle of operation	CO 4	T1-13.19
28	Constructional features	CO 4	T1-13.20
29	Understand the concept of P-N junction diode, symbol	CO 5	T1-13.8
30	Learn the V-I characteristics of P-N junction diode	CO 5	T1-17.1 to 17.2
31	Discuss the concept of half wave rectifier and full wave rectifier	CO 5	T1-17.3 to 17.4
32	Understand the bridge rectifiers and filters	CO 5	T1-17.6 to 17.7
33	Discuss the concept of diode as a switch, Zener diode as a voltage regulator	CO 5	T1-13.11
34	Know the concept of Transistors and Understand the configurations	CO 6	T1-13.12
35	Understand the DC characteristics of transistor	CO 6	T1-13.13
36	Understand the biasing and load line analysis.	CO 6	T1-13.13
37	Discuss how transistor acts as an amplifier.	CO 6	T1-13.13
PROBLEM SOLVING/ CASE STUDIES			
38	Numerical Examples on electrical quantities, Ohm's law, KCL, KVL	CO 1	T1-5.8 to 5.9
39	Numerical Examples on series, parallel elements and star to delta transformation and mesh analysis	CO 1	T1-5.5 to 5.8
40	Numerical Examples on nodal analysis and alternating quantities	CO 1	T1-6.8 to 6.9
41	Numerical Examples on Superposition theorem	CO 1	T1-6.2 to 6.3
42	Numerical Examples on reciprocity and maximum power transfer theorems	CO 1	R2-7.1 to 7.2
43	Numerical Examples on Thevenin's and Norton's theorems	CO 1	T1-13.1 to 13.3
44	Numerical Examples on EMF equation and types of DC generators	CO 3	T1-13.6 to 13.7

45	Numerical Examples on torque equation of DC motor	CO 3	T1-13.1 to 13.3
46	Numerical Examples on types of DC motors	CO 3	T1-13.13
47	Numerical Examples on EMF equation and equivalent circuit of 1 phase transformer	CO 4	T1-13.16 to 13.18
48	Numerical Examples on, efficiency for Transformers	CO 4	T1-13.14
49	Numerical Examples on, regulation for Transformers	CO 4	T1-13.16 to 13.18
50	Numerical Examples on EMF of Alternators	CO 4	T1-13.19
51	Numerical Examples on regulation of Alternators	CO 4	T1-13.20
52	Numerical Examples on Rectifiers	CO 5	T1-13.19
53	Numerical Examples on transistors	CO 6	T1-13.19
DISCUSSION OF DEFINITION AND TERMINOLOGY			
54	Definitions on basics of electrical circuits and electrical instruments	CO 1	T1-5.1 to 5.3
55	Definitions on DC machines	CO 2	T1-6.1 to 6.3
56	Definitions on single phase AC circuits and AC machines	CO 3	R2-7.1 to 7.2
57	Definitions on semiconductor diode and applications	CO 5	T1-13.1 to 13.3
58	Definitions on bipolar junction transistor and applications	CO 6	T1-13.11
DISCUSSION OF QUESTION BANK			
59	Questions from electrical circuits and electrical instruments	CO 1	T1-5.1 to 5.3
60	Questions from DC machines	CO 2	T1-6.1 to 6.3
61	Questions from single phase AC circuits and AC machines	CO 3	R2-7.1 to 7.2
62	Questions from semiconductor diode and applications	CO 5	T1-13.1 to 13.3
63	Questions from bipolar junction transistor and applications	CO 6	T1-13.11

Signature of Course Coordinator **HOD,CE**

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

Course Title	**ENGLISH LANGUAGE AND COMMUNICATION SKILLS LABORATORY**				
Course Code	AHSB08				
Program	B.Tech				
Semester	I	CE			
Course Type	Foundation				
Regulation	R18				
Course Structure	Theory			Practical	
	Lecture	Tutorials	Credits	Laboratory	Credits
	-	-	-	2	1
Course Coordinator	Dr. Jetty Wilson, Professor				

I COURSE OVERVIEW:

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

II COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites
-	-	-	-

III MARKS DISTRIBUTION:

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

IV DELIVERY / INSTRUCTIONAL METHODOLOGIES:

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

V EVALUATION METHODOLOGY:

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

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

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

Continuous Internal Assessment (CIA):

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

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

Continuous Internal Examination (CIE):

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

1. **Sofware based**

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

2. **Programming Based**

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

VI COURSE OBJECTIVES:

The students will try to learn:

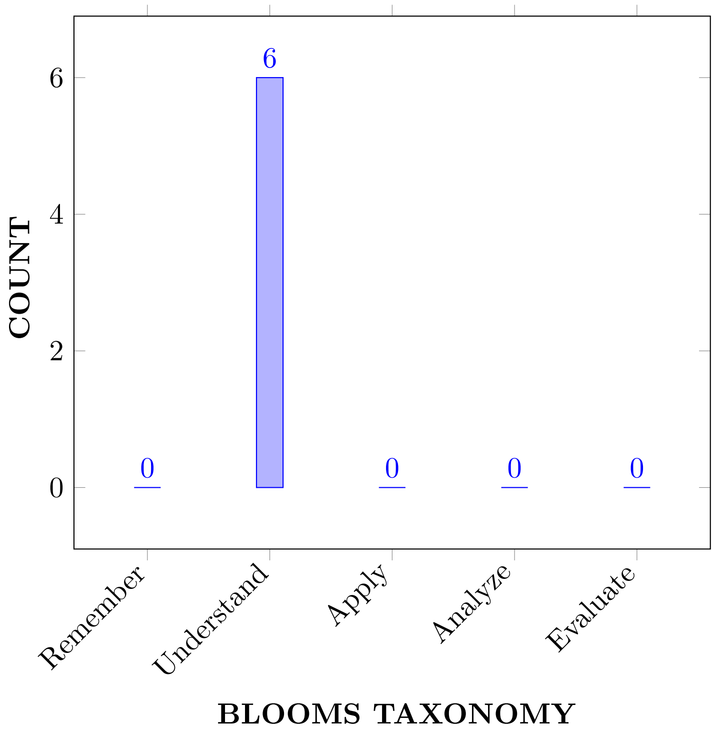
I	Facilitate computer-assisted multi-media instructions to make possible individualized and independent language learning.
II	The critical aspect of speaking and reading for interpreting in-depth meaning of the sentences.
III	Use language appropriately for social interactions such as public speaking,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

VII COURSE OUTCOMES:

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

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

COURSE KNOWLEDGE COMPETENCY LEVEL



VIII HOW PROGRAM OUTCOMES ARE ASSESSED:

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

3 = High; 2 = Medium; 1 = Low

IX HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

Program		Strength	Proficiency Assessed by
PSO 1	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.	-	-

PSO 2	Focus on formulation and evaluation of aircraft elastic bodies for characterization of aero elastic phenomena.	-	-
PSO 3	Make use of multi physics, computational fluid dynamics and flight simulation tools for building career paths towards innovative startups, employability and higher studies.	-	-

3 = High; 2 = Medium; 1 = Low

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

COURSE OUTCOMES	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key Competencies
CO 1	PO 10	Discuss the heeds of functional **grammar** and **punctuation** tools in **speaking** and **writing** by generating the **clarity** of an audio text.	5
CO 2	PO 9	Define the meaning of **individual work** and **team work** and also participate effectively to develop **leadership** qualities among the **diverse teams** in **multidisciplinary** settings.	5
CO 3	PO 10	Describe the **clarity** of **grammatical** usage and the obligation of **punctuation** marks in **speaking** and **writing**.	5
CO 4	PO 10	Choose suitable **grammatical** structures and **punctuation** marks at **speaking** and **writing** areas maintaining **clarity** at professional platform.	5
CO 5	PO 10	Interpret the **grammatical** knowledge and **punctuation** marks systematically towards providing the **clarity** in **speaking** and **writing**.	5
CO 6	PO 10	Demonstrate the role of **grammar** and **punctuation** marks understanding the meaning between the sentences as well as paragraphs in **speaking** or **writing** for a **clarity**.	5

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

COURSE 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. Jetty Wilson, Professor

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

CIVIL ENGINEERING
COURSE DESCRIPTION

Course Title	**ENGINEERING GRAPHICS AND DESIGN LAB**				
Course Code	AMEB02				
Program	B.Tech				
Semester	I	CE			
Course Type	Core				
Regulation	R 18				
Course Structure	Theory			Practical	
	Lecture	Tutorials	Credits	Laboratory	Credits
	-	-	-	3	1.5
Course Coordinator	Mr. K Tarun Kumar, Assistant Professor				

I COURSE OVERVIEW:

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

II COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites
-	-	-	-

III MARKS DISTRIBUTION:

Subject	SEE Examination	CIE Examination	Total Marks
Engineering Graphics and Design Lab	70 Marks	30 Marks	100

IV DELIVERY / INSTRUCTIONAL METHODOLOGIES:

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

V EVALUATION METHODOLOGY:

Each laboratory will be evaluated for a total of 100 marks consisting of 30 marks 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 basic knowledge about engineering drawing as a communicative language of engineers in ideation.
II	The ability to visualize, create and edit any object with all the physical and dimensional configurations using computer aided drawing tools.

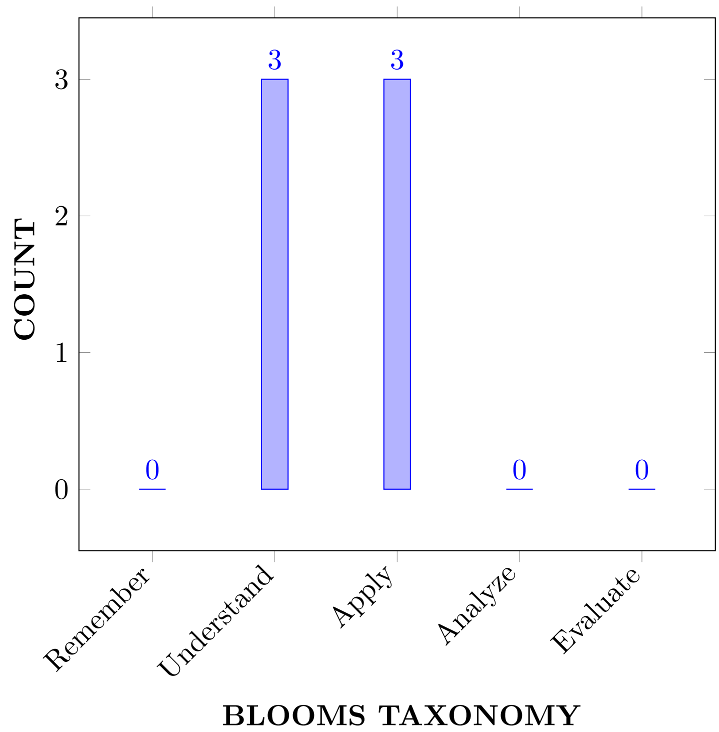
III	The code of engineering drawing practice as per the Bureau of Indian Standards and International practices.

VII COURSE OUTCOMES:

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

CO 1	**Illustrate** bureau of Indian standards conventions of engineering drawing with basic concepts, ideas and methodology for different geometries and their execution. .	Understand
CO 2	**Apply** the commands used in AutoCAD for development of multi-aspect sketches, additional and sectional view.	Apply
CO 3	**Construct** parabolic, Hyperbolic and elliptical curves for profiles likes buildings and bridges. **Build** Cycloidal and involutes profiles for developing new products like gears and other engineering applications.	Apply
CO 4	**Explain** various types of scales for engineering applications like maps, buildings, bridges.	Understand
CO 5	**Explain** the concept of projection of solids inclined to both the planes for interpretation of different views and orthographic projection concepts in solid modeling.	Understand
CO 6	**Recall** the orthographic projection concepts in solid modeling for use in conversation to isometric and Vice-versa	Apply

COURSE KNOWLEDGE COMPETENCY 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	3	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	3	Videos

3 = High; 2 = Medium; 1 = Low

IX HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

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

3 = High; 2 = Medium; 1 = Low

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

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

CO 2	PO 1	Recall the basic commands of AutoCAD for various drawings and draw using **scientific principles** and **engineering fundamentals**.	2
	PO 3	Understand the given **problem statement** related to question formatted for engineering drawings and based upon type use different AutoCAD commands .	1
CO 3	PO 1	Develop expression for eccentricity and Identify the appropriate type of curve for **problem solving** using **engineering sciences**.	2
	PO 3	Use research based knowledge for different methods of drawing engineering curves and draw with **modern tools** .	3
CO 4	PO 1	Apply the **engineering knowledge** to classify Cycloidal and involutes profiles in user Coordinate System to draw engineering problems.	1
	PO 3	Build practical experience in building the real time products, **using industry standard** and **collaboration technique** in the field of curves.	2
CO 5	PO 5	Recall various types of scales and **use principles of BIS**, and **engineering fundamentals** for engineering applications like maps, buildings, bridges. .	2
CO 6	PO 1	Make a use of an appropriate plane to draw different position of points and lines to solve **engineering problems** for **solution enhancement**	2
	PO 5	Recall various positions in coordinate system for points and lines **use principles of views**, and **engineering fundamentals** for completing the drawing	2

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

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

XII ASSESSMENT METHODOLOGY DIRECT:

CIE Exams	✓	SEE Exams	✓	Assignments	✓
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 ENGINEERING DRAWING**
	Principles of Engineering Graphics and their significance, usage of Drawing instruments, lettering..
WEEK II	**OVERVIEW OF COMPUTER GRAPHICS**
	Listing the computer technologies that impact on graphical communication, Demonstrating knowledge of the theory of CAD software
WEEK III	**OVER VIEW OF COMPUTER AIDED DRAFTING**
	Practial session of ACAD editing and Modify Commands and practice.
WEEK IV	**CONIC SECTIONS**
	Conic sections including the Rectangular Hyperbola (General method only); Cycloid, Epicycloid, Hypocycloid and Involute
WEEK V	**DRAWING PAPER SIZES AND SCALES**
	Drawing paper standards and Scales-Plain, Diagonal and Vernier Scales
WEEK VI	**PROJECTION OF POINTS**
	Principles of Orthographic Projections-Conventions-Projections of Points and lines inclined to both planes..
WEEK VII	**PROJECTION OF LINES**
	Projections of planes, Planes inclined to both the planes.
WEEK VIII	**PROJECTION OF REGULAR SOLIDS**
	Draw the orthographic views of geometrical solids of Prism, Pyramid, Cylinder and Cone.
WEEK IX	**ISOMETRIC PROJECTIONS**
	Principles of Isometric projection–Isometric Scale, Isometric Views, Conventions; Isometric Views of lines, Planes, Simple and compound Solids;.
WEEK X	**ORTHOGRAPHIC PROJECTIONS**
	Conversion of Isometric Views to Orthographic Views and Vice-versa
WEEK XI	**INTRODUCTION TO 3D**
	Setting environment for 3D drawings and UCS

WEEK XII	**PLOTTING AND TYPES OF EXPORTING DRAWING**
	Understanding how to export the drawing in other usable formats

TEXTBOOKS

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

REFERENCE BOOKS:

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

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	Principles of engineering drawing – Geometrical construction.	CO 1	T1:1.4 R1:1.2
2	Principles of dimensions and their execution. Introduction to auto-cad.	CO 1, CO2	T1:1.5 R1:2.4
3	Familiarization of auto-cad commands. Draw and modify commands, dimensions, line properties, status bar, etc..,	CO 2	T1:2.5 R1:2.5
4	Construction of Ellipse – General method	CO 3	T2:2.5 R1:2.6
5	Construction of parabola curves. – General method	CO 3	T1:22.7
6	Construction of hyperbola curves- General method	CO 3	T1:6.3 R2:5.3
7	Construction of various curves cycloid, epicycloids, hypocycloid and involutes	CO 4	T1:7.5 R1:6.3
8	Construction of various scales for engineering use- plain, diagonal, and vernier.	CO 5	T1:8.5 R1:6.8
9	Projection of points and lines inclined to single plane and both the planes.	CO 6	T1:12.2 R3:13.1
10	Projection of planes- inclined to single plane and both the planes.	CO 5	T1:12.3 R1:13.2
11	Projection of solids inclined tosingle plane and both the planes.	CO 4	T1:1.4 R1:1.2
12	Draw the basic isometric views. Convert the pictorial views to orthographic views and vice versa.	CO 5	T1:1.5 R1:2.4

XVI EXPERIMENTS FOR ENHANCED LEARNING (EEL):

S.No	Design Oriented Experiments
1	**Demonstration of twin vortex :** formation and calculation of vortex size for different geometries.
2	**Construction of hyperbolic curves:** –rectangle method, and parallelogram methods..
3	**Draw the development** of lateral surfaces of cube
4	**Draw the development** of lateral surfaces of prism
5	**Draw the development** of lateral surfaces of pyramid
6	**Draw the development** of lateral surfaces of cylinder
7	**Draw the development** of lateral surfaces of cone

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

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

CIVIL ENGINEERING

COURSE DESCRIPTION

Course Title	**BASIC ELECTRICAL ENGINEERING LABORATORY**				
Course Code	AEEB08				
Program	B.Tech				
Semester	I	CE			
Course Type	Foundation				
Regulation	IARE - R18				
Course Structure	Theory			Practical	
	Lecture	Tutorials	Credits	Laboratory	Credits
	-	-	-	3	1.5
Course Coordinator	Ms. T Saritha Kumari, Associate Professor				

I COURSE OVERVIEW:

The objective of the Basic Electrical Engineering Laboratory lab is to expose the students to the electrical circuits and give them experimental skill. The purpose of lab experiment is to continue to build circuit construction skills using different circuit element. It provides hands-on experience by examining the electrical characteristics of various AC and DC machines.

II COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites
UG	AHSC02	I	Linear ALgebra and Calculus

III MARKS DISTRIBUTION:

Subject	SEE Examination	CIE Examination	Total Marks
Basic Electrical 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 1), with 20 marks for continuous lab assessment during day to day performance, 10 marks for final internal lab assessment.

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

Continuous Internal Examination (CIE):

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

1. **Experiment Based**

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

2. **Programming Based**

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

VI COURSE OBJECTIVES:

The students will try to learn:

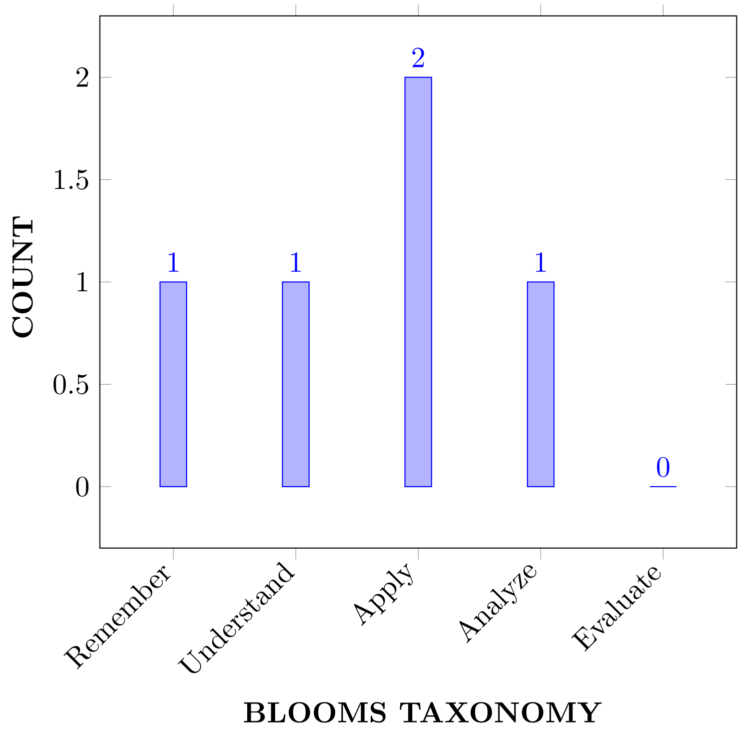
I	The basic laws, network reduction techniques and theorems for different circuits.
II	The performance characteristics of AC series and parallel circuits for measurement of electrical quantities using digital simulation tools.
III	The elementary experimental and modelling skills for handling problems with electrical machines in the industries and domestic applications to excel in professional career.
IV	The intuitive knowledge needed to test and analyse the performance leading to design of electric machines by conducting various tests and calculate the performance parameters.

VII COURSE OUTCOMES:

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

CO 1	**Analyze** an electric circuit using Ohm's and Kirchhoff's laws, nodal and mesh analysis.	Analyze
CO 2	**Apply** various network theorems for reducing complex networks into simple equivalent network.	Apply
CO 3	**Examine** the alternating quantities for different periodic wave forms and the passive networks.	Understand
CO 4	**Analyze** the performance characteristics of DC shunt machine at various loading conditions.	Analyze
CO 5	**Examine** the performance of single-phase transformers, induction motors and alternator by conducting a suitable test.	Understand

COURSE KNOWLEDGE COMPETENCY LEVEL



VIII HOW PROGRAM OUTCOMES ARE ASSESSED:

Program		Strength	Proficiency Assessed by
PO 1	**Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.	3	Laboratory experiments, internal and external lab exam

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 limitation.	1	Laboratory experiments, internal and external lab exam
PO 8	**Ethics:** Apply ethical principles and commit to professikonal ethics and responsibilties and norms of the engineering practice.	3	Laboratory experiments, internal and external lab exam
PO 9	**Individual and Team Work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.	2	Laboratory experiments, internal and external lab exam
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	Laboratory experiments,internal and external lab exam
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	Laboratory experiments, internal and external lab exam

3 = High; 2 = Medium; 1 = Low

IX HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

Program		**Strength**	**Proficiency Assessed by**
PSO 1	Design next-generation computer systems, networking devices, search engines, soft computing and intelligent systems, web browsers, and knowledge discovery tools.	-	-

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	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 **knowledge of mathematics, science and engineering fundamentals.**and various source transformation techniques are adopted for solving complex circuits.	3
	PO 5	Create,select and apply appropriate techniques,resources and modern engineering and IT tools **in solving the circuits**	1
	PO 8	Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice **in solving the circuits**	1
	PO 9	Work effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings **in solving the circuits**.	3
	PO 10	Communicate effectively on complex engineering activities with the engineering community and with society **in solving the circuits**.	5
	PO 12	The preparation and ability to engage in independent and life-long learning in the broadest context of technological change **in solving the circuits**.	3
	PSO 1	Solve complex electrical circuits by applying basic circuit concepts **by using computer programs.**	1
CO 2	PO 1	Demonstrate the various network theorems in order to determine the same **using principles of mathematics, science and engineering fundamentals.**	3
	PO 5	Create,select and apply appropriate techniques,resources and modern engineering and IT tools **in solving the complex circuits**	1
	PO 8	Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice **in solving complex circuits by using theroems**	1
	PO 9	Work effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings **in solving complex circuits by using theroems**	3
	PO 10	Communicate effectively on complex engineering activities with the engineering community and with society **in solving complex circuits by using theroems**	5
	PO 12	The preparation and ability to engage in independent and life-long learning in the broadest context of technological change **in solving the circuits by using theroems**	3

	PSO 1	Simplify complex electrical networks by applying various circuit theorems **by using computer programs.**	1
CO 3	PO 1	Understand the concept of alternating quantities with peak, average and root mean square values for different periodic wave forms and impedance of series RC,RL and RLC circuits by **knounderstanding and applying the fundamentals of mathematics, science and engineering.**	3
	PO 5	Create,select and apply appropriate techniques,resources and modern engineering and IT tools **in solving the circuits**	1
	PO 8	Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice **in understanding concept of alternating quantities with peak, average and root mean square values for different periodic wave forms and impedance of series RC,RL and RLC circuit**	1
	PO 9	Work effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings **in understanding concept of alternating quantities with peak, average and root mean square values for different periodic wave forms and impedance of series RC,RL and RLC circuits**	3
	PO 10	Communicate effectively on complex engineering activities with the engineering community and with society **in understanding concept of alternating quantities with peak, average and root mean square values for different periodic wave forms and impedance of series RC,RL and RLC circuits**	5
CO 4	PO 1	Apply (knowledge) magnetization characteristics DC shunt generator and performance characteristics of DC shunt machine by **analyzing complex engineering problems using the principles of mathematics, engineering science.**	3
	PO 8	Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice **in applying magnetization characteristics DC shunt generator and performance characteristics of DC shunt machine**	1
	PO 9	Work effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings **in applying magnetization characteristics DC shunt generator and performance characteristics of DC shunt machine**	3
	PO 10	Communicate effectively on complex engineering activities with the engineering community and with society **in applying magnetization characteristics DC shunt generator and performance characteristics of DC shunt machine**	5

CO 5	PO 1	Understand the performance characteristics of transformer, Imduction motors and alternator by using principles of **mathematics and engineering science**	3
	PO 8	Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice **by understanding the performance characteristics of transformer, Imduction motors and alternator**	1
	PO 9	Work effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings **by understanding the performance characteristics of transformer, Imduction motors and alternator**	3
	PO 10	Communicate effectively on complex engineering activities with the engineering community and with society **by understanding the performance characteristics of transformer, Imduction motors and alternator**	5
	PSO 1	Understand the performance characteristics of transformer, Imduction motors and alternator **by using computer programs.**	1

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

COURSE OUTCOMES	PROGRAM OUTCOMES						PROGRAM SPECIFIC OUT-COMES
	PO 1	PO 5	PO 8	PO 9	PO10	PO12	PSO1
CO 1	3	1	1	3	3	3	1
CO 2	3	1	1	3	3	3	1
CO 3	3	1	1	3	3		
CO 4	3		1	3	3		
CO 5	3		1	3	3		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	**OHM'S LAW, KVL AND KCL**
	Verification of Ohm's, Verification of Kirchhoff's current law and Voltage law using hardware and digital simulation.
WEEK II	**MESH ANALYSIS**
	Determination of mesh currents using hardware and digital simulation
WEEK III	**NODAL ANALYSIS**
	Measurement of nodal voltages using hardware and digital simulation.
WEEK IV	**IMPEDANCE OF SERIES RL AND RC CIRCUIT**
	Examine the impedance of series RL and RC circuit using hardware and digital simulation
WEEK V	**IMPEDANCE OF SERIES RLC CIRCUIT**
	Measure the impedance of series RLC Circuit using hardware and digital simulation.
WEEK VI	**SINGLE PHASE AC CIRCUITS**
	Determination of average value, RMS value, form factor, peak factor of sinusoidal wave using digital simulation.
WEEK VII	**SUPERPOSITION AND MAXIMUM POWER TRANSFER THEOREM**
	Verification of superposition and maximum power transfer theorem using hardware and digital simulation.
WEEK VIII	**THEVENIN'S AND NORTON'S THEOREM**
	Verification of Thevenin's and Norton's theorem using hardware and digital simulation.
WEEK IX	**SWINBURNE'S TEST**
	Predetermination of efficiency of DC shunt machine.
WEEK X	**MAGNITETIZATION CHARACTERISTICS**
	Determine the critical field resistance from magnetization characteristics of DC shunt generator.
WEEK XI	**BRAKE TEST ON DC SHUNT MOTOR**
	Study the performance characteristics of DC shunt motor by brake test
WEEK XII	**SPEED CONTROL OF DC SHUNT MOTOR**
	Verify the armature and field control techniques of DC shunt motor.
WEEK XIII	**OPEN CIRCUIT AND SHORT CIRCUIT TEST ON SINGLE PHASE TRANSFORMER**
	Determination of losses and efficiency of single-phase transformer.
WEEK XIV	**SYNCHRONOUS IMPEDENCE METHOD**
	Determine the regulation of alternator using synchronous impedance method.

TEXTBOOKS

1. A Sudhakar, Shyammohan S Palli, "Circuits and Networks", Tata McGraw-Hill, 4th Edition, 20103

2. P S Bimbhra, “Electrical Machinery”, Khanna Publishers, 1 st Edition,2011.

REFERENCE BOOKS:

1. A Chakrabarti, “Circuit Theory”, Dhanpat Rai Publications, 6th Edition, 2006.
2. K S Suresh Kumar, “Electric Circuit Analysis”, Pearson Education, 1st Edition, 2013.
3. Etter, “Introduction to MATLAB 7”, Pearson Education, 1st Edition, 2008.

XV COURSE PLAN:

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

S.No	Topics to be covered	CO’s	Reference
1	Verification of Ohm’s, Verification of Kirchhoff’s current law and voltage law using hardware.	CO 1	T1:1.1
2	Determination of mesh currents using hardware.	CO 2	T1:2.1
3	Measurement of nodal voltages using hardware.	CO 2	T1:2.4
4	Examine the impedance of series RL and RC circuit.	CO 3	T1:6.1
5	Measure the impedance of series RLC Circuit using hardware.	CO 3	T1:4.6
6	Determination of average value, RMS value, form factor, peak factor of sinusoidal wave.	CO 3	T1:5.1
7	Verification of superposition and maximum power transfer theorem using hardware and digital simulation.	CO 2	R3: T1:4.1
8	Verification of Thevenin’s and Norton’s theorem using hardware.	CO 2	T1:4.7
9	Predetermination of efficiency of DC shunt machine.	CO 4	T2:4.11
10	Determine the critical field resistance from magnetization characteristics of DC shunt generator.	CO 4	T2:4.11
11	Study the performance characteristics of DC shunt motor by brake test.	CO 4	T2:4.12
12	Speed control of DC shunt motor.	CO 4	T2:4.14
13	Determination of losses and efficiency of single-phase transformer.	CO 5	T2:1.1
14	Determine the regulation of alternator using synchronous impedance method.	CO 5	T2:5.4

XVI EXPERIMENTS FOR ENHANCED LEARNING (EEL):

S.No	Design Oriented Experiments
1	Verification of reciprocity theorem.
2	Determination of efficiency by load test in DC shunt generator.
3	Determination of efficiency by load test on DC series generator.
4	Determination of efficiency by load test on DC compound generator.
5	Determination of efficiency by load test on a single-phase transformer

Signature of Course Coordinator **HOD,CE**
Mrs. T Saritha Kumari, Assistant Professor

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

COURSE DESCRIPTION

Department	**CIVIL ENGINEERING**				
Course Title	**MATHEMATICAL TRANSFORM TECHNIQUES**				
Course Code	AHSB11				
Program	B.Tech				
Semester	II				
Course Type	Foundation				
Regulation	R-18				
Course Structure	Theory			Practical	
	Lecture	Tutorials	Credits	Laboratory	Credits
	3	1	4	-	-
Course Coordinator	Dr. S Jagadha, Associate Professor				

I COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites
B.Tech	AHSB02	I	Linear Algebra and Calculus

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	✓	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
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), 05 marks for Quiz and 05 marks for Alternative Assessment Tool (AAT).

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

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

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

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

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

VI COURSE OBJECTIVES:

The students will try to learn:

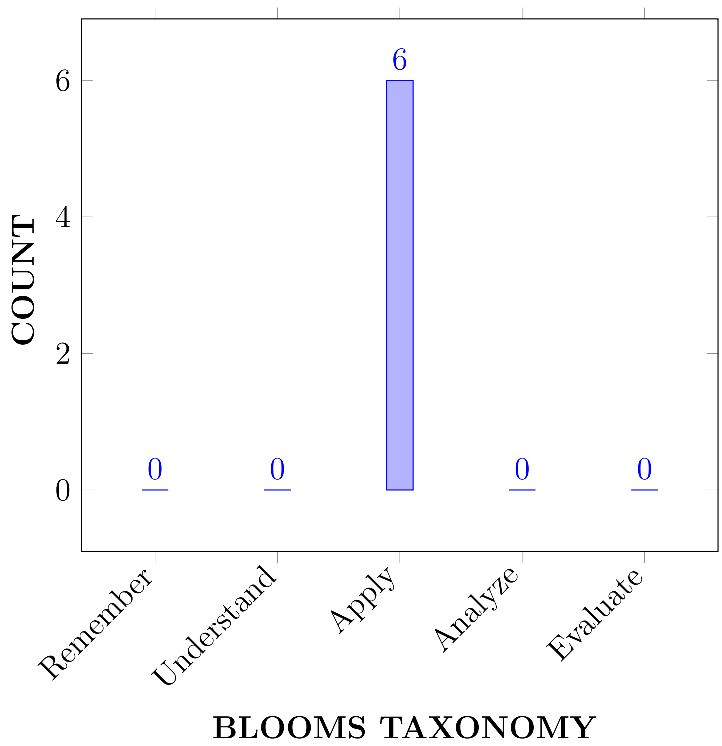
I	Enrich the knowledge of solving algebraic, transcendental and differential equation by numericalmethods
II	The operation of non-periodic functions by Fourier transforms.
III	The transformation of ordinary differential equations in Laplace field and its applications
IV	The partial differential equation for solving non-linear equations

VII COURSE OUTCOMES:

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

CO 1	**Solve** algebraic and transcendental equations using Bisection method, Regula-falsi method and Newton-Raphson method	Apply
CO 2	**Apply** numerical methods in interpolating the equal and unequal space data	Apply
CO 3	**Make use of** method of least squares to fit poliynomial curves and differential equation by numerical methods	Apply
CO 4	**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 5	**Explain** the properties of Laplace and inverse transform to various functions the integral transforms operations of calculus to algebra in linear differential equations	Apply
CO 6	**Solve** the linear, nonlinear partial differential equation by the method of Lagrange's ,separiable and Charpit to concern engineering field	Apply

COURSE KNOWLEDGE COMPETENCY LEVEL



VIII PROGRAM OUTCOMES:

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

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

IX HOW PROGRAM OUTCOMES ARE ASSESSED:

PROGRAM OUTCOMES		Strength	Proficiency Assessed by
PO 1	**Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.	3	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

PROGRAM OUTCOMES		Strength	Proficiency Assessed by
PO 4	**Conduct Investigations of Complex Problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.	1	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	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.	2	Seminar/ Conferences/ Research Papers
PSO 2	Focus on formulation and evaluation of aircraft elastic bodies for characterization of aero elastic phenomena.	-	-
PSO 3	Make use of multi physics, computational fluid dynamics and flight simulation tools for building career paths towards innovative startups, employability and higher studies.	-	-

3 = High; 2 = Medium; 1 = Low

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	**Solve complex engineering problems** involving algebraic and transcendental equations using Bisection method, Regula-falsi method and Newton-Raphson method along with **principles of mathematics**.	2
CO 2	PO 1	Apply numerical methods in interpolating the data and fitting the suitable curve in solving complex engineering problems with the help of basic Principle of mathematics to reach valid conclusions.	2
CO3	PO 1	Use numerical methods Taylor's series, Euler's, Picard's and Runge-Kutta methods in solving differential equations encountered in complex engineering problems with the help of basic Principle of mathematics	2
	PO 2	Make use of method of least squares and numerical methods to Identify the statement of the complex engineering problems involving the role of fitting the straight lines, second degree, exponential, power curves,differential equations along with principle of mathematics and interpret the results..	4
	PO4	Make use of the method of least squares in fitting the straight lines ,second degree, exponential, power curves in which coefficients are quantitatively measured by using MATLAB computer software.	1
	PSO1	Make use of the method of least squares in fitting the straight lines ,second degree, exponential, power curves in the design and implementation of complex systems triggered in Aeronautical Engineering	1
CO4	PO 2	Identify the range of non-periodic functions up to infinity and properties of complex Fourier transform in the statement of complex engineering problems which intensifies (apply) the boundary value problems using principle of mathematics related to engineering by the interpretation of results by Fourier integral and Fourier transform	2
	PSO1	Identify the properties of complex Fourier transform concern Aeronautical Engineering which intensifies (apply) the boundary value problems in the design and implementation of complex systems	1
CO5	PO1	Interpret the properties of Laplace and inverse Laplace transform (apply)in solving complex engineering problems for a function of a real variable 't' (time) (apply) to a function of a complex variable 's' (complex frequency) of various functions such as continuous, piecewise continuous, step and impulsive functions with basic Principle of mathematics to reach valid conclusions of engineering problems	2

Course Outcomes	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key competencies matched.
	PO2	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	4
CO6	PO1	Apply the method of Lagrange's linear equation Variable separaible to complex engineering problems such as Heat and Wave equations in the domain of engineering (Principle of mathematics and engineering)	2
	PO2	Identify the statement ofproperties of complex Fourier transform (understand)incomplex engineering problemswhich intensifies (apply) the boundary value problems using principle of mathematics related to engineering by the interpretation of results.	4

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

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	2	-	-	-	-	-	-	-	-	-	-	-	-	2	-
CO 2	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 3	2	4	-	1	-	-	-	-	-	-	-	-	1	-	-
CO 4	-	4	-	-	-	-	-	-	-	-	-	-	1	-	-
CO 5	2	4	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 6	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	66.7	-	-	-	-	-	-	-	-	-	-		-	-	-
CO 2	66.7	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 3	66.7	40	-	9	-	-	-	-	-	-	-	-	50	-	-
CO 4	-	40	-	-		-	-	-	-	-	-		50	-	-
CO 5	66.7	40	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 6	66.7	40	-	-		-	-	-	-	-	-		50	-	-

XV COURSE ARTICULATION MATRIX (PO / PSO MAPPING):

CO'S and PO'S and CO'S and PSO'S on the scale of 0 to 3, 0 being no correlation, 1 being the low correlation, 2 being medium correlation and 3 being high correlation.
0 - $0 \leq$ C$\leq$ 5% – No correlation

1 -5 <C≤ 40% – Low/ Slight
2 - 40 % <C < 60% –Moderate
3 - 60% ≤ C < 100% – Substantial /High

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

XVI ASSESSMENT METHODOLOGY-DIRECT:

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

XVII ASSESSMENT METHODOLOGY-INDIRECT:

✓	Early Semester Feedback	✓	End Semester OBE Feedback

XVIII SYLLABUS:

MODULE I	**ROOT FINDING TECHNIQUES AND INTERPOLATION**
	Solving algebraic and transcendental equations by bisection method, method of false position Newton-Raphson method; Interpolation: Finite differences, forward differences, backward differences and central differences; Symbolic relations; Newton's forward interpolation, Newton's backward interpolation; Gauss forward central difference formula, Gauss backward central difference formula; Interpolation of unequal intervals: Lagrange's interpolation, Newton's divided difference interpolation
MODULE II	**CURVE FITTING AND NUMERICAL SOLUTION OF ORDINARY DIFFERENTIAL EQUATIONS:**
	Fitting a straight line; Second degree curves; Exponential curve, power curve by method of least squares. Taylor's series method; Step by step methods: Euler's, modified Euler's and Runge-Kutta method

MODULE III	**FOURIER TRANSFORMS**
	Fourier integral theorem, Fourier sine and cosine integrals; Fourier transforms; Fourier sine and cosine transform, properties, inverse transforms, finite Fourier transforms Triple Integrals: Evaluation of triple integrals in Cartesian coordinates; volume of a region using triple integration.
MODULE IV	**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 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; Applications of partial differential equations of wave and heat equations

TEXTBOOKS

1. B.S. Grewal, "Higher Engineering Mathematics", Khanna Publishers, 36thEdition, 2010.
2. N.P. Bali and Manish Goyal, "A text book of Engineering Mathematics", Laxmi Publications, Reprint, 2008.
3. Ramana B.V., "Higher Engineering Mathematics", Tata McGraw Hill New Delhi, 11th Reprint,2010.

REFERENCE BOOKS:

1. Erwin Kreyszig, "Advanced Engineering Mathematics", John Wiley & Sons, 9thEdition, 2006.
2. Veerarajan T., "Engineering Mathematics for first year", Tata McGraw-Hill, New Delhi, 2008.
3. D. Poole, "Linear Algebra: A Modern Introduction", Brooks/Cole, 2ndEdition, 2005.
4. Dr. M Anita, "Engineering Mathematics-I", Everest Publishing House, Pune, First Edition, 2016

WEB REFERENCES:

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

COURSE WEB PAGE:

XIX COURSE PLAN:

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

S.No	Topics to be covered	CO's	Reference T1: 4.1
OBE DISCUSSION			
1	Introduction to outcome based education		
CONTENT DELIVERY (THEORY)			
2	Define Algebraic and Transcendental equations	CO 1	T1:12.1, R1:4.2
3	Apply Bisection method to find the root	CO 1	T1:12.3, R1:4.4
4	Apply False Position method to find the root	CO 1	T1:12.3, R1:4.6
5	Apply Newton-Raphson method to find roots	CO 1	T1:12.3, R1:4.7
6	Define what interpolation is	CO2	T1:12.4, R1:4.13
7	Explain the relation between symbols	CO2	T1:12.4, R1:4.15
8	Solve the problems by Newton's forward method	CO2	T1:12.4, R1:4.20
9	Solve the problems by Newton's backward method	CO 2	T1:12.5, R1:8.8
10	Solve the problems by Gauss forward method	CO 2	T1:13.1, R1:5.3
11	Solve the problems by Gauss backward method	CO 2	T1:13.2, R1:5.5
12	Solve the problems by lagrange's and Newtons dividend difference	CO 2	T1:13.3, R1:5.9
13	Solve a straight line	CO 3	T1:14.4, R1:6.2
14	Solve a second degree parabola	CO 3	T1:15.2 , R1:6.6
15	Solve an exponential curve	CO 3	T1:15.1, R1:7.4,
16	Solve the ODE by Taylor's series method	CO 3	T1:15.1, R1:6.5
17	Solve the ODE by Euler's Method- Euler's modified method	CO 3	T1:15.3, R1:7.9
18	Solve the ODE by Runge-Kutta Methods	CO 3	T2: 7.15, R1:1.65
19	Fourier transform	CO4	T1:22.3 R1:10.8
20	Fourier sine transform	CO4	T1:22.4 R1:10.9
21	Fourier Cosine Transforms	CO4	T1:22.5 R1:10.9

22	Properties of Fourier Transforms	CO4	T1:22.4 R1:10.9
23	Inverse Fourier Transform	CO4	T2:15.5 R1:7.5
24	Finite Fourier Transform	CO4	T2:16.5 R1:7.6
25	Infinite Fourier Transform	CO4	T2:16.5 R1:7.6
26	Aplications of Fourier Transform	CO4	T2:16.5 R1:7.6
27	First, second shifting theorems and change of scale property of Laplace transforms	CO5	T1:21.2 R1:5.1
28	Laplace transforms of Derivatives, Integrals, multiplication and Division by t to a function	CO5	T1:21.4 R1:5.1
29	Laplace transform of periodic functions	CO5	T1:21.7-21.10 R1:5.2-5.4
30	First, second shifting theorems and change of scale property of Inverse Laplace Transforms	CO5	T1:21.12 R1:5.1,5.6
31	Inverse Laplace transforms of Derivatives, Integrals, multiplication and Division by s to a function	CO5	T1:21.13 R1:5.1,5.3
32	Convolution theorem	CO5	T1:21.13 R1:5.4
33	Application of Laplace Transforms	CO5	T1:21.14 R1:5.5
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	CO 6	T1:17.5-17.6 R1:16.3.1
41	Lagrange's Linear Equation -Method of Multipliers	CO 6	T1:17.1-17.2 R1:16.1-16.2
PROBLEM SOLVING/ CASE STUDIES			
42	Solving problems by Bisection method to find the root	CO 1	T1:12.3, R1:4.4
43	Solving problems on False Position method to find the root	CO 1	T1:12.3, R1:4.6
44	Solving problems on Newton-Raphson method to find roots	CO 1	T1:12.3, R1:4.7
45	Solve the problems by Newton's forward method	CO2	T1:12.4, R1:4.20
46	Solve the problems by Newton's backward method	CO 2	T1:12.5, R1:8.8
47	Solve the problems by Gauss forward method	CO 2	T1:13.1, R1:5.3
48	Solve the problems by Gauss backward method	CO 2	T1:13.2, R1:5.5
49	Solve the problems by lagrange's and Newtons dividend difference	CO 2	T1:13.3, R1:5.9
50	Solve the ODE by Euler's Method- Euler's modified method	CO 3	T1:15.3, R1:7.9
51	Solve the ODE by Runge-Kutta Methods	CO 3	T2: 7.15, R1:1.65
52	Solving problems on Laplace Transform of First, second shifting theorems and change of scale property	CO 4	T1:21.1,21.4 R1:5.1
53	Solving problems on Inverse Laplace transforms of derivatives, integrals, multiplied by s, divided by s	CO 4	T1:21.13 R1:5.1,5.3
54	Solving problems on Convolution theorem	CO 4	T1:21.14 R1:5.5
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 Roots finding techniques and interpolation	CO 1,2	T1:21.1,21.4 R1:5.1
58	Definitions and terminology on Curve fitting and Numerical solution of ordinary differential equations	CO 3	T1:22.1-22.2R1:10.8

59	Definitions and terminology on Fourier transforms	CO 4	T1:22.1-22.2R1:10.8
60	Definitions and terminology on Laplace transforms	CO 5	T1:21.1,21.4 R1:5.1
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	Discussion of Roots finding techniques and interpolation	CO 1,2	T1:21.1,21.4 R1:5.1
63	Discussion ofCurve fitting and Numerical solution of ordinary differential equations	CO 3	T1:22.1-22.2 R1:10.8
64	Discussion of Fourier transforms	CO 4	T2:15.5 R1:7.5
65	Discussion of Laplace transforms	CO 5	T2:10.3 R1:16.4
66	Discussion 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	**ENGINEERING CHEMISTRY**				
Course Code	**AHSB03**				
Program	**B.Tech**				
Semester	**II**				
Course Type	**FOUNDATION**				
Regulation	R-18				
Course Structure	Theory			Practical	
	Lecture	Tutorials	Credits	Laboratory	Credits
	3	1	4		
Course Coordinator	Dr V Anitha Rani, Associate Professor				

I COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites
-	-	-	-

II COURSE OVERVIEW:

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

III MARKS DISTRIBUTION:

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

IV CONTENT DELIVERY / INSTRUCTIONAL METHODOLOGIES:

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

V EVALUATION METHODOLOGY:

The SEE is conducted for 70 marks of 3 hours duration. The syllabus for the theory courses is divided into FIVE modules and each module carries equal weightage in terms of marks distribution. The question paper pattern is as follows. Two full questions with either or choice will be drawn from each module. Each question carries 14 marks. There could be a maximum of two sub divisions in a question.

Semester End Examination (SEE): The SEE is conducted for 70 marks of 3 hours duration. The syllabus for the theory courses is divided into FIVE modules and each module carries equal weightage in terms of marks distribution. The question paper pattern is as follows. Two full questions with "either" or "choice" will be drawn from each module. Each question carries 14 marks. There could be a maximum of two sub divisions in a question.
The expected percentage of cognitive level of the questions is broadly based on the criteria given in below Table.

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

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

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

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

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

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

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

VI COURSE OBJECTIVES:

The students will try to learn:

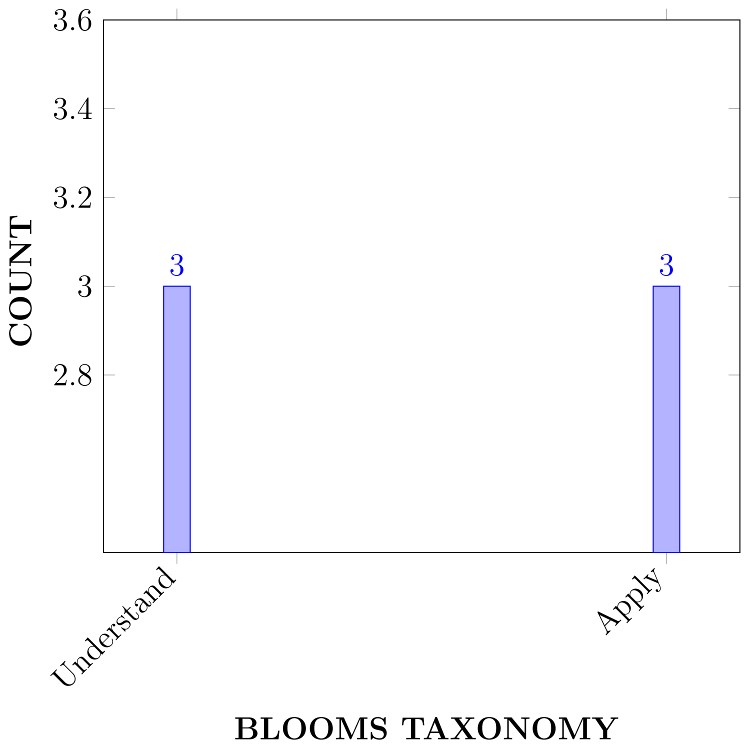
I	The concepts of electrochemical principles and causes of corrosion in the new development and breakthroughs efficiently in engineering and technology.
II	The different parameters to remove causes of hardness of water and their reactions towards the complexometric method.
III	The microscopic chemistry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

VII COURSE OUTCOMES:

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

CO 1	**Explain** the 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	**Illustrate** the molecular orbital energy level diagrams of different molecules and theories of bonding for understanding the magnetic properties of coordination compounds.	Understand
CO 5	**Explain** the mechanism of different chemical reactions, stereo isomers for finding the optically active compounds and synthesizing the drug molecules.	Understand
CO 6	**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

COURSE KNOWLEDGE COMPETENCY LEVEL



VIII PROGRAM OUTCOMES:

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

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

IX HOW PROGRAM OUTCOMES ARE ASSESSED:

PROGRAM OUTCOMES		Strength	Proficiency Assessed by
PO 1	**Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.	2.5	SEE/CIE/Quiz/ AAT
PO 2	**Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.	1	SEE/CIE/Quiz/ AAT
PO 7	**Environment and sustainability:** understand the impact of the professional engineering solutions in societal and Environmental contexts, and demonstrate the knowledge of, and need for sustainable development.	2	SEE/CIE/Quiz/ AAT

3 = High; 2 = Medium; 1 = Low

X HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

PROGRAM SPECIFIC OUTCOMES		Strength	Proficiency Assessed by
PSO 1	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.	-	-
PSO 2	Focus on formulation and evaluation of aircraft elastic bodies for characterization of aero elastic phenomena.	-	-
PSO 3	Make use of multi physics, computational fluid dynamics and flight simulation tools for building career paths towards innovative startups, employability and higher studies.	-	-

3 = High; 2 = Medium; 1 = Low

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

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

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

Course Outcomes	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key competencies matched.
CO 1	PO 1	Explain the electrochemical properties for producing electrical energy (understand) by using principles of science for solving engineering problems.	2
CO 2	PO 1	Choose different electrodes for finding pH of unknown solutions by applying mathematical expressions of cell potential by using principles of science and mathematics for solving engineering problems	3
	PO 2	Identify the problem formulation and abstraction for calculating electrode potential under non standard conditions by applying Nernst equation from the provided information.	2
CO3	PO1	Explain the concept of corrosion processes in metals by exposing to acidic environment for solving engineering problems by applying the principles of science	3

Course Outcomes	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key competencies matched.
	PO2	Identify the problem and formulate for finding the hardness of water in terms of $CaCO_3$ equivalents with given information and data by applying principles of science.	2
CO4	PO1	Explain the formation of molecular orbitals by linear combination of atomic orbitals, splitting of d orbitals for formation of octahedral, tetrahedral and square planar complexes for solving engineering problems by applying the principles of science.	2
CO5	PO1	Illustrate the structural and stereo isomers of optically active compounds, different types of molecular organic reactions for synthesizing drugs by using principles of science for solving engineering problems.	2
CO6	PO1	Classify different types of solid, liquid and gaseous fuels with their characteristics and calorific value by using principles of science and mathematics for solving engineering problems.	3
	PO2	Identify the given problem and formulate for finding the calorific value of fuel with the given information and data by applying principles of science.	2
	PO7	Make use of gaseous fuels like LPG, CNG to reduce the pollutants in atmosphere and know the impact in socio economic and environmental contexts for sustainable development.	2

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

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	3	-	-	-	-	-	-	-	-	-	-		-	-	-
CO 2	3	1	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 3	3	1	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 4	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 5	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 6	3	1	-	-	-	-	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	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 2	100	20.0	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 3	100	20.0	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 4	66.6	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 5	66.6	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 6	100	20.0	-	-	-	-	66.6	-	-	-	-	-	-	-	-

XV COURSE ARTICULATION MATRIX (PO / PSO MAPPING):

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

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

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

XVI ASSESSMENT METHODOLOGY-DIRECT:

CIE Exams	✓	SEE Exams	✓	5 minutes video	✓
Laboratory Practices	-	Student Viva	-	Certification	-
Term Paper	✓	-	-	-	-

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, types of electrodes; Calomel, Quinhydrone and glass electrode; Nernst equation; Electrochemical series and its applications; Numerical problems; Batteries: Primary (Dry cell) and secondary batteries (Lead-acid storage battery and Lithium ion battery). Causes and effects of corrosion: Theories of chemical and electrochemical corrosion, mechanism of electrochemical corrosion; Types of corrosion: Galvanic, water-line and pitting corrosion; Factors affecting rate of corrosion; Corrosion control methods: Cathodic protection, sacrificial anode and impressed current; Surface coatings: Metallic coatings- Methods of coating- Hot dipping, cementation, electroplating and Electroless plating of copper.
MODULE II	**WATER AND ITS TREATMENT**
	Introduction: Hardness of water, Causes of hardness; Types of hardness: temporary and permanent, expression and units of hardness; Estimation of hardness of water by complexometric method; Potable water and its specifications, Steps involved in treatment of water, Disinfection of water by chlorination and ozonization; Boiler feed water and its treatment, Calgon conditioning, Phosphate conditioning and Colloidal conditioning; External treatment of water; Ion-exchange process; Desalination of water: Reverse osmosis, numerical problems.
MODULE III	**MOLECULAR STRUCTURE AND THEORIES OF BONDING**
	Atomic and Molecular orbitals: Linear Combination of Atomic Orbitals LCAO), molecular orbitals of diatomic molecules; Molecular orbital energy level diagrams of N2, O2F2, CO and NO molecules. Crystal Field Theory (CFT): Salient Features of CFT-Crystal Field; Splitting of transition metal ion d- orbitals in Tetrahedral, Octahedral and square planar geometries; Band structure of solids and effect of doping on conductance.
MODULE IV	**STEREOCHEMISTRY, REACTION MECHANISM AND SYNTHESIS OF DRUG MOLECULES**
	Introduction to representation of 3-dimensional structures: Structural and stereoisomers, configurations, symmetry and chirality; Enantiomers, diastereomers, optical activity and Absolute configuration; Conformation analysis of n- butane. Substitution reactions: Nucleophilic substitution reactions, Mechanism of SN1, SN2 reactions; Electrophilic and nucleophilic addition reactions; Addition of HBr to propene; Markownikoff and anti Markownikoff's additions; Grignard additions on carbonyl compounds; Elimination reactions: Dehydro halogenation of alkylhalides; Saytzeff rule; Oxidation reactions: Oxidation of alcohols using KMnO4 and chromic acid; Reduction reactions: Reduction of carbonyl compounds using LiAlH4 & NaBH4; Hydroboration of olefins; Structure, synthesis and pharmaceutical applications of Paracetamol and Aspirin.
MODULE V	**FUELS AND COMBUSTION**

	Fuels: Definition, classification of fuels and characteristics of a good fuels; Solid fuels: Coal; Analysis of coal: Proximate and ultimate analysis; Liquid fuels: Petroleum and its refining; Cracking: Fixed bed catalytic cracking; Knocking: Octane and cetane numbers; Gaseous fuels: Composition, characteristics and applications of natural gas, LPG and CNG; Combustion: Calorific value: Gross Calorific Value(GCV) and Net Calorific Value(NCV), calculation of air quantity required for complete combustion of fuel, numerical problems.

TEXTBOOKS

1. P. C. Jain and Monica Jain, "Engineering Chemistry", Dhanpat Rai Publishing Company, 16th Edition, 2017.
2. Shashi Chawla, "Engineering Chemistry", Dhanat Rai and Company, 2011, 1st Edition.
3. R.T. Morrison, RN Boyd and SK Bhattacharya, "Organic Chemistry", Pearson, 7th Edition, 2011
4. K.F. Purcell and J.C. Kotz, "Inorganic Chemistry", Cengage learning, 2017.

REFERENCE BOOKS:

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

WEB REFERENCES:

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

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	Concept of Electro chemical cells	CO1	T1,T2
3	Numerical problems on EMF: Galvanic Cells	CO 2	T1,T2
4	Types of Electrodes: Calomel, Quinhydrone and Glass electrode	CO 2	T1,T2
5	Nernst equation and its applications	CO 2	T1,T2
6	Batteries: Primary cells (dry cells)	CO 1	T1,T2
7	Secondary cells (lead-Acid cell). Applications of batteries	CO 1	T1,T2
8	Corrosion-Definition ,Causes and effects of corrosion, Theories of corrosion – Chemical corrosion theory	CO 1	T1,T2

9	Types of corrosion (water line and pitting), Factors affecting rate of corrosion	CO 1	T1,T2
10	Corrosion control methods – Cathodic protection and metallic coating.	CO 1	T1,T2
11	Hardness of water, expression of hardness-units; Types of hardness: Temporary hardness, permanent hardness and numerical problems.	CO 3	T1,T2
12	Estimation of temporary and permanent hardness of water by EDTA	CO 3	T1,T2
13	Potable water and its specifications, steps involved in its treatment of water.	CO 3	T1,T2
14	Boiler troubles – Priming and foaming, caustic embrittlement	CO 3	T1,T2
15	Treatment of boiler feed water – Internal treatment (Phosphate, carbonate and calgon conditioning)	CO 3	T1,T2
16	Ion exchange process, steps involved in the treatment of this process	CO 3	T1,T2
17	Sterilization of potable water by chlorination and ozonization	CO 3	T1,T2
18	purification of water by reverse osmosis process. Numerical problems	CO 3	T1,T2
19	Shapes of Atomic Orbitals	CO 4	T1,T2
20	Linear combination of Atomic orbitals (LACO)	CO 4	T1,T2
21	Molecular orbitals of diatomic molecules N2 O2 and F2.	CO 4	T1,T2
22	Molecular orbitals diatomic CO and NO molecule	CO 4	T1,T2
23	Crystal Field Theory (CFT), Salient Features of CFT-Crystal Fields	CO 4	T1,T2
24	Splitting of transition metal ion d- orbitals in Tetrahedral	CO 4	T1,T2
25	Splitting of transition metal ion Octahedral and square planar geometries	CO 4	T1,T2
26	Band structure of solids and effect of doping on conductance	CO 4	T1,T2
27	Introduction to representation of 3-dimensional structures	CO 5	T1,T2
28	Structural and stereoisomers of organic compounds	CO 5	T3
29	Configurations, symmetry and chirality.	CO 5	T3
30	Enantiomers, diastereomers, optical activity and Absolute configuration	CO 5	T3
31	Conformation alanalysis of n- butane	CO 5	T3
32	Nucleophilic substitution reactions, Mechanism of SN1, SN2 reactions	CO 5	T3
33	Electrophilic and nucleophilic addition reactions; Addition of HBr to Propene; Markownikoff and anti Markownikoff's additions	CO 5	T3
34	Grignard additions on carbonyl compounds, EliminationreactionsDehydro halogenations of alkylhalides	CO 5	T3
35	Oxidation reactions: Oxidation of alcohols using KMnO4 and chromicacid.	CO 5	T3
36	Reduction reactions: Reduction of carbonyl compounds using LiAlH4& NaBH4	CO 5	T3

37	Hydroboration of olefins	CO 5	T3
38	Structure, synthesis and pharmaceutical applications of Paracetamol and Aspirin.		T3
39	Definition, classification of fuels and characteristics of a good fuels	CO 5	T1,T2
40	Solid fuel Coal, analysis of coal- proximate analysis	CO 6	T1,T2
41	Analysis of coal -ultimate analysis.	CO 6	T1,T2
42	Liquid fuels: Petroleum and its refining Cracking: Fixed bed catalytic cracking;	CO 6	T1,T2
43	Knocking: Octane and cetane numbers	CO 6	T1,T2
44	Gaseous fuels: Composition, characteristics and applications of Natural gas, LPG and CNG	CO 6	T1,T2
45	Combustion: Calorific value-Gross calorific value(GCV) and net calorific value(NCV)	CO 6	T1,T2
46	Calculation of air quantity required for complete combustion of fuel, numerical problems.	CO 6	T1,T2
PROBLEM SOLVING			
1	Probelms on EMF	CO 1	T1:3.3.1; R3:3.2
2	Probelms on Nernst equation	CO 1	T2:16.5; R3:8.10
3	Determination of Electrode potential	CO 2	T2:16.5; R3:8.10
4	Determination of Hardness	CO 3	T1:3.3.1; R3:3.2
5	Determination of Hardness by EDTA	CO 3	T2:16.5; R3:8.10
6	Crystal field stabalization energy	CO 4	T2:16.5; R3:8.10
7	Proximate Analysis of coal	CO 6	T1:3.3.1; R3:3.2
8	ultimate Analysis of coal	CO 6	T2:16.5; R3:8.10
9	Dulungs Equation for coal analysis	CO 6	T2:16.5; R3:8.10
10	Probelms on Combustion	CO 6	T1:3.3.1; R3:3.2
DISCUSSION OF DEFINITION AND TERMINOLOGY			
1	Electro Chemistry and Batteries	CO 1	T2:16.5; R3:8.10
2	Water and Its Treatment	CO 2	T1:3.3.1; R3:3.2
3	Molecular Structure and Theories of Bonding	CO 3	T2:16.5; R3:8.10
4	Streo chemistry,Reaction Mechanisim	CO 4	T2:16.5; R3:8.10

5	Fuels and Combustion	CO 6	T2:16.5; R3:8.10
DISCUSSION OF QUESTION BANK			
1	Electro Chemistry and Batteries	CO 1	T2:16.5; R3:8.10
2	Water and Its Treatment	CO 2	T1:3.3.1; R3:3.2
3	Molecular Structure and Theories of Bonding	CO 3	T2:16.5; R3:8.10
4	Streo chemistry,Reaction Mechanisim	CO 4	T2:16.5; R3:8.10
5	Fuels and Combustion	CO 6	T2:16.5; R3:8.10

Signature of Course Coordinator **HOD,**CE

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

CIVIL ENGINEERING

COURSE DESCRIPTION

Course Title	**WAVES AND OPTICS**				
Course Code	AHSB04				
Program	B.Tech				
Semester	II	CE			
Course Type	Foundation				
Regulation	IARE - R 18				
Course Structure	Theory			Practical	
	Lecture	Tutorials	Credits	Laboratory	Credits
	3	1	4	-	-
Course Coordinator	Dr.Rizwana, Professor				

I COURSE PRE-REQUISITES:

Level	**Course Code**	**Semester**	**Prerequisites**
-	-	-	-

II COURSE OVERVIEW:

This course 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**
Waves and Optics	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
60 %	Understand
40 %	Apply
0 %	Analyze

Continuous Internal Assessment (CIA):

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

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

Continuous Internal Examination (CIE):

Two CIE exams shall be conducted at the end of the 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 below.

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

VI COURSE OBJECTIVES:

The students will try to learn:

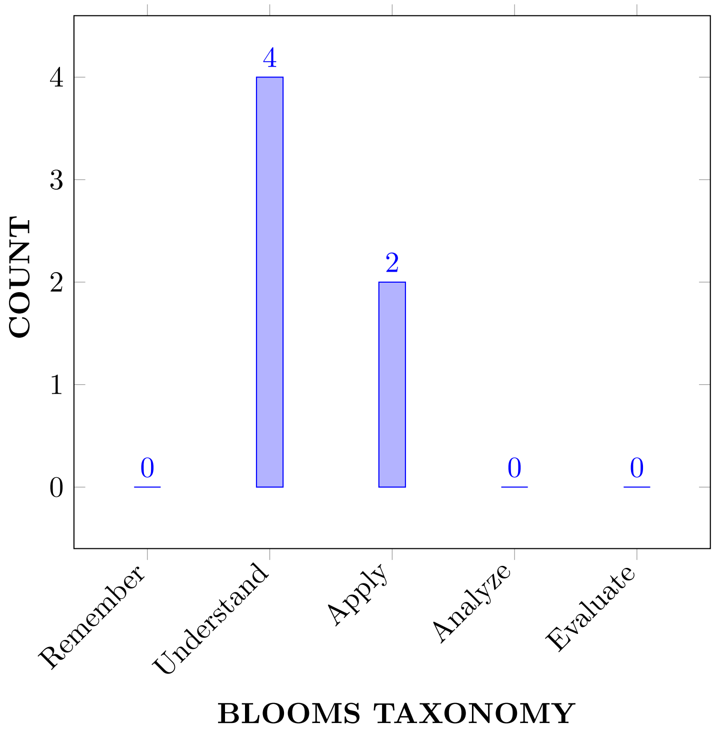
I	Basic formulations in wave mechanics for the evolution of energy levels and quantization of energies for a particle in a potential box with the help of mathematical description.
II	Fundamental properties of semiconductors including the band gap, charge carrier concentration, doping and charge carrier 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.	Apply
CO 2	**Demonstrate** the classification of solids and important aspects of semiconductors in terms of carrier concentration and Fermi level.	Understand
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	Build Embedded Software and Digital Circuit Development platform for Robotics, Embedded Systems and Signal Processing Applications.	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
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

CO 2	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
	PSO 1	**Make use of** the knowledge of **charge transport mechanism** in semiconductors **to build Embedded systems**.	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
	PSO 3	**Make use of**interference in computational fluid dynamics and flight simulation tools.	1
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

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

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

COURSE OUTCOMES	PROGRAM OUTCOMES												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	-	-	-	-	-	-	-	-	35	-	-
CO 3	100	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 4	100	40	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 5	100	-	-	18	-	-	-	-	-	-	-	-	-	-	-
CO 6	100	40	-	-	-	-	-	-	-	-	-	-	-	-	-

XV COURSE ARTICULATION MATRIX (PO – PSO MAPPING):

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

0 - $0 \leq$ C$\leq$ 5% – No correlation
1-5 $<$C$\leq$ 40% – Low/ Slight
2 - 40 % $<$C $<$ 60% –Moderate
3 - 60% $\leq$ 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	-	-	-	-	-	-	-	-	1	-	-
CO 3	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 4	3	2	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 5	3	-	-	1	-	-	-	-	-	-	-	-	-	-	-
CO 6	3	2	-	-	-	-	-	-	-	-	-	-	-	-	-
TOTAL	18	8	-	2	-	-	-	-	-	-	-	-	1	-	-
AVERAGE	3	2	-	1	-	-	-	-	-	-	-	-	1	-	-

XVI ASSESSMENT METHODOLOGY DIRECT:

CIE Exams	✓	SEE Exams	✓	Seminars	-
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,CE**
Dr. Rizwana, Professor

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

CIVIL ENGINEERING
COURSE DESCRIPTION

Course Title	**ENGINEERING CHEMISTRY LABORATORY**				
Course Code	AHSB09				
Program	B.Tech				
Semester	II	CE			
Course Type	FOUNDATION				
Regulation	IARE – R18				
Course Structure	Theory			Practical	
	Lecture	Tutorials	Credits	Laboratory	Credits
	-	-	-	3	1.5
Course Coordinator	Mr G Mahesh Kumar, Assiatant Professor				

I COURSE OVERVIEW:

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

II COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites	Credits
-	-	-	-	-

III MARKS DISTRIBUTION:

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

IV DELIVERY / INSTRUCTIONAL METHODOLOGIES:

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

V EVALUATION METHODOLOGY:

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

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

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

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

Continuous Internal Assessment (CIA):

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

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

Continuous Internal Examination (CIE):

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

A. Experiment Based

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

B. Programming Based

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

VI COURSE OBJECTIVES:

The students will try to learn:

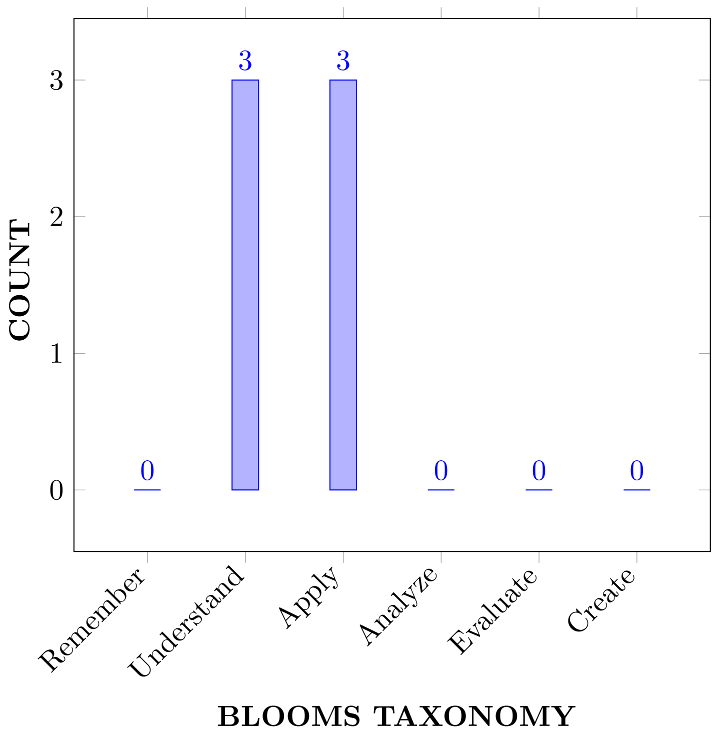
I	The basic principles involved in chemical analysis and mechanism of synthetic organic reactions. processes.
II	The need and importance of quality of water for industrial and domestic use..
III	The measurement of physical properties like surface tension and viscosity.
IV	The knowledge on existing future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

VII COURSE OUTCOMES:

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

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

COURSE KNOWLEDGE COMPETENCY LEVEL



VIII HOW PROGRAM OUTCOMES ARE ASSESSED:

Program		Strength	Proficiency Assessed by
PO 1	**Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.	-	SEE/CIE
PO 2	**Design/development of solutions:** Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences	-	SEE/CIE
PO 7	**Modern tool usage:** Environment and sustainability: understand the impact of the professional engineering solutions in societal and Environmental contexts, and demonstrate the knowledge of, and need for sustainable development.	-	SEE/CIE

3 = High; 2 = Medium; 1 = Low

IX HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

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

3 = High; 2 = Medium; 1 = Low

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

COURSE OUTCOMES	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key Competencies
CO 1	PO 1	Explain the mechanism of chemical reactions for synthesizing drug molecules by applying mathematical expressions for finding the percentage of Aspirin by using principles of science for solving engineering problems.	3

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

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

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

3 = High; 2 = Medium; 1 = Low

XII ASSESSMENT METHODOLOGY DIRECT:

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

	Preparation of Thiokol rubber .
WEEK 11	**VOLUMETRIC ANALYSIS**
	Determination of percentage of copper in brass. .
WEEK 12	**VOLUMETRIC ANALYSIS**
	Estimation of MnO 2 in pyrolusite .

TEXTBOOKS

1. Vogel's, "Quantitative Chemical Analaysis", Prentice Hall, 6th Edition, 2000.
2. Gary D.Christian, "Analytical Chemistry",Wiley India, 6th Edition, 2007.

REFERENCE BOOKS:

1. A text book on experiments and calculation Engg. S.S. Dara.
2. Instrumental methods of chemical analysis, Chatwal, Anand, Himalaya Publications

XV COURSE PLAN:

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

S.No	Topics to be covered	CO's	Reference
1	Preparation of Aspirin.	CO 1, CO 2	R1, R2
2	Estimation of hardness of water by EDTA method.	CO 2	R1, R2
3	Conductometric titration of strong acid Vs strong base	CO 3,	R1, R2
4	Potentiometric titration of strong acid Vs strong base.	CO 3	R1, R2
5	Conductometric titration of mixture of acid Vs strong base	CO 3	R1, R2
6	Potentiometric titration of weak acid Vs strong base	CO 3	R1, R2
7	Determination of surface tension of a given liquid using stalagmometer	CO4	R1, R2
8	Determination of viscosity of a given liquid by using Ostwald's viscometer	CO4	R1, R2
9	Estimation of dissolved oxygen in water	CO 2	R1, R2
10	Preparation of Thiokol rubber	CO 5	R1, R2
11	Determination of percentage of copper in brass.	CO 6	R1, R2
12	Estimation of MnO 2 in pyrolusite	CO6	R1, R2

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

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

Course Title	**PHYSICS LABORATORY**				
Course Code	AHSB10				
Program	B.Tech				
Semester	II	CE			
Course Type	FOUNDATION				
Regulation	IARE - R18				
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
-	-	-	-	-

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:

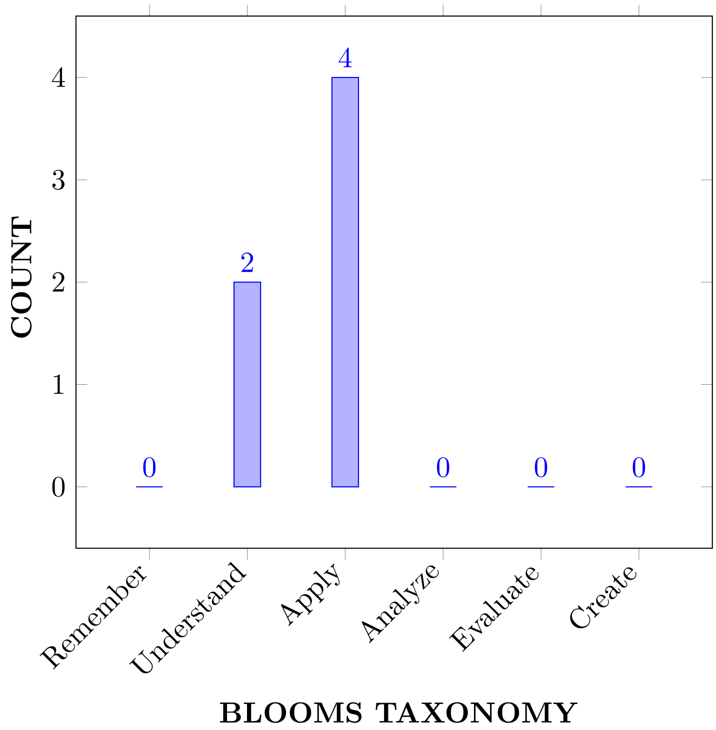
I	To familiarize with the lab facilities, equipment, standard operating procedures.
II	About the different kinds of functional electric and magnetic materials which paves a way for them to use in various technical and engineering applications.
III	The analytical techniques and graphical analysis to study 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 modern computer tools for creating innovative career paths, to be an entrepreneur and desire for higher studies.	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,CE**
Mr.K Saibaba, Assistant Professor

INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

Dundigal, Hyderabad - 500 043

CIVIL ENGINEERING

COURSE DESCRIPTION

Course Title	**PROGRAMMING FOR PROBLEM SOLVING LABORATORY**					
Course Code	ACSB02					
Program	B.Tech					
Semester	I	CE				
Course Type	Foundation					
Regulation	IARE - R18					
Course Structure	Theory			Practical		
	Lecture	Tutorials	Credits	Laboratory	Credits	
	-	-	-	4	2	
Course Coordinator	Mr. Ravinder, Assistant Professor					

I COURSE OVERVIEW:

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

II COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites
-	-	-	-

III MARKS DISTRIBUTION:

Subject	SEE Examination	CIE Examination	Total Marks
PROGRAMMING FOR PROBLEM SOLVING 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.

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

Continuous Internal Assessment (CIA):

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

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

Continuous Internal Examination (CIE):

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

1. **Experiment Based**

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

2. **Programming Based**

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

VI COURSE OBJECTIVES:

The students will try to learn:

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

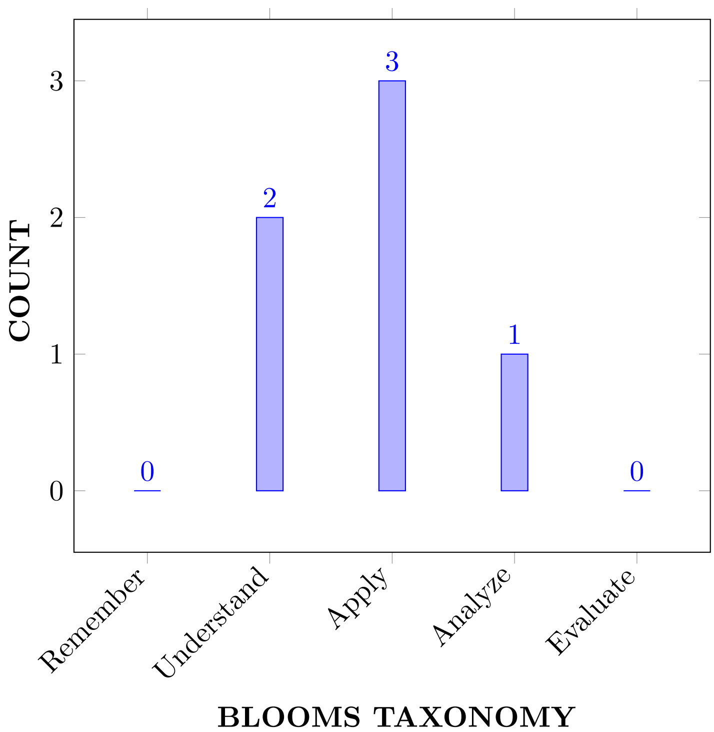
III	The practical implementation and usage of non linear data structures for solving problems of different domain.
IV	The knowledge of more sophisticated data structures to solve problems involving balanced binary search trees, AVL Trees, B-trees and B+ trees, hashing.
V	The graph traversals algorithms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

VII COURSE OUTCOMES:

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

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

COURSE KNOWLEDGE COMPETENCY LEVEL



VIII HOW PROGRAM OUTCOMES ARE ASSESSED:

Program		Strength	Proficiency Assessed by
PO 1	**Engineering knowledge:**Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.	2	Viva-voce/Laboratory Practices
PO 2	**Problem analysis:**Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences	2	Viva-voce/Laboratory Practices
PO 3	**Design/development of solutions:**Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.	2	Viva-voce/Laboratory Practices
PO 5	**Modern Tool Usage:**Create, select, and apply appropriate techniques, resources, and modern Engineering and IT tools including prediction and modeling to complex Engineering activities with an understanding of the limitations.	2	Viva-voce/Laboratory Practices
PO 10	**Communication:**Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.	2	Viva-voce/Laboratory Practices
PO 12	**Life-long learning:**Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.	2	Viva-voce/Laboratory Practices

3 = High; 2 = Medium; 1 = Low

IX HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

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

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

3 = High; 2 = Medium; 1 = Low

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

COURSE OUTCOMES	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key Competencies
CO 1	PO 1	Understand (knowledge) the basic concept of algorithm analysis which provides theoretical estimates for the resources needed by any algorithm for a given computational problem. These estimates provide an insight into reasonable directions of search for efficient algorithms by applying the principles of **mathematics and science**	3
	PO 5	Understand the (given **knowledge**) appropriate techniques, resources, and modern Engineering and IT tools including prediction and modeling to complex 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

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 6	R1: 7.1
11	Determine the rate of flow through Nothches.	CO 6	R1:7.2

12	Determine the rate of flow through a Orifice meter	CO 6	R1:7.3

XVI EXPERIMENTS FOR ENHANCED LEARNING (EEL):

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

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

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

CIVIL ENGINEERING
COURSE DESCRIPTION

Course Title	**Workshop / Manufacturing Practices Laboratory**				
Course Code	AMEB01				
Program	B.Tech				
Semester	I	CE			
Course Type	FOUNDATION				
Regulation	IARE - R18				
Course Structure	Theory			Practical	
	Lecture	Tutorials	Credits	Laboratory	Credits
	-	-	-	4	2
Course Coordinator	Mr. GOOTY ROHAN, Assistant Professor				

I COURSE OVERVIEW:

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

II COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites	Credits
-	-	-	-	-

III MARKS DISTRIBUTION:

Subject	SEE Examination	CIE Examination	Total Marks
Workshop / Manufacturing Practices Laboratory	70 Marks	30 Marks	100

IV DELIVERY / INSTRUCTIONAL METHODOLOGIES:

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

V EVALUATION METHODOLOGY:

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

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

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

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

Continuous Internal Assessment (CIA):

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

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

Continuous Internal Examination (CIE):

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

A. Experiment Based

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

B. Programming Based

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

VI COURSE OBJECTIVES:

The students will try to learn:

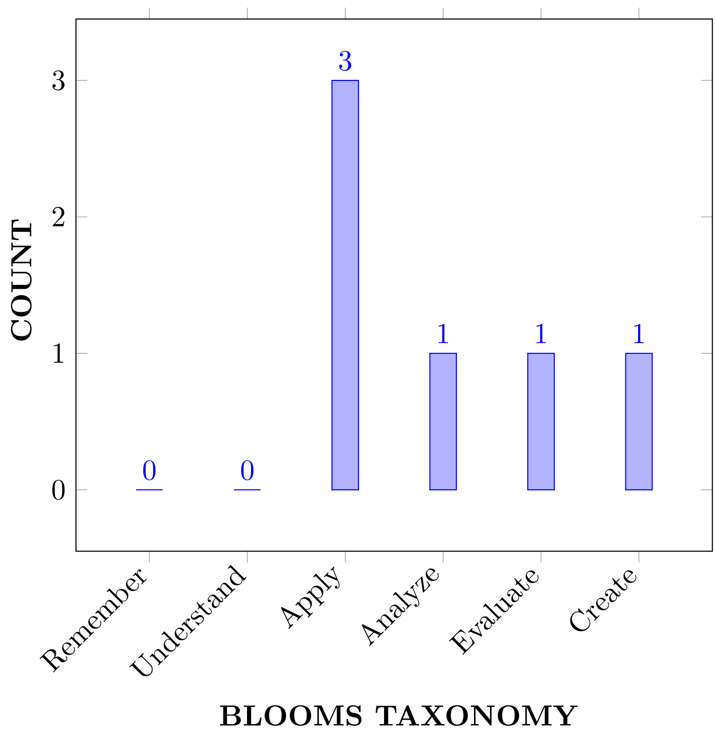
I	The application of jigs and fixtures, measuring, marking and cutting tools in various types of manufacturing processes.
II	The preparation of different joints in carpentry and fitting and also familiarizes wood working machinery.
III	The concepts of forming processes by forging, black-smithy and tin-smithy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

VII COURSE OUTCOMES:

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

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

COURSE KNOWLEDGE COMPETENCY LEVEL



VIII HOW PROGRAM OUTCOMES ARE ASSESSED:

Program		Strength	Proficiency Assessed by
PO 1	**Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.	2	Lab Exercises
PO 3	**Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.	2	CIA
PO 5	**Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.	2	Lab Exercises
PO 11	**Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.	3	SEE

3 = High; 2 = Medium; 1 = Low

IX HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

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

3 = High; 2 = Medium; 1 = Low

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

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

	PO 5	Develop the given resources and engineering tools into proper fitment as given in the diagrammatical representation.	2
	PO 11	Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.	2
	PSO 3	Make use of Experimental tools for Building Career Paths towards Innovation Startups, Employability in different mechanical trades.	2
CO 2	PO 1	Apply the knowledge of engineering fundamentals to join given metal pieces according to given sketch to develop required joint.	1
	PO 5	Develop the given resources and engineering tools into proper fitment as given in the diagrammatical representation.	2
	PO 11	Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.	2
	PSO 3	Make use of Experimental tools for Building Career Paths towards Innovation Startups, Employability in different mechanical trades.	2
CO 3	PO 1	Apply the knowledge of engineering fundamentals to make metal rod into given required shape according to given sketch to develop required joint.	1
	PO 5	Develop the given resources and engineering tools into required shape as given in the diagrammatical representation.	2
	PSO 3	Make use of Experimental tools for Building Career Paths towards Innovation Startups, Employability in different mechanical trades.	2
CO 4	PO 1	Apply the knowledge of engineering fundamentals to make the casting product from given materials according to given sketch to develop required shape.	1
	PO 3	Conversion of given design into a practical output using design solution for complex engineering problems and design system components.	2
	PO 11	Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.	2
CO 5	PO 5	Develop the given resources and engineering tools into required shape as given in the diagrammatical representation.	2

	PO 11	Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.	2
CO 6	PO 1	Apply the knowledge of engineering fundamentals to make the required electrical connection according to given circuit diagram to develop connection.	1
	PO 5	Develop the given resources and engineering tools into proper fitment as given in the diagrammatical representation.	2
	PO 11	Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.	2
	PSO 3	Make use of Experimental tools for Building Career Paths towards Innovation Startups, Employability in different mechanical trades.	2

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

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

3 = High; 2 = Medium; 1 = Low

XII ASSESSMENT METHODOLOGY DIRECT:

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

XIII ASSESSMENT METHODOLOGY INDIRECT:

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

XIV SYLLABUS:

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

TEXTBOOKS

1. Hajra Choudhury S.K., Hajra Choudhury A.K. and Nirjhar Roy S.K., Elements of Workshop Technology, Media promoters and publishers private limited, Mumbai, Vol. I 2008 and Vol. II 2010.
2. Kalpakjian S, Steven S. Schmid, Manufacturing Engineering and Technology, Pearson Education India Edition, 4th Edition, 2002.
3. Gowri P. Hariharan, A. Suresh Babu, Manufacturing Technology – I, Pearson Education, 2008.
4. Roy A. Lindberg, Processes and Materials of Manufacture, Prentice Hall India, 4 th Edition, 1998.
5. Rao P.N., Manufacturing Technology, Vol. I and Vol. II, Tata McGraw-Hill House, 2017

REFERENCE BOOKS:

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

XV COURSE PLAN:

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

S.No	Topics to be covered	CO's	Reference
1	Tenon joint and Mortise joint.	CO 1, CO 2	T1:1.4, R1:1.2
2	Dove tail joint and Lap joint.	CO 1, CO 2	T1:1.5, R1:1.3
3	Straight fit and Square fit.	CO 3, CO 4	T2:12.2, R2:13.1
4	V fit and Semicircular fit.	CO 3, CO 4	T2:12.3, R2:13.4
5	S-bend and J-bend.	CO 5, CO 6	T3:9.1, R3:3
6	Fan and Round to Square shape.	CO 5, CO 6	T3:9.1, R3:3
7	Wheel flange and bearing housing.	CO 5, CO 6	T4:1.9, R2:1.8
8	Bearing housing and Wheel flange.	CO 5, CO 6	T4:2, R2:1.9
9	Rectangular tray and Round tin.	CO 4, CO 5	T5:1.4, R1:1.2
10	Make a Square Tin and Conical Funnel.	CO 5, CO 6	T5:1.7, R2:1.3
11	Series connection and parallel Connection.	CO 5, CO 6	T4:1.4, R1:1.2

12	One bulb controlled by two switches and tube light connection.	CO 5, CO 6	T5:7.1, R3:3.8

XVI EXPERIMENTS FOR ENHANCED LEARNING (EEL):

S.No	Design Oriented Experiments
1	**Divided Tenon Joint:** It is the simplest form of Mortise and tenon joint and this joint is made by fitting a short tenon into a continuous groove. This joint has the advantage of being easy to cut and is often used to make cabinet doors and other light duty frame and panel assemblies.
2	**Cross Fitting:** It is the fundamental of type of fitting which are used fitting trade and it is formed by joining the two inclined shaped cut specimens together and is often used to join the universal bearings.
3	**Hexagonal Headed Bolt:** Hexagonal bolts are large bolts with a six-sided head used to fasten wood to wood, or metal to wood. These will have a tendency to spin as you tighten them.
4	**Open scoop:** Open scoop is used for accurately dispensing powders and granules hygienically. It is suitable for any hygienic application.
5	**T-Pipe Joint:** T-pipe is a type of fitting which is T-shaped having two outlets at 90 degrees to the main line. It is short piece of pipe with a lateral outlet.it is widely used as pipe fittings.
6	**Grooved Pulley:** Grooved pulley often used to for holding a belt, wire rope or rope and incorporated into a pulley. These sheave pins on a axle or bearing inside the frame of the pulley. This allows wire or rope to move freely, minimizing friction and wear on the cable.
7	**Bell Indicator circuit:** Bell indicator circuit is used where a bell and buzzers are needed to control from different locations. Bell indicator circuit is also known as hoteling circuit where an electric bell is controlled from more than one locations.

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

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

CIVIL ENGINEERING
COURSE DESCRIPTION

Department	CIVIL ENGINEERING				
Course Title	SURVEYING AND GEOMATICS				
Course Code	ACEB01				
Program	B.Tech				
Semester	III				
Course Type	CORE				
Regulation	R18				
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	AHSB02	I	Linear Algebra and Calculus

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 (Table 2), with 20 marks for Continuous Internal Examination (CIE), 05 marks for Quiz and 05 marks for Alternative Assessment Tool in table

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	Complex Problem Solving
40%	40%	20%

VI COURSE OBJECTIVES:

The students will try to learn:

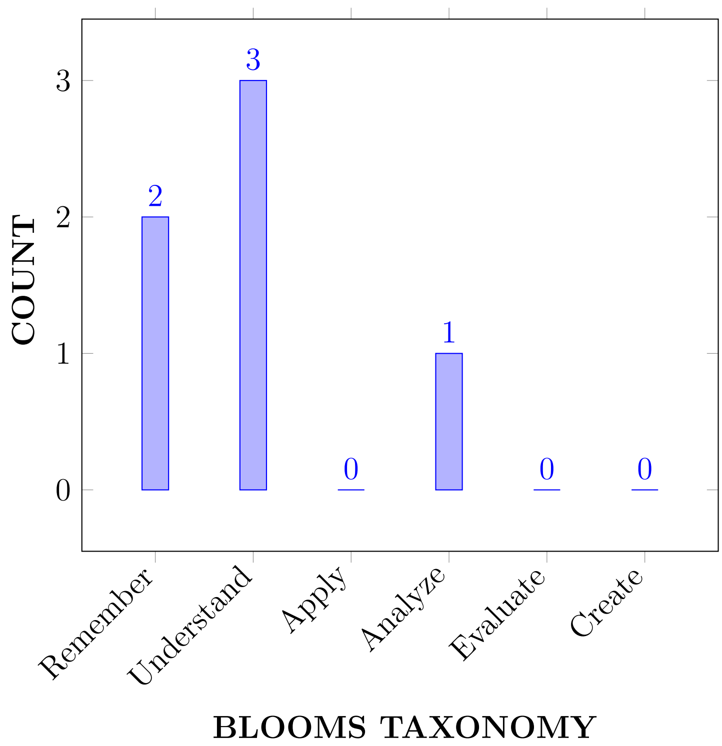
I	The importance and fundamentals of surveying for measuring field parameters using traditional and modern instruments involved in civil construction.
II	The designing of curves and path alignment at suitable locations by implementing the principles of geometry and trigonometry.
III	The programming tools 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 OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO 1	✓	✓	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 2	✓	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 3	-	✓	-	-	✓	-	-	-	-	-	-	-	✓	-	-
CO 4	-	✓	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 5	✓	-	-	-	-	-	-	-	-	-	-	-	✓	-	-
CO 6	-	✓	-	-	-	-	-	-	-	-	-	-	-	-	-

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

COURSE OUTCOMES	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key Competencies
CO 1	PO 1	Apply the knowledge and principals of mathematics to engineering problems in determining an area enclosed by irregular boundary line using the knowledge of **mathematics and science fundamentals**	2
	PO 2	Analyse and **formulate** the engineering problems to determine exact field measurements to serve as a legal record. Analyse and **identify the problem statement,formulation and abstraction** for the **development of solution.**	4
CO 2	PO 1	Use the **fundamentals of engineering** and **science** in identifying the suitable alignment or path for curves at various terrains.	2
CO 3	PO 2	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 - $0 \leq C \leq 5\%$ – 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	-	-	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. B Suresh, Assistant Professor

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

COURSE DESCRIPTION

Department	**CIVIL ENGINEERING**				
Course Title	**ENGINEERING MECHANICS**				
Course Code	AMEB03				
Program	B. Tech				
Semester	THREE				
Course Type	Foundation				
Regulation	IARE - R18				
Course Structure	Theory			Practical	
	Lecture	Tutorials	Credits	Laboratory	Credits
	3	1	4	-	-
Course Coordinator	Mr. B D Y Sunil, Assistant Professor				

I COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites
B.Tech	AHSB02	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). 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
%	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), 05 marks for Quiz and 05 marks for Alternative Assessment Tool (AAT).

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

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

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

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

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

VI COURSE OBJECTIVES:

The students will try to learn:

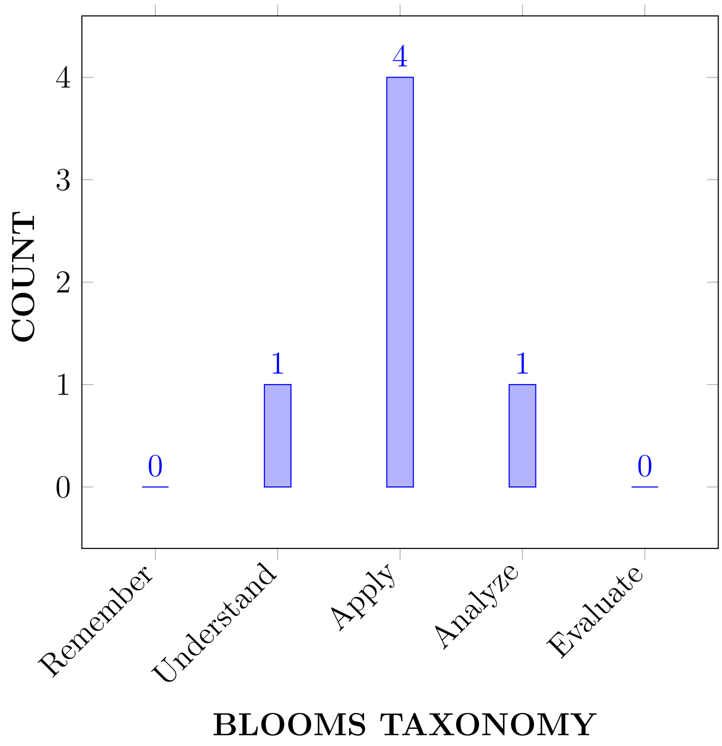
I	Students should develop the ability to work comfortably with basic engineering mechanics concepts required for analyzing static structures.
II	Identify an appropriate structural system to studying a given problem and isolate it from its environment, model the problem using good free-body diagrams and accurate equilibrium equations.
III	Understand the meaning of centre of gravity (mass)/centroid and moment of Inertia using integration methods and method of moments .
IV	To solve the problem of equilibrium by using the principle of work and energy, impulse momentum and vibrations for preparing the students for higher level courses such as Mechanics of Solids, Mechanics of Fluids, Mechanical Design and Structural Analysis etc .

VII COURSE OUTCOMES:

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

CO 1	**Deduce** the 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.

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

IX HOW PROGRAM OUTCOMES ARE ASSESSED:

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

3 = High; 2 = Medium; 1 = Low

X HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

PROGRAM SPECIFIC OUTCOMES		Strength	Proficiency Assessed by
PSO 1	Formulate and evaluate engineering concepts of design, thermal and production to provide solutions for technology aspects in digital manufacturing.	3	Research papers / Group discussion / Short term courses

3 = High; 2 = Medium; 1 = Low

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

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

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

Course Outcomes	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key competencies matched.
CO 1	PO 1	Apply the knowledge and principals of mathematics to engineering problems for determining reactions and resultants of forces using the knowledge of mathematics and science fundamentals	2
	PO 2	Analyze and formulate the engineering problems to determine the reactions and resultants of given force systems. Analyze and identify the problem statement, formulation and abstraction for the development of solution.	4
CO2	PO 2	Collect the data from complex engineering problems and implement them to draw the free body diagrams and interpret the results	3
CO 3	PO 2	Formulate the force system of friction problem and identify the appropriate equilibrium equation and develop the solution from the first principles of mathematics.	4
	PO 4	Understand the principles of engineering and apply them to the friction systems by analyzing the condition of motion of rest of the body	2

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

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

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

XIV PERCENTAGE OF KEY COMPETENCIES FOR CO – PO/ PSO

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	66.7	40.0	-	-	-	-	-	-	-	-	-		-	-	-
CO 2	-	30	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 3	-	40	-	18.2	-	-	-	-	-	-	-	-	-	-	-
CO 4	66.7	-	-	-		-	-	-	-	-	-		-	-	-
CO 5	66.7	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 6	-	30.0	-	18.2		-	-	-	-	-	-		100	-	-

XV COURSE ARTICULATION MATRIX (PO / PSO MAPPING):

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

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

1 -5 <C$\leq$ 40% – Low/ Slight

2 - 40 % <C < 60% –Moderate

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

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

XVI ASSESSMENT METHODOLOGY-DIRECT:

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

XVII ASSESSMENT METHODOLOGY-INDIRECT:

	Assessment of mini projects by experts	✓	End Semester OBE Feedback

XVIII SYLLABUS:

MODULE I	**INTRODUCTION TO ENGINEERING MECHANICS**
	Force Systems Basic concepts, Particle equilibrium in 2-D and 3-D; Rigid Body equilibrium; System of Forces, Coplanar Concurrent Forces, Components in Space – Resultant- Moment of Forces and its Application; Couples and Resultant of Force System, Equilibrium of System of Forces, Free body diagrams, Equations of Equilibrium of Coplanar Systems and Spatial Systems; Static Indeterminacy.
MODULE II	**FRICTION AND BASICS STRUCTURAL ANALYSIS**
	Types of friction, Limiting friction, Laws of Friction, Static and Dynamic Friction; Motion of Bodies, wedge friction, screw jack and differential screw jack; Equilibrium in three dimensions; Method of Sections; Method of Joints; How to determine if a member is in tension or compression; Simple Trusses; Zero force members; Beams and types of beams; Frames and Machines.

MODULE III	**CENTROID AND CENTRE OF GRAVITY AND VIRTUAL WORK AND ENERGY METHOD**
	Centroid of simple figures from first principle, centroid of composite sections; Centre of Gravity and its implications; Area moment of inertia- Definition, Moment of inertia of plane sections from first principles, Theorems of moment of inertia, Moment of inertia of standard sections and composite sections; Mass moment inertia of circular plate, Cylinder, Cone, Sphere, Hook. Virtual displacements, principle of virtual work for particle and ideal system of rigid bodies, degrees of freedom. Active force diagram, systems with friction, mechanical efficiency. Conservative forces and potential energy (elastic and gravitational), energy equation for equilibrium. Applications of energy method for equilibrium. Stability of equilibrium.
MODULE IV	**PARTICLE DYNAMICS AND INTRODUCTION TO KINETICS**
	Particle dynamics- Rectilinear motion; Plane curvilinear motion (rectangular, path, and polar coordinates). 3-D curvilinear motion; Relative and constrained motion; Newton's 2nd law (rectangular, path, and polar coordinates). Work-kinetic energy, power, potential energy. Impulse-momentum (linear, angular); Impact (Direct and oblique). Introduction to Kinetics of Rigid Bodies covering, Basic terms, general principles in dynamics; Types of motion, Instantaneous centre of rotation in plane motion and simple problems.
MODULE V	**MECHANICAL VIBRATIONS**
	Basic terminology, free and forced vibrations, resonance and its effects; Degree of freedom; Derivation for frequency and amplitude of free vibrations without damping and single degree of freedom system, simple problems, types of pendulum, use of simple, compound and torsion pendulums.

TEXTBOOKS

1. Irving H. Shames (2006), "Engineering Mechanics", Prentice Hall, 4th Edition,2013
2. F. P. Beer and E. R. Johnston (2011), "Vector Mechanics for Engineers", Vol I - Statics, Vol II, – Dynamics, Tata McGraw Hill , 9th Edition,2013
3. R. C. Hibbler (2006), "Engineering Mechanics: Principles of Statics and Dynamics", Pearson Press.

REFERENCE BOOKS:

1. S.Bhavikatti,"ATextBookofEngineeringMechanics",NewAgeInternational,1st Edition,2012.
2. A.K.Tayal, "Engineering Mechanics", Uma Publications, 14th Edition, 2013.
3. R. K. Bansal "Engineering Mechanics", Laxmi Publication, 8thEdition, 2013.

WEB REFERENCES:

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

COURSE WEB PAGE:

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

XIX COURSE PLAN:

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

S.No	Topics to be covered	CO's	Reference
OBE DISCUSSION			
1	Discussion on Objectives and Outcomes of the course Engineering Mechanics		
CONTENT DELIVERY (THEORY)			
1	Introduction to 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 and Basic Structural Analysis	CO 2	T2:5.6 R1:1.12.3
3	Module – 3 – Centroid, Centre of Gravity and Virtual Work and Energy Method	CO 3, CO4	T2:5.10 R1:1.15
4	Module – 4 – Particle Dynamics and Introduction to Kinetics	CO 5	T2:5.15 R1:1.16
5	Module – 5 – Mechanical Vibrations	CO 6	T2:5.17 R1:1.13.1

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

Signature of Course Coordinator **HOD,CE**

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

COURSE DESCRIPTION

<table>
<tr><td>Department</td><td colspan="5">Civil Engineering</td></tr>
<tr><td>Course Title</td><td colspan="5">Building Materials Construction and Planning</td></tr>
<tr><td>Course Code</td><td colspan="5">ACEB02</td></tr>
<tr><td>Program</td><td colspan="5">B.Tech</td></tr>
<tr><td>Semester</td><td colspan="5">III</td></tr>
<tr><td>Course Type</td><td colspan="5">CORE</td></tr>
<tr><td>Regulation</td><td colspan="5">R18</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. K.Lokesh , Assistant Professor</td></tr>
</table>

I COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites
-	-	-	-

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 (Table 2), with 20 marks for Continuous Internal Examination (CIE), 05 marks for Quiz and 05 marks for Alternative Assessment Tool in table

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	Complex Problem Solving
40%	40%	20%

VI COURSE OBJECTIVES:

The students will try to learn:

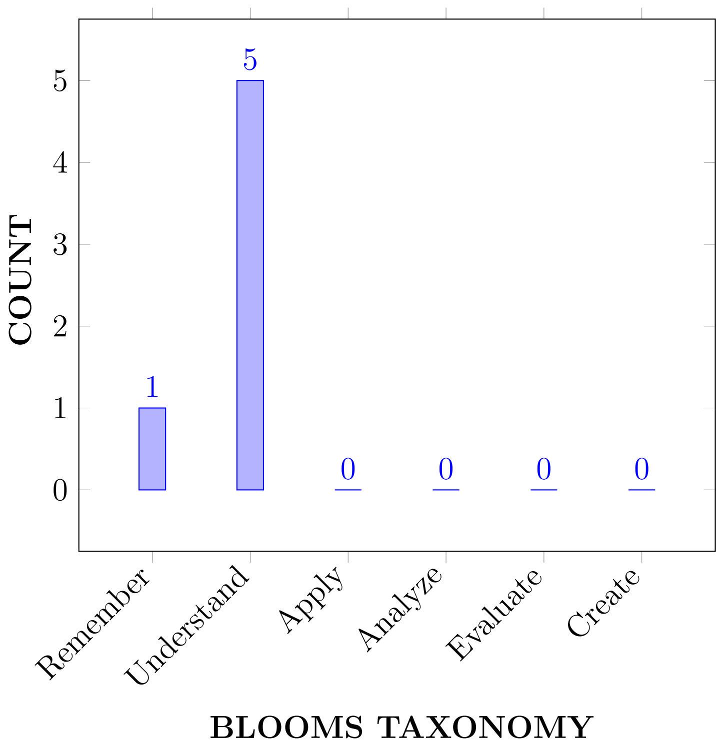
I	The basics of material science and behavior of various building materials used in construction
II	The construction materials required for the assigned work.
III	The procedural knowledge of the simple testing methods of cement, lime and concrete etc.
IV	The requirements and different types of stairs.

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	**BUILDING COMPONENTS AND FOUNDATIONS**
	Lintels, arches, different types of floors-concrete, mosaic, terrazzo floors, pitched, flat and curved roofs, leanto-roof, coupled roofs, trussed roofs, king and queen post. Trusses; RCC roofs, madras terrace/shell roofs; Foundations: Shallow foundations, spread, combined, strap and mat footings
MODULE IV	**WOOD, ALUMINUM AND GLASS**
	Structure, properties, seasoning of timber; Classification of various types of woods used in buildings, defects in timber; Alternative materials for wood, galvanized iron, fiber-reinforced plastics, steel, aluminum; Types of masonry, English and Flemish bonds, rubble and ashlars masonry, cavity and partition walls
MODULE V	**STAIRS AND BUILDING PLANNING**
	Stairs: Definitions, technical terms and types of stairs, requirements of good stairs; Geometrical design of RCC doglegged and open-well stairs; Principles of building planning, classification building and planning and building by laws.

TEXTBOOKS

1. Sushil Kumar "Building Materials and construction", Standard Publishers, 20th edition, reprint, 2015.
2. Dr. B.C.Punmia, Ashok kumar Jain, Arun Kumar Jain, "Building Construction, Laxmi Publications (P) ltd., New Delhi.
3. Rangawala S. C. "Engineering Materials", Charter Publishing House, Anand, India.

REFERENCE BOOKS:

1. S. K. Duggal, "Building Materials", New Age International (P) Limited, 4th Edition,2016
2. National Building Code (NBC) of India
3. P C Vergese, "Building Materials", PHI Learning Pvt. Ltd, 2nd Edition, 2015.
4. Building Materials and Components, CBRI, India, 1990.

WEB REFERENCES:

1. http://nptel.ac.in/courses/105102088/
2. http://nptel.ac.in/courses/105101088/

XIX COURSE PLAN:

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

S.No	Topics to be covered	CO's	Reference
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)			
1-2	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	Building Components and Foundations (Module III)	CO 3	R4:5.1
4	Wood, Aluminum and Glass(Module IV)	CO 4, 5	T1:7.5
5	Stairs and Building Planning (Module V)	CO 6	T1: 4.1

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

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

COURSE DESCRIPTION

Department	**CIVIL ENGINEERING**				
Course Title	**BASIC ELECTRONCIS ENGINEERING**				
Course Code	AEEB04				
Program	B.Tech				
Semester	III	CE			
Course Type	Foundation				
Regulation	IARE - R18				
Course Structure	Theory			Practical	
	Lecture	Tutorials	Credits	Laboratory	Credits
	3	0	3	-	-
Course Coordinator	Ms.B Navothna, Assistant Professor				

I COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites
B.Tech	AHSB02	I	Linear Algebra and Calculus

II COURSE OVERVIEW:

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

III MARKS DISTRIBUTION:

Subject	SEE Examination	CIE Examination	Total Marks
Basic Electronics Engineering	70 Marks	30 Marks	100

IV CONTENT DELIVERY / INSTRUCTIONAL METHODOLOGIES:

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

V EVALUATION METHODOLOGY:

The course will be evaluated for a total of 100 marks, with 30 marks for Continuous Internal Assessment (CIA) and 70 marks for Semester End Examination (SEE). Out of 30 marks allotted for CIA during the semester, marks are awarded by taking average of two 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
0%	Remember
67%	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), 05 marks for Quiz and 05 marks for Alternative Assessment Tool (AAT).

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

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

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

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

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

VI COURSE OBJECTIVES:

The students will try to learn:

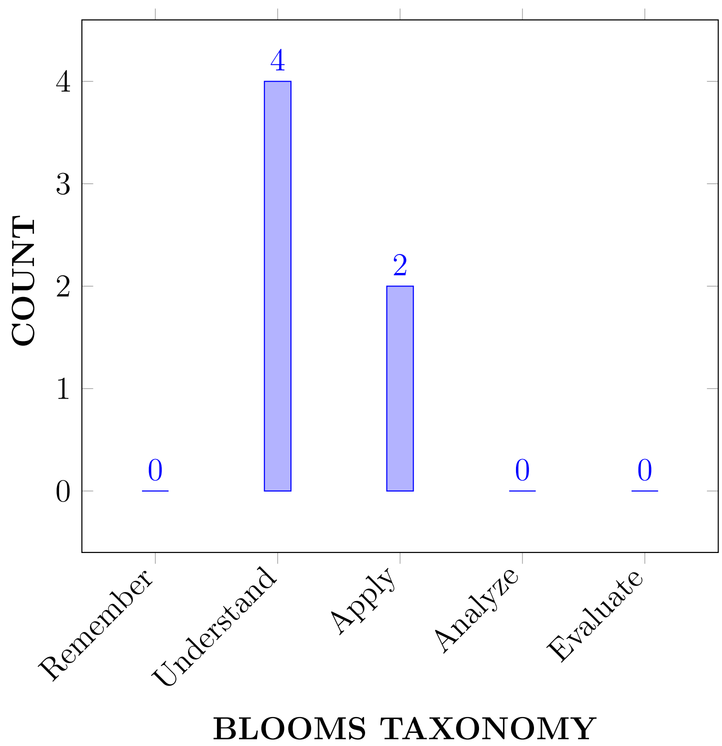
I	Understanding of the basic elements encountered in electric networks, and operation of measuring instruments.
II	The construction and working principle of DC generator, DC motor, andtypes of DC machines based on field excitation method.
III	Analyze the characteristics of alternating quantities and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

VII COURSE OUTCOMES:

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

CO 1	**Solve** complex electrical circuits by applying network reduction techniques for reducing into a simplified circuit.	Apply
CO 2	**Differentiate** the working of moving iron and moving coil type instruments for computing electrical qunatities using suitable instrument.	Understand
CO 3	**Demonstrate** the construction, principle and working of DC machines for their performance analysis.	Understand
CO 4	**Illustrate** alternating quantities of sinusoidal waveform and working , construction of single phase transformers,induction motors, alternators for analysis of AC waveforms and AC machines.	Understand
CO 5	**Apply** the PN junction characteristics for the doide applications such as switch and rectifier.	Apply
CO 6	**Extend** the biasing techniques for bipolar and uni-polar transistor amplifier circuits considering stability condition for establishing a proper operating point.	Understand

COURSE KNOWLEDGE COMPETENCY LEVEL



VIII PROGRAM OUTCOMES:

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

IX HOW PROGRAM OUTCOMES ARE ASSESSED:

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

3 = High; 2 = Medium; 1 = Low

X HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

PROGRAM SPECIFIC OUTCOMES		Strength	Proficiency Assessed by
PSO 1	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.	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**	Recollect the concept of electricity is described through scientific principles, importance Kirchhoff laws in relation with law of conservation of energy and charge circuits are explained using mathematical principles and various source transformation techniques are adopted for solving complex circuits.	3

Course Outcomes	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key competencies matched.
	PO 2	Derive standard expressions for equivalent resistances, inductances and capacitance by using series-parallel networks i.e mathematical calculations.	1
	PSO 1	Solve complex electrical circuits by applying basic circuit concepts by using computer programs.	1
CO 2	**PO 1**	Understand the working principles of indicating instruments and classify types based on construction engineering disciplines.	3
CO 3	**PO 1**	The principle of operation and characteristics of DC machines are explained by applying engineering fundamentals including device physics.	3
CO 4	**PO 1**	Understand about alternating quantities of an AC signal and working of single phase transformers,induction motors and alternators using engineering principles and mathematical equations.	3
	PSO 1	Develop equivalent circuit of single phase transformer referred to both sides by developing computer programs.	1
CO 5	**PO 1**	Outline of materials and brief description of formation of semi-conductor devices by using basic fundamentals of science and engineering.	3
	PO 2	Recognize (knowledge) the working and characteristics of diode and understand application which is rectifier circuit using engineering knowledge, and types of rectifiers.	3
CO 6	**PO 1**	List out various transistor configurations and discuss their working using principles of science and mathematical principles.	3
	PO 2	Explain the concept of biasing and load lines and their applicability in solving problems and working of transistors as switch and amplifier.	3

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

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

XIV PERCENTAGE OF KEY COMPETENCIES FOR CO – PO/ PSO

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	100	10	-	-	-	-	-	-	-	-	-	-	25	-	-
CO 2	100	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 3	100	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 4	100	-	-	-	-	-	-	-	-	-	-	-	25	-	-
CO 5	100	25	-	-	-	-	-	-	-	-	-		-	-	-
CO 6	100	25	-	-	-	-	-	-	-	-	-		-	-	-

XV COURSE ARTICULATION MATRIX (PO / PSO MAPPING):

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

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

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	3	1	-	-	-	-	-	-	-	-	-	-	1	-	-
CO 2	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 3	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 4	3	-	-	-	-	-	-	-	-	-	-	-	1	-	-
CO 5	3	1	-	-	-	-	-	-	-	-	-		-	-	-
CO 6	3	1	-	-	-	-	-	-	-	-	-		-	-	-
TOTAL	**18**	**3**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**2**	**0**	**0**
AVERAGE	**3**	**0.5**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0.3**	**0**	**0**

XVI ASSESSMENT METHODOLOGY-DIRECT:

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

XVII ASSESSMENT METHODOLOGY-INDIRECT:

	Assessment of mini projects by experts	✓	End Semester OBE Feedback

XVIII SYLLABUS:

MODULE I	**ELECTRICCIRCUITS,ELECTROMAGNETISM AND INSTRUMENTS**
	Electrical Circuits: Basic definitions, types of elements, Ohm's Law, resistive networks, inductive networks, capacitive networks, Kirchhoff's Laws, series, parallel circuits and star delta transformations, simple problems, Faradays law of electromagnetic induction; Instruments: Basic principles of indicating instruments, permanent magnet moving coil and moving iron instruments.
MODULE II	**DC MACHINES**
	DC Machines: Principle of operation of DC generator, EMF equation, principle of operation of DC motors, torque equation, types of DC machines, applications, three point starter.
MODULE III	**ALTERNATING QUANTITIES AND AC MACHINES**
	Alternating Quantities: Sinusoidal AC voltage, average and RMS values, form and peak factor, concept of three phase alternating quantity; Transformer: Principle of operation, EMF equation, losses, efficiency and regulation. Three Phase Induction Motor: Principle of operation, slip, slip torque characteristics, efficiency, applications; Alternator: Principle of operation, EMF Equation, efficiency, regulation by synchronous impedance method.
MODULE IV	**SEMICONDUCTOR DIODE AND APPLICATIONS**
	Semiconductor Diode: P-N Junction diode, symbol, V-I characteristics, half wave rectifier, full wave rectifier, bridge rectifier and filters, diode as a switch, Zener diode as a voltage regulator.
MODULE V	**BIPOLAR JUNCTION TRANSISTOR AND APPLICATIONS**
	Bipolar junction: Working principle of transistors, DC characteristics, CE, CB, CC configurations, biasing, load line, applications.

TEXTBOOKS

1. A Chakrabarti, "Circuit Theory", Dhanpat Rai Publications, 6thEdition,2004.
2. K S Suresh Kumar, "Electric Circuit Analysis", Pearson Education, 1stEdition,2013.
3. WillianmHayt, Jack E Kemmerly S M Durbin, "Engineering Circuit Analysis", Tata McGraw Hill, 7thEdition,2010.
4. R L Boylestad, Louis Nashelsky, "Electronic Devices and Circuits", PEI / PHI, 9th Edition, 2006.
5. 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/aeronautical-engineering-autonomous/basic-electrical-and-electronics-engineering

XIX COURSE PLAN:

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

S.No	Topics to be covered	CO's	Reference T1: 4.1
OBE DISCUSSION			
1	Course Description on Outcome Based Education (OBE): Course Objectives, Course Outcomes (CO), Program Outcomes (PO) and CO - PO Mapping	-	-
CONTENT DELIVERY (THEORY)			
2	Electrical Circuits: Basic definitions, Types of elements	CO 1	T1-5.2 to 5.3
3	Ohm's Law, Kirchhoff Laws	CO 1	T1-5.4 to 5.5
4	Series, parallel circuits	CO 1	T1-5.5 to 5.8
5	Derivation for Star-delta and delta-star transformations	CO 1	T1-5.8 to 5.9
6	Mesh analysis and Nodal Analysis	CO 1	T1-5.11 to 5.12
7	Working of moving iron type instruments	CO 2	T1-5.14 to 5.15
8	Working of moving coil type inst0ruments	CO 2	T1-5.16 to 5.16
9	Principle of operation for DC generators	CO 3	R2-7.1 to 7.2
10	Construction and EMF equation for DC generators	CO 3	R2-7.4
11	Types of DC generators	CO 3	R2-7.3
12	Principle of operation for DC motors	CO 3	R2-7.3.1 to 7.3.2
13	Back EMF, torque equation for DC motors	CO 3	R2-7.3.3 to 7.3.6
14	Types of DC motors	CO 3	R2-7.6
15	Losses and efficiency for DC generators, motors	CO 3	T1-13.1 to 13.3
16	Principle of operation for Single Phase Transformers	CO 4	T1-13.1 to 13.3

17	Construction and EMF equation for Single Phase Transformers	CO 4	T1-13.5 to 13.6
18	Types of transformers and turns ratio	CO 4	T1-13.6 to 13.7
19	Operation of transformer under no load	CO 4	T1-13.7 to 13.9
20	Operation of transformer under on load	CO 4	T1-13.8
21	Equivalent circuit for Transformers	CO 4	T1-17.1 to 17.2
21	Phasor diagrams of transformer	CO 4	T1-17.3 to 17.4
22	Losses of Transformers	CO 4	T1-17.6 to 17.7
23	Efficiency of Transformers	CO 4	T1-13.11
24	Regulation for Transformers	CO 4	T1-13.12
25	Three Phase Induction motor: Principle of operation	CO 4	T1-13.13
26	slip, slip -torque characteristics	CO 4	T1-13.14
27	Alternators: Introduction, principle of operation	CO 4	T1-13.19
28	Constructional features	CO 4	T1-13.20
29	Understand the concept of P-N junction diode, symbol	CO 5	T1-13.8
30	Learn the V-I characteristics of P-N junction diode	CO 5	T1-17.1 to 17.2
31	Discuss the concept of half wave rectifier and full wave rectifier	CO 5	T1-17.3 to 17.4
32	Understand the bridge rectifiers and filters	CO 5	T1-17.6 to 17.7
33	Discuss the concept of diode as a switch, Zener diode as a voltage regulator	CO 5	T1-13.11
34	Know the concept of Transistors and Understand the configurations	CO 6	T1-13.12
35	Understand the DC characteristics of transistor	CO 6	T1-13.13
36	Understand the biasing and load line analysis.	CO 6	T1-13.13
37	Discuss how transistor acts as an amplifier.	CO 6	T1-13.13
PROBLEM SOLVING/ CASE STUDIES			
38	Numerical Examples on electrical quantities, Ohm's law, KCL, KVL	CO 1	T1-5.8 to 5.9
39	Numerical Examples on series, parallel elements and star to delta transformation and mesh analysis	CO 1	T1-5.5 to 5.8
40	Numerical Examples on nodal analysis and alternating quantities	CO 1	T1-6.8 to 6.9
41	Numerical Examples on Superposition theorem	CO 1	T1-6.2 to 6.3
42	Numerical Examples on reciprocity and maximum power transfer theorems	CO 1	R2-7.1 to 7.2
43	Numerical Examples on Thevenin's and Norton's theorems	CO 1	T1-13.1 to 13.3

44	Numerical Examples on EMF equation and types of DC generators	CO 3	T1-13.6 to 13.7
45	Numerical Examples on torque equation of DC motor	CO 3	T1-13.1 to 13.3
46	Numerical Examples on types of DC motors	CO 3	T1-13.13
47	Numerical Examples on EMF equation and equivalent circuit of 1 phase transformer	CO 4	T1-13.16 to 13.18
48	Numerical Examples on, efficiency for Transformers	CO 4	T1-13.14
49	Numerical Examples on, regulation for Transformers	CO 4	T1-13.16 to 13.18
50	Numerical Examples on EMF of Alternators	CO 4	T1-13.19
51	Numerical Examples on regulation of Alternators	CO 4	T1-13.20
52	Numerical Examples on Rectifiers	CO 5	T1-13.19
53	Numerical Examples on transistors	CO 6	T1-13.19
DISCUSSION OF DEFINITION AND TERMINOLOGY			
54	Definitions on basics of electrical circuits and electrical instruments	CO 1	T1-5.1 to 5.3
55	Definitions on DC machines	CO 2	T1-6.1 to 6.3
56	Definitions on single phase AC circuits and AC machines	CO 3	R2-7.1 to 7.2
57	Definitions on semiconductor diode and applications	CO 5	T1-13.1 to 13.3
58	Definitions on bipolar junction transistor and applications	CO 6	T1-13.11
DISCUSSION OF QUESTION BANK			
59	Questions from electrical circuits and electrical instruments	CO 1	T1-5.1 to 5.3
60	Questions from DC machines	CO 2	T1-6.1 to 6.3
61	Questions from single phase AC circuits and AC machines	CO 3	R2-7.1 to 7.2
62	Questions from semiconductor diode and applications	CO 5	T1-13.1 to 13.3
63	Questions from bipolar junction transistor and applications	CO 6	T1-13.11

Signature of Course Coordinator **HOD,CE**

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

COURSE DESCRIPTION

Department	**CIVIL ENGINEERING**				
Course Title	**DATA STRUCTURES**				
Course Code	ACSB03				
Program	B.Tech				
Semester	III				
Course Type	Core				
Regulation	R-18				
Course Structure	Theory			Practical	
	Lecture	Tutorials	Credits	Laboratory	Credits
	3	-	3	-	-
Course Coordinator	Ms. M. Kalairasri, Assistant Professor				

I COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites
B.Tech	ACSB01	II	Programming for Problem Solving

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.
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
60%	Understand
20%	Apply
10%	Analyze

Continuous Internal Assessment (CIA):
CIA is conducted for a total of 30 marks (Table 2), with 20 marks for Continuous Internal Examination (CIE), 05 marks for Quiz and 05 marks for Alternative Assessment Tool in table

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	Complex Problem Solving
40%	40%	20%

VI COURSE OBJECTIVES:

The students will try to learn:

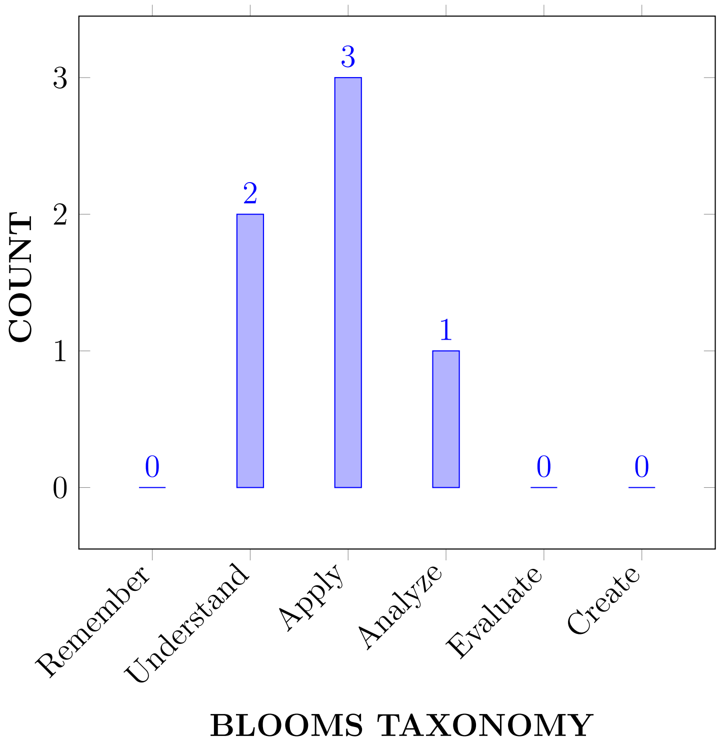
I	The skills needed to understand and analyze performance trade-offs of different algorithms implementations and asymptotic analysis of their running time and memory usage.
II	The knowledge of basic abstract data types (ADT) and associated algorithms: stacks, queues, lists, tree, graphs, hashing and sorting, selection and searching.
III	The fundamentals of Non-linear Data structure to store, retrieve, and process data efficiently.
IV	The implementing these data structures and algorithms and Understand essential for future programming and software engineering courses.
V	Analyze and choose appropriate data structure to solve problems in real world.

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.	-	-
PSO 2	**Focus on** improving performance of structures with reference to safety, serviceability and sustainable green building technology.	-	-
PSO 3	**Make use of** Make use of advanced structural analysis and project management software for creating modern avenues to succeed as an entrepreneur, to 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.
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
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
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
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
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
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

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
	3	10	10	11	1	5	3	3	12	5	12	12	6	2	2
CO 1	1	4	2	-	-	-	-	-	-	2	-	-	-	-	-
CO 2	1	5	2	-	1	-	-	-	-	2	-	3	-	-	-
CO 3	2	7	5	4	1	-	-	-	-	2	-	3	-	-	-
CO 4	3	7	2	4	1	-	-	-	-	2	-	3	-	-	-
CO 5	1	-	2	-	1	-	-	-	-	2	-	-	-	-	-
CO 6	3	7	5	4	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
	3	10	10	11	1	5	3	3	12	5	12	12	2	2	2
CO 1	33.3	40	20	-	-	-	-	-	-	40	-	-	-	-	-
CO 2	33.3	50	20	-	100	-	-	-	-	40	-	25	-	-	-
CO 3	66.6	70	50	36.3	100	-	-	-	-	40	-	25	-	-	-
CO 4	100	70	20	36.3	100	-	-	-	-	40	-	-	-	-	-
CO 5	33.3	-	20	-	100	-	-	-	-	40	-	-	-	-	-
CO 6	100	70	50	36.3	100	-	-	-	-	40	-	25	-	-	-

XV COURSE ARTICULATION MATRIX (PO – PSO MAPPING):

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

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

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	1	1	1	-	-	-	-	-	-	1	-	-	-	-	-
CO 2	1	2	1	-	3	-	-	-	-	1	-	1	-	-	-
CO 3	3	3	2	1	3	-	-	-	-	1	-	1	-	-	-
CO 4	3	3	1	1	3	-	-	-	-	1	-	1	-	-	-
CO 5	1	-	1	-	3	-	-	-	-	1	-	-	-	-	-
CO 6	3	3	2	1	3	-	-	-	-	1	-	1	-	-	-
TOTAL	**12**	**12**	**8**	**3**	**15**	**-**	**-**	**-**	**-**	**6**	**-**	**4**	**-**	**-**	**-**
AVERAGE	**2.0**	**2.4**	**1.3**	**1.0**	**3.0**	**-**	**-**	**-**	**-**	**1**	**-**	**1**	**-**	**-**	**-**

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**
Ms. M. Kalairasri, Assistant Professor

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

CIVIL ENGINEERING
COURSE DESCRIPTION

Course Title	**SURVEYING AND GEOMATICS LABORATORY**				
Course Code	ACEB03				
Program	B.Tech				
Semester	III	CE			
Course Type	CORE				
Regulation	IARE - R18				
Course Structure	Theory			Practical	
	Lecture	Tutorials	Credits	Laboratory	Credits
	-	-	-	3	1.5
Course Coordinator	Mr. B Suresh , Assistant Professor				

I COURSE OVERVIEW:

Surveying and Geomatics Laboratory is the application of technology and scientific principles for tracing, design, operation and management of facilities.Surveying refers to tracing points on ground or field. This course gives an overview on surveying with respect to tracing of points locating inaccessible points, curve and path, contours etc., This course also focuses on advanced surveying techniques, including EDM, photogrammetry and Remote sensing. Further the course is useful to solve the complex problems related to the inaccessible distances, remote elevation and remote distances by collecting and evaluating the data such as horizontal distances, vertical distances,slopes and elevations

II COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites
B.Tech	AHSB02	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
-	-	-	-	-	-

VI COURSE OBJECTIVES:

The students will try to learn:

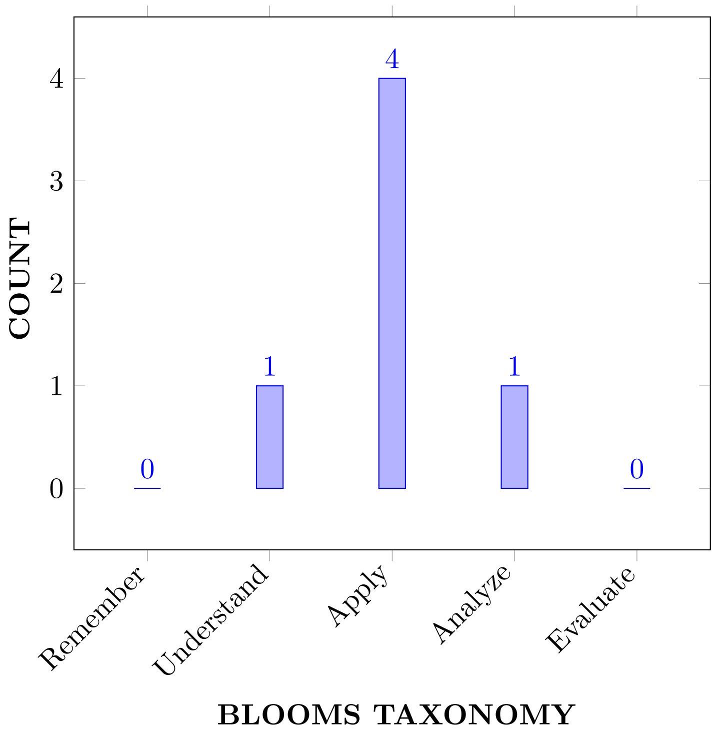
I	The types of surveys, methods and technology involved in measuring field parameters using traditional and modern instruments.
II	The operating principles of various levelling instruments and analyze their performance characteristics under various terrains.
III	The measurement of alteration works, detecting land use and land cover, creating base maps for visual reference.

VII COURSE OUTCOMES:

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

CO 1	**Utilize** the concept of traversing to measure irregular boundaries and survey lines in filed.	Apply
CO 2	**Make use of** prismatic compass to measure bearings, dip, declination and local attractions.	Apply
CO 3	**Demonstrate** the two point and three point problem in plane table surveying for tracing out the centering point or station point.	Understand
CO 4	**Identify** the reduced levels using leveling apparatus for illustrating longitudinal section and cross section and plotting.	Apply
CO 5	**Make use of** Rankine's curve method for investigating the suitable path along the alignment and conflict points.	Apply
CO 6	**Distinguish** elevation and remote distance in total station at various operating conditions and data record keeping.	Analyze

COURSE KNOWLEDGE COMPETENCY LEVEL



VIII HOW PROGRAM OUTCOMES ARE ASSESSED:

Program		Strength	Proficiency Assessed by
PO 1	**Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.	3	Lab Exercises/CIA/SEE
PO 2	**Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences	1	Lab Exercises/CIA/SEE
PO 5	**Modern Tool Usage:** Create, select, and apply appropriate techniques, resources, and modern Engineering and IT tools including prediction and modeling to complex Engineering activities with an understanding of the limitations	3	Lab Exercises/CIA/SEE
PO 9	**Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.	1	Lab Exercises/CIA/SEE

3 = High; 2 = Medium; 1 = Low

IX HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

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

3 = High; 2 = Medium; 1 = Low

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

COURSE OUTCOMES	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key Competencies
CO 1	PO 1	Utilize the concept of bearing system to a considerable extent appreciate (understanding) their importance and applicability (apply) in solving (complex) bearing angle measurement problems by applying the **principles of Mathematics and Engineering**	3
	PO 2	Understand the calibration procedure of compass for (**information and data**) reaching substantiated conclusions by the interpretation of results	1

CO 2	PO 1	Explain (understanding) various parts of theodolite in detail and apply the principle of traversing, in calculating horizontal and vertical angles by applying **principles of Mathematics, Science and Engineering**	3
CO 3	PO 2	Understand the given **problem statement** and formulate (complex) two point and three point problems in plane table surveying (understanding)and their importance, applicability (apply) in solving complex engineering problems from the provided information and substantiate with the interpretation of variations results.	1
	PO 9	Recall the fundamental of plane table surveying and understand the concept of orientation resection and radiation which helps the **Ability to work with all levels of people in an organization .**	1
CO 4	PO 1	Recognize (knowledge) the importance and application (apply) of leveling, in solving (complex) problems associated with leveling by applying the **principles of Mathematics, Science and Engineering**	3
	PO 5	Understand the given problem statement and apply the **simulation packages** for the analysis of longitudinal and cross sectional analysis and similarity parameters for predicting physical parameters that govern the plotting on ground	1
	PO 9	Recall the fundamental of EDM and understand the concept of RDM and REM which helps the **Ability to work with all levels of people in an organization.**	1
	PSO 1	Apply (knowledge) Design and Supervise Sub-Structures and Super Structures for Residential and Public Buildings, (apply) for illustrating longitudinal section and cross section by applying the **Quantitative building survey and quality assurance**	1
CO 5	PO 1	Apply the basic conservation laws of science for various curves setting in surveying and use **mathematical principles** for investigating the suitable path along the alignment and conflict points. (complex) engineering equations by understanding the appropriate parametric assumptions and limitations based on **engineering fundamentals** of surveying and Geomatics.	3
	PSO 1	Apply (knowledge) Design and Supervise Sub-Structures and Super Structures for Residential and Public Buildings, (apply) for illustrating longitudinal section and cross section by applying the **Quantitative building survey and quality assurance**	1
CO 6	PO 2	Using standard stadia diaphragm derive the Tacheometric equation to analyze complex surveying problems with help of **Problem or opportunity identification.**	1

	PO 5	Understand the given problem statement and apply the appropriate techniques of advances **Computer software simulation packages** for the analysis of electronic distance measurements and similarity parameters for predicting physical parameters that govern the plotting on ground **technically**	3

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

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

XII ASSESSMENT METHODOLOGY DIRECT:

CIE Exams	PO 1,PO 2, PO 5, PO 9, PSO 1	SEE Exams	PO 1,PO 2, PO 5, PO 9, PSO 1	Seminars	-
Laboratory Practices	PO 1,PO 2, PO 5	Student Viva	PO 1, PO 5	Certification	-
Assignments	-				

XIII ASSESSMENT METHODOLOGY INDIRECT:

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

XIV SYLLABUS:

WEEK I	**SURVEY OF AN AREA BY CHAIN SURVEY (CLOSED TRAVERSE) AND PLOTTING**
	Measurement of an area by chain survey .
WEEK II	**CHAINING ACROSS OBSTACLES**
	Chaining across obstacles
WEEK III	**DETERMINATION OF DISTANCE BETWEEN TWO INACCESSIBLE POINTS WITH COMPASS**
	Calculation of distance between two points with compass survey.
WEEK IV	**CORRECTION FOR LOCAL ATTRACTION BY PRISMATIC COMPASS**
	Corrections for local attraction by prismatic compass
WEEK V	**RADIATION METHOD, INTERSECTION METHODS BY PLANE TABLE SURVEY**
	Radiation method and intersection methods by plane table survey.
WEEK VI	**AN EXERCISE OF LONGITUDINAL SECTION AND CROSS SECTION AND PLOTTING**
	An exercise of longitudinal section and cross section and plotting.
WEEK VII	**MEASUREMENT OF HORIZONTAL ANGLES BY METHOD OF REPETITION AND REITERATION**
	Measurement of horizontal angles.
WEEK VIII	**TRIGONOMETRIC LEVELING- HEIGHTS AND DISTANCE PROBLEMS**
	Trigonometric leveling- heights and distance problems.
WEEK IX	**HEIGHTS AND DISTANCES USING PRINCIPLES OF TACHEOMETRIC SURVEY**
	Heights and distances using principles of tacheometric survey.
WEEK X	**CURVE SETTING –DIFFERENT METHODS**
	Curve setting: different methods.
WEEK XI	**DETERMINATION OF AN AREA USING TOTAL STATION**
	Determination of an area using total station.
WEEK XII	**DETERMINATION OF REMOTE HEIGHT USING TOTAL STATION**
	Determination of remote height 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. H. S. Moondra, Rajiv Gupta, "Laboratory Manual for Civil Engineering", CBS Publishers Pvt .Ltd., New Delhi, 2^{nd} Edition, 2013
2. S. S. Bhavikatti, "Surveying Theory and Practice", IK Books, New Delhi, 2010

REFERENCE BOOKS:

1. James M. Anderson, Edward M. Mikhail, "Surveying: Theory and Practice", Tata Mc Graw Hill Education, 2012.

XV COURSE PLAN:

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

S.No	Topics to be covered	CO's	Reference
1	Measurement of an area by chain survey Obtain the direction of a surveying line with a prismatic and surveyors compass.	CO 1, CO 2,CO 3, CO 4,CO 5, CO 6	T1: 1.1
2	Chaining across obstacles.	CO 1, CO 2,CO 3, CO 4,CO 5, CO 6	T1: 2.1
3	Calculation of distance between two points with compass survey.	CO 1, CO 2,CO 3, CO 4,CO 5, CO 6	T2: 3.9
4	Corrections for local attraction by prismatic compass	CO 1, CO 2,CO 3, CO 4,CO 5, CO 6	R1: 1.4
5	Radiation method and intersection methods by plane table survey.	CO 1, CO 2,CO 3, CO 4,CO 5, CO 6	T1: 5.4
6	An exercise of longitudinal section and cross section and plotting.	CO 1, CO 2,CO 3, CO 4,CO 5, CO 6	T1: 6.6
7	Measurement of horizontal angles.	CO 1, CO 2,CO 3, CO 4,CO 5, CO 6	R1: 5.4
8	Trigonometric leveling- heights and distance problems.	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	Curve setting: different methods.	CO 1, CO 2,CO 3, CO 4,CO 5, CO 6	T1: 10.6
11	Determination of an area using total station.	CO 1, CO 2,CO 3, CO 4,CO 5, CO 6	R1:7.2
12	Determination of remote height using total station.	CO 1, CO 2,CO 3, CO 4,CO 5, CO 6	R1:11.4
13	Calculating distance, gradient and different heights between two inaccessible points using total station.	CO 1, CO 2,CO 3, CO 4,CO 5, CO 6	T1:12.3

XVI EXPERIMENTS FOR ENHANCED LEARNING (EEL):

S.No	Design Oriented Experiments
1	**SURFER 13:** Surfer is a Contouring and surface modelling software used for Graphical representation of drawing.
2	**ArcGIS:** Encourage students to Collect and manage data, create professional maps, perform traditional and advanced spatial analysis, and solve real problems .

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

INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

Dundigal, Hyderabad - 500 043

CIVIL ENGINEERING

COURSE DESCRIPTION

Course Title	**Civil Engineering Drawing Laboratory**				
Course Code	ACEB04				
Program	B.Tech				
Semester	III	CE			
Course Type	Core				
Regulation	IARE - R18				
Course Structure	Theory			Practical	
	Lecture	Tutorials	Credits	Laboratory	Credits
	-	-	-	2	2
Course Coordinator	Mr. K Tarun Kumar, Assistant Professor				

I COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites
B.Tech	AMEB02	I	Engineering Graphics And Design Laboratory

II COURSE OVERVIEW:

CADLab is a product that bridges the gap between simulation/numerical engines like MATLAB and SOLIDWORKS. It creates a seamless link between SOLIDWORKS and simulation/numerical engine software products to help the customers accomplish their design objectives easily and efficiently.

III DELIVERY / INSTRUCTIONAL METHODOLOGIES:

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

IV 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
-	-	-	-	-	-

V COURSE OBJECTIVES:

The students will try to learn:

I	Understand and study CAD commands for drafting any type of civil engineering drawings.
II	Implement building regulations for designing of buildings.
III	Draft plans of single and multistoried buildings.
IV	Develop the detailing of building components such as roof truss, doors, windows etc.

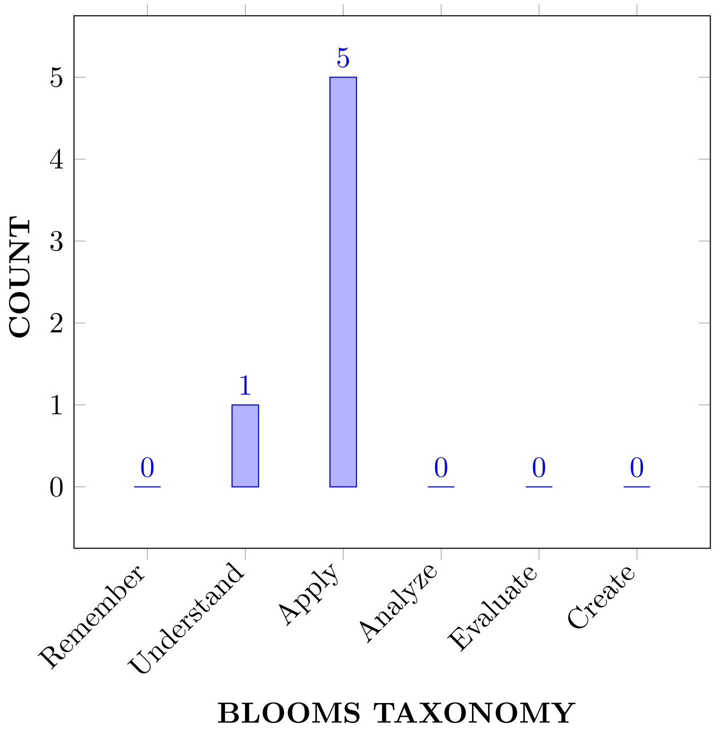
VI COURSE OUTCOMES:

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

CO 1	**Illustrate** bureau of Indian standards, conventions of engineering drawing with basic concepts, ideas and methodology for different geometries and their execution.	Understand
CO 2	**Apply** AutoCAD software for development of multi-aspect sketches, additional and sectional view.	Apply
CO 3	**Construct** parabolic, Hyperbolic and elliptical curves for profiles likes buildings and bridges.	Apply

CO 4	**Solve** projection in planes located in various quadrants to use in manufacturing processes.	Apply
CO 5	**Construct** projection of solids inclined to both the planes for interpretation of different views.	Apply
CO 6	**Draw** the orthographic projections for solid modeling to using in conversation of isometric and Vice-versa.	Apply

COURSE KNOWLEDGE COMPETENCY LEVEL



VII HOW PROGRAM OUTCOMES ARE ASSESSED:

Program outcomes		Strength	Proficiency Assessed by
PO 1	Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.	3	Lab Exercises/CIA/ SEE
PO 2	Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences	1	Lab Exercises/CIA/ SEE
PO 5	Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern Engineering and IT tools including prediction and modelling to complex Engineering activities with an understanding of the limitations	3	Lab Exercises/CIA/ SEE

3 = High; 2 = Medium; 1 = Low

VIII HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

Program		Strength	Proficiency Assessed by
PSO 2	Make use of multi physics, computational fluid dynamics and flight simulation tools for building career paths towards innovative startups, employability and higher studies.	1	LAB Exercises

3 = High; 2 = Medium; 1 = Low

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

COURSE OUTCOMES	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key Competencies
CO 1	PO 1	Recall the basic commands of AutoCAD for various curves and scales using scientific principles and engineering fundamentals.	2
	PO 5	Understand Scales and Curves with different methods conceptually and apply them in modeling a complex engineering activity	1
	PSO 3	Make use of computational and experimental tools for building career paths towards innovative startups to be an entrepreneur.	2
CO 2	PO 1	Recall the commands of AutoCAD and draw engineering curves using mathematics, scientific principles and engineering fundamentals.	3
	PO 3	Understand the given problem statement related to question formatted for engineering drawings and based upon type use different AutoCAD commands .	1
CO 3	PO 1	Develop expression for eccentricity and Identify the appropriate type of curve for problem solving using engineering sciences.	2
	PO 3	Use research based knowledge for different methods of drawing engineering curves and draw with modern tools.	1
CO 4	PO 1	Recall theory of projection in planes located in various quadrants to draw using scientific principles and engineering fundamentals	2
	PO 5	Understand various positions in coordinate system for Planes use principles of views, and engineering fundamentals completing the drawing.	2
CO 5	PO 1	Recognize the representation concept of projection of solids inclined to both the planes for interpretation of different views for problem solving.	1
	PO 5	Understand the principle of solids inclined to both the planes principles of views, and engineering fundamentals for completing the drawing.	1

CO 6	PO 1	Identify the concept of orthographic projections and isometric projections use principles of views, and engineering fundamentals for completing the drawing	2
	PSO 3	Make use of computational and modeling experimental tools for building career paths towards innovative startups to be an entrepreneur.	2

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

XI 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	-	-	-	100	-	-	-	-	-	-	-	-	20	-
CO 2	100	10	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 3	66.7	10	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 4	66.7	-	-	-	100	-	-	-	-	-	-	-	-	-	-
CO 5	33.3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 6	66.7	-	-	-	-	-	-	-	-	-	-	-	-	20	-

XII COURSE ARTICULATION MATRIX (PO – PSO MAPPING):

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

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

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

TOTAL	16	2	-	-	6	-	-	-	-	-	-	-	-	2	-
AVERAGE	2.67	1	-	-	3	-	-	-	-	-	-	-	-	1	-

XIII ASSESSMENT METHODOLOGY DIRECT:

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

XIV ASSESSMENT METHODOLOGY INDIRECT:

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

XV SYLLABUS:

WEEK I	BUILDINGS
	Load bearing walls including details of doors and windows.
WEEK II	**STANDARD DRAWINGS**
	Typical two storied building including all MEP, joinery, rebars, finishing and other details.
WEEK III	**RCC FRAMED STRUCTURES - 1**
	Floor plans, Elevations.
WEEK IV	**RCC FRAMED STRUCTURES - 2**
	Sectional views.
WEEK V	REINFORCEMENT DRAWINGS - 1
	Typical beams.
WEEK VI	REINFORCEMENT DRAWINGS - 2
	Typical Columns
WEEK VII	**REINFORCEMENT DRAWINGS - 3**
	Typical Slabs
WEEK VIII	**REINFORCEMENT DRAWINGS - 4**
	Typical Spread footings
WEEK IX	**INDUSTRIAL BUILDINGS - 1**
	North light roof structures
WEEK X	**INDUSTRIAL BUILDINGS - 2**
	Trusses
WEEK XI	**PERSPECTIVE VIEW - 1**
	One storey buildings.
WEEK XII	**PERSPECTIVE VIEW - 2**
	Two storey buildings

TEXTBOOKS

1. M. N. Sesha Prakash, Dr. G. S. Servesh, ―Computer Aided Design Laboratory‖, Laxmi Publications, 2012.

REFERENCE BOOKS:

1. P.J.Sha, ―Engineering Graphics‖, S. Chand Publishers, 2014.

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	BUILDINGS	CO 1,CO 3	T1:1.4,R1:1.2
2	STANDARD DRAWINGS	CO 1,CO 2	T1:1.5,R1:1.3
3	RCC FRAMED STRUCTURES - 1	CO 2,CO 4	T2:12.2, R2:13.1
4	RCC FRAMED STRUCTURES - 2	CO 3,CO 4	T2:12.3,R2:13
5	REINFORCEMENT DRAWINGS - 1	CO 3,CO 4	T1:9.1,R2:3
6	REINFORCEMENT DRAWINGS - 2	CO 3,CO 4	T1:9.1,R2:3
7	REINFORCEMENT DRAWINGS - 3	CO 2 CO 4	T2:1.9, R2:1.8
8	REINFORCEMENT DRAWINGS - 4	CO 2 CO 4	T2:2, R2:1.9
9	INDUSTRIAL BUILDINGS - 1	CO 4 CO 5	T2:1.4, R1:1.2
10	INDUSTRIAL BUILDINGS - 2	CO 4 CO 5	T2:1.4, R1:1.2
11	PERSPECTIVE VIEW - 1	CO 4 CO 5	T2:1.4, R1:1.2
12	PERSPECTIVE VIEW - 2	CO 4 CO 5	T2:1.4, R1:1.2

XVII EXPERIMENTS FOR ENHANCED LEARNING (EEL):

S.No	Design Oriented Experiments
1	Detailing of Hospital Building
2	Detailing of School Building
3	Detailing irrigation structures
4	Detailing of roads

Signature of Course Coordinator **HOD, CE**

Mr. K Tarun Kumar, Assistant Professor

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

CIVIL ENGINEERING

COURSE DESCRIPTION

Course Title	**DATA STRUCTURES LABORATORY**				
Course Code	ACSB05				
Program	B.Tech				
Semester	III	CE			
Course Type	Core				
Regulation	IARE - R18				
Course Structure	Theory			Practical	
	Lecture	Tutorials	Credits	Laboratory	Credits
	-	-	-	3	1.5
Course Coordinator	Ms. M. Kalairasi,Assistant Professor				

I COURSE OVERVIEW:

A data structure is a particular way of organizing data in a computer so that it can be used effectively. It covers the design and analysis of fundamental data structures and engages learners to use data structures as tools to algorithmically design efficient computer programs that will cope with the complexity of actual applications. A Data Structure is a particular way of storing and organizing data in a computer so that it can be stored, retrieved, or updated efficiently. Data structures are generally based on the ability of a computer to fetch and store data at any place in its memory, specified by an address. This course is essential for image viewer software, in this images are linked with each other so, images uses a linked list to view the previous and the next images using the previous and next buttons. Web pages can be accessed using the previous and the next URL links which are linked using linked list. The music players also use the same technique to switch between music. To keep the track of turns in a multi player game, a circular linked list is used.

II COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites
B.Tech	ACSB01	II	Programming for Problem Solving
B.Tech	ACSB02	II	Programming for Problem Solving Laboratory
B.Tech	ACSB03	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.

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	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	Understand various data representation techniques in the real world.
II	Implement linear and non-linear data structures. .
III	Analyze various algorithms based on their time and space complexity

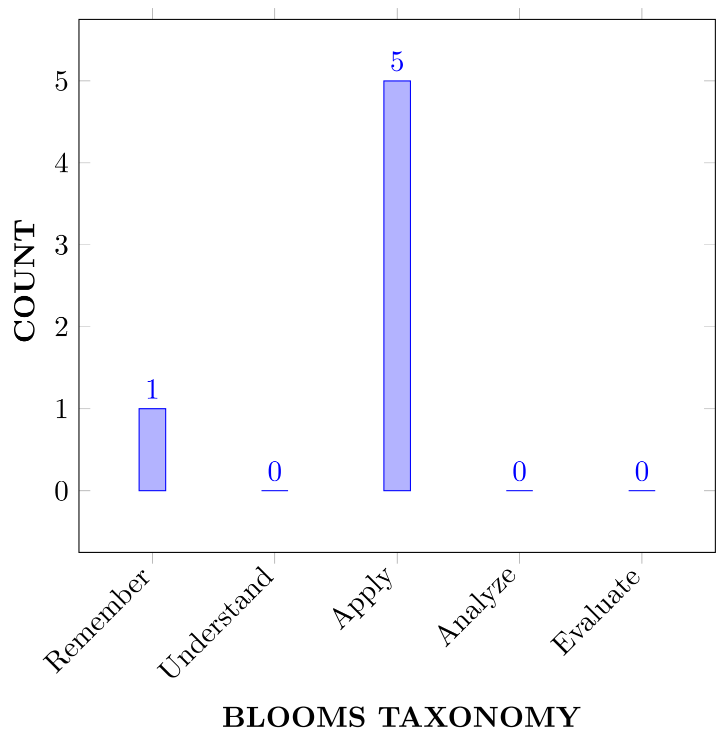
IV	Develop real-time applications using suitable data structure.
V	Identify suitable data structure to solve various computing problems

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 next-generation computer systems, networking devices, search engines, soft computing and intelligent systems, web browsers, and knowledge discovery tools.	2	Lab Exercises
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 Exercises
PSO 3	Practical experience in shipping real world software, using industry standard tools and collaboration techniques will equip to secure and succeed in first job upon graduation in IT industry.	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	**BASICS OF PYTHON**
	Write Python programs for the following: a. To find the biggest of given n numbers using control statements and lists b. To print the Fibonacci series using functions c. To find GCD of two numbers
WEEK II	**SEARCHING TECHNIQUES**
	Write Python programs for implementing the following searching techniques to arrange a list of integers in ascending order. a. Linear search b. Binary search
WEEK III	**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 IV	**IMPLEMENTATION OF STACK AND QUEUE**
	Write Python programs to for the following: a. Design and implement Stack and its operations using List. b. Design and implement Queue and its operations using List
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 operations on Single Linked List. (i) Creation (ii) insertion (iii) deletion (iv) traversal
WEEK VII	**IMPLEMENTATION OF CIRCULAR SINGLE LINKED LIST**
	Write Python programs for 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 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 a Python program to implement Stack using linked list.
WEEK X	**IMPLEMENTATION OF QUEUE USING LINKED LIST**
	Write a Python program to implement Linear 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 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.

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1. S. Lipschutz, “Data Structures”, Tata McGraw Hill Education, 1st Edition, 2008.
2. Samanta, “Classic Data Structures”, PHI Learning, 2nd Edition, 2004.Gottfried Byron,
3. “Schaum’s Outline of Programming with Python”, Tata Mc Graw Hill, 1st Edition, 2010.
4. Rance D. Necaise, “Data Structures and Algorithms using Python”, Wiley, John Wiley and Sons, INC., 2011.
5. Benjamin Baka, David Julian, “Python Data Structures and Algorithms”, Packt Publishing Ltd., 2017.

WEB REFERENCES:

1. https://docs.python.org/3/tutorial/datastructures.html
2. http://interactivepython.org/runestone/static/pythonds/index.html
3. http://www.tutorialspoint.com/data-structures-algorithms
4. http://www.geeksforgeeks.org/data-structures/
5. http://www.studytonight.com/data-structures
6. http://www.coursera.org/specializations/data-structures-algorithms
7. http://cse01-iiith.vlabs.ac.in/

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	Basics of Python	CO 1	T1
2	Searching 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
6	**Flow through pipes:** How many non-null links are there in a binary tree with N nodes?
7	**Flow through pipes:** How can we remove loops in a linked list? What are the functions of fast and slow pointers?

Signature of Course Coordinator **HOD,CE**
Ms. M. Kalairasi, Assistant Professor

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

CIVIL ENGINEERING
COURSE DESCRIPTION

Course Title	**ENGINEERING GEOLOGY**				
Course Code	ACEB05				
Program	B.Tech				
Semester	IV	CE			
Course Type	CORE				
Regulation	IARE-R18				
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	AHSB03	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 (Table 2), with 20 marks for Continuous Internal Examination (CIE), 05 marks for Quiz and 05 marks for Alternative Assessment Tool in table

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%

COURSE OBJECTIVES:

The course should enable the students to:

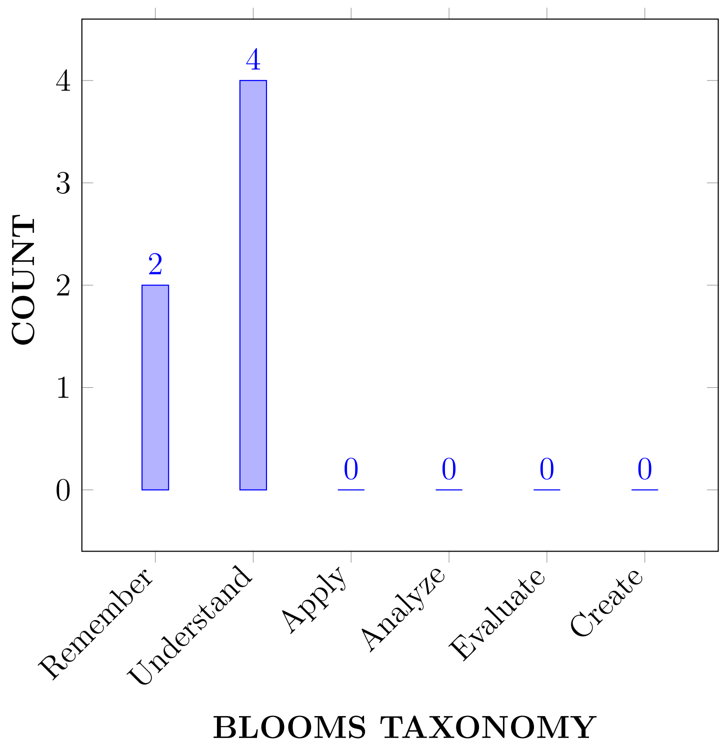
I	Asses engineering properties of rock and unconsolidated materials in the characterization of geologic sites for civil work projects and the quantification of processes such as rock slides, soil-slope stability, settlement, and liquefaction.
II	Involves the collection, analysis, and interpretation of geological data and information required for the safe development of civil works.
III	Assessment and mitigation of geologic hazards such earthquakes, landslides, flooding; the assessment of timber harvesting impacts; and groundwater remediation and resource evaluation.

VI 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



VII 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

VIII HOW PROGRAM OUTCOMES ARE ASSESSED:

Program Outcomes		Strength	Proficiency Assessed by
PO 1	Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.	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

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.	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

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	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

	PO 3	Minerals and rocks will get acquainted with environmental conditions by natural dynamic processes and their actions.	1
CO 2	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

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	-	-	-	-	-	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	-	-

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	-	-	-	-	-	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	-	-

XIV COURSE ARTICULATION MATRIX (PO – PSO MAPPING):

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

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

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

XV ASSESSMENT METHODOLOGY DIRECT:

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

XVI ASSESSMENT METHODOLOGY INDIRECT:

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

XVII 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.

XVIII COURSE PLAN:

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

S.No	Topics to be covered	CO's	Reference T1: 4.1
OBE DISCUSSION			
	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	ACEB06				
Program	B.Tech				
Semester	IV	CE			
Course Type	Core				
Regulation	IARE -R18				
Course Structure	Theory			Practical	
	Lecture	Tutorials	Credits	Laboratory	Credits
	3	1	4	-	-
Course Coordinator	Ms Durga Sharma, Assistant Professor				

I COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites
B.Tech	AHSB02	I	Linear Algebra and Calculus
B.Tech	AHSB11	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 Mechanics	70 Marks	30 Marks	100

IV CONTENT DELIVERY / INSTRUCTIONAL METHODOLOGIES:

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

V EVALUATION METHODOLOGY:

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

Semester End Examination (SEE): The SEE is conducted for 70 marks of 3 hours duration. The syllabus for the theory courses is divided into FIVE modules and each module carries equal weightage in terms of marks distribution. The question paper pattern is as follows. Two full questions with "either" or "choice" will be drawn from each module. Each question carries 14 marks. There could be a maximum of two sub divisions in a question.
The expected percentage of cognitive level of the questions is broadly based on the criteria given in below Table.

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

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

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

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

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

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

is given in table

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

VI COURSE OBJECTIVES:

The students will try to learn:

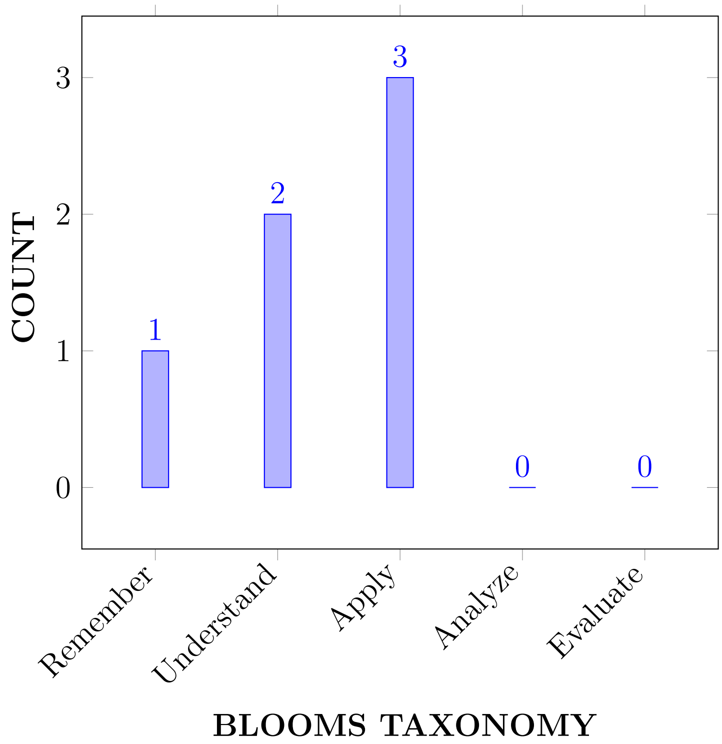
I	Understand and study the effect of fluid properties on a flow system.
II	Apply the concept of fluid pressure, its measurements and applications.
III	Explore the static, kinematic and dynamic behavior of fluids.
IV	Assess the fluid flow and flow parameters using measuring devices.

VII COURSE OUTCOMES:

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

CO 1	**Recall** basic principles and concepts of Fluid Mechanics for ascertaining differences between solids and fluids.	Remember
CO 2	**Utilize** sound knowledge of fundamental properties of fluids and fluid continuum, principle of manometry, Archimedes's for measuring pressure and analysing hydro-static forces on various types of floating and immersed bodies.	Apply
CO 3	**Interpret** different types of fluid flows, concept of continuity equation for analyzing velocity potential functions and flownet	Understand
CO 4	**Make use of** Euler's, Bernoulli's and Momentum equation for understanding concepts of dynamics of fluid flows.	Apply
CO 5	**Understand** the concept of Boundary layer theory, Navier-Stoke's Equations, Vonkarmen momentum integral equation for analysing fluid flow and estimating boundary layer thickness.	Understand
CO 6	**Apply** the principles of dimensional analysis for building the relation between model and prototypes	Apply

COURSE KNOWLEDGE COMPETENCY LEVEL



VIII PROGRAM OUTCOMES:

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

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/Quiz/AAT
PO 2	**Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.	2	CIE/Quiz/AAT
PO 3	**Design/Development of Solutions:** Design solutions for complex Engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and Environmental considerations	2	CIE/Quiz/AAT
PO 4	**Conduct Investigations of Complex Problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.	1	Assignments/ SEE /CIE, AAT, QUIZ
PO 10	**Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions. e.	2	SEE/ CIE, AAT, QUIZ

3 = High; 2 = Medium; 1 = Low

X HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

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

3 = High; 2 = Medium; 1 = Low

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

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

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

Course Outcomes	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key competencies matched.
CO 1	PO 1	**Recall** (knowledge) the various properties of fluids**using the knowledge of mathematics, science and engineering fundamental.**	3
	PO 2	**Design the problem statement** associated with the given data and **formulate** their cause to **develop the solutions** using the concept of pressure.	3
CO 2	PO 1	Use the **engineering and scientific principles** to understand the conservation laws in differential forms to **determine** velocities, pressures and acceleration in a moving liquid.	2
	PO 2	Analyze the given **information and data** from the conservation laws in differential forms and **implementing** them for determination of various hydraulic parameters in fluid flows.	2
	PO 3	Use the **fundamentals of engineering and science** with the mass and energy equations for **determining** analytical solutions of fluid flow problems.	2
	PO 10	Communicate clearly in form of**writing**assignments, preparing **subject matter** in form of Tech Talk and five- minute video, and maintain a profound **speaking style.**	3
	PSO 1	Recall the concept of law of conservation of mass and energy in design and analysis of **water conveyance systems with environmental impact and remediation measures.**	2
CO 3	PO 1	Use the **fundamentals of engineering and science** in the determination of total energy of various geometrical cross sections for discharge with applications of Bernoulli's theorem.	2
	PO 2	Understand the concepts of velocity potential, stream function to **develop solutions** using **principles of mathematical and Engineering science**.	3

Course Outcomes	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key competencies matched.
	PO 4	**Understanding** of differential forms of conservation laws and **apply** them to determine the solutions of **engineering problems.**	3
	PSO 1	Recall the concept of law of conservation of mass and energy in design and analysis of **water conveyance systems with environmental impact and remediation measures.**	2
CO 4	PO 1	Use the **fundamentals of engineering and science** in the **determination** of thickness of boundary layer using Boundary layer theory.	2
	PO 2	**Analyze the complex engineering problems** for real flows using Bernoulli's theorem to **develop solutions** for various geometrical cross sections and **validate** with the **experimental design.**	4
	PO 10	**Communicate** clearly in form of **writing** assignments, preparing **subject matter** in form of **Tech Talk** and 5 Minute video, and maintain a profound **speaking style**	5
CO 5	PO 1	Apply the knowledge of **mathematical and science principles** for estimating total energy of various geometrical cross sections in engineering problems using conservation of energy.	2
	PO 2	**Analyze the complex engineering problems** for using Bernouli's equation to **develop solutions** for various geometric cross sections.	2
	PO 3	Use the **fundamentals of engineering and science** with the mass and energy equations for **determining** analytical solutions of fluid flow problems.	2
	PO 4	**Understanding** of differential forms of conservation laws and **apply** them to determine the solutions of **engineering problems.**	3
	PSO 1	Analyze the **procurement and construction**Techniques confining to **codes of practice** to design the geometrical cross sections for various types of open channels.	3
CO 6	PO 1	Apply the knowledge of **mathematical and science principles** for estimating total energy of various geometrical cross sections in engineering problems using conservation of energy.	2
	PO 2	**Analyze the complex engineering problems** for using Bernouli's equation to **develop solutions** for various geometric cross sections.	2
	PO 4	**Understanding** of differential forms of conservation laws and **apply** them to determine the solutions of **engineering problems.**	3
	PSO 1	Analyze the **procurement and construction**Techniques confining to **codes of practice** to design the geometrical cross sections for various types of open channels.	3

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

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

XIV PERCENTAGE OF KEY COMPETENCIES FOR CO – PO/ PSO

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	100	-	-	-	-	-	-	-	-	-	-		-	-	-
CO 2	100	20	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 3	100	40	-	-	-	-	-	-	-	-	-	-	10	-	-
CO 4	100	-	40	20	-	-	-	-	-	40	-	-	-	-	-
CO 5	66.67	20	20	30	-	-	-	-	-	-	-	-	20	-	-
CO 6	66.67	20	-	30	-	-	-	-	-	-	-	-	20	-	-

XV COURSE ARTICULATION MATRIX (PO / PSO MAPPING):

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

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

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

XVI ASSESSMENT METHODOLOGY-DIRECT:

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

XVII ASSESSMENT METHODOLOGY-INDIRECT:

	Assessment of mini projects by experts	✓	End Semester OBE Feedback

XVIII SYLLABUS:

MODULE I	**INTRODUCTION AND HYDROSATICS FORCES**
	Dimensions and units – Physical properties of fluids - specific gravity, viscosity, surface tension, Vapour pressure and their influences on fluid motion, Pressure at a point, Pascal's law, Hydrostatic law - atmospheric, gauge and vacuum pressures. Measurement of pressure, Pressure gauges, Manometers: Simple and differential U-tube Manometers. Hydrostatic forces on submerged plane, horizontal, vertical, inclined and curved surfaces. Center of pressure, buoyancy, meta-center, meta-centric height. Derivations and problems.
MODULE II	**FLUID STATICS**
	Fluid Pressure: Pressure at a point, Pascal's law, pressure variation with temperature, density and altitude. Piezometer, U-Tube Manometer, Single Column Manometer, U-Tube Differential Manometer, Micro manometers. Pressure gauges, Hydrostatic pressure and force: horizontal, vertical and inclined surfaces. Buoyancy and stability of floating bodies.
MODULE III	**FLUID KNIEMATICS**
	Description of fluid flow, Stream line, path line and streak lines and stream tube. Classification of flows: Steady and unsteady, uniform and non-uniform, laminar and turbulent, rotational and irrotational flows. Equation of continuity for 1 - D, 2 - D, and 3 - D flows – stream and velocity potential functions, flow net analysis.
MODULE IV	**FLUID DYNAMICS**
	Euler's and Bernoulli's equations for flow along a streamline for 3 - D flow, Navier – Stokes equations (Explanationary), Momentum equation and its applications. Forces on pipe bend. Pitot-tube, Venturimeter and Orifice meter, classification of orifices, flow over rectangular, triangular, trapezoidal and stepped notches, Broad crested weirs.
MODULE V	**DIMENSIONAL ANALYSIS**
	Dimensional Analysis and Dynamic Similitude - Definitions of Reynolds Number, Froude Number, Mach Number, Weber Number and Euler Number; Buckingham's ϕ-Theorem

TEXTBOOKS

1. Frank M. White, "Fluid Mechanics ", McGraw Hill Education Private Limited, 8th Edition, 2017 .
2. Modi and Seth, "Fluid Mechanics‖", Standard book house, 2011.
3. R.K. Rajput, "A text of Fluid mechanics and hydraulic machines", S. Chand and company Pvt. Ltd, Sixth Edition, 2015.
4. S.K. Som and G. Biswas, —Introduction to Fluid Machines‖, Tata Mc Grawhill publishers Pvt. Ltd, 2010.
5. Ramdurgaia, — Fluid Mechanics and Machinery‖, New Age Publications, 2007.

REFERENCE BOOKS:

1. Yuan S W, "Foundations of fluid Mechanics", Prentice-Hall, 2nd Edition, 1987.
2. Shiv Kumar, "Fluid Mechanics Basic Concepts and Principles", Ane Books Pvt Ltd., 2010.
3. R.K. Bansal ,A text of Fluid mechanics and hydraulic machines- Laxmi Publications (P) ltd., New Delhi, 2011.

WEB REFERENCES:

1. https://nptel.ac.in/courses/112105171/1
1. https://www.iare.ac.in/?q=courseslist/71

COURSE WEB PAGE:

XIX COURSE PLAN:

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

S.No	Topics to be covered	CO's	Reference
OBE DISCUSSION			
1	Outcome based education system discussion on hydraulic and hydraulic machinery	-	
CONTENT DELIVERY (THEORY)			
2	Explanation of various units and introduction to fluid mechanics.	CO 1	T1: 2.4 R2:1-1.7
3-4	Vapor pressure, boiling point, cavitation, Surface tension, capillarity, Bulk modulus of elasticity, compressibility.	CO 1	T1: 2.4 R2:1-1.7
5-6	Fluid Pressure: Pressure at a point, Pascal's law.	CO 2	T1: 2.6-14 R2:1-1.7
7-8	Measurement of pressure using various mechanical gauges	CO 2	T1: 2.15-20 R1:1-1.7
9-10	Single Column Manometer, U -Tube Differential Manometer, Micro manometers.	CO 2	T1: 3.1-.3 R1:2-2.8
11-13	Hydrostatic pressure and force: horizontal, vertical and inclined surfaces, Buoyancy and stability of floating bodies .	CO 2	T1 – T3 R1 - R3
14-17	Classification of fluid flows with respect to time, space and combination of fluid flows.	CO 3	T2: 6.1-5 R1:2-2.8
18-19	Stream line, path line, streak line and stream tube; stream function, velocity potential function.	CO 3	T1: 9.1-5 R2:2-2.8

20-22	Derivation of continuity equations in Cartesian coordinates.	CO 4	T1 – T3 R1 - R3
23-26	Surface and body forces; Equations of motion - Euler's equation.	CO 4	T2: 9.6-7 R2: 3-3.8
27-30	Bernoulli's equation – derivation and application	CO 5	T2: 4.5
31-32	Approximate Solutions of Navier-Stoke's Equations, Boundary layer (BL) – concepts, Prandtl contribution,	CO 5	T1 – T3 R1 - R3
33-34	Vonkarmen momentum integral equation, laminar and turbulent boundary layers (no deviation), BL in transition, separation of BL, control of BL, flow around submerged objects, Drag and Lift forces .	CO 5	T1: 10.1-5 R2: 4-4.8
35-38	Dimensional Analysis and Dynamic Similitude - Buckingham's -Theorem, prototype and model type analysis.	CO 6	T1: 10.5-7 R2: 4-4.8
39-40	Dimensional Analysis and Dynamic Similitude - Definitions of Reynolds Number, Froude Number, Mach Number, Weber Number and Euler Number	CO 6	T1: 10.7 R2: 4-4.8
PROBLEM SOLVING/ CASE STUDIES			
1	Problems on Properties of fluid	CO 1	R2:7.5
2	Problems on Surface tension and Vapour Pressure	CO 1	R2:7.5
3	Problems on Basic equations of fluid statics	CO 1	R2:7.5
4	Problems on Pressure Measuring Devices	CO 2	R2:7.5
5	Problems on Hydrostatic force on submerged surfaces	CO 2	R2:7.5
6	Problems on Buoyancy and Stability	CO 3	R2:7.5
7	Problems on Liquids in Rigid Body Motion	CO 3	R2:7.5
8	Problems on velocity field	CO 4	R2:7.5
9	Problems on continuity equations	CO 4	R2:7.5
10	Problems on Irrotational Flow,Stream Function and velocity Potential	CO 4	R2:7.5
11	Problems on practical applications of Bernoulli's equation – Venturimeter, orifice meter, pitot tube	CO 4	R2:7.5
12	Problems on Dimensional Analysis and Dynamic Similitude - Buckingham's -Theorem, prototype and model type analysis	CO 5	R2:7.5
13	Calculation of Reynolds Number, Froude Number, Mach Number, Weber Number and Euler Number	CO 5	R2:7.5
14	Problems on Reynolds Number, Froude Number, Mach Number,	CO 6	R2:7.5
15	Problems on Weber Number and Euler Number	CO 6	R2:7.5
DISCUSSION OF DEFINITION AND TERMINOLOGY			
1	Discussion on properties of fluid, pascal's law, pressure measuring devices and Hydrostatic forces	CO 1 CO 2	R4:2.1
2	Discussion on fluid flow, types of fluid flow and continuity equation.	CO 3	T4:7.3
3	Discussion on Eulers's, Bernoulli's equation and momentum equation	CO 4	R4:5.1

4	Discussion on Boundary layer theory, Prandtl contribution and Vonkarmen momentum integral equation.	CO 5	T1:7.5
5	Discussion on Dimensional Analysis, dimensionless numbers.	CO 6	T1: 8.1
DISCUSSION OF QUESTION BANK			
1	Basic concepts and definitions - important question and solution (Module I)	CO 1	T1: 11.1-7 R2: 11-11.10
2	Fluid statics - important question and solution (Module II)	CO 2	T4: 2.1 -2.2 R2: 13-13.7
3	Fluid kinematics- important question and solution (Module III)	CO 3	T4: 2.3 -2.6 R2: 13-13.7
4	Fluid dynamics - important question and solution (Module IV)	CO 4	T4: 2.7 - 2.9 R2: 13-13.7
5	Dimensional Analysis, dimensionless numbers (Module V)	CO 6	T1: 8.1

Signature of Course Coordinator **HOD,CE**

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

COURSE DESCRIPTION

Department	**CIVIL ENGINEERING**				
Course Title	**STRENGTH OF MATERIALS**				
Course Code	ACEB07				
Program	B.Tech				
Semester	IV				
Course Type	Professional Core				
Regulation	R-18				
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	AMEB03	I	Engineering Mechanics

II COURSE OVERVIEW:

Fluid mechanics is branch of applied mechanics that is concerned with the behavior of fluids either in motion (fluid dynamics) or at rest (fluid statics). This course introduces to a broad range of fundamental concepts, methods of fluid mechanics, mathematical description of fluid flows and the solution of some important flow problems. The course emphasizes importance of dimensionless numbers in various engineering fluid flow problems for designing a prototype and model. It discusses the basic concept of bluff body aerodynamics, boundary layer and physical aspects of boundary layer thickness. Compare and contrast various fluid machinery based on flow properties and its applications.

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
✓	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
40 %	Understand
30 %	Apply
20 %	Analyze

Continuous Internal Assessment (CIA):
CIA is conducted for a total of 30 marks (Table 2), with 20 marks for continuous internal examination (CIE), 05 marks for quiz and 05 marks for alternative assessment tool

Component	Theory			Total Marks
Type of Assessment	CIE Exam	Quiz	AAT	
CIA Marks	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:

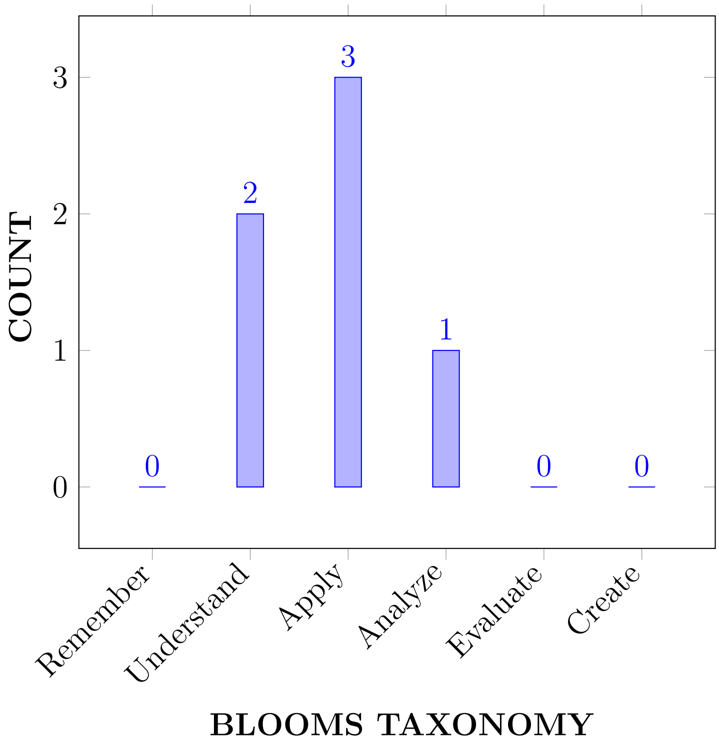
I	The fundamentals of stress-strain relationships and behavior of structural elements subjected to gradual, sudden and impact loading.
II	The behavior of determinate beams in response to various applied loads and load combinations.
III	The energy transmission through solid and hollow circular shafts and various applications of close coiled helical springs.
IV	The design of thin cylindrical and spherical shells by considering hoop, radial and longitudinal stresses .

VII COURSE OUTCOMES:

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

CO 1	**Summerise** 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	**Apply** fluid pressure concepts for computing circumferential and longitudinal stresses and strains on thin walled cylindrical and spherical shells, produced by fluids stored under pressure.	Apply
CO 6	**Take part in** developing novel concepts, which will enhance the strength and stability of structures for solving the real time problems.	Analyse

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
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	SEE/ CIE, AAT, QUIZ

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		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	✓	✓	-	-	-	-	-	-	-	-	-	-	✓	-	-
CO 2	✓	✓	-	-	-	-	-	-	-	-	-	-	✓	-	-
CO 3	-	✓	-	-	-	-	-	-	-	-	-		✓	-	-
CO 4	✓	✓	-	-	-	-	-	-	-	-	-	-	✓	-	-
CO 5	✓	✓	-	-	-	-	-	-	-	-	-	-	✓	-	-
CO 6	✓	-	-	-	-	-	-	-	-	-	-	✓	-	✓	-

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

Course Outcomes	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key competencies matched.
CO 1	PO 1	Explain the basic properties of materials and the concept of stress and strain using the knowledge of **mathematics and 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	Computes tensile and compressive strength of members, with the help of the **knowledge** of elastic properties of materials.	1
CO 2	PO 1	Apply the knowledge of textbfmathematics, engineering fundamentals for computing the stress distribution across the section of simple and composite bars.	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

Course Outcomes	**PO'S PSO'S**	**Justification for mapping (Students will be able to)**	**No. of Key competencies matched.**
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 fluid pressure exerted on thin walled cylindrical and spherical shells, for solving engineering problems related to fluid storage containers, applying the principles of **mathematics and engineering fundamentals**.	2
	PO 2	**Data** regarding fluids and other materials **is collected**, **problem statement is framed and formulates the problem for the development of solution for complex engineering structures** such as thin walled cylindrical and spherical shells.	4
	PSO 1	Determine hoop and longitudial stress exerted on the inner walls of pipes and conduits, with the help of the **concepts of fluid pressure**.	1
CO 6	PO 1	Apply the basic knowledge of strength of materials and develop new methods for assessment of behavior of materials under external loads, with the help of the **principles of mathematics** and **engineering fundamentals.**	2
	PO 12	Recognize the importance of strength and stability of structural members, under varying load conditions and tries to **enhance design skill** for improving the strength and stability of existing structures towards **future advancement** and **lifelong learning.**	3
	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	PROGRAM OUTCOMES												PSO'S		
	PO 1	PO 2	PO 3	PO 4	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	-	-	-	-	-	-	-	-	-		1	-	-
CO 2	2	5	-	-	-	-	-	-	-	-	-	-	1	-	-
CO 3	-	5	-	-	-	-	-	-	-	-	-	-	1	-	-
CO 4	2	5	-	-	-	-	-	-	-	-	-	-	1	-	-
CO 5	2	4	-	-	-	-	-	-	-	-	-	-	1	-	-
CO 6	2	-	-	-	-	-	-	-	-	-	-	3	-	2	-

XIV PERCENTAGE OF KEY COMPETENCIES FOR CO – PO/ PSO

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	66.6	50	-	-	-	-	-	-	-	-	-		10	-	-
CO 2	66.6	50	-	-	-	-	-	-	-	-	-	-	10	-	-
CO 3	-	50	-	-	-	-	-	-	-	-	-	-	10	-	-
CO 4	66.6	50	-	-	-	-	-	-	-	-	-	-	10	-	-
CO 5	66.6	40	-	-	-	-	-	-	-	-	-	-	10	-	-
CO 6	66.6	-	-	-	-	-	-	-	-	-	-	37.5	-	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		
	PO 1	PO 2	PO 3	PO 4	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	-	-
CO 3	-	2	-	-	-	-	-	-	-	-	-	-	1	-	-
CO 4	3	2	-	-	-	-	-	-	-	-	-	-	1	-	-
CO 5	3	2	-	-	-	-	-	-	-	-	-	-	1	-	-
CO 6	3	-	-	-	-	-	-	-	-	-	-	1	-	3	-
TOTAL	15	10	-	-	-		-	-	-	-		1	5	3	-
AVERAGE	3.0	2.0	-	-	-		-	-	-	-	-	1	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:

	Assessment of mini projects by experts	✓	End Semester OBE Feedback

XVIII SYLLABUS:

MODULE I	**STRESSES AND STRAINS**
	Concept of stress and strain, St. Venant's principle, stress and strain diagram, Elasticity and plasticity, types of stresses and strains, Hooke's law stress – strain diagram for mild steel working stress, factor of safety, Lateral strain, Poisson's ratio and volumetric strain – Elastic moduli and the relationship between them; Bars of varying section, composite bars, temperature stresses. Strain Energy – Resilience, Gradual, sudden, impact and shock loadings, simple applications, two dimensional system, stress at a point on a plane, principal stresses and principal planes, Mohr circle of stress, ellipse of stress and their applications. Two dimensional stress-strain system, principal strains and principal axis of strain, circle of strain and ellipse of strain. Relationship between elastic constants.
MODULE II	**BENDING MOMENT AND SHEAR FORCE DIAGRAMS**
	Bending Moment (BM) and Shear Force (SF) diagrams. BM and SF diagrams for cantilevers simply supported and fixed beams with or 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 concentrated loads (two or three) and uniformly distributed loads, uniformly varying loads, application of moments. Relationship between moment, slope and deflection, Moment area method, Macaulay's method. Use of these methods to calculate slope and deflection for determinant beams.
MODULE III	**FLEXURAL STRESSES AND SHEAR STRESSES IN BEAMS**
	Derivation of bending equation, Neutral axis, determination of bending stresses, section modulus of rectangular and circular sections (Solid and Hollow), I, T, Angle and Channel sections, Design of simple beam sections. Shear stress distribution across various beam sections like rectangular, circular, triangular, I, T angle sections.
MODULE IV	**TORSION**

	Derivation of torsion equation and its assumptions. Applications of the equation of the hollow and solid circular shafts, torsional rigidity, Combined torsion and bending of circular shafts, principal stress and maximum shear stresses under combined loading of bending and torsion. Analysis of close-coiled-helical springs.
MODULE V	**THIN CYLINDERS AND SPHERES**
	Derivation of formulae and calculations of hoop stress, longitudinal stress in a cylinder, and sphere subjected to internal pressures.

TEXTBOOKS

1. Timoshenko, S. and Young, D. H., "Elements of Strength of Materials", DVNC, New York, USA.
2. Kazmi, S. M. A., "Solid Mechanics" TMH, Delhi, India.
3. Hibbeler, R. C. Mechanics of Materials. 6th ed. East Rutherford, NJ: Pearson Prentice Hall, 2004.
4. Crandall, S. H., N. C. Dahl, and T. J. Lardner. An Introduction to the Mechanics of Solids. 2nd ed. New York, NY: McGraw Hill, 1979.

REFERENCE BOOKS:

1. Mechanics of Materials - Ferdinand P. Beer, E. Russel Jhonston Jr., John T. DEwolf – TMH 2002
2. Strength of Materials by R. Subramanian, Oxford University Press, New Delhi.

WEB REFERENCES:

1. http://www.nptelvideos.in/2012/11/strength-of-materials- prof.html
2. https://http://ocw.mit.edu/courses/civil-and-environmental-engineering/1-050-solid-mechanics-fall-2004/lecturenotes/
3. https://www.youtube.com/watch?v=coRgpxG2pyY-and-list=PLLbvVfERDon3oDfCYxkwRct1Q6YeOzi9g

COURSE WEB PAGE:

XIX COURSE PLAN:

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

S.No	Topics to be covered	CO's	Reference
OBE DISCUSSION			
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 R2: 3.3
7	Stresses in bars of uniform sections.	CO 1	T1: 1.1, 1.2 R2: 3.3
8	Stresses in bars of uniformly tapering sections.	CO 1	T1: 1.1, 1.2 R2: 3.3
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 R2: 3.5-3.6
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	Introduction to thin cylinders and spheres. Projected area theorem.	CO 5	T2:23.3 R2: 8.3
37	Thin cylindrical shells subjected to internal pressure. Volumetric change.	CO 5	T2:23.4 R2: 8.4
38	Thin spherical shells subjected to internal pressure. Volumetric change.	CO 5	T2:23.7 R2: 8.6
39	Design of thin cylindrical shells.	CO 5	T2:23.6 R2: 8.8
40	Numerical examples on cylindrical shells.	CO 5	T3:23.8 R2: 8.10
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 Strain energy in tapering sections.	CO 1	R2:7.5
5	Numerical Examples on Principal Stresses.	CO 1	R2:7.5
6	Numerical Examples on Principal Stresses. (Graphical method)	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 cylindrical shells.	CO 5	R1:7.5
15	Numerical examples on spherical shells.	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 thin cylinders and spheres	CO 5	R1: 7.1
DISCUSSION OF QUESTION BANK			
1	Questions from simple stresses and strains.	CO 1	T1: 1.1, 1.2 R2: 3.3
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 thin cylinders and spheres	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
COURSE DESCRIPTION

Department	**CIVIL ENGINEERING**				
Course Title	**PROBABILITY AND STATISTICS**				
Course Code	AHSB12				
Program	B.Tech				
Semester	IV	CE			
Course Type	Foundation				
Regulation	R- 18				
Course Structure	Theory			Practical	
	Lecture	Tutorials	Credits	Laboratory	Credits
	3	1	4	-	-
Course Coordinator	Ms. P. Srilatha, Assistant Professor				

I COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites
-	-	-	-

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 over real-world 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	✓	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
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), 05 marks for Quiz and 05 marks for Alternative Assessment Tool (AAT).

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

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

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

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

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

VI COURSE OBJECTIVES:

The students will try to learn:

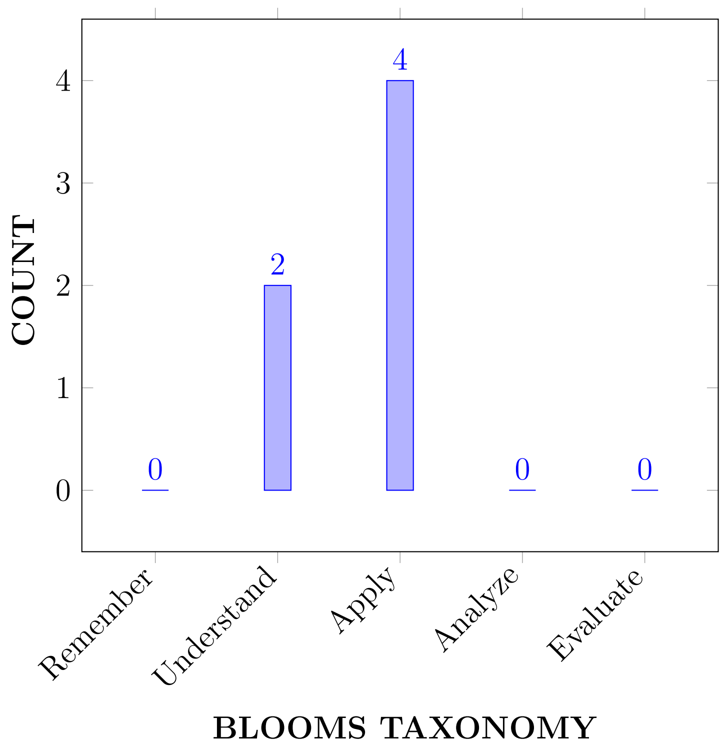
I	The Principles of probability, the theory of random variables, basic random variate distributions and their applications.
II	The Methods and techniques for quantifying the degree of closeness among two or more variables and linear regression analysis.
III	The Estimation statistics and Hypothesis testing 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 concepts of Baye's theorem, 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 sample in 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.

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

IX HOW PROGRAM OUTCOMES ARE ASSESSED:

PROGRAM OUTCOMES		Strength	Proficiency Assessed by
PO 1	**Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.	3	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

PROGRAM OUTCOMES		Strength	Proficiency Assessed by
PO 4	**Conduct Investigations of Complex Problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.	1	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.	-	-
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

Course Outcomes	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key competencies matched.
	PO 4	The expected values, variances for the given discrete random variables will be quantitatively measured by using statistical computer software (R-software).	1
CO 2	**PO 1**	Interpret the Probability distributions such as Binomial, Poisson and Normal distribution (Understanding) with the support of evaluation of integrals (principles of mathematics) and appreciate their importance and applicability (Apply) in solving complex engineering problems involving uncertainty.	2
	PO 2	Understand the statement and formulation of a complex engineering problem which involves the events of uncertainty, Model it with suitable probability distribution and Apply the concepts of discrete or continuous distributions along with basic principles of mathematics to develop the solution and reaching substantiated conclusions by the interpretation of results	5
CO 3	**PO 1**	Interpret (Understand) the results of Bivariate and Correlation Analysis by using ratios, square roots, straight lines and planes (principles of mathematics) for statistical forecasting (Apply)in complex engineering problems involving bivariate or multivariate data.	2
CO 4	**PO 1**	Select appropriate statistical methods (understand) for solving some real-time complex engineering problems governed by correlation with the knowledge of fundamental principles of mathematics.	2
	PO 4	Interpret the results of Bivariate and Multivariate Regression and quantifying the degree of closeness between two or more variables by using statistical computer software (R-software, SPSS-software).	1
CO 5	**PO 1**	Apply tests of hypotheses which involves the role of mathematical tools like statements, sets, ratios and percentages (principles of mathematics) for both large samples and small samples (knowledge) in making decisions over statistical claims that arise in complex engineering problems which requires sampling inspections.	2
	PO 2	Understand the statement and formulation of a complex engineering problem which needs verification of truth values of numerical or statistical hypothesis, collect the necessary information and data through sampling techniques, apply tests of hypotheses (both large and small samples) along with basic principles of mathematics to develop the solution and reaching substantiated conclusions by the interpretation of results	5
	PO 4	Make Use of R software package in computing confidence intervals, statistical averages and hypothesis testing. (Computer software relevance)	1

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	Test for the assessment of goodness of fit of the given probability distribution model by using statistical quantitative methods and statistical computer software (R-software).	1

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

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

XIV PERCENTAGE OF KEY COMPETENCIES FOR CO – PO/ PSO

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	66.7	-	-	9.0	-	-	-	-	-	-	-		-	-	-
CO 2	66.7	50.0	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 3	66.7	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 4	66.7	-	-	9.0	-	-	-	-	-	-	-	-	-	-	-
CO 5	66.7	50.0	-	9.0	-	-	-	-	-	-	-	-	-	-	-
CO 6	66.7	-	-	9.0	-	-	-	-	-	-	-		-	-	-

XV COURSE ARTICULATION MATRIX (PO / PSO MAPPING):

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

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

XVI ASSESSMENT METHODOLOGY-DIRECT:

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

XVII ASSESSMENT METHODOLOGY-INDIRECT:

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

XVIII SYLLABUS:

MODULE I	**PROBABILITY AND RANDOM VARIABLES**
	Probability, Conditional Probability, Baye's Theorem; 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; Multiple correlation and 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.

REFERENCE BOOKS:

1. N. P. Bali, "Engineering Mathematics", Laxmi Publications, 9th Edition, 2016.& Co., 6th Edition, 2014.
2. S. C. Gupta, V. K. Kapoor, "Fundamentals of Mathematical Statistics", S. Chand & Co., 10th Edition, 2000.
3. Richard Arnold Johnson, Irwin Miller and John E. Freund, "Probability and Statistics for Engineers", Prentice Hall, 8th Edition, 2013.

WEB REFERENCES:

1. http://e4uhu.com/down/Applied/9th
2. https://toaz.info/32fa2f50-8490-42cf-9e6a-f50cb7ea9a5b
3. http://www.mathworld.wolfram.com

XIX COURSE PLAN:

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

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

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

PROBLEM SOLVING/ CASE STUDIES			
42	Problem solving session on discrete random variable	CO 1	T2:26.3
43	Problem solving session on continuous random variables	CO 1	R2:21.48
44	Problem solving session on mathematical expectation	CO 1	T2:26.6 R2:21.50
45	Problem solving session on Binomial distribution	CO 1	T2:26.7 R2:21.51
46	Problem solving session on Poisson distribution	CO 2	T2:26.8
47	Problem solving session on Normal distribution	CO 2	T2:26.10
48	Problem solving session on Karl Pearson's correlation	CO 3	T2:26.14 R2:21.55
49	Problem solving session on Spearman's rank correlation	CO 3	T2:26.15 R2:21.58
50	Problem solving session on linear regression	CO 4	T2:26.16 R2:21.61
51	Problem solving session on sampling distribution of means	CO 5	T2:25.12 R2:21.24
52	Problem solving session on central limit theorem	CO 5	T2:25.16 R2:21.29
53	Problem solving session on large sample tests	CO 5	T2:25.14 R2:21.31
54	Problem solving session on t-test	CO 6	T2:25.14 R2:21.33
55	Problem solving session on F-test	CO 6	R2:21.33
56	Problem solving session on Chi-square - test	CO 6	T2:27.2 R2:21.64
DISCUSSION OF DEFINITION AND TERMINOLOGY			
57	Definitions & terminology discussion on probability and random variables	CO 1	T2:26.6 R2:21.50
58	Definitions & terminology discussion on probability distributions.	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 and random variables.	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. Srilatha

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

CIVIL ENGINEERING

COURSE DESCRIPTION

Department	**CIVIL ENGINEERING**				
Course Title	**MATERIALS, TESTING AND EVALUATION**				
Course Code	ACEB08				
Program	B.Tech				
Semester	IV	CE			
Course Type	Core				
Regulation	IARE-R18				
Course Structure	Theory			Practical	
	Lecture	Tutorials	Credits	Laboratory	Credits
	3	1	4	-	-
Course Coordinator	Mr K. Anand Goud, Assistant Professor				

I COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites
B.Tech	ACEB02	III	Building Materials, Construction and Planning

II COURSE OVERVIEW:

Material testing and evaluation describes various tests to be performed on civil engineering materials to evaluate their quality and to decide their suitability for use in construction. The course deals with the current testing technologies and their applications for testing of construction materials. Materials testing provides basic skills for selecting material in design and evaluation of mechanical and structural properties of material. It also provides knowledge on behavior of metallic and non-metallic structural materials and fundamentals of fracture mechanics of structural materials.

III MARKS DISTRIBUTION:

Subject	SEE Examination	CIE Examination	Total Marks
Materials, Testing and Evaluation	70 Marks	30 Marks	100

IV DELIVERY / INSTRUCTIONAL METHODOLOGIES:

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

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.

Percentage of Cognitive Level	**Blooms Taxonomy Level**
30 %	Remember
60 %	Understand
10 %	Apply
0 %	Analyze
0 %	Evaluate
0 %	Create

Continuous Internal Assessment (CIA):

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

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

Continuous Internal Examination (CIE):

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

Quiz - Online Examination

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

Alternative Assessment Tool (AAT)

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

Concept Video	Tech-talk	Open Ended Experiment
40%	40%	20%

VI COURSE OBJECTIVES:

The students will try to learn:

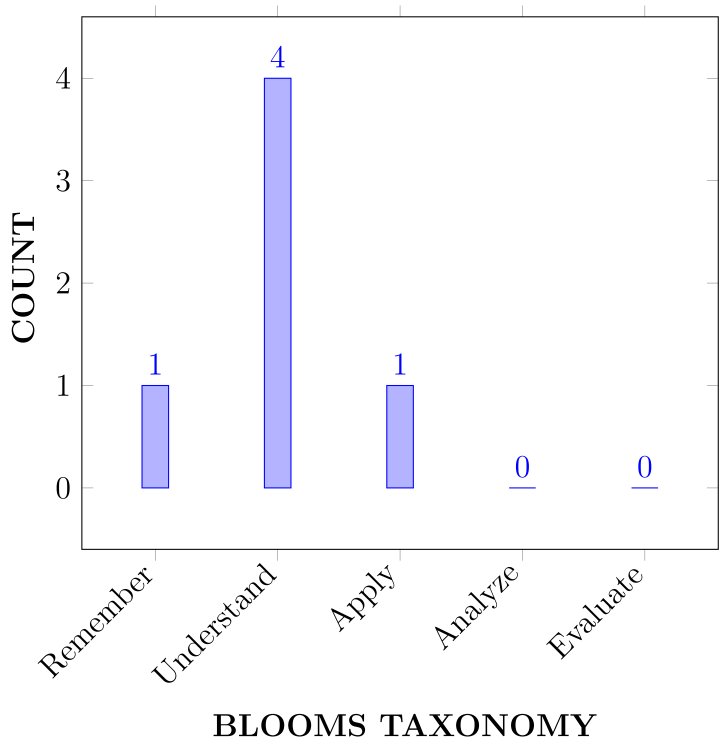
I	The properties and importance of various constituent materials of concrete used in construction.
II	The mechanical behavior of engineering materials under compressive and tensile loads.
III	The fundamentals of fracture mechanics and identify initiation and propagation of crack around stress-strain fields.
IV	The standard testing procedures and assess engineering properties of construction materials.

VII COURSE OUTCOMES:

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

CO 1	**Classify** the construction materials based on their behaviour for using in various construction fields.	Understand
CO 2	**Explain** the mechanical behaviour of steel and concrete by standard testing procedures for identifying their performance.	Understand
CO 3	**Identify** the modes of failures in concrete caused by fracture to avoid the failure of concrete structures.	Remember
CO 4	**Explain** composition of metals and testing procedures of construction materials for estimating their engineering properties.	Understand
CO 5	**Explain** special materials like polymers, composites used in construction for satisfying the future needs of industry.	Understand
CO 6	**Select** suitable Cementitious materials to substantiate cement in concrete structuresfor producing ecofriendly/green concrete.	Apply

COURSE KNOWLEDGE COMPETENCY LEVEL



VIII PROGRAM OUTCOMES:

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

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

IX HOW PROGRAM OUTCOMES ARE ASSESSED:

Program		Strength	Proficiency Assessed by
PO 1	**Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.	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.	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 modeling to complex engineering activities with an understanding of the limitation	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 superstructures for residential and public buildings, industrial structures, irrigation structures, powerhouses, highways, railways, airways, docks and harbours.	1	CIE/ SEE / AAT
PSO 2	Focus on improving performance of structures with reference to safety and serviceability, and sustainable green building technology.	3	CIE / SEE / AAT

3 = High; 2 = Medium; 1 = Low

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

COURSE OUTCOMES	**PROGRAM OUTCOMES**												**PSO'S**		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	-	✓	-	✓	-	-	-	-	-	-	-	-	-	✓	-
CO 2	-	✓	-	✓	✓	-	-	-	-	-	-	-	✓	✓	-
CO 3	✓	✓	-	✓	-	-	-	-	-	-	-	-	✓	✓	-
CO 4	-	-	-	✓	✓	-	-	-	-	-	-	-	✓	✓	-
CO 5	✓	-	✓	✓	-	-	-	-	-	-	-	-	-	✓	-
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 2	Classify the different materials based on the **data collected** and **implement** the same in construction based on their properties.	2
	PO 4	Categorize the materials based on the **knowledge of characteristics of particular materials, processes** and understanding the quality issues, industry standards	3
	PSO 2	Classify the materials to **improve performance of structures** with reference to **safety & serviceability** by using **sustainable green building technology.**	3
CO 2	PO 2	Analyse mechanical behaviour of metals, **experimenting** with different types of loads and by **collecting data** from **results**	3
	PO 4	**Describe the performance** of metals, concrete through the use of standard methods, **appropriate codes, engineering principles** by understanding the **characteristics of particular materials, processes** with **good laboratory skills**.	5
	PO 5	Understand the behaviour of materials by applying appropriate techniques and modern engineering tools.	1
	PSO 1	Understand the mechanical behaviour of materials used in residential, industrial, **water treatment and distribution** systemsbased on **material knowledge** for **assessing strength** and **quality** by using standard **codes of practice**.	5
	PSO 2	Examine the mechanical behaviour of materials like concrete and steel to **improve the performance** of structures by enhancing **safety and serviceability.**	2
CO 3	PO 1	Identify the modes of failures in materials by applying the basic **Engineering principles.**	1
	PO 2	**Identify the modes of failure** in concrete by **collecting the information** and **develop the solution** by **interpreting the results.**	4

	PO 4	Explain the failure pattern of concrete materials with the knowledge of **characteristics of materials** by understanding the **codes of practice, industry standards and quality issues.**	3
	PSO 1	Identify the modes of failure occur in concrete due to fracture based on **material knowledge** for improving **quality** of structures.	2
	PSO 2	Identify the modes of failure which will help to **improve the performance** of structures with increased **safety and serviceability.**	1
CO 4	PO 4	Perform testing on construction materials by understanding the **appropriate codes, industry standards** and **technical literature**.	2
	PO 5	**Select and apply appropriate testing method** to know the characteristics of materials by understanding the limitations.	1
	PSO 1	Understand the various material testing procedures used for determining engineering properties of materials with the help of **material knowledge, codes of practice.**	2
	PSO 2	Focus on **improving performance** of materials/structures by testing with reference to **safety and serviceability of structures.**	2
CO 5	PO 1	Choose different composite materials to develop a new generation concrete for solving complex Engineering problems along with enhanced performance by applying principles of **Engineering fundamentals** and their integration and support with other engineering disciplines, scientific methodologies.	2
	PO 3	Investigate and identify special materials and new generation materials for satisfying the future needs of industry including **environmental and sustainability** and production, operation, maintenance	2
	PO 4	Understand the **characteristics, quality issues and industry standards** of composite materials used in construction and describe **the performance of structures**/components using analytical testing methods.	4
	PSO 2	Identify the modes of failure which will help to **improve the performance** of structures with increased **safety and serviceability.**	2

CO 6	PO 4	Understand the **characteristics, quality issues and industry standards** of cementitious materials used in construction and describe **the performance of structures**/components using analytical testing methods.	3
	PO 5	**Select and apply appropriate testing method** to know the characteristics of materials by understanding the limitations.	1
	PSO 2	Understand the properties of cementitious materials for **Improving the performance** of structures and to create ecofriendly environment with the application of **green building technology** with increased **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	-	2	-	3	-	-	-	-	-	-	-	-	-	3	-
CO 2	-	3	-	5	1	-	-	-	-	-	-	-	5	2	-
CO 3	1	4	-	3	-	-	-	-	-	-	-	-	2	1	-
CO 4	-	-	-	2	1	-	-	-	-	-	-	-	2	2	-
CO 5	2	-	2	4	-	-	-	-	-	-	-	-	-	2	-
CO 6	-	-	-	3	1	-	-	-	-	-	-	-	-	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	00.0	20.0	0.0	27.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	100.0	0.0
CO 2	00.0	30.0	0.0	27.6	100	0.0	0.0	0.0	0.0	0.0	0.0	0.0	50.0	66.6	0.0
CO 3	33.3	40.0	0.0	27.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	20.0	33.3	0.0
CO 4	00.0	0.0	0.0	18.1	100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	20.0	66.7	0.0
CO 5	66.7	00.0	20.0	36.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	66.6	0.0
CO 6	0.0	0.0	0.0	27.6	100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	100	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
2 - 40 % <C < 60% –Moderate
1-5 <C≤ 40% – Low/ Slight
3 - 60% ≤ 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	-	-	-	-	-	-	-	-	-	3	-
CO 2	-	1	-	1	3	-	-	-	-	-	-	-	2	3	-
CO 3	1	1	-	1	-	-	-	-	-	-	-	-	1	1	-
CO 4	-	-	-	1	3	-	-	-	-	-	-	-	1	3	-
CO 5	3	-	1	1	-	-	-	-	-	-	-	-	-	3	-
CO 6	-	-	-	1	3	-	-	-	-	-	-	-	-	3	-
TOTAL	4	3	1	6	9	-	-	-	-	-	-	-	4	16	-
AVERAGE	2	1	1	1	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:

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

XVIII SYLLABUS:

MODULE I	**INTRODUCTION TO ENGINEERING MATERIALS**

	Cements, Sand, Concrete (plain, reinforced and steel fiber / glass fiber reinforced, light weight concrete, high Performance Concrete, Polymer Concrete) Ceramics, and Refractories, Bitumen and asphaltic materials, Timbers, Glass and Plastics, Structural Steel and other Metals, Paints and Varnishes, Acoustical Material and geo-textiles, rubber and asbestos, laminates and adhesives, Graphene, Carbon composites and other engineering materials including properties and uses.
MODULE II	**INTRODUCTION TO MATERIAL TESTING**
	Introduction to material Engineering; Mechanical behavior and mechanical characteristics; Elasticity principle and characteristics; plastic deformation of metals; tensile test-standards for different material (brittle, quasi-brittle, elastic) True stress-strain interpretation of tensile test; hardness tests; bending and torsion test; strength of ceramic; Internal friction, creep fundaments and characteristics; Brittle fracture of steel-temperature transition approach; Background of fracture mechanics; fracture toughness testing for different materials; concept of fatigue of materials; Structural integrity assessment procedure and fracture mechanics.
MODULE III	**STANDARD TESTING & EVALUATION PROCEDURES**
	Mechanical testing of various metals; naming systems for various irons, steels and nonferrous metals; elastic deformation; plastic deformation. Impact test and transition temperatures; fracture mechanics background; fracture toughness-different materials, Fatigue of material, Creep.
MODULE IV	**STANDARD TESTING PROCEDURES**
	Tests& testing of bricks, Tests & testing of sand, Tests & testing of concrete, Tests & testing of soils, Tests & testing of bitumen & bituminous mixes.
MODULE V	**TESTING PROCEDURES OF SPECIAL MATERIALS**
	Testing of polymers and polymer based materials, tests and testing of metals, special materials, composites and cementitious materials. Explanation of mechanical behavior of these materials.

TEXTBOOKS

1. Chudley, R., Greeno, “building construction handbook”, R. Butterorth Heinemann, 6th edition, 2006.

2. Khanna, S.K., Justo, C.E.G and Veeraragavan, A, “Highway Materials and Pavement Testing”, Nem Chand & Bros, 5th Edition.

3. Various related updated & recent standards of BIS, IRC, ASTM, RILEM, AASHTO, etc. corresponding to materials used for Civil Engineering applications.

REFERENCE BOOKS:

1. KyriakosKomvopoulos, “Mechanical Testing of Engineering Materials”, Cognella, 2011.

2. E.N. Dowling, “Mechanical Behaviour of Materials”, Prentice Hall International, 1993.

3. American Society for Testing and Materials (ASTM), Annual Book of ASTM Standards (post 2000)

WEB REFERENCES:

1. https://nptel.ac.in/courses/105/102/105102012/

COURSE WEB PAGE:

1. https://lms.iare.ac.in/index?route=course/details&course371

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 objectives, Course outcomes, Program Outcomes and CO-PO Mapping		
CONTENT DELIVERY (THEORY)			
2	Introduction on Materials, Testing and Evaluation	CO 1	T1: 1.1-1.7
3	Cement - Composition.	CO 1	T1: 1.8-1.9,
4	Bogue's Compounds	CO 1	T1: 1.13-1.1
5	Types of Cement	CO 1	T1:2.1-2.6, T1: 2.18, R2:5.1
6	Types of Cement	CO 1	T1: 5.1-5.3
7	Fine Aggregate (Sand)	CO 1	T1: 5.4-5.5
8	Concrete- Plain, Reinforced and Steel Fiber Glass Fiber Reinforced concrete	CO 1	T1: 3.2-3.4, R2:6.3
8	Types of Concrete Light Weight Concrete, High Performance Concrete, Polymer Concrete	CO 1	T1: 3.7-3.9
9	Ceramics and Refractories	CO 1	T1: 3.15-3.18, R2:6.5
10	Bitumen, Glass	CO 1	T1:3.26-3.27, T1:3.19,
11	Paints and varnishes	CO 1	T2 :3.6-3.7, R1:7.1
12	Geosynthetics	CO 1	T2:3.8-3.9
13	Carbon composites and asbestos	CO 1	T2:3.9-3.11, R1:7.5

14	Adhesives	C03	T2: 6.1-6.4, R2:7.2
15	Assumptions in Strength of Materials	CO 2	T1:6.3-6.36
16	Types of stress and strain	CO 2	T1:6.6, R1:3.5
17	Mechanical Characteristics-elasticity and plasticity	CO 2	T1: 6.6, R1:8.4
18	True stress-strain interpretation of tensile test	CO 2	T1: 6.4-6.5, R1:8.5
19	Hardness tests	CO 4	T1: 6.7.1-6.7.7.15
20	Impact testing of metals & tensile strength curing	CO 4	T1: 6.7-6.8
21	Creep fundamentals and characteristics	CO 2	T1: 4.2-4.3
22	Brittle fracture of steel	CO 3	T1: 7.2, R1:8.6
23	Ductile fracture	CO 3	T1: 7.3, R1:8.8
24	Background of fracture mechanics	CO 3	T1: 7.4
25	fracture toughness	CO 3	T1: 7.6, R1:9.1.4
26	Types of metals	CO4	T1: 7.8
27	steel	CO 4	T1: 7.7 R2:9.2.1
28	Fatigue of materials	CO 3	T1: 7.8 R1: 6.8-6.9
29	Testing of bricks-1	CO 4	T1: 10.1-10.2, R1:4.2.3
30	Testing of bricks-2	CO 4	T1:10.7-10.9
31	Testing of sand- sieve analysis	CO4	T1:10.8-10.11, R1: 10.1-10.2
32	Testing of sand- bulking	CO4	T1:8.1-8.3
33	Testing of fresh concrete- slump cone test	CO4	T1:8.1.1-8.1.4
34	Testing of hardened concrete- Compressive strength test	CO4	T1:8.2
35	Testing of hardened concrete- Splitting Tensile strength test, Rebound hammer test	CO 4	T1:8.3
36	Testing of soil- silt content, sieve analysis test	CO4	T1:11.3

37	Testing of soil- moisture content test, Atterberg Limits of Soil Classification	CO4	R1:9.2
38	Bitumen testing	CO4	R1:11.5
39	Composites-Definition, composition	CO5	R1:11.5-11.7
40	Composites-, applications, advantages, classification	CO5	T1:11.9
41	Cementitious materials	CO6	T1:11.13
PROBLEM SOLVING/ CASE STUDIES			
42	Hardness test methods	CO4	T1:11.13-11.14
43	Fatigue of materials	CO8	R2:14.2-14.3
44	Ductile behaviour	CO3	R2:14.15
45	Elasticity and plasticity	CO2	R1:12.8
46	High performance concrete	CO1	T1:12.10
47	fiber reinforced concrete	CO 1	R1:12.10.2
48	Soil tests	CO 4	R1:12.13
49	Design the concrete mix	CO 1	R1:12.13.2
50	Fineness modulus of aggregates	CO 1	R2:16.1-16.9
51	Setting time of cement	CO 1	T1:13.1-13.4
52	Flyash- classification , Properties	CO 6	R2:14.2
53	Cementitious materials-Silica fume	CO 6	R2:14.2-14.3
54	Cementitious materials- GGBS	CO 6	R2:14.15
55	Testing of polymers	CO 5	R1:12.8
56	Mechanical behavior of cementitious materials	CO 6	T1:12.10
DISCUSSION OF DEFINITION AND TERMINOLOGY			
57	Introduction to Engineering Materials	CO 1	R1:12.10.2
58	Introduction to Material Testing	CO 3	R2:14.2-14.3
59	Standard testing and Evaluation Procedures	CO 3, CO 4	R2:14.15
60	Standard Testing Procedures	CO 4	R2:14.2-14.3
61	Testing Procedures of Special Materials	CO 5, CO 6	R2:14.15
DISCUSSION OF QUESTION BANK			
62	Introduction to Engineering Materials	CO 1	R1:12.8
63	Introduction to Material Testing	CO 3	T1:12.10
64	Standard testing and Evaluation Procedures	CO 3, CO 4	R1:12.10.2

65	Standard Testing Procedures	CO 4	R2:14.2-14.3
66	Testing Procedures of Special Materials	CO 5, CO 6	R2:14.2-14.3

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

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

COURSE DESCRIPTION

Department	**CIVIL ENGINEERING**				
Course Title	**ENVIRONMENTAL SCIENCE**				
Course Code	AHSB07				
Program	B.Tech				
Semester	IV				
Course Type	FOUNDATION				
Regulation	R-18				
Course Structure	Theory			Practical	
	Lecture	Tutorials	Credits	Laboratory	Credits
	3	-	3	-	-
Course Coordinator	Dr V Anitha Rani, Associate Professor				

I COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites	Credit
-	-	-	-	-

II COURSE OVERVIEW:

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

III MARKS DISTRIBUTION:

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

IV CONTENT DELIVERY / INSTRUCTIONAL METHODOLOGIES:

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

V EVALUATION METHODOLOGY:

The course will be evaluated for a total of 100 marks, with 30 marks for Continuous Internal Assessment (CIA) and 70 marks for Semester End Examination (SEE). 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 emphasis on the questions is broadly based on the following criteria:

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

Continuous Internal Assessment (CIA):
CIA is conducted for a total of 30 marks (Table 1), with 20 marks for Continuous Internal Examination (CIE), 05 marks for Quiz and 05 marks for Alternative Assessment Tool (AAT).

Continuous Internal Assessment (CIA):
CIA is conducted for a total of 30 marks (Table 2), with 20 marks for Continuous Internal Examination (CIE), 05 marks for Quiz and 05 marks for Alternative Assessment Tool in table

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	Complex Problem Solving
40%	40%	20%

VI COURSE OBJECTIVES:

The students will try to learn:

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

VII COURSE OUTCOMES:

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

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

COURSE KNOWLEDGE COMPETENCY LEVEL

VIII PROGRAM OUTCOMES:

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

IX HOW PROGRAM OUTCOMES ARE ASSESSED:

PROGRAM OUTCOMES		Strength	Proficiency Assessed by
PO 1	**Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.	2	CIE/Quiz/AAT
PO 4	**Conduct investigations of complex problems:**Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.	2	CIE/Quiz/AAT
PO 7	**Environment and sustainability:** understand the impact of the professional engineering solutions in societal and Environmental contexts, and demonstrate the knowledge of, and need for sustainable development.	3	CIE/Quiz/AAT

3 = High; 2 = Medium; 1 = Low

X HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

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

3 = High; 2 = Medium; 1 = Low

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

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

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

Course Outcomes	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key competencies matched.
CO 1	PO 1	Explain the basic concept of environment, earths major cycle and its function related food chain, food web, and ecological pyramid for the importance of ecosystem and flow of energy in ecosystem by using principles of science for solving engineering problems.	2
	PO 7	Summarize about the toxicity of heavy metals on the biotic and abiotic components in in socio economic Environmental and politics contexts for Sustainable development.	3
CO 2	PO 1	Classify about different types of natural resources and their applicability and illustrate the utility of renewable resources efficiency by using principles of science for solving engineering problems.	2
	PO 7	Identify renewable and non renewable resources, Alternate energy resources and understand the impact in socio economic Environmental and politics contexts for Sustainable development.	3
CO3	PO 1	Explain the renewable and non renewable energy resource by using principles of science for solving engineering problems.	2
	PO 7	Utilize renewable and non renewable resources, Alternate energy resources and understand the impact in socio economic, politics and Environmental contexts for Sustainable development.	3
CO4	PO 1	Explain the fundamentals of Biodiversity and biotic resources, importance of biodiversity, the ecological values, India is mega diversity nation, the threats to biodiversity and importance of conservation of biodiversity by applying the principle of science for solving engineering problems.	2

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

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

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

XIV PERCENTAGE OF KEY COMPETENCIES FOR CO – PO/ PSO

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

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

XV COURSE ARTICULATION MATRIX (PO / PSO MAPPING):

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

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

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

XVI ASSESSMENT METHODOLOGY-DIRECT:

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

XVII ASSESSMENT METHODOLOGY-INDIRECT:

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

XVIII SYLLABUS:

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

TEXTBOOKS

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

REFERENCE BOOKS:

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

XIX COURSE PLAN:

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

S.No	Topics to be covered	CO’s	Reference
OBE DISCUSSION			
1	Course Description on Outcome Based Education (OBE): Course Objectives, Course Outcomes (CO), Program Outcomes (PO) and CO-PO Mapping		
CONTENT DELIVERY (THEORY)			
1	Explain the scope and importance of Environment and need for Public Awareness	CO 1	T1:1.1.3 R1:2.1
2	Identify scope and importance of ecosystem	CO1	T1:1.1.4 R1:2.7.1
3	Explain Structure and function of ecosystem	CO1	T1:1.1.6 R1:2.7.4
4	Relate the Food chain food web and pyramids	CO1	T1:1.7.2 R1:2.15
5	Realate the Flow of energy	CO1	T1:1.7.2 R1:2.16
6	Explain the Biogeochemical cycles.	CO1	T1:1.7.6 R1:2.17
7	Interpret the Biomagnifications.	CO1	T1:1.7.3 R1:2.19
8	Classify the Living and non living resources	CO 2	T1:2.1 R1:2.21
9	Explain the Water resources: use and over utilization of surface and ground water	CO 2	T1:2.2.2 R1:2.3
10	Explain the Floods and Drought	CO 2	T1:2.2.4 R1:4.1

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

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

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

Signature of Course Coordinator **HOD,CE**

INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

Dundigal, Hyderabad - 500 043

CIVIL ENGINEERING

COURSE DESCRIPTION

Course Title	**ENGINEERING GEOLOGY LABORATORY**				
Course Code	ACEB09				
Program	B.Tech				
Semester	IV	CE			
Course Type	CORE				
Regulation	IARE - R18				
Course Structure	Theory			Practical	
	Lecture	Tutorials	Credits	Laboratory	Credits
	-	-	-	2	1
Course Coordinator	Ms. P Sri Poojitha, Assistant Professor, CE				

I 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.

II COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites
-	-	-	-

III MARKS DISTRIBUTION:

Subject	SEE Examination	CIE Examination	Total Marks
ENGINEERING GEOLOGY LABORATORY	70 Marks	30 Marks	100

IV DELIVERY / INSTRUCTIONAL METHODOLOGIES:

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

V EVALUATION METHODOLOGY:

Each laboratory will be evaluated for a total of 100 marks consisting of 30 marks 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
0	0	0	0	0	0

VI COURSE OBJECTIVES:

The students will try to learn:

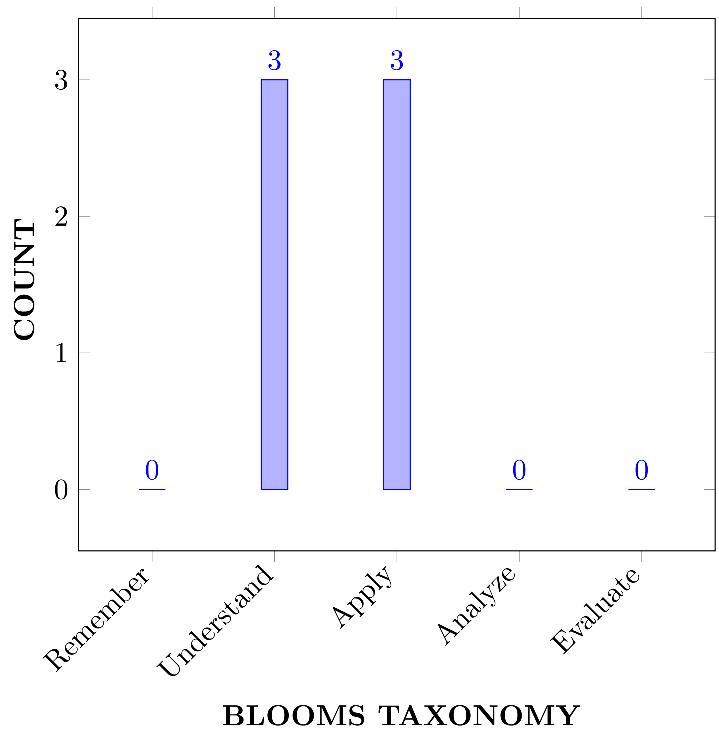
I	Study the physical properties of minerals and rocks.
II	Identify rocks and mineral by megascopic and microscopic techniques.
III	Interpret and draw profiles and sections of different geological features.
IV	Solve simple structure geology problems..

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 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

IX 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

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

COURSE OUTCOMES	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key Competencies
CO 1	PO 1	Recall the basic 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

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	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 2	2	2	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 3	1	2	-	-	-	-	-	-	-	-	-	-	-	2	-
CO 4	-	-	-	1	-	-	-	-	-	-	-	-	-	2	-
CO 5	-	-	-	2	-	-	-	-	-	-	-	-	-	2	-
CO 6	-	-	-	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	**PHYSICAL PROPERTIES OF MINERALS**
	Study of physical properties of minerals
WEEK II	**GROUP OF MINERALS**
	Study of different group of minerals.
WEEK III	**IDENTIFICATION OF SILICA GROUP MINERALS**
	Identification of Quartz, Amethyst, Opal
WEEK IV	**IDENTIFICATION OF FELDSPAR GROUP MINERALS**

	Identification of Orthoclase, Plagioclase Feldspar.
WEEK V	**IDENTIFICATION OF MINERALS**
	Identification of Jasper, Calcite, Graphite; Talc; Muscovite Mica
WEEK VI	**IDENTIFICATION OF AMPHIBOLE GROUP MINERALS**
	Olivine, Hornblende, Magnetite, Hematite, Corundum, Kyanite, Garnet, Galena, Gypsum.
WEEK VII	**IDENTIFICATION OF IGNEOUS ROCKS**
	Identification of Granite, Pegmatite, Dolerite and Basalt rocks
WEEK VIII	**IDENTIFICATION OF SEDIMENTARY ROCKS**
	Identification of Conglomerate, Sandstone, Limestone and Shale rocks
WEEK IX	**IDENTIFICATION OF METAMORPHIC ROCKS**
	Identification of Marble, Slate, Gneiss and Schist rocks
WEEK X	**TOPOGRAPHICAL FEATURES**
	Study of topographical features from Geological maps.
WEEK XI	**GEOLOGICAL PROBLEMS**
	Dip, Strike direction
WEEK XII	**GEOLOGICAL MAPS**
	Identification of symbols in maps.

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

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 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

XVI 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**
Ms. P Sri Poojitha, Assistant Professor

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

CIVIL ENGINEERING
COURSE DESCRIPTION

Course Title	**Fluid Mechanics Laboratory**	
Course Code	ACEB10	
Program	B.Tech	
Semester	IV	CE
Course Type	Core	
Regulation	IARE - R 18	

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
Fluid Mechanics and Hydraulic Machinery Laboratory	70 Marks	30 Marks	100

IV DELIVERY / INSTRUCTIONAL METHODOLOGIES:

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

V EVALUATION METHODOLOGY:

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

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

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

Continuous Internal Assessment (CIA):

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

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

Continuous Internal Examination (CIE):

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

1. **Experiment Based**

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

2. **Programming Based**

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

VI COURSE OBJECTIVES:

The students will try to learn:

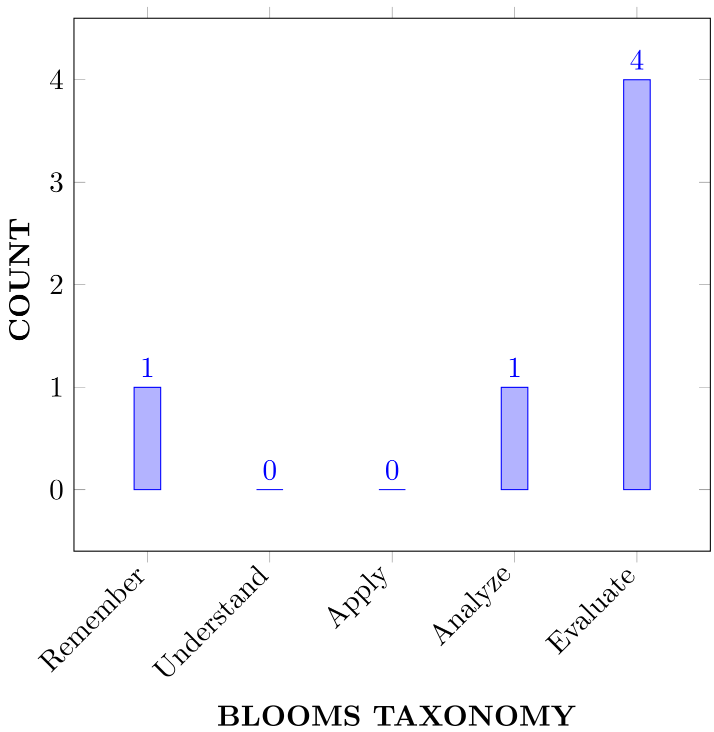
I	Enrich the concept of fluid mechanics and hydraulic machines.
II	Demonstrate the classical experiments in fluid mechanics and hydraulic machinery.
III	Correlate various flow measuring devices such as Venturimeter, orifice meter and notches etc.
IV	Discuss the performance characteristics of turbines and pumps.

VII COURSE OUTCOMES:

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

CO 1	**Recall** the basic principle of fluid mechanics for determining their properties through various laboratory tests.	Remember
CO 2	**Determine** coefficient of discharge for measuring actual discharge using different discharge measuring device.	Evaluate
CO 3	**Measure** friction factor of pipe for calibration of losses in pipes.	Evaluate
CO 4	**Examine** coefficient of minor losses for verifying Bernoulli's equation.	Analyze
CO 5	**Determine** impact of jet on vanes and study of hydraulic jump for finding the impact on both flat and curved surfaces and analysing hydraulic jump in open channel flow.	Evaluate
CO 6	**Determine** performance test of various turbines and pumps for evaluating the speed and energy required in running any hydro-electric scheme.	Evaluate

COURSE KNOWLEDGE COMPETENCY LEVEL



VIII HOW PROGRAM OUTCOMES ARE ASSESSED:

Program		Strength	Proficiency Assessed by
PO 1	**Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.	3	Lab Exercises
PO 3	**Design/Development of Solutions:** Design solutions for complex Engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and Environmental considerations	2	Lab Exercises
PO 4	**Conduct Investigations of Complex Problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.	2	Lab Exercises
PO 7	**Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development	2	Videos

3 = High; 2 = Medium; 1 = Low

IX HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

Program		Strength	Proficiency Assessed by
PSO 1	Design and supervise sub-structures and superstructures for residential and public buildings, industrial structures, irrigation structures, powerhouses, highways, railways, airways, docks and harbours.	2	Lab Exercises
PSO 3	Self-Learning and Service: Graduates will be motivated for continuous self-learning in engineering practice and/ or pursue research in advanced areas of civil engineering in order to offer engineering services to the society, ethically and responsibly.	1	Lab Exercises

3 = High; 2 = Medium; 1 = Low

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

COURSE OUTCOMES	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key Competencies
CO 1	PO 1	Apply the knowledge and **principals of mathematics** to engineering problems for testing the quality of materials using the knowledge of **science and engineering fundamentals.**	2
	PO 7	Understand the impact of professional engineering solutions in societal and environmental context and develop a special concrete to promote **environmental safety** for sustainable **socio economic development**	2
	PSO 1	Explain the properties of fluid and **principle of fluid mechanics** to understand the fluid flow in irrigation practices and hydraulic schemes .	2
CO 2	PO 1	Apply the knowledge and **principals of mechanics** to understand water resources engineering using the knowledge of **science and engineering fundamentals**.	2
	PO 4	**Select and apply appropriate techniques** for determining coefficient of discharge **understanding the limitations of each measuring device**.	2
	PSO 1	Select suitable discharge measuring device based on **suitability of methods and equipment for measurements** for **analysing water flow problems**.	2
CO 3	PO 1	Apply the knowledge and **principals of mechanics** to understand water resources engineering using the knowledge of **science and engineering fundamentals**.	2
	PO 4	**Select and apply appropriate techniques** for determining friction factor of pipe and **understanding the limitations** to determine frictional losses in pipes.	2
	PSO 3	**Determine different conditions** of pressure changes in pipe network for determining friction factor of pipe in the branching pipes and **understanding the methods** to reduce the head loss due to frictional losses in pipes.	2
CO 4	PO 1	Apply the knowledge and **principals of mathematics** to engineering problems for **determining** coefficient of minor losses using concept of Bernoulli's theorem.	2
	PO 3	Determine the coefficient of minor losses after thorough **investigation** of different types of pipe fitting material and ensure its **applicability in pipe network analysis**.	3
	PSO 1	Explain the properties of fluid and **principle of fluid mechanics** to **understand** the fluid flow in irrigation practices and hydraulic schemes .	2
CO 5	PO 1	Apply the knowledge and **principals of mechanics** to understand water resources engineering using the knowledge of **science and engineering fundamentals**.	2

	PO 3	**Determine the impact of jet** on vanes for finding the impact of both flat and curved surfaces to **understand** the amount of torque required to generate electricity.	2
	PSO 1	**Analyse** different value of depth before a hydraulic jump to that **calculated from theory and calculate energy loss** in a hydraulic jump for **understanding a energy distribution** of fluid flow in hydraulic schemes.	3
CO 6	PO 1	Apply the knowledge and **principals of mechanics** to understand water resources engineering using the knowledge of **science and engineering fundamentals**.	2
	PO 3	**Determine the performance characteristics** of Turbine and pumps constant head, constant speed and constant efficiency to **understand working principle of** turbines and pumps in hydroelectric power generation process.	2
	PSO 1	**Analyse** different types of turbo machinery, **to understand the essential difference** between turbines and pumps clearly to know the amount of energy created using fluid movement and to **determine** the fluid movement created using energy.	3

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

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

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

COURSE OUTCOMES	**PROGRAM OUTCOMES**												**PSO'S**		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO 1	66.67	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
COURSE DESCRIPTION

<table>
<tr><td>Department</td><td colspan="5">CIVIL ENGINEERING</td></tr>
<tr><td>Course Title</td><td colspan="5">STRENGTH OF MATERIALS LABORATORY</td></tr>
<tr><td>Course Code</td><td colspan="5">ACEB11</td></tr>
<tr><td>Program</td><td colspan="5">B.Tech</td></tr>
<tr><td>Semester</td><td>IV</td><td colspan="4">CE</td></tr>
<tr><td>Course Type</td><td colspan="5">CORE</td></tr>
<tr><td>Regulation</td><td colspan="5">R18</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>-</td><td>-</td><td>-</td><td>2</td><td>1</td></tr>
<tr><td>Course Coordinator</td><td colspan="5">Mr S. SivaRamaKrishna, Assistant Professor</td></tr>
</table>

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	AMEB03	II	Engineering Mechanics

III MARKS DISTRIBUTION:

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

IV DELIVERY / INSTRUCTIONAL METHODOLOGIES:

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

V EVALUATION METHODOLOGY:

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

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

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

Continuous Internal Assessment (CIA):

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

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

Continuous Internal Examination (CIE):

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

1. **Experiment Based**

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

2. **Programming Based**

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

VI COURSE OBJECTIVES:

The students will try to learn:

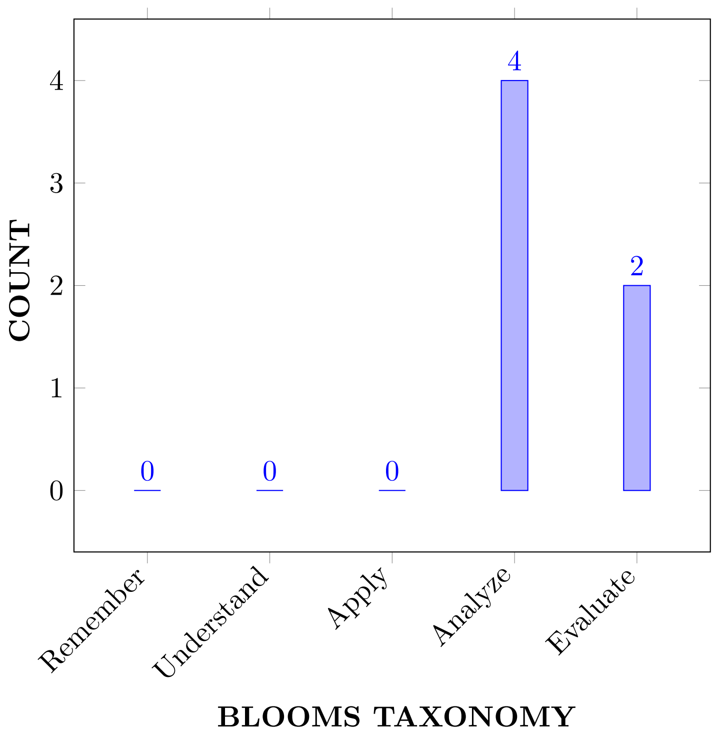
I	The different mechanical properties of different solid engineering materials used in civil engineering applications.
II	The behavior of various material samples under different loads and equilibrium conditions
III	The characterization of materials subjected to tension, compression, shear, torsion, 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	Lab Exercise
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 Specific Outcomes		Strength	Proficiency Assessed by
PSO 2	Focus on Improving Performance of Structures with reference to Safety, Serviceability and Sustainable Green Building Technology..	1	Lab Exercises

3 = High; 2 = Medium; 1 = Low

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

COURSE OUTCOMES	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key Competencies
CO 1	PO 1	Recall (knowledge) the different beam generally come across in design, and calculate tension by applying the principles of **mathematics and engineering fundamentals.**	2
	PO 2	Understand the given **problem statement** of structural members related to young's modulus from the provided **information and data** in reaching substantiated solutions by the **interpretation of results.**	3
	PO 5	Make use of **modern engineering tools** for calculation of tension in members.	1

	PSO 2	Select the appropriate method for the analysis of structures using **Safety** and **serviceability of structure** for different loads for the design purpose.	2
CO 2	PO 1	Understand the different components in the engineering structures (multistoried structures and bridges) and its behavior by **using mathematics and engineering fundamentals.**	2
	PO 2	Analyze cantilever beam for calculation of stress and strain using strain gauge test by **formulate** and **state a problem,** and **develop solution** and **document the results.**	4
	PO 5	Use of **Modern tools** in the design of cantilever beam by the concept of stress strain in a specimen.	1
CO 3	PO 1	Recall (knowledge) different shaft generally come across in design, and calculate angle of twist under torsional load by applying the principles of **mathematics and engineering fundamentals.**	2
	PO 2	Analyze the shaft to Calculate angle of twist under torsional loading for determining the rigidity using the structural analysis concepts, **formulate** and **state a problem,** and **develop solution** and **document the results.**	4
	PSO 2	Understand the design of shafts based on Indian standards using **Performance improvement** and **Safety and serviceability** of shaft.	3
CO 4	PO 1	Understand the different components in the engineering structures (structures and bridges) and its behavior by **using mathematics and engineering fundamentals.**	2
	PO 2	Analyze steel specimen for the concept of sudden load acting on a specimen using Izod and Charpy test by **formulate** and **state a problem,** and **develop solution** and **document the results.**	4
	PO 5	Use of **Modern tools** in the design of steel by the concept of sudden loading in steel specimen.	1
CO 5	PO 1	Understand the concept of comcrete in the engineering structures (multistoried structures and bridges) to determine the compresive strength of concrete by **using mathematics and engineering fundamentals.**	2
	PO 5	Design of concrete grade by the Use of modern engineering modeling to complex engineering activities with **understanding of the limitations**	1
CO 6	PO 1	Make use of advanced methods of analysis for solving engineering problems related to structures by applying the principles of **engineering fundamentals** and their **integration and support with other engineering disciplines, mathematics.**	2

	PO 2	Analyze the spring wire for critical load combinations to know the design forces using the structural analysis concepts **formulate** and **state a problem,** and **develop solution** and **document the results.**	4

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

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

XII ASSESSMENT METHODOLOGY DIRECT:

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

XIII ASSESSMENT METHODOLOGY INDIRECT:

	Assessment of Mini Projects by Experts	✓	End Semester OBE Feedback

XIV SYLLABUS:

WEEK I	**DIRECT TENSION TEST**
	Study the behaviour of mild steel and various materials under different loads. To determine a) Tensile b) Yield strength c) Elongation d) Young's modulus
WEEK II	**BENDING TEST ON CANTILEVER BEAM**
	(a) To evaluate the deflections of the beam made ofsteel. and (b) To evaluate the modulus of elasticity of the beam made of steel
WEEK III	**BENDING TEST ON SIMPLY SUPPORTED BEAM**
	(a) To evaluate the deflections of the beam made ofsteel. and (b) To evaluate the modulus of elasticity of the beam made of steel.
WEEK IV	**TORSION TEST**
	Determine of Modulus of rigidity of various specimens.
WEEK V	**HARDNESS TEST**

	To conduct hardness test on mild steel, carbon steel, brass and aluminium specimens using (a) Brinell's Hardness Test. (b) Rockwell's Hardness Test.
WEEK VI	**SPRING TEST**
	Determine the stiffness of the spring and the Modulus of rigidity of wire material.
WEEK VII	**COMPRESSION TEST**
	To perform compression test on CTM/UTM for Concrete block
WEEK VIII	**IMPACT TEST**
	To evaluate the impact strength of steel specimen using (a) Izod test. (b) Charpy Test.
WEEK IX	**SHEAR TEST**
	Batch- To evaluate the shear strength of the given specimens using universal testing machine.
WEEK X	**VERIFICATION OF MAXWELL'SRECIPROCAL THEOREM ON BEAMS**
	Batch-I : To verify the Maxwell's reciprocal theorem for beam deflections.
WEEK XI	**STRAIN MEASUREMENTS**
	Use of electrical resistance strain gauges .
WEEK XII	**DEFLECTIN OF CONTINUOUS BEAMS**
	To evaluate deflections on a continuous beam. .
WEEK XIII	**REVIEW - I**
	Spare session for additional repetitions and review.

TEXTBOOKS

1. R. S Kurmi, Gupta, "Strength of Materials", S. Chand, 24th Edition, 2005.
2. Gere, Timoshenko, "Mechanics of Materials", McGraw Hill, 3rd Edition, 1993.
3. William Nash, "Strength of Materials", Tata McGraw Hill, 4th Edition, 2004.

REFERENCE BOOKS:

1. Strength of Materials by R. Subramanian, Oxford University Press, New Delhi.
2. Mechanics of Materials - Ferdinand P. Beer, E. RusselJhonston Jr., John T. DEwolf – TMH 2002.

XV COURSE PLAN:

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

S.No	Topics to be covered	CO's	Reference
1	Study the behavior of mild steel and various materials under different loads. To determine: a) Tensile b) Yield strength c) Elongation d) Youngs modulus	CO 1	T2:2.3
2	Determine the Youngs modulus of the given material with the help of deflection of Cantilever beam.	CO 2	R1:2.6
3	Determine the Youngs modulus of the given material with the help of deflection of Simple Supported Beam	CO 2	T1:2.6

4	Determine of Modulus of rigidity of various specimens.	CO 3	T2:2.7 R1:2.18
5	Determination of hardness number of different specimens such as steel, brass, copper and aluminum.	CO 4	T2:2.22
6	Determine the stiffness of the spring and the Modulus of rigidity of wire material	CO 4	T2:2.25
7	Determine the compressive stress of concrete cube.	CO 5	T2:2.26 R1:2.55
8	Determine the toughness of the materials like steel, copper, brass and other alloys using Charpy test.	CO 4	T2:2.3
9	Determine Youngs modulus of the given specimen.	CO 6	R1:2.6
10	To verify the Maxwell's reciprocal theorem for beam deflections.	CO 2, CO 6	T1:2.6
11	Use of electrical resistance strain gauges for measurement of strain.	CO 6	R1:7.2
12	Determine the Youngs modulus and deflection for the given material with the help of continious Beam.	CO 2, CO 6	R1:7.2
13	Spare session for additional repetitions and review.	CO 1 to CO 6	R1:7.3

XVI EXPERIMENTS FOR ENHANCED LEARNING (EEL):

S.No	Design Oriented Experiments
1	Demonstration the hardness number of different alloys
2	Demonstrate the behavior of composite materials subjected to different loading conditions.
3	Encourage students to design and analyze of different beams and columns

Signature of Course Coordinator **HOD,CE**
Mr. S SivaRamaKrishna, Assistant Professor

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

COURSE DESCRIPTION

Department	**CIVIL ENGINEERING**				
Course Title	**MECHANICS OF MATERIALS**				
Course Code	ACEB12				
Program	B.Tech				
Semester	V				
Course Type	CORE				
Regulation	IARE-18				
Course Structure	Theory			Practical	
	Lecture	Tutorials	Credits	Laboratory	Credits
	2	1	3	-	-
Course Coordinator	Dr Venu M, 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:

Civil engineers are required to design structures like buildings, dams, bridges, etc. The time varying nonlinear applied loads on these structures, along with the self-weight, have to be safely transmitted to the ground. A structural engineer must be able to design a structure in such a way that none of its members fail during load transfer process. This foundational course in civil engineering is intended to introduce to concepts of stress and strain due to external loading on a structural member and their calculations. For this, the concept and calculation of slopes and deflections of beams using various methods are covered in depth. Deflections by energy methods and analysis of propped cantilevers, fixed and continuous beams under various load combinations. Through this course content engineers can design the structures for safety and serviceability.

III MARKS DISTRIBUTION:

Subject	SEE Examination	CIE Examination	Total Marks
Mechanics of Materials	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
25 %	Understand
50 %	Apply
15 %	Analyze

Continuous Internal Assessment (CIA):
CIA is conducted for a total of 30 marks (Table 2), with 20 marks for continuous internal examination (CIE), 05 marks for quiz and 05 marks for alternative assessment tool

Component	Theory			Total Marks
Type of Assessment	CIE Exam	Quiz	AAT	
CIA Marks	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:

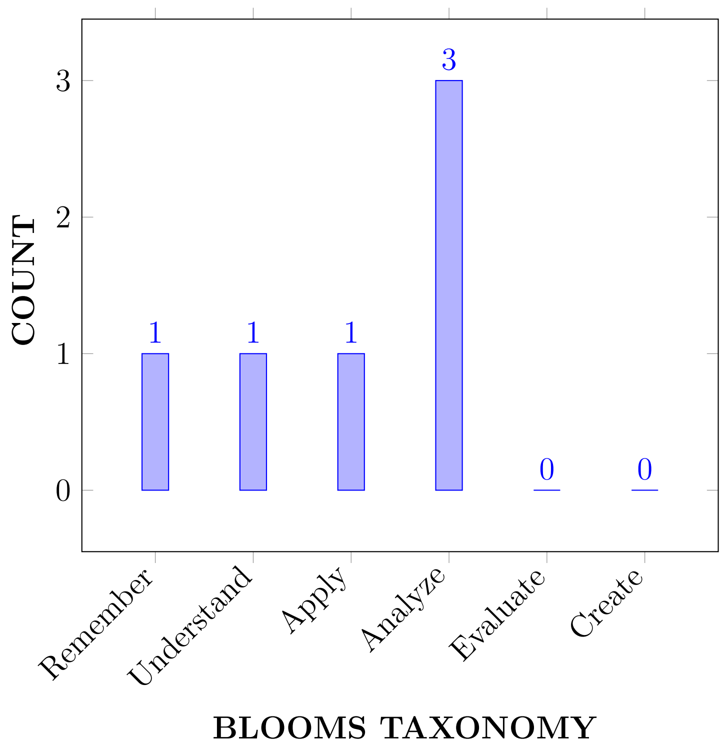
I	The fundamental concepts of mechanics of deformable structures and their behaviour.
II	Analysis of structural elements with the help of different mathematical, analytical and energy methods for the purpose of design.
III	Analysis of structures independently in real world situations where the design of structures involved.

VII COURSE OUTCOMES:

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

CO 1	**Recall** the concepts of buckling of columns and struts under axial loading for understanding the behavior of column.	Remember
CO 2	**Develop** the expressions for critical loads and stresses for columns and struts with different end conditions using Euler's and Rankine's methods.	Apply
CO 3	**Analyse** the beams and trusses for slopes and deflections subjected to various load combinations using analytical methods.	Analyse
CO 4	**Analyse** the beams and trusses for slopes and deflections subjected to various load combinations using energy methods.	Analyse
CO 5	**Analyse** propped cantilever and fixed beams to know the shear forces and bending moments at various locations in the beam for designing propped cantilever and fixed beams.	Analyse
CO 6	**Explain** the concepts of clapeyron's theorem of three moments for analysing continuous beams including sinking of supports.	Understand

COURSE KNOWLEDGE COMPETENCY LEVEL



VIII PROGRAM OUTCOMES:

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

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

IX HOW PROGRAM OUTCOMES ARE ASSESSED:

PROGRAM 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.	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	Assignments / AAT

X HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

PROGRAM OUTCOMES		Strength	Proficiency Assessed by
PSO 1	Design and supervise sub-structures and superstructures for residential and public buildings, industrial structures, irrigation structures, powerhouses, highways, railways, airways, docks and harbours.	1	CIE / SEE / AAT

3 = High; 2 = Medium; 1 = Low

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

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

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

Course Outcomes	PO'S PSO'S	Justification for mapping (Students will be able to	No. of Key competencies matched
CO 1	PO 1	Understand the buckling of columns and struts due to the axial loading and bending moment by applying the principles of **mathematics and science.**	2
CO 2	PO 2	Understand the given **problem statement** related to buckling of columns from the **provided information and data** for determining the stresses and safe **design** of columns.	3
	PO 4	Apply the **knowledge of characteristics of material** and use **analytical methods** to determine the stresses in columns.	2
CO 3	PO 1	Apply the **principles mathematics and science** to get the solutions of the beams and trusses for defection and slope.	2

Course Outcomes	PO'S PSO'S	Justification for mapping (Students will be able to	No. of Key competencies matched
	PO 2	Understand the given **problem statement** of structural members related to slope and deflections from the provided **information and data** in reaching substantiated solutions by the **interpretation of results.**	3
	PO 4	Understand the various **analytical methods** to solve **engineering problems** in beams by using mathematical and **engineering principles.**	3
	PSO 1	Understand the analytical and energy methods for slopes and deflections of beams and trusses using **mathematical principles** and **engineering knowledge.**	2
CO 4	PO 1	Apply the **principles mathematics and science** to get the solutions of the beams and trusses for defection and slope.	2
	PO 2	Understand the given **problem statement** of structural members related to slope and deflections from the provided **information and data** in reaching substantiated solutions by the **interpretation of results.**	3
	PO 4	Understand the various **analytical methods** to solve **engineering problems** in beams by using mathematical and **engineering principles.**	3
	PSO 1	Understand the analytical and energy methods for slopes and deflections of beams and trusses using **mathematical principles** and **engineering knowledge.**	2
CO 5	PO 1	Apply the **knowledge of mathematics, science** and engineering fundamentals to the solutions of propped cantilever and fixed beams.	2
	PO 2	Understand the **problem statement** of propped cantilever and fixed beams from the given **information** and **develop the solutions** to increase the safety, durability of the structures.	3
	PSO 1	Analyze the propped cantilever and fixed beams for maximum shear force and maximum bending moments using **mathematical principles** and **engineering knowledge.**	2
CO 6	PO 2	**Collect the data** and understand the **problem statement** to **develop the solutions** for slope, deflection of continuous beams in structure.	3
	PO 4	Use various **methods** like Clapeyron's theorem of three moments by Understanding **engineering principles**	2

Course Outcomes	PO'S PSO'S	Justification for mapping (Students will be able to	No. of Key competencies matched
	PSO 1	Analyze the continuous beams for maximum shear force and maximum bending moments using **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	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 2	-	3	-	2	-	-	-	-	-	-	-	-	-	-	-
CO 3	2	3	-	3	-	-	-	-	-	-	-	-	2	-	-
CO 4	2	3	-	3	-	-	-	-	-	-	-	-	2	-	-
CO 5	2	3	-	-	-	-	-	-	-	-	-	-	2	-	-
CO 6	-	3	-	2	-	-	-	-	-	-	-	-	2	-	-

XIV PERCENTAGE OF KEY COMPETENCIES FOR CO – PO/ PSO

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	66.6	-	-	-	-	-	-	-	-	-	-		-	-	-
CO 2	-	30	-	18.1	-	-	-	-	-	-	-	-	-	-	-
CO 3	66.6	30	-	27.2	-	-	-	-	-	-	-	-	20.0	-	-
CO 4	66.6	30	-	27.2	-	-	-	-	-	-	-	-	20.0	-	-
CO 5	66.6	30	-	-	-	-	-	-	-	-	-	-	20.0	-	-
CO 6	-	30	-	18.1	-	-	-	-	-	-	-	-	20.0	-	-

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	-	1	-	1	-	-	-	-	-	-	-	-	-	-	-
CO 3	3	1	-	1	-	-	-	-	-	-	-	-	1	-	-
CO 4	3	1	-	1	-	-	-	-	-	-	-	-	1	-	-
CO 5	3	1	-	-	-	-	-	-	-	-	-	-	1	-	-
CO 6	-	1	-	1	-	-	-	-	-	-	-	-	1	-	-
TOTAL	12	5	-	4									4		
AVERAGE	3.0	1.0	-	1.0									1.0		

XVI ASSESSMENT METHODOLOGY-DIRECT:

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

XVII ASSESSMENT METHODOLOGY-INDIRECT:

	Assessment of mini projects by experts	✓	End Semester OBE Feedback

XVIII SYLLABUS:

MODULE I	**COLUMNS AND STRUTS: BUCKLING**
	Introduction: Types of columns, short, medium and long columns, axially loaded compression members, crushing load, Euler's theorem for long columns, assumptions, derivation of Euler's critical load formulae for various end conditions. Equivalent length of a column, slenderness ratio, Euler's critical stress, limitations of Euler's theory, Rankine's formula. Laterally loaded struts, subjected to uniformly distributed and concentrated loads, maximum bending moment and stress due to transverse and lateral loading.
MODULE II	**DEFLECTIONS OF BEAMS**
	Bending into a circular arc, slope, deflection and radius of curvature, differential equation for the elastic line of a beam, double integration and Macaulay's methods, determination of slope and deflection for cantilever and simply supported beams subjected to various loads, Mohr's theorems, moment area method, application to simple cases including overhanging beams; Conjugate beam method, concept of conjugate beam method, difference between a real beam and a conjugate beam, deflections of determinate beams with constant and different moments of inertia.

MODULE III	**DEFLECTIONS BY ENERGY METHODS**
	Energy Methods: Work energy method, principal of virtual work, unit load method, Castigliano's theorem for displacements of cantilever beam with concentrated load and uniformly distributed load. Deflections of simple beams like cantilever beams, simply supported beams with concentrated loads and uniformly distributed loads. Deflections of pin jointed trusses; Maxwell's theorem of reciprocal; Betti's Law.
MODULE IV	**INDETERMINATE BEAMS: PROPPED CANTILEVER AND FIXED BEAMS**
	Analysis of propped cantilever and fixed beams using the method of consistent deformation, including the beams with varying moments of inertia, subjected to uniformly distributed load, central point load, eccentric point load, number of point loads, uniformly varying load and combination of loads, shear force and bending moment diagrams for propped cantilever and fixed beams, deflection of propped cantilever and fixed beams; Effect of rotation of a support.
MODULE V	**INDETERMINATE BEAMS: CONTINUOUS BEAMS**
	Continuous beams, Clapeyron's theorem of three moments, analysis of continuous beams with constant and variable moments of inertia with one or both ends fixed, continuous beams with overhang; Effects of sinking of supports.

TEXTBOOKS

1. 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.

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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.

WEB REFERENCES:

1. https://nptel.ac.in/courses/105/106/105106172/
2. https://nptel.ac.in/courses/105/105/105105108/

COURSE WEB PAGE:

1. https://lms.iare.ac.in/index?route=course/details&course_id=416

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 on columns and struts, types of columns-short, medium and long columns.	CO 1	T1:3.1 R1: 20.1
3	Axially loaded compression members, crushing load.	CO 1	T1:3.9 R1: 20.2
4	Euler's theorem for long columns, assumptions.	CO 1	T1:3.3 R1: 20.3
5	Derivation of Euler's critical load formulae for various end conditions and problems.	CO 2	T1:3.4 R1: 20.4
6	Equivalent length of a column, slenderness ratio.	CO 2	T1:3.4 R1: 20.6
7	Euler's critical stress, limitations of Euler's theory.	CO 2	T1:3.7
8	Rankine's formula. Laterally loaded struts subjected to uniformly distributed and concentrated loads.	CO 2	T1:2.7 R1: 20.7
9-10	Maximum bending moment and stress due to transverse and lateral loading.	CO 2	T1:2.9
11	Introduction on Bending into a circular arc, slope, deflection and radius of curvature.	CO 3	T1:2.9 R1: 12.1 – 12.3
12	Differential equation for the elastic line of a beam.	CO 3	T1:6.2
13-14	Double integration and Macaulay's methods	CO 3	T1:6.8 R1: 12.4 – 12.6
15-16	Mohr's theorem, moment area method, application to simple cases including overhanging beams.	CO 3	T1:6.9 R1: 13.1 – 13.6
17-19	Conjugate beam method, concept of conjugate beam method, difference between a real beam and a conjugate beam.	CO 3	T1:5.1,5.2 R1: 14.1 – 14.3
20	Determinate beams with constant and different moments of inertia.	CO 3	T1:5.3,5.4
21-23	Introduction on energy methods, principal of virtual work, unit load method.	CO 4	T1:10 R1: 15.1 – 15.2
24-25	Castigliano's theorem for displacements of cantilever beam with concentrated load and uniformly distributed load.	CO 4	T1:10.17
26-27	Deflections of simple beams like cantilever beams, simply supported beams with concentrated loads and uniformly distributed loads	CO 4	T2:9.1 R1: 15.3 – 15.6

28-30	Deflections of pin jointed trusses.	CO 4	T2:12
31	Analyze structures using Maxwell's theorem of reciprocal deflections and Betti's Law.	CO 4	T2:13
32-34	Analyze propped cantilever and fixed beams using different methods.	CO 5	T2:13.1 R1: 16.1 – 16.3
35-37	Derive the expressions propped cantilever and fixed beams under various conditions.	CO 5	T2:13
38	Calculate the deflection of propped cantilever and fixed beams. Understand the effect of rotation of a support.	CO 5	T2:9.2
39-40	Explain the Clapeyron's theorem of three moments.	CO 6	T1:4.8 R1: 17.1 – 17.3
41-43	Analyze continuous beams with constant and variable moment of inertia.	CO 6	T1:4.14 R1: 17.4 – 17.6
44-45	Analyze continuous beams with overhangs and calculate the Effects of sinking of supports.	CO 6	T2:11
PROBLEM SOLVING/ CASE STUDIES			
1	Calculate the Euler's load or buckling load or critical load for columns with different end conditions.	CO 2	T1:3.4 R1: 20.4
2	Calculate the rankine's load for columns with different end conditions	CO 2	T1:2.7 R1: 20.7
3	Calculate the slopes and deflections of beams using double integration method.	CO 3	T1:6.8 R1: 12.4 – 12.6
4	Calculate the slopes and deflections of beams using macaulay's method.	CO 3	T1:6.8 R1: 12.4 – 12.6
5	Calculate the slopes and deflections of beams using moment area method.	CO 3	T1:6.9 R1: 13.1 – 13.6
6	Calculate the slopes and deflections of beams using conjugate beam method.	CO 3	T1:5.1,5.2 R1: 14.1 – 14.3
7	Calculate the slopes and deflections of beams using strain energy method.	CO 4	T1:10.17
8	Calculate the slopes and deflections of beams using unit load method.	CO 4	T2:9.1 R1: 15.3 – 15.6
9	Calculate the slopes and deflections of beams using principle of virtual work.	CO 4	T2:9.1 R1: 15.3 – 15.6
10	Calculate the deflections of plane trusses using unit load method.	CO 4	T2:12
11	Analysis of propped cantilever beam for shear forces and bending moments.	CO 5	T2:13
12	Analysis of fixed beam for shear forces and bending moments.	CO 5	T2:9.2
13	Analysis of continuous beam for shear forces and bending moments using theorem of three moments.	CO 6	T1:4.8 R1: 17.1 – 17.3

14	Analysis of continuous beam for shear forces and bending moments using theorem of three moments with different end conditions.	CO 6	T1:4.14 R1: 17.4 – 17.6
15	Analysis of continuous beam for shear forces and bending moments using theorem of three moments with different moment of inertias.	CO 6	T2:11
DISCUSSION OF DEFINITION AND TERMINOLOGY			
1	Concepts of columns and struts, critical load expressions for columns with different end conditions, Rankine's load calculations, compression members with lateral loads.	CO 1,2	T1: 3.1 – 3.10 R1: 20.1 – 20.7
2	Concepts of slopes and deflections of simply supported and cantilever beams, understanding of double integration method, macaulay's method, moment area method and conjugate beam method.	CO 3	T1:6.1 – 6.8 R1: 12.1 – 12.6
3	Concepts of slopes and deflections of beams and trusses using energy methods like strain energy, principle of virtual work and unit load method.	CO 4	T2:9.1 R1: 15.3 – 15.6
4	Analysis of propped cantilever and fixed beams with different loading conditions and different moment of inertias.	CO 5	T2:13
5	Analysis of continuous beams with different loading conditions and different moment of inertias.	CO 6	T1:4.8 – 4.10 R1: 17.1 – 17.6
DISCUSSION OF QUESTION BANK			
1	Concepts of columns and struts, critical load expressions for columns with different end conditions, Rankine's load calculations, compression members with lateral loads.	CO 1,2	T1: 3.1 – 3.10 R1: 20.1 – 20.7
2	Concepts of slopes and deflections of simply supported and cantilever beams, understanding of double integration method, macaulay's method, moment area method and conjugate beam method.	CO 3	T1:6.1 – 6.8 R1: 12.1 – 12.6
3	Concepts of slopes and deflections of beams and trusses using energy methods like strain energy, principle of virtual work and unit load method.	CO 4	T2:9.1 R1: 15.3 – 15.6

4	Analysis of propped cantilever and fixed beams with different loading conditions and different moment of inertias.	CO 5	T2:13
5	Analysis of continuous beams with different loading conditions and different moment of inertias.	CO 6	T1:4.8 – 4.10 R1: 17.1 – 17.6

Signature of Course Coordinator **HOD, CE**
Dr. Venu M, Professor

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

CIVIL ENGINEERING
COURSE DESCRIPTION

Course Title	**STRUCTURAL ENGINEERING**				
Course Code	ACEB13				
Program	B.Tech				
Semester	V	CE			
Course Type	Professional Core				
Regulation	IARE - R18				
Course Structure	Theory			Practical	
	Lecture	Tutorials	Credits	Laboratory	Credits
	3	1	4	-	-
Course Coordinator	Mr.S. Sivaramakrishna, Assistant Professor				

I COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites
B.Tech	ACEB07	IV	Strength of Materials

II COURSE OVERVIEW:

The course of Structural Engineering comprises a set of fundamental theorems of mechanics that obey physical laws required to study and predict the behavior of structures for computation of deformations, internal forces and stresses. This course mainly discusses the energy, force and displacement methods for the analysis of arches, determinate and indeterminate beams and trusses. This course also includes the effects of rolling loads on bridge girders and truss girders. Through this course content engineers can analyze the response of various structural members under different loading conditions for design, safety and serviceability.

III MARKS DISTRIBUTION:

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

IV CONTENT DELIVERY / INSTRUCTIONAL METHODOLOGIES:

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

V EVALUATION METHODOLOGY:

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

Semester End Examination (SEE): The SEE is conducted for 70 marks of 3 hours duration. The syllabus for the theory courses is divided into FIVE modules and each module carries equal weightage in terms of marks distribution. The question paper pattern is as follows. Two full questions with "either" or "choice" will be drawn from each module. Each question carries 14 marks. There could be a maximum of two sub divisions in a question.

The expected percentage of cognitive level of the questions is broadly based on the criteria given in Table: 1.

Percentage of Cognitive Level	Blooms Taxonomy Level
0%	Remember
30%	Understand
30%	Apply
40 %	Analyze
0 %	Evaluate
0 %	Create

Continuous Internal Assessment (CIA):

CIA is conducted for a total of 30 marks (Table 2), with 20 marks for Continuous Internal Examination (CIE), 05 marks for Quiz and 05 marks for Alternative Assessment Tool in table

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:

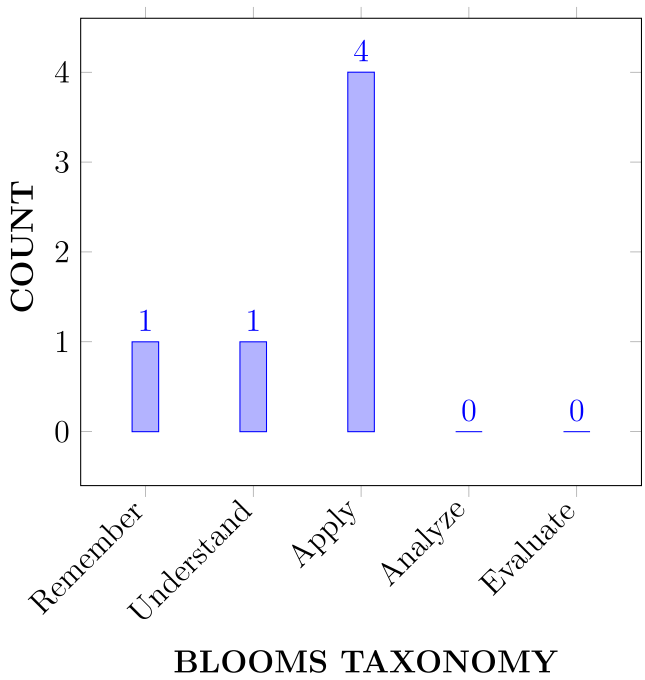
I	The behavior of arches under the action of uniformly distributed loads and concentrated loads.
II	The concepts of energy methods for analyzing the components of various industrial structures.
III	The analysis of indeterminate beams and rigid frames by displacement methods for designing framed structures.
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	**Recall** various types of arches and select appropriate arch in field applications.	Remember
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	**Apply** the concepts of slope-deflection, moment distribution and Kani's methods for analysing continuous beam with and without support settlement.	Apply
CO 5	**Explain** the effect of rolling loads for thorough understanding of the variations in internal forces 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.	2	CIE/SEE/AAT
PO 3	**Design/Development of Solutions:** Design solutions for complex Engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and Environmental considerations	1	CIE/SEE/AAT
PO 12	**Life-Long Learning:** Recognize the need for and having the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.	1	CIE/SEE/AAT

3 = High; 2 = Medium; 1 = Low

X HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

Program		Strength	Proficiency Assessed by
PSO 1	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/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 4	✓	-	-	-	✓	-	-	-	-	-	-		✓	-	-
CO 5	✓	✓	-	-	-	-	-	-	-	-	-	-	✓	-	-
CO 6	-	✓	✓	-	-	-	-	-	-	-	-		✓	-	-

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

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
	PSO 1	Understand the behaviour of arches under various loads and apply energy principles in analysing the arch for horizontal thrust at the supports, with the help of the **mathematical principles and engineering fundamentals**	2
CO 4	PO 2	**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
	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 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	5	-	-	-	-	-	-	-	-	-	-	2	-	-
CO 3	-	4	-	-	-	-	-	-	-	-	-	-	2	-	-
CO 4	2	-	-	-	-	-	-	-	-	-	-		1	-	-
CO 5	2	5	-	-	-	-	-	-	-	-	-	-	2	-	-
CO 6	-	4	4	-	-	-	-	-	-	-	-	-	2	-	-
CO 7	-	5	-	-	-	-	-	-	-	-	-	-	2	-	-
CO 8	2	-	-	-	-	-	-	-	-	-	-	-	2	-	-
CO 9	2	4	1	-	-	-	-	-	-	-	-	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	50	-	-	-	-	-	-	-	-	-	-	50	-	-
CO 3	-	40	-	-	-	-	-	-	-	-	-	-	50	-	-
CO 4	66.7	-	-	-	-	-	-	-	-	-	-		25	-	-
CO 5	66.7	50	-	-	-	-	-	-	-	-	-	-	50	-	-
CO 6	-	40	40	-	-	-	-	-	-	-	-	-	50	-	-
CO 7	-	50	-	-	-	-	-	-	-	-	-	-	50	-	-
CO 8	66.7	-	-	-	-	-	-	-	-	-	-	-	50	-	-
CO 9	66.7	40	10	-	-	-	-	-	-	-	-	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	-	1	-	-	-	-	-	-	-	-	-	-	2	-	-
CO 4	3	-	-	-	-	-	-	-	-	-	-		1	-	-
CO 5	3	2	-	-	-	-	-	-	-	-	-	-	2	-	-
CO 6	-	1	1	-	-	-	-	-	-	-	-		2	-	-
CO 7	-	2	-	-	-	-	-	-	-	-	-	-	2	-	-
CO 8	3	-	-	-	-	-	-	-	-	-	-	-	2	-	-
CO 9	3	1	1	-	-	-	-	-	-	-	-	1	2	-	-
TOTAL	18	9	2	-	-	-	-	-	-	-	-	1	15	-	-
AVERAGE	3	1.5	1	-	-	-	-	-	-	-	-	1	2	-	-

XVI ASSESSMENT METHODOLOGY DIRECT:

CIE Exams	PO1, PO2, PO3, PSO1	SEE Exams	PO1, PO2, PO3, PSO1	Seminars	-
Laboratory Practices	-	Student Viva	-	Certification	-
Term Paper	-	5 Minutes Video	PO10, PO12	Open Ended Experiments	-
Assignments	PO10, PO12				

XVII ASSESSMENT METHODOLOGY INDIRECT:

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

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			
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 2	T1: 16.4, R1: 7.2
3-4	Analysis of three hinged parabolic arches. Determination of normal thrust and radial shear. Numerical Examples.	CO 2	T1: 16.4, R1: 7.3
5	Numerical Examples on three hinged parabolic arches.	CO 2	T1: 16.1
6	Analysis of three hinged circular arch. Numerical examples	CO 2	T1: 16.5
7	Numerical examples on circular arches.	CO 3	T1: 16.5, R1: 7.4
8	Introduction to two hinged arches.	CO 3	T1:16.6, R1: 7.1
9	Analysis of two hinged parabolic arches. Analysis of two hinged circular arches.	CO 3	T1:16.7, R1: 7.1
10-11	Analysis of two hinged parabolic arches. Problems on secondary stresses in two hinged arches.	CO 3	T1:16.10
12-13	Problems on secondary stresses in two hinged arches due to temperature and elastic shortening of rib.	CO 3	T1:16.10-16.13
14-15	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 4	T1:14.1
16	Degree of indeterminacy of pin jointed plane frames. Degree of kinematic indeterminacy of beams and frames.	CO 5	T1: 14.1
17-18	Analysis of trusses with degree of external redundancy one. Procedure. Numerical Examples.	CO 5	T1:Ex.14.1, 14.2
19-20	Analysis of trusses with degree of internal redundancy one. Procedure. Numerical Examples.	CO 5	T1: 14.3, R1: 10.3
21-22	Stresses due to error in length – Temperature stresses. – Numerical Example.	CO 5	T1:14.4, R1:10.5
23-24	Analysis of trusses with degree of redundancy two. Procedure. Numerical Examples.	CO 5	R1:10.7
25	Introduction to slope-deflection method. Slope-deflection equations, and procedure. Introduction to Fixed end moments	CO 6	T1:9.1, R 1:7.6.3
26	Fixed end moments due to symmetric point load and eccentric point load. Numerical Examples	CO 6	R2:1.3-11
27	Fixed end moments due to UDL , UVL and a couple. Numerical Examples	CO 6	R2:1.4-14

28	Fixed end moments due to rotation and sinking of supports. Numerical Examples	CO 6	R2:1.7-20
29	Analysis of continuous beams with and without sinking of supports by slope-deflection method. Numerical Examples.	CO 6	T1: 9.3
30-31	Numerical Examples on analysis of continuous beams by Slope deflection method	CO 6	T1: 9.4
32-33	Introduction to Moment distribution method. Carry over factor, absolute stiffness and relative stiffness, distribution factor.	CO 6	T1: 10.2
34	Analysis of continuous beams with and without sinking of supports by moment distribution method. Procedure. Numerical Examples.	CO 6	T1: 10.1
35	Numerical Examples on analysis of continuous beams by moment distribution method.	CO 6	T1: 10.5
36-37	Analysis of rigid jointed frames with and without sway by slope deflection method. Numerical examples	CO 7	T1: 9.9
38-39	Analysis of rigid jointed frames with and without sway by moment distribution method. Numerical examples.	CO 7	T1: 10.9
40	Introduction to Kani's method. Rotation factor . Displacement factor. Rotation Contributions.	CO 7	T1: 28.1
41-42	Procedure for analysis of continuous beams with and without sinking of supports by Kani's method. Numerical Examples.	CO 7	T1: 28.2
42-46	Numerical Examples on analysis of continuous beams by moment distribution method	CO 7	T1:10.4, R1: 28.3
47	Introduction to moving or rolling loads and influence lines. Effect of moving loads on Shear force and bending moment at a given section.	CO 8	T1: 1.1-03
48	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 8	T1: 1.2
49-51	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 8	T1: 1.4
52	Equivalent uniformly distributed load – Focal length.- Numerical Examples.	CO 8	T1: 1.8-47
53-54	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 9	T1: 2.3, R1: 5.2

55-57	Load position for maximum BM at a section-Point loads, UDL longer than the span, UDL shorter than the span. – Numerical Examples.	CO 9	T1: 2.4, R1: 5.10
58-60	Numerical Examples on Rolling loads and Influence lines.	CO 9	T1: 63, R1: 5.5
PROBLEM SOLVING/ CASE STUDIES			
1	Calculate the Euler's load or buckling load or critical load for columns with different end conditions.	CO 2	T1:3.4 R1: 20.4
2	Calculate the rankine's load for columns with different end conditions	CO 2	T1:2.7 R1: 20.7
3	Calculate the slopes and deflections of beams using double integration method.	CO 3	T1:6.8 R1: 12.4 – 12.6
4	Calculate the slopes and deflections of beams using macaulay's method.	CO 3	T1:6.8 R1: 12.4 – 12.6
5	Calculate the slopes and deflections of beams using moment area method.	CO 4	T1:6.9 R1: 13.1 – 13.6
6	Calculate the slopes and deflections of beams using conjugate beam method.	CO 4	T1:5.1,5.2 R1: 14.1 – 14.3
7	Calculate the slopes and deflections of beams using strain energy method.	CO 5	T1:10.17
8	Calculate the slopes and deflections of beams using unit load method.	CO 6	T2:9.1 R1: 15.3 – 15.6
9	Calculate the slopes and deflections of beams using principle of virtual work.	CO 6	T2:9.1 R1: 15.3 – 15.6
10	Calculate the deflections of plane trusses using unit load method.	CO 7	T2:12
11	Analysis of propped cantilever beam for shear forces and bending moments.	CO 8	T2:13
12	Analysis of fixed beam for shear forces and bending moments.	CO 9	T2:9.2
13	Analysis of continuous beam for shear forces and bending moments using theorem of three moments.	CO 7	T1:4.8 R1: 17.1 – 17.3
14	Analysis of continuous beam for shear forces and bending moments using theorem of three moments with different end conditions.	CO 7	T1:4.14 R1: 17.4 – 17.6
15	Analysis of continuous beam for shear forces and bending moments using theorem of three moments with different moment of inertias.	CO 7	T2:11

DISCUSSION OF DEFINITION AND TERMINOLOGY			
1	Concepts 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; classification of two hinged arches.	CO 1,2	T1: 3.1 – 3.10 R1: 20.1 – 20.7
2	Concepts of static and kinematic indeterminacies, Analysis of trusses with up to two degrees of internal and external indeterminacies using Castiglione's theorem.	CO 3,4	T1:6.1 – 6.8 R1: 12.1 – 12.6
3	Concepts of slopes and deflections of beams and trusses using energy methods like strain energy, principle of virtual work and unit load method.	CO 6	T2:9.1 R1: 15.3 – 15.6
4	Analysis of propped cantilever and fixed beams with different loading conditions and different moment of inertias.	CO 8	T2:13
5	Analysis of continuous beams with different loading conditions and different moment of inertias.	CO 7	T1:4.8 – 4.10 R1: 17.1 – 17.6
DISCUSSION OF QUESTION BANK			
1	Module I	CO 1,2	T1: 3.1 – 3.10 R1: 20.1 – 20.7
2	Module II	CO 3,4	T1:6.1 – 6.8 R1: 12.1 – 12.6
3	Module III	CO 5,6	T2:9.1 R1: 15.3 – 15.6
4	Module IV	CO 7,8	T2:13
5	Module V	CO 9	T1:4.8 – 4.10 R1: 17.1 – 17.6

Signature of Course Coordinator **HOD,CE**
Mr. S. Sivaramakrishna, Assistant Professor

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

COURSE DESCRIPTION

Department	**CIVIL ENGINEERING**				
Course Title	**HYDRAULIC ENGINEERING**				
Course Code	ACEB14				
Program	B.Tech				
Semester	V	CE			
Course Type	Core				
Regulation	R18				
Course Structure	Theory			Practical	
	Lecture	Tutorials	Credits	Laboratory	Credits
	3	-	3	-	1
Course Coordinator	Ms. N Sri Ramya, Assistant Professor				

I COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites
R18	ACEB06	IV	Fluid Mechanics
R18	AMEB03	III	Engineering Mechanics

II COURSE OVERVIEW:

Hydraulic Engineering is concerned with the flow and conveyance of fluids in both closed pipes and open channels. The course deals with the principles of fluid mechanics and application of collection, control, transport, measurement, and use of water. First part of the course deals with analysis and design of hydraulic parameters for closed pipes. Latter part emphasis open channel flow, which is governed by the interdependent interaction between the water and the channel, hydraulic structures for various types of the flows to overcome the head losses

III MARKS DISTRIBUTION:

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

IV CONTENT DELIVERY / INSTRUCTIONAL METHODOLOGIES:

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

V EVALUATION METHODOLOGY:

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

Semester End Examination (SEE): The SEE is conducted for 70 marks of 3 hours duration. The syllabus for the theory courses is divided into FIVE modules and each module carries equal weightage in terms of marks distribution. The question paper pattern is as follows. Two full questions with "either" or "choice" will be drawn from each module. Each question carries 14 marks. There could be a maximum of two sub divisions in a question.
The expected percentage of cognitive level of the questions is broadly based on the criteria given in below Table.

Percentage of Cognitive Level	Blooms Taxonomy Level
20%	Remember
60 %	Understand
20 %	Apply
0 %	Analyze
0 %	Evaluate
0 %	Create

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

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

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

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

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

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

VI COURSE OBJECTIVES:

The students will try to learn:

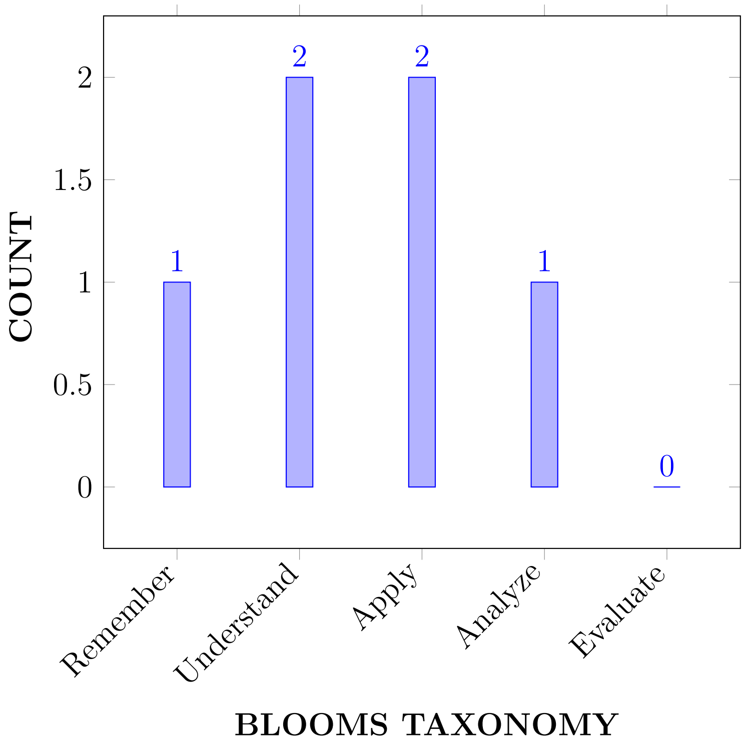
I	The principles of Fluid Mechanics for design and analysis of different geometrical configurations in both laminar and turbulent flows.
II	The estimation of lift and drag forces for various shapes using boundary layer theory and approximate numerical solution methods.
III	The fundamentals concepts of an open channel flow, their relationships by applying fluid properties, hydrostatics, and the conservation equations.
IV	The design of open channels, energy dissipaters and hydraulic structures for uniform and gradually varied conditions.

VII COURSE OUTCOMES:

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

CO 1	**Recall** basic fluid properties and identify appropriate fluid systems for analysis of the flow in closed pipes.	Remember
CO 2	**Choose** the types of flows such as laminar, turbulent using Reynolds's experiment to reduce the losses in smooth and rough pipes by Moody's diagram	Apply
CO 3	**Apply** the concept of boundary layer and viscosity theorem, the lift and drag forces on different shapes of the objects using various methods applicable to avoid the flow separation problems.	Understand
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	**Summarize** the geometrical properties of the open channels and establish the relationships among them for the designing of the most economical sections.	Apply
CO 6	**Outline** the ideas and importance of critical flow parameters such as specific energy, specific force, and specific depth, Hydraulic jump for classification of surface profiles in gradually varied flows.	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	**Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.	3	CIE/Quiz/ AAT
PO 2	**Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.	1	CIE/Quiz/ AAT
PO 4	**Conduct Investigations of Complex Problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.	1	Assignments/ SEE /CIE, AAT, QUIZ
PO 10	**Communication:** Communicate effectively on complex engineering activities with the Engineering community and with society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.	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 superstructures for residential and public buildings, industrial structures, irrigation structures, powerhouses, highways, railways, airways, docks, and harbors.	3	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** (knowledge) the basic properties, various types, patterns of fluid flow configurations and to a considerable extent appreciate (understanding) their importance and applicability (apply) in solving (complex) fluid flow engineering problems by applying **the principles of mathematics, science and Engineering**	3
	PO 10	Communicate clearly in form of **writing** assignments, preparing **subject matter** in form of Tech Talk on Fluid properties and five-minute video, and maintain a profound **speaking style**	3
	PSO 1	**Analyse** and supervise irrigation structures, powerhouses, docks, and harbours using **engineering fundamentals and advanced tools**.	3
CO 2	PO 1	**Apply the knowledge of Engineering problems** for analysing various types of pipe connections such as series, parallel and lateral connections using **mathematical principles and fundamentals of science.**	3

Course Outcomes	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key competencies matched.
	PO 2	Analyse various types of pipe network **problems** and **identify solutions** for the **effective design and develop solution** in real world problems.	4
	PO 4	Understanding of **Engineering principles** and the ability to apply them to analyse in conducting and **solve engineering problems**.	4
	PO 10	Communicate clearly in form of **writing** assignments, preparing **subject matter** in form of Tech Talk and five-minute video on Behavior of fluid flow, and maintain a profound **speaking style**.	3
CO 3	PO 1	Recall the knowledge and principles of **mathematics and scientific methodology** for estimating hydraulic parameters with the help of Hardy Cross method, Dead-end method using **fundamentals of science.**	3
	PO 2	**Identify the problems** associated with the water distribution networks and **formulate** their cause to **develop the solutions** using advanced software tools.	4
	PO 4	Understand **the principles of engineering and apply** them to the mechanism of turbulence in pipes to **determine** the behaviour of the fluid particles.	4
	PO 10	Communicate clearly in form of **writing** assignments on Pipe network analysis, preparing **subject matter** in form of Tech Talk and five-minute video, and maintain a profound **speaking style**.	3
	PSO 1	**Analyse** and supervise irrigation structures, powerhouses, docks, and harbours using **engineering fundamentals and advanced tools**.	3
CO 4	PO 1	Use the **fundamentals of engineering and science** in the determination of the applications of drag and lift forces acting on the bodies which are submerged in the fluid medium.	2
	PO 2	Identify the behaviour of the boundary layer over smooth, rough boundaries and **problems** associated with them from the **first principles of mathematics and generate the solution.**	3
	PO 4	**Understanding** the context of engineering knowledge that can be **applied**in developing the software tools	2
	PO 10	Communicate clearly in form of **writing** assignments, preparing **subject matter** in form of Tech Talk and five-minute video various methods applicable for the separation of the boundary layer, and maintain a profound **speaking style.**	3
CO 5	PO 1	Relate the principles of using **mathematical principles and scientific methodology** and apply those results in analysing the behaviour of fluid flow **(own engineering discipline)**.	3
	PO 4	Understanding the **engineering principles** and the **ability** to apply them to analyse in conducting and **solve engineering problems**	3

Course Outcomes	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key competencies matched.
	PO 10	Communicate clearly in form of **writing** assignments, preparing **subject matter** in form of Tech Talk on types of flow and five-minute video, and maintain a profound **speaking style.**	3
CO 6	PO 1	Use the **fundamentals of engineering and science** in identifying the conditions of resistance to the flow of fluid in smooth and rough boundaries.	2
	PO 2	**Formulate** Stoke's law with their applications, **identify** the causes of turbulence, and **develop the solution** from Moody's diagram for the friction values.	3
	PO 10	Communicate clearly in form of **writing** assignments, preparing **subject matter** in form of Tech Talk and five-minute video to measure viscosity using Moody's chart , and maintain a profound **speaking style.**	3
	PSO 1	Differentiate the behavior of various hydraulic parameters such as pressure, shear stress, viscosity, and velocity of flow by **understanding and analyzing** the basic concepts of closed pipe flow.	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	-	-	-	-	-	-	-	-	3	-	-	3	-	-
CO 2	3	4	-	3	-	-	-	-	-	3	-	-	-	-	-
CO 3	3	4	-	2	-	-	-	-	-	3	-	-	3	-	-
CO 4	2	3	-	2	-	-	-	-	-	3	-	-	-	-	-
CO 5	3	-	-	3	-	-	-	-	-	3	-	-	3	-	-
CO 6	3	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	67	-	-	-	-	-	-	-	-	60	-	-	50	-	-
CO 2	67	50	-	18	-	-	-	-	-	60	-	-	-	-	-
CO 3	100	40	-	18	-	-	-	-	-	60	-	-	50	-	-
CO 4	67	30	-	18	-	-	-	-	-	60	-	-	100	-	-
CO 5	100	-	-	18	-	-	-	-	-	-	-		-	-	-
CO 6	67	30	-	-	-	-	-	-	-	60	-	-	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	2	-	-	-	-	-	-	-	-	2		-	3	-	-
CO 2	2	2	-	1	-	-	-	-	-	2	-	-	-	-	-
CO 3	3	2	-	1	-	-	-	-	-	2	-	-	3	-	-
CO 4	3	1	-	1	-	-	-	-	-	3	-	-	-	-	-
CO 5	3	-	-	1	-	-	-	-	-	-	-	-	3	-	-
CO 6	3	1	-	-	-	-	-	-	-	2	-	-	3	-	-
TOTAL	16	6	-	4	-	-	-	-	-	11	-	-	12	-	-
AVERAGE	2.7	1.5	-	1	-	-	-	-	-	3	-	-	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	**FLOW THROUGH PIPES**
	Loss of head through pipes, Darcy – Wiesbatch equation, minor losses, total energy equation, hydraulic gradient line, Pipes in series, equivalent pipes, pipes in parallel, flow through laterals, flows in dead end pipes, siphon. Analysis of pipe networks: Hardy Cross method.
MODULE II	**LAMINAR AND TURBULENT FLOWS IN CLOSED PIPES**
	Laminar flow through circular pipes, annulus and parallel plates. Stoke's law, Measurement ofviscosity. Reynold's experiment, Transition from laminar to turbulent flow. Definition of turbulence, scale and intensity, Causes of turbulence, instability, mechanism of turbulence and effect of turbulent flow in pipes. Resistance to flow of fluid in smooth and rough pipes, Moody's diagram.

MODULE III	**BOUNDARY LAYER THEORY**
	Assumption and concept of boundary layer theory, Boundary layer thickness, displacement, momentum and energy thickness – problems. Laminar and Turbulent boundary layers on a flat plate. Laminar sub-layer, smooth and rough boundaries. Local and average friction coefficients. Boundary layer separation and control.
MODULE IV	**OPEN CHANNEL FLOW: UNIFORM FLOW**
	Comparison between open channel flow and pipe flow, Geometrical parameters of a channel, classification of open channels, classification of open channel flow, Velocity distribution of channel section. Uniform Flow - Chezy's formula, Manning's formula. Factors affecting Manning's Roughness Coefficient. Most economical section of channel. Computation of Uniform flow, normal depth.
MODULE V	**OPEN CHANNEL FLOW: NON - UNIFORM FLOW**
	Non – Uniform Flow: Specific energy, specific energy curve, critical flow, discharge curve specific force, specific depth, and critical depth. Gradually Varied Flow –Dynamic Equation of Gradually Varied Flow, Classification of channel bottoms lopes, Classification of surface profile, Computation of water surface profile by Direct Step method. Hydraulic Jump- Theory of hydraulic jump, Elements and characteristics of hydraulic jump in a rectangular Channel, length and height of jump, location of jump, Types, applications and location of hydraulic jump.

TEXTBOOKS

1. P. M. Modi and S. M. Seth, "Hydraulics and Fluid Mechanics", Standard Book House, 22nd Edition, 2019.
2. Rajput R.K., "A text book of Fluid Mechanics, S.Chand Publications, 1998.
3. Subramanya K. "Open Channel Flow", Tata McGraw Hill Publications, 3rd Edition, 2009.
4. Narayana and C. R. Ramakrishnan Pillai, "Principles of Fluid Mechanics and Fluid Machines", Sangam Books Ltd, 1st Edition, 2003.

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1. Ojha CSP, Chandramouli P. N., Berndtsson R., "Fluid Mechanics and Machinery, Oxford University Press, 2010.
2. Chow V.T., "Open Channel Hydraulics", Blackburn Press, 2009.
3. Franck N. White, —Fluid Mechanics‖, Tata McGraw Hill Publications, 8th Edition, 2015.

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1. https://nptel.ac.in/courses/112105171/1
2. https://textofvideo.nptel.iitm.ac.in/112105171/lec1.pdf
3. https://www.fkm.utm.my/ syahruls/3-teaching/2-fluid-II/fluid-II-enote/32-pump-2.pdf
4. https://www.scribd.com/doc/16605891/Fluid-Mechanics

XIX COURSE PLAN:

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

S.No	Topics to be covered	CO's	Reference T1: 4.1
OBE DISCUSSION			
1	Couse objective, course outcomes, program outcomes and CO-PO mapping		
CONTENT DELIVERY (THEORY)			
1	Introduction to flow through pipes, types of losses in pipes with Classification and examples of major, minor losses in closed and open channel flows.	CO 1	T2:1.5 R1:1.12.1
2	Derivation and estimation of major losses through Darcy's Wiesbatch equation and Practical applications and importance of friction factor using Darcy's Wiesbatch equation.	CO 1	T2: 1.7 R1:1.12.3
3	Estimation and minor head losses and importance of Total Energy Lines, and Hydraulic Gradient lines	CO 1	T2: 1.10 R1:1.15
4	Various types of pipe connections – Pipes in series, pipes in parallel flow through laterals, flows in dead end pipes, siphon	CO 1	T2: 1.15 R1:1.16
5	Analysis of pipe networks: Hardy Cross method, Dead end method and equivalent pipe method	CO 1	T2: 1.17 R1:1.13.1
6	Problems on flow through pipes	CO 1	T2: 1.18 R1:1.13.2
7	Laminar flow through circular pipes, annulus and parallel plates	CO 2	T2: 1.19 R1:1.13.3
8	Derivation of shear stress for the above three cases	CO 2	T2: 1.20 R1:1.7.1
9	Derivation of velocity profiles for laminar flow through pipes	CO 2	T2: 1.24 R1:1.17.3
10	Stokes law and its applications of Stoke's law	CO 2	T2:6.1 R1:2.3
11	Measurement of Viscosity by various methods – Falling sphere method, rotating cylinder method, capillary tube method and Orifice type viscometers	CO 2	T2:6.3 R1:2.6.1
12	Demonstration of Reynold's experiment for the classification of various types of flows in pipes and open channels	CO 2	T2:6.5 R1:2.6.2
13	Definition of turbulence, scale and intensity, Causes of turbulence, instability, mechanism of turbulence	CO 2	T2:7.3 R1:2.8
14	effect of turbulent flow in pipes, Resistance to flow of fluid in smooth and rough pipes	CO 2	T2:7.5,7.6 R1:2.9.2
15	Importance of Moody's chart in the determination of friction factor	CO 2	T2:7.7 R1:2.10

16	Problems on laminar and turbulent flow through closed pipes for the determination of shear, viscosity and velocity parameters	CO 2	T2:7.7 R1:2.10
17	Assumption and concept of boundary layer theory	CO 3	T2:7.11 R1:2.10.2
18	Definition of Boundary layer thickness and derivation of formula for the boundary layer thickness	CO 3	T2:7.11
19	Definition of momentum with derivation of formula for the momentum and energy layer thickness	CO 3	T2:15.2 R1:8.2
20	Definition of energy thickness and derivation of formula for the energy layer thickness	CO 3	T2:15.7 R1:8.3.3
21	Laminar and Turbulent boundary layers on a flat plate	CO 3	T2:2.1 R1:7.9.2
22	Laminar sub-layer, smooth and rough boundaries	CO 4	T2:2.2 R1:7.9.1
23	Local and average friction coefficients and Boundary layer	CO 4	T2:2.4 R1:7.11
24	Separation and control of boundary layer	CO 4	T2:16.8 R1:8.12.1
25	Comparison between open channel flow and pipe flow	CO 5	T2:16.8 R1:8.12.2
26	Geometrical parameters of a channel - Rectangular, triangular and trapezoidal sections	CO 5	T2:5.17 R1:1.13.1
27	Classification of open channel flow based on various parameters	CO 5	T2:5.18 R1:1.13.2
28	Velocity distribution of channel section	CO 5	T2:5.19 R1:1.13.3
29	Uniform Flow – Chezy's formula, Manning's formula derivation	CO 5	T2:6.1 R1:2.3
30	Factors affecting Manning's Roughness Coefficient	CO 5	T2:1.2 R1:7.2
31 - 32	Most economical section of channel – Rectangular, triangular and trapezoidal sections	CO 5	T2:1.16 R1:7.7
33 - 34	Non – Uniform Flow: Specific energy, specific energy curve.	CO 6	T2:6.3 R1:2.6.1
35 - 36	Critical flow, discharge curve specific force, specific depth, and critical depth	CO 6	T2:6.5 R1:2.6.2
37 - 38	Gradually Varied Flow –Dynamic Equation of Gradually Varied Flow	CO 6	T2:5.24 R1:1.17.3
39	Classification of channel bottoms lopes based on slopes of channel	CO 6	T2:6.1 R1:2.3
40	Classification of surface profile based on slopes of channel	CO 6	T2:6.3 R1:2.6.1
41 - 42	Computation of water surface profile by Direct Step method.	CO 6	T2:15.13 R1:8.7.2

43	Hydraulic Jump- Theory of hydraulic jump, Elements and characteristics of hydraulic jump in a rectangular Channel	CO 6	T2:15.13 R1:8.7.2
44	Length and height of jump, location of jump, Types of hydraulic jump	CO 6	T2:15.16 R1:8.7.3
45	Applications and location of hydraulic jump.	CO 6	T1:11.9 R2:12.24
PROBLEM SOLVING/ CASE STUDIES			
1-3	Problems on Flow through pipes	CO 1	T2: 4.2-4.13
4-6	Problems on Laminar and Turbulent flows in Closed Pipes	CO 2	T2: 4.2-4.13
7-9	Problem on Boundary Layer theory	CO 3, CO 4	T2: 4.2-4.13
10-12	Open Channel Flow: Uniform Flow	CO 5	T1.4.2-4.10
13-15	Open Channel Flow: Non-Uniform Flow	CO 6	T1.4.2-4.10
DISCUSSION OF DEFINITION AND TERMINOLOGY			
1	Loss of head through pipes, Darcy – Wiesbatch equation, minor losses, total energy equation, hydraulicgradient line, Pipes in series, equivalent pipes, pipes in parallel, flow through laterals, flows in dead end pipes, siphon. Analysis of pipe networks: Hardy Cross method.	CO 1	T2: 4.2-4.13
2	Laminar flow through circular pipes, annulus and parallel plates. Stoke's law, Measurement of viscosity. Reynold's experiment, Transition from laminar to turbulent flow. Definition of turbulence, scale and intensity, Causes of turbulence, instability, mechanism of turbulence and effect of turbulent flow in pipes. Resistance to flow of fluid in smooth and rough pipes, Moody's diagram.	CO 2	T1.4.2-4.10
3	Assumption and concept of boundary layer theory, Boundary layer thickness, displacement, momentum and energy thickness – problems. Laminar and Turbulent boundary layers on a flat plate. Laminar sub-layer, smooth and rough boundaries. Local and average friction coefficients. Boundary layer, separation and control.	CO 3, CO 4	T2:5.2-5.7

4	Comparison between open channel flow and pipe flow, Geometrical parameters of a channel, classification of open channels, classification of open channel flow, Velocity distribution of channel section. Uniform Flow - Chezy's formula, Manning's formula. Factors affecting Manning's Roughness Coefficient. Most economical section of channel. Computation of Uniform flow, normal depth.	CO 5	T2:9.1-9.7
5	Non – Uniform Flow: Specific energy, specific energy curve, critical flow, discharge curve specific force,specific depth, and critical depth. Gradually Varied Flow –Dynamic Equation of Gradually Varied Flow,Classification of channel bottoms lopes, Classification of surface profile, Computation of water surface profile by Direct Step method. Hydraulic Jump- Theory of hydraulic jump, Elements and characteristics of hydraulic jump in a rectangular Channel, length and height of jump, location of jump, Types, applications and location of hydraulic jump.	CO 6	T2:11.1-11.4 R3:12.34-12.36
DISCUSSION OF QUESTION BANK			
1	Loss of head through pipes, Darcy – Wiesbatch equation, minor losses, total energy equation, hydraulicgradient line, Pipes in series, equivalent pipes, pipes in parallel, flow through laterals, flows in dead end pipes, siphon. Analysis of pipe networks: Hardy Cross method.	CO 1	T2: 4.2-4.13
2	Laminar flow through circular pipes, annulus and parallel plates. Stoke's law, Measurement of viscosity. Reynold's experiment, Transition from laminar to turbulent flow. Definition of turbulence, scale and intensity, Causes of turbulence, instability, mechanism of turbulence and effect of turbulent flow in pipes. Resistance to flow of fluid in smooth and rough pipes, Moody's diagram.	CO 2	T1.4.2-4.10
3	Assumption and concept of boundary layer theory, Boundary layer thickness, displacement, momentum and energy thickness – problems. Laminar and Turbulent boundary layers on a flat plate. Laminar sub-layer, smooth and rough boundaries. Local and average friction coefficients. Boundary layer, separation and control.	CO 3, CO 4	T2:5.2-5.7

4	Comparison between open channel flow and pipe flow, Geometrical parameters of a channel, classification of open channels, classification of open channel flow, Velocity distribution of channel section. Uniform Flow - Chezy's formula, Manning's formula. Factors affecting Manning's Roughness Coefficient. Most economical section of channel. Computation of Uniform flow, normal depth.	CO 5	T2:9.1-9.7
5	Non – Uniform Flow: Specific energy, specific energy curve, critical flow, discharge curve specific force,specific depth, and critical depth. Gradually Varied Flow –Dynamic Equation of Gradually Varied Flow,Classification of channel bottoms lopes, Classification of surface profile, Computation of water surface profile by Direct Step method. Hydraulic Jump- Theory of hydraulic jump, Elements and characteristics of hydraulic jump in a rectangular Channel, length and height of jump, location of jump, Types, applications and location of hydraulic jump.	CO 6	T2:11.1-11.4 R3:12.34-12.36

Signature of Course Coordinator **HOD,CE**
Ms. N Sri Ramya, Assistant Professor

INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

Dundigal, Hyderabad - 500 043

COURSE DESCRIPTION

Department	**ELECTRONICS AND COMMUNICATION ENGINEERING**				
Course Title	**BUSINESS ECONOMICS AND FINANCIAL ANALYSIS**				
Course Code	AHSB14				
Program	B.Tech				
Semester	V				
Course Type	Core				
Regulation	R-18				
Course Structure	Theory			Practical	
	Lecture	Tutorials	Credits	Laboratory	Credits
	3	-	3	-	-
Course Coordinator	Dr. S. Sivasankara Rao, Associate Professor				

I COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites
-	-	-	-

II COURSE OVERVIEW:

The present course is designed in such a way that it gives an overview of concepts of Economics. Managerial Economics enables students to understand micro environment in which markets operate how price determination is done under different kinds of competitions. Financial Analysis gives clear idea about concepts, conventions and accounting procedures along with introducing students to fundamentals of ratio analysis and interpretation of financial statements. Break Even Analysis is very helpful to the Business Concern for Decision Making, controlling and forward Strategic Planning. Ratio analysis gives an idea about financial forecasting, financial planning, controlling the business and decision making.

III MARKS DISTRIBUTION:

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

IV CONTENT DELIVERY / INSTRUCTIONAL METHODOLOGIES:

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

V EVALUATION METHODOLOGY:

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

Semester End Examination (SEE): The SEE is conducted for 70 marks of 3 hours duration. The syllabus for the theory courses is divided into FIVE modules and each module carries equal weightage in terms of marks distribution. The question paper pattern is as follows. Two full questions with "either" or "choice" will be drawn from each module. Each question carries 14 marks. There could be a maximum of two sub divisions in a question.
The expected percentage of cognitive level of the questions is broadly based on the criteria given in below Table.

Percentage of Cognitive Level	Blooms Taxonomy Level
16%	Remember
17%	Understand
17%	Apply
50%	Analyze
0%	Evaluate
0%	Create

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

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

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

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

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

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

VI COURSE OBJECTIVES:

The students will try to learn:

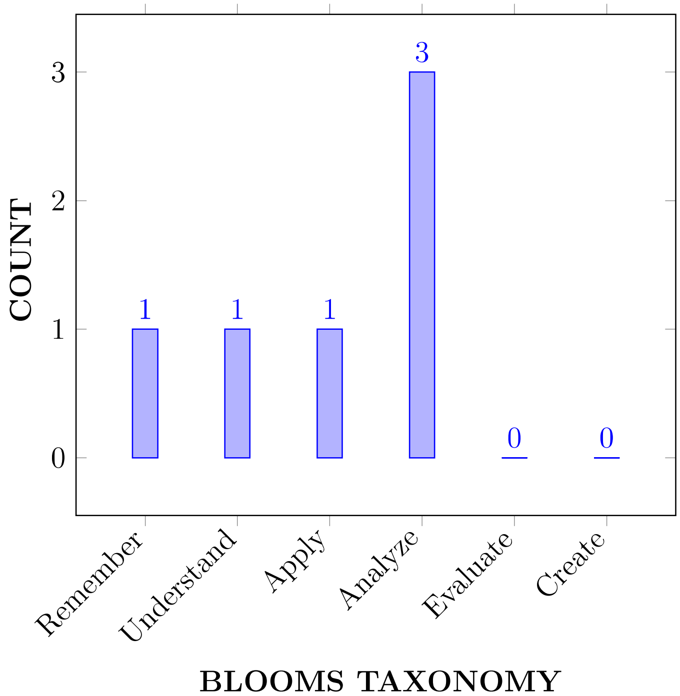
I	The concepts of business economics and demand analysis helps in optimal decision making in business environment
II	The functional relationship between Production and factors of production and able to compute breakeven point to illustrate the various uses of breakeven analysis.
III	The features, merits and demerits of different forms of business organizations existing in the modern business environment and market structures.
IV	The concept of capital budgeting and allocations of the resources through capital budgeting methods and compute simple problems for project management.
V	Various accounting concepts and different types of financial ratios for knowing financial positions of business concern.

VII COURSE OUTCOMES:

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

CO 1	**List** the basic concepts of managerial economics and analysis, measurement of demand and its forecasting to know the current status of goods and services.	Remember
CO 2	**Examine** to know the current status of goods and services. to know the economies and diseconomies of scale in manufacturing sector.	Analyze
CO 3	**Summarize** the four basic market models like perfect competition, monopoly, monopolistic competition, and oligopoly to know the price and quantity are determined in each model.	Understand
CO 4	**Compare** various types of business organizations and discuss their implications for resource allocation to strengthen the market environment.	Analyze
CO 5	**Analyze** different project proposals by applying capital budgeting techniques to interpret the solutions for real time problems in various business projects.	Analyze
CO 6	**Develop** the ability to use a basic accounting system along with the application of ratios to create (record, classify, and summarize) the data needed to know the financial position of the organization.	Apply

COURSE KNOWLEDGE COMPETENCY LEVEL



VIII PROGRAM OUTCOMES:

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

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

IX HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

PROGRAM SPECIFIC OUTCOMES		Strength	Proficiency Assessed by
PSO 1	Build Embedded Software and Digital Circuit Development platform for Robotics, Embedded Systems and Signal Processing Applications.	-	-
PSO 2	Focus on the Application Specific Integrated Circuit (ASIC) Prototype designs, Virtual Instrumentation and System on Chip (SOC) designs.	-	-
PSO 3	Make use of High Frequency Structure Simulator (HFSS) for modeling and evaluating the Patch and Smart Antennas for Wired and Wireless Communication Applications.	-	-

3 = High; 2 = Medium; 1 = Low

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

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

XI JUSTIFICATIONS FOR CO – PO/ PSO MAPPING -DIRECT:

Course Outcomes	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key competencies matched.
CO 1	PO 1	**Recall** (knowledge) the scientific fundamentals of economic activities performed by the businessmen in the business for profit earning.	2
	PO 2	**Interpret** and identify the demand and its analysis with the mathematical and natural principles of demand forecasting methods.	6
	PO 8	**Define** (knowledge) the responsibilities of the engineering practices by knowing the best economical practices.	1
	PO 9	**Match** (knowledge) the economical implication to effectively function as a team member, and as a member or leader in diverse teams.	5
	PO 11	**Relate** (knowledge) the knowledge and understanding of the economic principles and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.	6
CO 2	PO 1	**Recall** (Knowledge) the knowledge of mathematics, science in the production function through Different Combination of variable inputs with Economies of Scale.	2
	PO 2	**Demonstrate** the different cost concepts and determine the significance of Break Even Analysis.	5
	PO 8	**Relate** (Knowledge) (Knowledge) the ethical principles and commit to professional ethics and responsibilities and norms of the production management	2
	PO 9	**Show** (Fundamentals) the production function implications for effective implementation of gang compositions in a team work and in multidisciplinary settings.	6
	PO 11	**Define** the economies of scale in production function and Break Even Analysis knowledge applied in one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.	5
CO 3	PO 8	**List** (Knowledge) (Knowledge) different structures of market and how price is determined under different market structures commit to professional ethics and responsibilities and norms of the engineering practice.	2
	PO 9	**Match** the market structures and the market entry strategies as an individual, and as a member in diverse teams.	6
CO 4	PO 8	**Categorize** the ethical principles and commit to professional ethics and responsibilities belongs to different forms of business organizations existing in the modern business.	2

Course Outcomes	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key competencies matched.
	PO 9	**Classify** various business organizations and their functioning as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.	6
CO 5	PO 1	**Explain** the ethical issues involved in the allocation of funds under the concept of capital budgeting.	1
	PO 11	**Summarize** the concept of capital budgeting and allocations of the resources through capital budgeting methods of the management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.	8
CO 6	PO 2	**Explain** the GAAP principles and ratios to analyse complex engineering problems reaching substantiated conclusions using first principles of accounts and profitability and efficiency of the organization.	6
	PO 11	**Illustrate**the accounting methods and procedures and accounting principles to manage the financial aspects in a project.	8

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

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

XIII PERCENTAGE OF KEY COMPETENCIES FOR CO – PO/ PSO

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	66.7	60.0	-	-	-	-	-	33.3	41.6	-	50.0	-	-	-	-
CO 2	66.7	50.0	-	-	-	-	-	66.7	50.0	-	41.6	-	-	-	-
CO 3	-	-	-	-	-	-	-	66.7	50.0	-	-	-	-	-	-
CO 4	-	-	-	-	-	-	-	66.7	50.0	-	-	-	-	-	-
CO 5	33.3	-	-	-	-	-	-	-	-	-	75.0	-	-	-	-
CO 6	-	20.0	-	-	-	-	-	-	-	-	75.0	-	-	-	-

XIV COURSE ARTICULATION MATRIX (PO / PSO MAPPING):

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

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

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	3	3	-	-	-	-	-	1	2	-	2	-	-	-	-
CO 2	3	2	-	-	-	-	-	3	2	-	2	-	-	-	-
CO 3	-	-	-	-	-	-	-	3	2	-	-	-	-	-	-
CO 4	-	-	-	-	-	-	-	3	2	-	-	-	-	-	-
CO 5	1	-	-	-	-	-	-	-	-	-	3	-	-	-	-
CO 6	-	1	-	-	-	-	-	-	-	-	3	-	-	-	-
TOTAL	7	7	-	-	-	-	-	10	8	-	-	-	-	-	-
AVERAGE	2.3	2.3	-	-	-	-	-	2.5	2	-	2.5	-	-	-	-

XV ASSESSMENT METHODOLOGY-DIRECT:

CIE Exams	PO 1, PO 2, PO 8,PO 9 PO 11	SEE Exams	PO 1, PO 2, PO 8,PO 9 PO 11	Seminars	PO8
Laboratory Practices	-	Student Viva	-	Certification	-
Term Paper	-	5 Minutes Video	PO 1, PO 2, PO 8,PO 9 PO 11	Open Ended Experiments	-
Assignments	PO 9				

XVI ASSESSMENT METHODOLOGY-INDIRECT:

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

XVII SYLLABUS:

MODULE I	**INTRODUCTION&DEMAND ANALYSIS**
	Introduction to Business Economics: Definition, Nature and Scope of Managerial Economics – Demand Analysis: Demand Determinants, Law of Demand and its exceptions. Elasticity of Demand: Definition, Types, Measurement and Significance of Elasticity of Demand. Demand Forecasting, Factors governing demand forecasting, methods of demand forecasting

MODULE II	**PRODUCTION & COST ANALYSIS**
	Theory of Production and Cost Analysis: Production Function – Iso-quants and Iso-costs, MRTS, Least Cost Combination of Inputs, Cobb-Douglas Production function, Laws of Returns, Internal and External Economies of Scale. Cost Analysis: Cost concepts; Break-even analysis, Determination of Break – Even point (Simple Problems) , Managerial Significance of BEA.
MODULE III	**MARKETS & NEW ECONOMIC ENVIRONMENT**
	LMarket structures: Types of competition, Features of perfect competition, Monopoly and monopolistic competition. Price determination & Price Statistics: Price Output determination in case of perfect competition and monopoly. Features and evaluation of different forms of Business organization: Sole proprietorship, partnership, Joint Stock Company, public enterprises and their types.
MODULE IV	**CAPITAL BUDGETING**
	Capital and its significance, types of capital, estimation of fixed and working capital requirements, methods and sources of raising capital- Trading Forecast, Capital budget, Cash Budget. Features of capital budgeting proposals, methods of capital budgeting – payback method, Accounting rate of return(ARR), Net Present Value Method (simple problems).
MODULE V	**INTRODUCTION TO FINANCIAL ACCOUNTING AND FINANCIAL ANALYSIS**
	Financial accounting objectives, functions, importance; Accounting concepts and accounting conventions - double-entry book keeping, journal, ledger, trial balance; Final accounts: Trading account, profit and loss account and balance sheet with simple adjustments; Financial analysis: Analysis and interpretation of liquidity ratios, activity ratios, capital structure ratios and profitability ratios (simple problems), Du Pont chart.

TEXTBOOKS

1. Aryasri, "Managerial Economics and Financial Analysis", TMH publications, 4thEdition,2012.
2. M. KasiReddy, Saraswathi, "Managerial Economics and Financial Analysis", PHI Publications, New Delhi, 2ndEdition,2012.
3. Varshney, Maheswari, "Managerial Economics", Sultan Chand Publications, 11thEdition,2009.

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1. D.N. Dwivedi, "Managerial Economics", Vikas Publication House Pvt.Ltd, 2ndEdition,2012.
2. S.N. Maheshwari & S.K.Maheshwari, "Financial Accounting", Vikas Publication House Pvt.Ltd,4thEdition, 2012.
3. R.NarayanaSwamy, "Financial Accounting- A managerial Perspective", Pearson publications, 1stIndian Reprint Edition,2012.

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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
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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

XVIII COURSE PLAN:

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

S.No	Topics to be covered	CO's	Reference
OBE DISCUSSION			
1	Discussion on Course Outcomes and how these COs mapped with POs and PSOs.		
CONTENT DELIVERY (THEORY)			
2-3	Explain about managerial economics according to the business	CO 1	T1- 1.3-1.8 R1-1.5-1.7
4-5	Describe about demand analysis, the Law of Demand and Demand Function.	CO 1	T1-2.2-2.11 R1-3.3-3.20
6-7	Understand elasticity of the demand of the product, different types, Measurement of Elasticity of Demand and Factors influencing on Elasticity of Demand.	CO 1	T1-3.3-3.20 R1- 5.29-6.8
8	State different methods of Demand Forecasting and the factors governing Demand Forecasting.	CO 1	T1-4.6-4.19
9-10	Demonstrate the Production function, features of Iso-Quants and Iso-Costs, different types of Internal Economies, External Economies and Law of Returns.	CO 2	T1- 5.3-5.18 R1- 5.29-6.8
11-13	Different types of Internal Economies, External Economies ad Law of Returns with appropriate examples.	CO 2	T1- 5.3-5.18
14-15	Illustrate different types of costs	CO 2	T1- 5.29-6.8
16-17	Explain the Significance and Limitations of Break-Even Analysis	CO 2	T1- 7.13-7.14
18-19	Calculate Break-Even Point (Simple Problems)	CO 2	T1- 7.1-7.12

20-21	Illustrate the features, price-output determination under Perfect Competition, Monopoly and Monopolistic competition Markets.	CO 3	T1- 8.4-8.16 R2- 5.29-6.8
22-24	Demonstrate the Objectives, Policies and Methods of Pricing Strategies and Price Methods.	CO 3	T1- 8.21-8.25
25-26	Describe Features of business, Definitions of Various forms of Business Units.	CO 4	T1-9.3-9.15
27-30	State the Merits & Demerits of Different types of Public Enterprises and Changing Business Environment to Post Liberalization Scenario.	CO 4	T1-9.2-10.23 R1- 8.21-8.25
31-32	Explain the significance and classification of capital, Methods and Sources of Raising Finance.	CO 6	T1-9.2-10.23
33-34	Demonstrate the concept of capital budgeting and allocations of the resources through capital budgeting methods and compute simple problems.	CO 6	T1-11.3-11.5 R2-12.3-12.5
35-37	Illustrate the Significance of Financial Accounting, Double Entry, Accounts, Accounting Concepts and Conventions	CO 6	T1-12.1-12.26
38-40	Explain the meaning, advantages and Limitations of the Journal, Ledger and Trial Balance and Final Accounts and Solve simple Problems.	CO 6	T1-13.4-13.15 R2-11.3-11.5
41-42	Describe Meaning, Definitions and Limitations of Ratio Analysis	CO 6	T1-13.4-13.15 R2-11.7-11.8
43-45	Compute different types of Financial Ratios (Problems)	CO 6	T1-13.5-13.68
PROBLEM SOLVING/ CASE STUDIES			
46	Problems relating to Demand elasticty measurement and Forecasting	CO 1	T1: 1.1 - 2.8, R1:2.1
47	Problems relation to Break Even Point	CO 2	T2: 3.0 to 3.6, 5.0 to5.5 , R2:4.4
48	Problems in determining the price in different types of markets	CO 3,4	T3: 6.0 to 6.4, R1:5.1
49	Problems relating to Capital Budgeting Decisions	CO 5	R2:7.5
50	Problems relating to Final Accounts and Calculation of Ratios	CO 6	R3: 4.1
DISCUSSION OF DEFINITION AND TERMINOLOGY			
51	Introduction and Demand Analysis	CO 1	T1: 1.1 - 2.8, R1:2.1
52	Production and Cost Analysis	CO 2	T2: 3.0 to 3.6, 5.0 to5.5 , R2:4.4
53	Markets and New Environment	CO 3,4	T3: 6.0 to 6.4, R1:5.1
54	Capital Budgeting	CO 5	R2:7.5
55	Introduciton to Financial Accounting and Financial Analysis	CO 6	R3: 4.1

DISCUSSION OF QUESTION BANK			
56	Introduction and Demand Analysis	CO 1	T1: 1.1 - 2.8, R1:2.1
57	Production and Cost Analysis	CO 2	T2: 3.0 to 3.6, 5.0 to5.5 , R2:4.4
58	Markets and New Environment	CO 3,4	T3: 6.0 to 6.4, R1:5.1
59	Capital Budgeting	CO 5	R2:7.5
60	Introduciton to Financial Accounting and Financial Analysis	CO 6	R3: 4.1

Signature of Course Coordinator **HOD, CE**
Dr. S. Sivasankara Rao, Associate Professor

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

COURSE DESCRIPTION

Department	**CIVIL ENGINEERING**				
Course Title	**CONCRETE TECHNOLOGY**				
Course Code	ACEB26				
Program	B.Tech				
Semester	V				
Course Type	Core				
Regulation	R18				
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
B.Tech	ACEB02	IV	Building Materials, Construction and Planning

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
33.3%	Understand
16.6%	Apply
33.3 %	Analyze

Continuous Internal Assessment (CIA): CIA is conducted for a total of 30 marks (Table 2), with 20 marks for Continuous Internal Examination (CIE), 05 marks for Quiz and 05 marks for Alternative Assessment Tool (AAT).

Component	**Theory**			**Total Marks**
Type of Assessment	CIE Exam	Quiz	ATT	
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 centre. 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.

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

VI COURSE OBJECTIVES:

The students will try to learn:

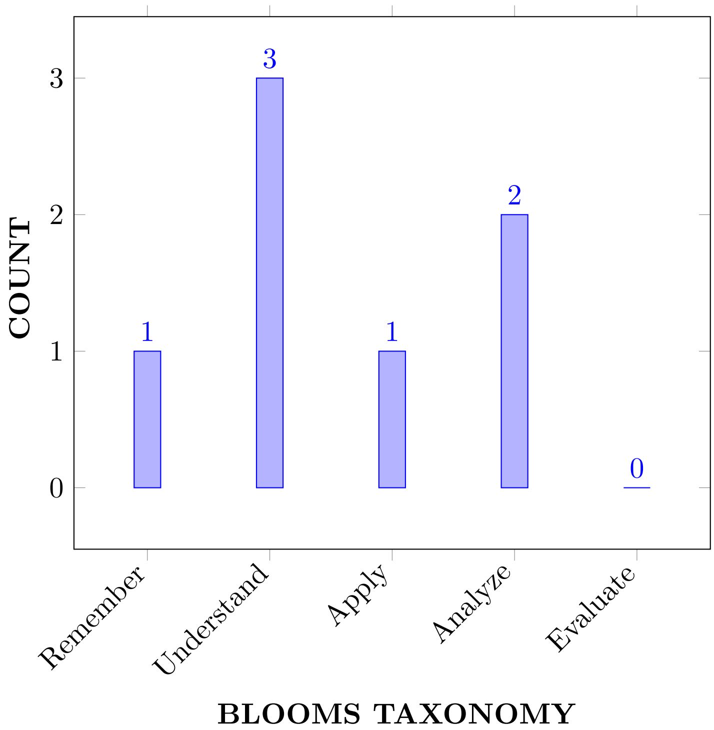
I	The fundamental properties of construction materials such as cement, aggregates and admixtures based on laboratory and filed tests for identifying material quality
II	The factors influencing workability and methods involved in measuring workability of fresh concrete.
III	The importance of water/cement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

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

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 2	-	3	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	-
AVERAGE	2.9	1.6	2	2	-	-	-	-	-	-	-	-	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	Course objectives, Course outcomes, Program Outcomes and CO-PO Mapping		
CONTENT DELIVERY (THEORY)			
2	Portland cement :chemical composition Hydration, setting of cement.	CO 1	T1: 1.8-1.9, T1: 2.28-2.28.2

3	structure of hydrate cement, Test on physical properties	CO 1	T1: 1.13-1.1
4	Different grades of cement	CO 1	T1:2.1-2.6, T1: 2.18, R2:5.1
5	Admixtures: Mineral and chemical admixtures.	CO 1	T1: 5.1-5.3
6	Admixtures-properties, dosage, effects usage.	CO 1	T1: 5.4-5.5
7	Aggregates: Classification of aggregate, particle shape & texture bond	CO 1	T1: 3.2-3.4, R2:6.3
8	strength and other mechanical properties of aggregate	CO 1	T1: 3.7-3.9
9	specific gravity, bulk density, porosity, adsorption & moisture content of aggregate	CO 1	T1: 3.15-3.18, R2:6.5
10	Bulking of sand,Deleterious substance in aggregate, Soundness of aggregate	CO 1	T1:3.26-3.27, T1:3.19-3.20, T2 :3.50
11	Alkali aggregate reaction, thermal properties	CO 1	T2 :3.6-3.7, R1:7.1
12	Sieve analysis, fineness modulus,Grading curves	CO 1	T2:3.8-3.9
13	grading of fine & coarse aggregates, gap graded aggregate, maximum aggregate size	CO 2	T2:3.9-3.11, R1:7.5
14	Workability :factors affecting workability , measurement of workability by different tests	C02	T2: 6.1-6.4, R2:7.2
15	setting times of concrete, effect of time and temperature on workability	CO 2	T1:6.3-6.36
16	segregation & bleeding, mixing and vibration of concrete	CO 2	T1:6.6, R1:3.5
17	steps in manufacture of concrete, quality of mixing water.	CO 2	T1: 6.6, R1:8.4
18	Water / Cement ratio: Abram's Law, Gel space ratio	CO 2	T1: 6.4-6.5, R1:8.5
19	Nature of strength of concrete, Maturity concept	CO 3	T1: 6.7.1-6.7.7.15
20	Strength in tension & compression, factors affecting strength, relation between compression & tensile strength curing	CO 3	T1: 6.7-6.8
21	Testing of hardened concrete: compression tests, tension tests	CO 3	T1: 4.2-4.3
22	Factors affecting strength, flexure tests, splitting tests	CO 3	T1: 7.2, R1:8.6

23	Non-destructive testing methods, codal provisions for NDT	CO 3	T1: 7.3, R1:8.8
24	Elasticity, creep & shrinkage, modulus of elasticity, dynamic modulus of elasticity, Poisson's ratio	CO 3	T1: 7.4
25	creep of concrete, factors influencing creep, relation between creep & time, nature of creep, effects of creep	CO 3	T1: 7.6, R1:9.1.4
26	shrinkage, types of shrinkage	CO5	T1: 7.8
27	Factors in the choice of mix proportions	CO 5	T1: 7.7 R2:9.2.1
28	Durability of concrete & tensile strength, curing	CO 5	T1: 7.8 R1: 6.8-6.9
29	Quality Control of concrete	CO 5	T1: 10.1-10.2, R1:4.2.3
30	Statistical methods, Acceptance criteria	CO 5	T1:10.7-10.9
31	Proportioning of concrete mixes by various methods	CO5	T1:10.8-10.11, R1: 10.1-10.2
32	Proportioning of concrete mixes by various methods	CO 5	T1:8.1-8.3
33	BIS method of mix design	CO 5	T1:8.1.1-8.1.4
34	BIS method of mix design	CO 5	T1:8.2
35	Light weight aggregates, polymer concrete	CO 6	T1:8.3
36	cellular concrete , no fines concrete, high density concrete	CO 5	T1:11.3
37	fiber reinforced concrete, different types of fibers	CO 6	R1:9.2
38	factors affecting properties of F.R.C, applications	CO 6	R1:11.5
39	high performance concrete	CO 6	R1:11.5-11.7
40	high performance concrete	CO 6	T1:11.9
41	self-consolidating concrete, SIFCON	CO 6	T1:11.13
PROBLEM SOLVING/ CASE STUDIES			
1	Design the concrete mix for grade M30 with suitable conditions	CO 4	T1:11.13-11.14
2	Design the concrete mix for grade M35 with suitable conditions	CO 4	R2:14.2-14.3
3	Design the concrete mix for grade M 40 with suitable conditions	CO 4	R2:14.15
4	Design the concrete mix for grade M45 with suitable conditions	CO 4	R1:12.8
5	Design the concrete mix for grade M50 with suitable conditions	CO 4	T1:12.10
6	Design of concrete mix for grade M20 with suitable conditions.	CO 4	R1:12.10.2
7	Design the concrete mix for grade M55 with suitable conditions.	CO 4	R1:12.13
8	Design the concrete mix for grade M60 with suitable conditions.	CO 4	R1:12.13.2
9	Fineness modulus of aggregates	CO 1	R2:16.1-16.9

10	Setting time of cement	CO 1	T1:13.1-13.4
11	Affect of gel space ratio on properties of hardened concrete	CO 5	R2:14.2
12	relationship between time and creep	CO 5	R2:14.2-14.3
13	Compressive strength of hardened concrete.	CO 6	R2:14.15
14	creep affect on hardened concrete	CO 6	R1:12.8
15	Effect of water cement ratio on the properties of hardened concrete	CO 6	T1:12.10
DISCUSSION OF DEFINITION AND TERMINOLOGY			
1	Cement admixtures and aggregates	CO 1	R1:12.10.2
2	Fresh concrete	CO 2	R2:14.2-14.3
3	Hardened concrete and its testing	CO 3	R2:14.15
4	Mix design	CO 4	R2:14.2-14.3
5	Special concrete	CO 5	R2:14.15
DISCUSSION OF QUESTION BANK			
1	Cement admixtures and aggregates	CO 1	R1:12.8
2	Fresh concrete	CO 2	T1:12.10
3	Hardened concrete and its testing	CO 3	R1:12.10.2
4	Mix dsesign	CO 4	R2:14.2-14.3
5	Special concrete	CO 5	R2:14.2-14.3

Signature of Course Coordinator **HOD,CE**

Mr. K. Anand Goud, Assistant Professor

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

COURSE DESCRIPTION

Department	**CIVIL ENGINEERING**				
Course Title	**MECHANICAL PROPERTIES OF MATERIALS**				
Course Code	AMEB54				
Program	B Tech				
Semester	V				
Course Type	Open Elective				
Regulation	R-18				
Course Structure	Theory			Practical	
	Lecture	Tutorials	Credits	Laboratory	Credits
	3	-	3	-	-
Course Coordinator	Ms. V Lakshmi Prasanna, Assistant Professor				

I COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites
B.Tech	AAEB04	III	Mechanics of Solids
B.Tech	AAEB02	III	Engineering Thermodynamics
B.Tech	AAEB07	IV	Environmental Science

II COURSE OVERVIEW:

This course equips the students for successful careers in the field of Materials Science and Engineering. The course is designed to teach timeless fundamentals underlying the discipline, while preparing the students to apply modern day approaches to materials problems. The course discusses crystallography, material selection and product design related strategies. This course provides ample opportunity for young engineers to become involved in cutting edge Materials Science and Engineering research by joining one of the many faculty-led research groups in the college campus.

III MARKS DISTRIBUTION:

Subject	SEE Examination	CIE Examination	Total Marks
Mechanical properties of materials	70 Marks	30 Marks	100

IV DELIVERY / INSTRUCTIONAL METHODOLOGIES:

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

V EVALUATION METHODOLOGY:

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

Semester End Examination (SEE): The SEE is conducted for 70 marks of 3 hours duration. The syllabus for the theory courses is divided into FIVE modules and each module carries equal weightage in terms of marks distribution. The question paper pattern is as follows. Two full questions with "either" or "choice" will be drawn from each module. Each question carries 14 marks. There could be a maximum of two sub divisions in a question.

The expected percentage of cognitive level of the questions is broadly based on the criteria given in Table: 1.

Percentage of Cognitive Level	Blooms Taxonomy Level
10%	Remember
70 %	Understand
10 %	Apply
10 %	Analyze
0 %	Evaluate
0 %	Create

COURSE OBJECTIVES:

The students will try to learn:

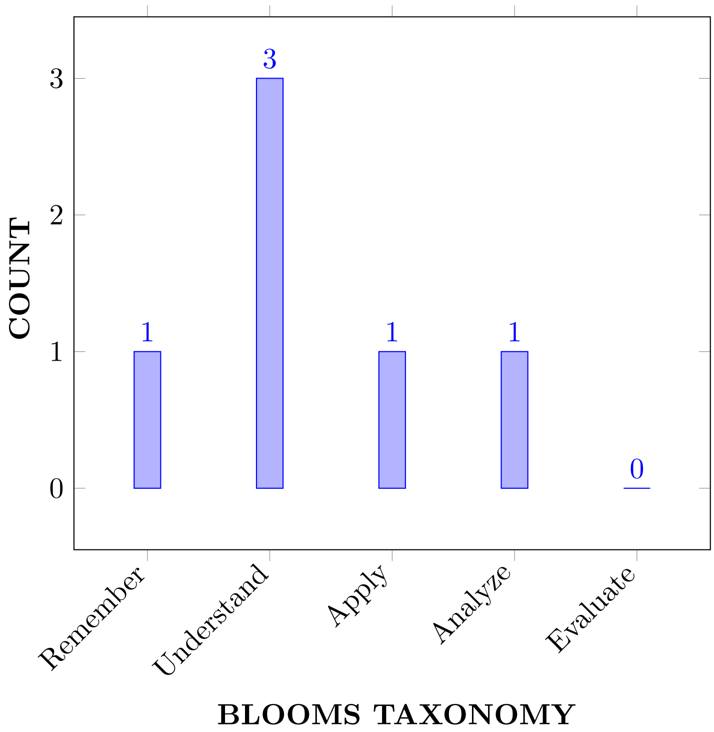
I	The selection among the materials and the product design cycle in deciding the manufacturability of the product on the basis of physical properties of materials.
II	The material selection, product design cycle, manufacturing process and optimization techniques which playa keyrole in regulating the performance characteristics of a product and its workability..
III	The importance of material life cycle, eco-selection and the product personality in optimizing the material handling cost and increasing the productivity..

COURSE OUTCOMES:

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

CO 1	**Classify** the types of materials and their related aerospace engineering applications.	Understand
CO 2	**Identify** the microscopic structure and the macroscopic mechanical properties of tailor-made materials for aerospace structural member working and maintenance.	Apply
CO 3	**Explain** the plastic behaviors of crystalline and non-crystalline materials influencing the product lifecycle as per end user requirements.	Understand
CO 4	**Analyse** the anticipated mechanical properties of materials as a function of their fabrication, processing conditions and service conditions of a product.	Analyse
CO 5	**Show** the working operation of mechanical products and its related mechanisms.	Remember
CO 6	**Classify** the materials and processes that are helpful creating the product character and its personality.	Understand

COURSE KNOWLEDGE COMPETENCY LEVEL



VI 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	SEE/CIE
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	SEE/CIE
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	SEE/CIE
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	SEE/CIE

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	SEE/CIE
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	SEE/CIE
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	SEE/CIE
PO 8	**Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.	3	SEE/CIE
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	SEE/CIE
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	SEE/CIE
PO 11	**Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.	3	SEE/CIE
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	SEE/CIE

3 = High; 2 = Medium; 1 = Low

VII 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	-	-	-	✓	-	-	-	-	-	-	-	-	-	-	- ✓

VIII 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	Summarize the influence of mechanical properties of materials, Aerospace systems and address crystallography, material selection and product design related strategies using **scientific principles, mathematical and engineering fundamentals.**	3
CO 2	PO 7	Relate the microscopic material structure and mechanical properties of tailor-made materials, then predict product design strategies to satisfy economic, **environmental and societal needs with engineering solutions**for aerospace structural members.	3
CO 3	PO 5	Observe the plastic behavior of crystalline and non-crystalline materials of a product **using modern techniques, skills, and engineering tools** suitable for optimizing a product's governing parameters and enhancing overall performance of its life cycle.	3
CO 4	PO 3	Relate mechanical properties of materials as a function of a product's design, manufacturing, processing condition, workability and maintenance that contribute to meet customer satisfaction within **realistic constraints such as economic, environmental, ethical, health and safety, manufacturability, and sustainability.**	1
CO 5	PO 10	Describe the operation of mechanical products and their related mechanisms and **communicate effectively with a wide range of audiences** about the selection of materials/processes and their related product management strategies.	1

CO 6	PO 12	Select materials and processes that are useful in creating product character and recognizing the need to implement design for excellence strategies, and **engage in lifelong learning.**	1
	PSO 1	Have advanced fundamental understanding of materials behavior, or conceived, designed, and realized useful products and technology platforms within realistic engineering constraints, as demonstrated by, for example, **development of new materials, improvement of existing materials, development of new materials processing, or development of new analytical tools.**	4
	PSO 2	Are valued in their careers not only for their understanding of crystallography, materials properties, ashby charts, manufacturing technology, environmental engineering, design of excellence strategies, but equally for their analytical and creative abilities fostered by a broad engineering and liberal education, to work effectively in multidisciplinary teams to **solve complex problems, and deal with business and non-technical aspects of engineering.**	4
	PSO 3	Have embraced professional and ethical attitudes in their material science and aeronautical engineering work, are effective communicators, are aware of the **needs & challenges of a diverse workplace, have become engaged in their broader professional and social communities, and continue to be engaged in life-long learning.**	4

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

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

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

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO 1	100	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CO 2	0	0	0	0	0	0	100	0	0	0	0	0	0	0	0

CO 3	0	0	0	0	100	0	0	0	0	0	0	0	0	0	0
CO 4	0	0	100	0	0	0	0	0	0	0	0	0	0	0	0
CO 5	0	0	0	0	0	0	0	0	0	100	0	0	0	0	0
CO 6	0	0	0	0	0	0	0	0	0	0	0	100	100	100	100

XI 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	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CO 2	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0
CO 3	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0
CO 4	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0
CO 5	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0
CO 6	0	0	0	0	0	0	0	0	0	0	0	3	3	3	3
TOTAL	3	0	3	0	3	0	3	0	0	3	0	0	3	3	3
AVERAGE	3	0	3	0	3	0	3	0	0	3	0	0	3	3	3

XII ASSESSMENT METHODOLOGY DIRECT:

CIE Exams	PO 1-12, PSO 1-3	SEE Exams	PO 1-12, PSO 1-3	Seminars	PO 1-6, PSO 1-3
Laboratory Practices	-	Student Viva	-	Certification	-
Term Paper	-	5 Minutes Video	PO 1-12, PSO 1-3	Open Ended Experiments	-
Assignments	PO 1-12, PSO 1-3	Tech talk	PO 1-12, PSO 1-3		

XIII ASSESSMENT METHODOLOGY INDIRECT:

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

XIV SYLLABUS:

MODULE I	STRUCTURE OF METALS
	Structure of metals: Crystallography, Miller indices, packing efficiency, density calculations, grains and grain boundaries, effect of grain size on the properties, determination of grain size by different methods, constitution of alloys, necessity of alloying, types of solid solutions, Hume-Rothery rules, intermediate alloy phases.
MODULE II	MATERIAL SELECTION
	The basics, metals and metallic structure, metallic alloys, ceramics and glasses, polymers and composites for mechanical design, material properties: surface and other functional properties, the selection strategy, Attribute limits and material indices, the selection procedure, shape factor, Computer-aided selection, and the structural index Case Studies: Diaphragms for pressure actuators, Deflection limited design with brittle polymers, Nylon bearings for ship rudders.
MODULE III	PROCESSES AND PROCESS SELECTION
	Introduction and synopsis, classifying processes, the processes: shaping, joining, and finishing, Systematic process selection, Ranking: process cost, Computer - aided process selection, supporting information Case studies: Forming ceramic tape valves, Forming a silicon nitride micro-beam, Fabricating a pressure vessel.
MODULE IV	DESIGN PROCESS
	Material Selection using Ashby method, micro-structural shape factors, exploring and comparing structural sections, multiple Constraints and objectives in material selection, optimal selection with and without shape factor, multiple objectives, role of materials in shaping the product character.
MODULE V	METHODS TO MINIMIZE COST OF MATERIAL HANDLING
	Environmental Impact: Materials and the environment, the material life cycle, material and energy consuming systems, the eco-attributes of materials, eco-selection, Case studies - Drink containers and crash barriers. materials and industrial design: Introduction and synopsis, the requirements pyramid, product character, using materials and processes to create product personality.

TEXTBOOKS

1. M. F. Ashby, "Material Selection in Mechanical Design", Elsevier, 4th Edition, 2015.

2. M. Ashby, K. Johnson, "Materials and Design", Lakshmi Publications, Elsevier, 3rd Edition, 2014.

REFERENCE BOOKS:

1. Kenneth G. Budinski, "Engineering Materials: Properties and Selection", PHI, 1st Edition, 2013.

2. J. G. Gerdeen, H. W. Lord, R. A. L., "Engineering Design with Polymers and Composites", CRC Press, 2ndEdition, 2011.

XV COURSE PLAN:

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

Lecture No	Topics to be covered	CO's	Reference
1	Structure of Metals	CO 1	T1: 1.1-1.3 R4:1.1-1.8
2	Crystallography & Miller Indices	CO 1	T1: 1.12 R4:1.1-1.8
3	Packing Efficiency & Density Calculations	CO 1	T1: 1.12 R4:1.1-1.8
4	Grains and Grain Boundaries, Effect of Grain Size on The Properties	CO 1	T1: 2.1-2.3 R2:2.3
5	Determination of Grain Size by Different Methods	CO 1	T1:2.4-2.5 R2:3.2
6	Constitution of Alloys & Necessity of Alloying	CO 1	T1:2.15 R2:2.9
7-9	Types of Solid Solutions, Hume-Rothery Rules & Intermediate Alloy Phases	CO 1	T1:2.16-2.17 R2:2.9-2.10
10	Material Selection	CO 2	T1:2.13-2.14 R2:2.11
11	The Basics, Metals and Metallic Structure, Metallic Alloys, Ceramics and Glasses, Polymers And Composites For Mechanical Design	CO 2	T1:2.20 R2:2.11
12	Material Properties: Surface and Other Functional Properties	CO 2	T1:2.21 R2:3.5
13	The Selection Strategy	CO 2	T1:2.21 R2:3.5
14	Attribute Limits and Material Indices,	CO 2	T1:3.1 R2:3.7
15	The Selection Procedure, Shape Factor	CO 2	T1:3.2-3.3 R2:3.7
16	Computer-Aided Selection, and the Structural Index	CO 2	T1:3.4 R2:3.7
17	Case Studies: Diaphragms for Pressure Actuators & Deflection Limited Design with Brittle Polymers.	CO 2	T1:4.1-4.2 R2:4.1
18	Case Studies: Nylon Bearings for Ship Rudders	CO 2	T1:4.3,4.5 R2:5.1
19	Processes and Process Selection	CO 3-4	T1:4.3.2,4.3.3 R2:5.2
20	Introduction and Synopsis	CO 3-4	T1:4.6 R2:5.4

21	Classifying Processes	CO 3-4	T1:3.5.2-3.5.5 R2:4.3-4.4
22	The Processes: Shaping, Joining, And Finishing	CO 3-4	T1:3.5.2-3.5.51 R2:4.3-4.4
23	Systematic Process Selection	CO 3-4	T1:3.5.7-3.5.8 R2:4.5
24	Ranking & Process Cost	CO 3-4	T1:4.7-4.8 R2:6.1
25	Computer - Aided Process Selection & Supporting Information	CO 3-4	T1:4.9-4.10 R2:6.2
26	Case Studies: Forming Ceramic Tape Valves & Forming A Silicon Nitride Micro-Beam	CO 3-4	T1:5.1-5.2 R2:7.1-7.2
27	Case Studies: Fabricating A Pressure Vessel.	CO 3-4	T1:5.3-5.4 R2:7.4
28	Design Process	CO 3-4	T1:5.4-5.7 R2:7.4
29	Material Selection	CO 5	T1:5.4-5.7 R2:7.4
30	Material Selection Using Ashby Method	CO 5	T1:5.4-5.7 R2:7.4
31	Micro-Structural Shape Factors	CO 5	T1:5.2.7 R2:7.3
32	Shape Factors and Structural Sections	CO 5	T1:5.8 R2:7.3
33	Exploring and Comparing Structural Sections	CO 5	T1:6.3-6.4
34	Multiple Constraints and Objectives In Material Selection	CO 5	T1:6.3-6.4 R2:7.4
35	Optimal Selection With/Without Shape Factor Or/And Multiple Objectives	CO 5	T1:6.1 R2:7.7
36	Role of Materials In Shaping The Product Character	CO 5	T1:6.2 R2:6.3
37	Environmental Impact: Materials and The Environment	CO 6	T1:6.3-6.4 R2:7.8
38	The Material Life Cycle	CO 6	T1:6.3-6.4 R2:7.8
39	Material and Energy Consuming Systems	CO 6	T1:7.1-7.4 R2:8.1
40	The Eco-Attributes of Materials,	CO 6	T1:7.3,7.5-7.7 R2:8.6
41	Eco-Selection	CO 6	T1:7.5-7.7 R2:8.6

42	Case Studies-Drink Containers and Crash Barriers	CO 6	T1:7.8 R2:8.6
43	Materials and Industrial Design: Introduction and Synopsis	CO 6	T1:7.9 R2:8.7
44	The Requirements Pyramid, Product Character	CO 6	T1:8.2 R2:7.12-7.13
45	Using Materials and Processes to Create Product Personality.	CO 6	T1:8.2 R2:7.12-7.13

Signature of Course Coordinator **HOD**
Ms. V Lakshmi Prasanna, Assistant Professor

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

CIVILL ENGINEERING

COURSE DESCRIPTION

Course Title	**HYDRAULIC ENGINEERING LABORATORY**				
Course Code	ACEB15				
Program	B.Tech				
Semester	V	CE			
Course Type	CORE				
Regulation	IARE - R18				
Course Structure	Theory			Practical	
	Lecture	Tutorials	Credits	Laboratory	Credits
	-	-	-	2	1
Course Coordinator	Ms. N Sri Ramya, Assistant Professor				

I COURSE OVERVIEW:

The Hydraulic Engineering laboratory is designed to examine the properties of fluids and to conduct experiments for an in-compressible fluids (Water). It is an introductory course where flow behavior, fluid forces and analysis tools are introduced. This course will also provide the fundamental knowledge on basic devices used to determine the rate of flow, friction and performance of hydraulic machines. The course also discusses about various flow measuring devices, total energy in pipes, pumps, turbines used in fluid Mechanics and measurement of their performance characteristics. Students are expected to get hands on experience on investigating the fundamentals of fluid statics as well as kinematics and kinetics of fluid flow and operation of turbo machineries

II COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites
B.Tech	ACEB10	III	Fluid Mechanics Laboratory

III MARKS DISTRIBUTION:

Subject	SEE Examination	CIE Examination	Total Marks
Hydraulic 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 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

VI COURSE OBJECTIVES:

The students will try to learn:

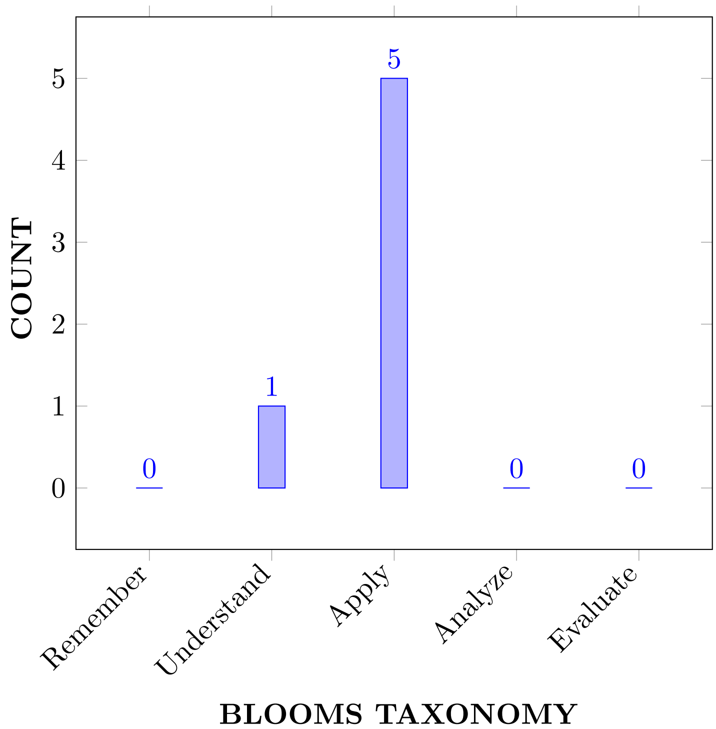
I	The various types of fluids, properties and behaviour under static and dynamic conditions of closed conduit and open channels.
II	The measurement of flow rate through various internal and external flow systems
III	The operating principle of various turbo machinery and analyze their performance characteristics under various operating conditions..

VII COURSE OUTCOMES:

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

CO 1	**Utilize** the concept of calibrating orifice and venturi meter to reduce the uncertainty in the discharge coefficient. .	Apply
CO 2	**Make use of** pipe friction test apparatus to measure the friction factor under a range of flow rates and flow regimes.	Apply
CO 3	**Demonstrate** the verification of Bernoulli‘s theorem for incompressible steady continuous flow.	Understand
CO 4	**Identify** the critical Reynolds number using Reynolds apparatus for illustrating the transition of laminal flow into turbulent flow.	Apply
CO 5	**Make use of** jet impact apparatus for investigating the reaction forces produced by the change in momentum.	Apply
CO 6	**Utilize** Weirs, Notch and orifice meter for determining the rate of discharge through external and internal flow system.	Apply

COURSE KNOWLEDGE COMPETENCY LEVEL



VIII HOW PROGRAM OUTCOMES ARE ASSESSED:

Program		Strength	Proficiency Assessed by
PO 1	**Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.	2	Lab Exercises
PO 3	**Design/Development of Solutions:** Design solutions for complex Engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and Environmental considerations	2	CIA
PO 5	**Modern Tool Usage:** Create, select, and apply appropriate techniques, resources, and modern Engineering and IT tools including prediction and 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 3	Make use of multi physics, computational fluid dynamics and flight simulation tools for building career paths towards innovative startups, employability and higher studies.	2	Lab Exercises

3 = High; 2 = Medium; 1 = Low

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

COURSE OUTCOMES	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key Competencies
CO 1	PO 1	Utilize the concept of calibration to a considerable extent appreciate (understanding) their importance and applicability (apply) in solving (complex) fluid flow engineering problems by applying the **principles of Mathematics and Engineering**	3
	PO 2	Understand the (given **problem statement**) calibration procedure for (provided **information and data**) in reaching substantiated conclusions by the interpretation of results	3

	PSO 3	Apply (**knowledge**) properties, various types and patterns of fluid flow configurations (apply) for solving design problems by applying the **principles of Mathematics, Science and Engineering**	3
CO 2	PO 1	Explain (understanding) various effects of viscosity in flow through pipes and apply Newtons law of viscosity, in calculating energy loss by applying **principles of Mathematics, Science and Engineering**	3
	PO 5	Understand the (given **problem statement**) effects of viscosity, and capillary rise for the bodies immersed in fluids. (from the provided **information**) in solving analysis problems.	2
	PSO 3	Apply (**knowledge**) Newtons law of viscosity (understanding) in body, under different inlet conditions in (apply) solving flow through pipes by applying the principles of **Mathematics, Science and Engineering**	3
CO 3	PO 1	Summarize (**knowledge**) the concept of pressure measuring devices applications and effect of buoyancy on submerged bodies (understanding) their importance and applicability (apply) in solving (complex) fluid flow engineering problems by applying the textbfprinciples of Mathematics, Science and Engineering	3
	PO 3	Understand the given **problem statement** and formulate (complex) of pressure measuring devices applications and effect of buoyancy on submerged bodies (understanding) their importance and applicability (apply) in solving (**complex**) fluid flow engineering problems from the provided information and substantiate with the **interpretation** of variations in the **results**.	3
	PSO 3	Apply (knowledge) various effects of viscosity, static pressure, surface tension, Newton's law of viscosity, pressure difference and capillary rise (apply) in solving aircraft analysis problems by applying the **principles of Mathematics, Science and Engineering**	3
CO 4	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, Science and Engineering**	3
	PO 5	Understand the given **problem statement and formulate** the dimensional analysis and similarity parameters for predicting physical parameters that govern fluid systems in designing prototypes devices	2
	PSO 3	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 **principles of Mathematics, Science and Engineering**	3

CO 5	PO 1	Apply the basic conservation laws of science for various phenomena of fluid systems and use **mathematical principles** for deriving (complex) fluid flow engineering equations by understanding the appropriate parametric assumptions and limitations based on **engineering fundamentals** of fluid mechanics.	3
	PO 3	Understand the given **problem statement** and formulate (complex) fluid flow engineering phenomena and system for deriving various governing equations of fluid mechanics from the provided information and substantiate with the **interpretation** of variations in the results.	2
	PO 5	Make use of **computational and experimental tools** for creating innovative career paths, to be an entrepreneur and desire for higher studies in the field of fluid mechanics.	2
	PSO 3	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 **principles of Mathematics, Science and Engineering**	3
CO 6	PO 1	Apply the knowledge of **Mathematics and Engineering fundamentals** for determining unit indicators, and performance of hydraulic machines such as speed, discharge and power numbers etc for designing the new equipment's as per the requirements	2
	PO 5	Using first **principles of Sciences and Engineering fundamentals** understand the concept of unit indicators, and performance of hydraulic machines such as speed, discharge and power numbers for designing desired equipment's.	2
	PSO 3	Extend the focus to **understand the innovative and dynamic challenges** involves in evaluation of hydraulic machine performance.	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 3	PO 5	PSO 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		2	3

XII ASSESSMENT METHODOLOGY DIRECT:

CIE Exams	PO 1, PO 3, PSO 3	SEE Exams	PO 1,PO 3, PO 5, PSO 3	Seminars	-
Laboratory Practices	PO 1,PO 3, PO 5, PSO 3	Student Viva	PO 1, PO 5	Certification	-
Assignments	-				

XIII ASSESSMENT METHODOLOGY INDIRECT:

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

XIV SYLLABUS:

WEEK I	**INTRODUCTION TO HYDRAULIC ENGINEERING LABORATORY**
	Introduction to Hydraulic Engineering laboratory
WEEK II	**FRICTION FACTOR FOR A SQUARE PIPE**
	Measurement of Friction factor for a given square pipe
WEEK III	**MINOR LOSSES IN CLOSED PIPES – I**
	Determination of minor losses due to sudden expansion in a closed pipe
WEEK IV	**MINOR LOSSES IN CLOSED PIPES – II**
	MINOR LOSSES IN CLOSED PIPES – II
WEEK V	**COEFFICIENT OF DISCHARGE FOR CONVERGENT MOUTH PIECE**
	Measuring the co-efficient of discharge for convergent type of mouth pieces.
WEEK VI	**COEFFICIENT OF DISCHARGE FOR DIVERGENT MOUTH PIECE**
	Measuring the co-efficient of discharge for divergent type of mouth pieces..
WEEK VII	**COEFFICIENT OF DISCHARGE FOR TRAPEZOIDAL NOTCH**
	Determination of co-efficient of discharge for the given trapezoidal notch.
WEEK VIII	**COEFFICIENT OF DISCHARGE FOR STEPPED NOTCH**
	Determination of co-efficient of discharge for the given stepped notch

WEEK IX	**PERFORMANCE TEST OF KAPLAN TURBINE**
	Determination of maximum efficiency of Kaplan turbine.
WEEK X	**IMPACT OF JET ON AN INCLINED PLATE**
	To find the coefficient of impact by the jet of water on an inclined plate
WEEK XI	**HYDRAULIC JUMP**
	To perform test on hydraulic jump to find the length and height of jump.
WEEK XII	**DISCHARGE THROUGH A WEIR**
	To find the discharge through a weir in an open channel
WEEK XIII	**BERNOULLI'S EXPERIMENT**
	To determine the total head at all the duct points for an inclined pipe using Bernoullis experiment.
WEEK XII	**TIME OF EMPTYING A TANK USING MOUTHPIECE**
	To estimate the time taken to empty the tank using mouthpiece.

TEXTBOOKS

1. Frank M. White, "Fluid Mechanics ", McGraw Hill Education Private Limited, 8th Edition, 2017 .

2. R. K Bansal, "Fluid mechanics and hydraulic machines", Laxmi publications ltd, 9th Edition, 2011.

3. Robert W Fox, Alan T McDonald, "Introduction to fluid Mechanics" John Wiley and Sons, 6th Edition, 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	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**
Ms. N Sri Ramya, Assistant Professor

INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

Dundigal, Hyderabad - 500 043

CIVIL ENGINEERING

COURSE DESCRIPTION

Course Title	CONCRETE TECHNOLOGY LABORATORY				
Course Code	ACEB16				
Program	B.Tech				
Semester	V	CE			
Course Type	Core				
Regulation	IARE - R18				
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.

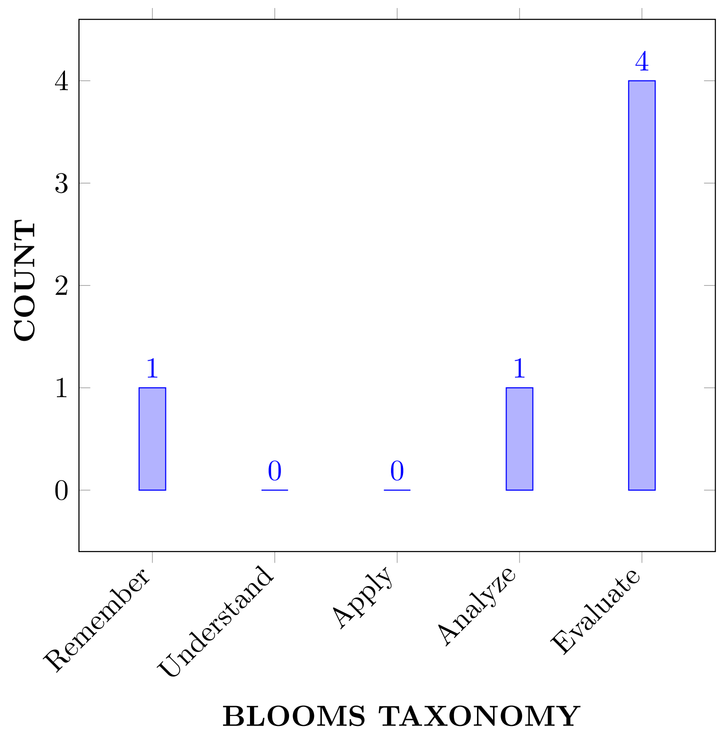
II	The factors influencing workability and methods involved in measuring workability of fresh concrete.
III	The importance of water/cement ratio and its influence on compressive strengths of hardened concrete.
IV	The concept of quality control and design of concrete mix for ensuring quality of concrete.

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≤ 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	**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 2	R1: 4.3
4	Initial and final setting times of cement.	CO 2	R1: 3.2
5	Specific gravity of cement.	CO 3	R1: 5.4
6	Compressive strength of cement.	CO 2	R3: 6.2
7	Soundness of cement.	CO 2	R3: 7.1
8	Fineness modulus of fine and coarse aggregate.	CO 4	R2: 6.6
9	Bulking of sand.	CO 4	R2: 7.2
10	Workability tests on fresh concrete.	CO 5	R1: 8.1

11	Test for compressive strength of cement concrete.	CO 6	R1:8.4
12	Revision	CO 2, CO 3, CO 6	R1:7.3, R2: 8.1

XVIII EXPERIMENTS FOR ENHANCED LEARNING (EEL):

S.No	Design Oriented Experiments
1	Strength of concrete made of silica fume and fly-ash.
2	Strength of concrete made of steel fibres.
3	Light weight concrete using light weight aggregates.
4	Investigation on characteristics properties of high performance Self-compacting concrete for m40 and m50.
5	Measurement of Workability of Concrete Mix.

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

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

Department	**CIVIL ENGINEERING**				
Course Title	**ENGINEERING ECONOMICS, ESTIMATION AND COSTING**				
Course Code	ACEB17				
Program	B.Tech				
Semester	VI	CE			
Course Type	CORE				
Regulation	IARE - R18				
Course Structure	Theory			Practical	
	Lecture	Tutorials	Credits	Laboratory	Credits
	3	-	3	-	-
Course Coordinator	Mr. Ch. Balakrishna, Assistant Professor				

I COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites
B.Tech	ACEB02	III	Building Materials and Construction Planning
B.Tech	ACEB08	IV	Materials, Testing and Evaluation

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 DELIVERY / INSTRUCTIONAL METHODOLOGIES:

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

V EVALUATION METHODOLOGY:

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

Semester End Examination (SEE): The SEE is conducted for 70 marks of 3 hours duration. The syllabus for the theory courses is divided into FIVE modules and each module carries equal weightage in terms of marks distribution. The question paper pattern is as follows. Two full questions with "either" or "choice" will be drawn from each module. Each question carries 14 marks. There could be a maximum of two sub divisions in a question.

The expected percentage of cognitive level of the questions is broadly based on the criteria given in Table: 1.

Percentage of Cognitive Level	Blooms Taxonomy Level
20%	Remember
40 %	Understand
40 %	Apply
20%	Analyze
0 %	Evaluate
0 %	Create

Continuous Internal Assessment (CIA):
CIA is conducted for a total of 30 marks (Table 2), with 20 marks for Continuous Internal Examination (CIE), 05 marks for Quiz and 05 marks for Alternative Assessment Tool (Table 3).

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:

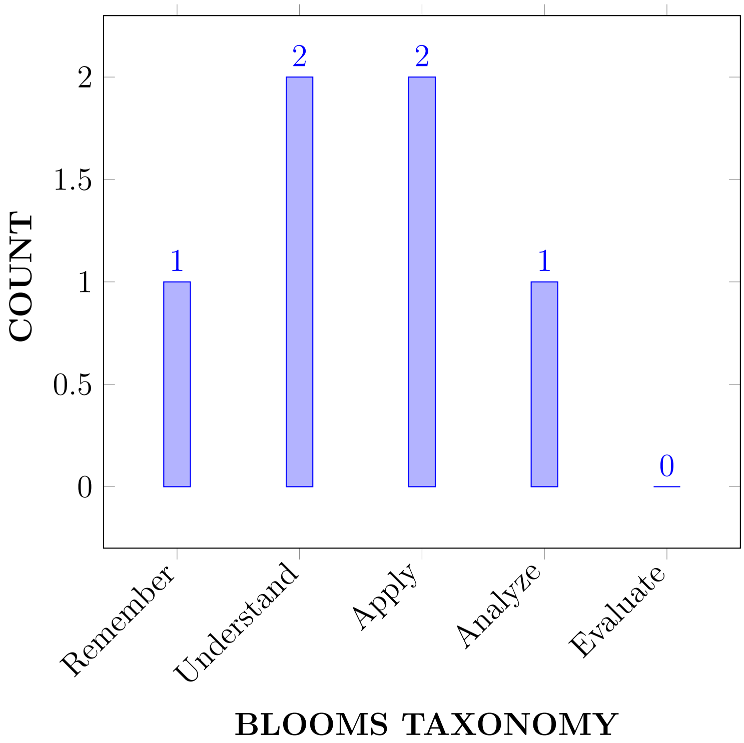
I	The importance and fundamentals of estimation and costing for measuring quantities of construction materials using traditional methods involved in project works.
II	The basic concept of earth work related to roads and canals for estimating earth work quantity using sectional area methods.
III	The concept 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	**Identify** the use of contract documents, tender documents and specifications for preparation of bill of quantities and bidding details of the projects.	Apply
CO 5	**Outline** the quantities of steel and concrete for preparing bar bending schedule, quantities of various elements of Reinforced cement concrete structures.	Understand
CO 6	**Classify** the different methods of valuation to asses the the actual value of the property.	Understand

COURSE KNOWLEDGE COMPETENCY LEVEL



VIII PROGRAM OUTCOMES:

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

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

IX HOW PROGRAM OUTCOMES ARE ASSESSED:

Program		Strength	Proficiency Assessed by
PO 1	**Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.	3	CIE/SEE/AAT
PO 2	**Problem analysis:** : Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences	1	CIE/SEE/AAT
PO 5	**Modern Tool Usage:** Create, select, and apply appropriate techniques, resources, and modern Engineering and IT tools including prediction and modelling to complex Engineering activities with an understanding of the limitations	3	CIE/SEE/AAT
PO 6	**The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.	1	CIE/SEE/AAT
PO 12	**Life-Long Learning:** Recognize the need for and having the preparation and ability to engage in independent and life-long learning in the broadest context of technological change	1	CIE/SEE/AAT

3 = High; 2 = Medium; 1 = Low

X HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

Program		Strength	Proficiency Assessed by
PSO 1	Design and Supervise Sub-Structures and Super Structures for Residential and Public Buildings, Industrial Structures, Irrigation Structures, Power Houses, Highways, Railways, Airways, Docs and Harbours.	1	CIE/SEE/AAT
PSO 3	Make use of Advanced Structural Analysis and Project Management Software for creating Modern Avenues to succeed as an Entrepreneur, Pursue Higher Studies and Career Paths.	3	CIE/SEE/AAT

3 = High; 2 = Medium; 1 = Low

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

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

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

Course Outcomes	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key competencies matched.
CO 1	PO 1	Identify the general items of works such as earth work excavation ,beams and columns in building and with specified standard units and applying the principles of **mathematical principles** and **engineering fundamentals**.	2
	PO 2	Choose the approximate and detailed estimation methods for the **information and data collection** of various quantities for brick work R.C.C. Retaining walls in the **documentation** purpose.	2
CO 2	PO 1	Apply the different methods like mid sectional area and mean sectional area for estimating the quantities of earth work for roads by using principles of **mathematical principles** and **engineering fundamentals**.	2

	PO 2	Identify problems related to design of road construction and canals for **development of solutions** and **documentation.**	2
	PO 6	Determining The road embankment and cutting of earth work quantities by using **Knowledge of commercial and economic context of engineering processes**	1
CO 3	PO 1	Apply **Mathematical principles** to calculate the quantities of rate analysis of **complex engineering problems.**	2
	PO 5	Apply appropriate techniques, resources, and **modern usage tool** to estimate the quantity of materials required for civil engineering works as per specifications	1
	PO 6	Determine overhead and contingent charges in rate analysis by using **Knowledge and understanding of commercial and economic context of engineering processes** and apply **Knowledge of management techniques to achieve engineering objectives**	2
	PSO 1	Design sub-structures and superstructures for buildings, industrial structures, irrigation structures, powerhouses, transportation infrastructures using **advanced tools** and **engineering fundamentals** develop bill of quantities, tender **documents** etc.	2
CO 4	PO 1	Identify different types of Contracts and the contract document 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 5	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 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	3	-	-	-	1	-	-	-	-	-	-	2	-	-
CO 5	2	-	-	-	-	-	-	-	-	-	-	-	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	30	-	-	-	20	-	-	-	-	-	-	20	-	-
CO 5	66.6	-	-	-	-	-	-	-	-	-	-	-	-		-
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	-	-	-	1	-	-	-	-	-	-	1	-	-
CO 5	3	-	-	-	-	-	-	-	-	-	-	-	-		-
CO 6	3	-	-	-	3	-	-	-	-	-	-	1	-	-	3
TOTAL	18	3	-	-	6	3	-	-	-	-	-	1	2	-	3
AVERAGE	3.0	1.0	-	-	3.0	1.0	-	-	-	-	-	1.0	1.0	-	3.0

XVI ASSESSMENT METHODOLOGY DIRECT:

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

XVII ASSESSMENT METHODOLOGY INDIRECT:

	Assessment of mini projects by experts	✓	End Semester OBE Feedback

XVIII SYLLABUS:

MODULE I	**GENERAL ITEMS OF WORK IN BUILDING**
	General items of work in building – Standard units principles of working out quantities for detailed and abstract estimates – Approximate method of estimating. Detailed estimates of buildings
MODULE II	**EARTHWORKS**
	Earthwork for roads and canals.
MODULE III	**RATE ANALYSIS**
	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	**REINFORCEMENT BAR BENDING**
	Reinforcement bar bending and bar requirement schedules.
MODULE V	**VALUATION**
	Valuation of buildings, standard specifications for different items of building construction.

TEXTBOOKS

1. B. N. Dutta, “Estimating and Costing”, UBS publishers, 2000.
2. G. S. Birdie., “Estimating and Costing”, Dhanpat Rai publications, 1988.

REFERENCE BOOKS:

1. Schedule of rates and standard data book by public works department, 2015.
2. I.S. 1200 (Parts I to XXV – 1974/method of measurement of building and Civil Engineering works – B.I.S)
3. M. Chakraborthi, “Estimation, costing and specifications”, Laxmi publications, 1982.
4. National building code, 2015.

WEB REFERENCES:

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

COURSE WEB PAGE:

1. https://akanksha.iare.ac.in

XIX COURSE PLAN:

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

S.No	Topics to be covered	CO’s	Reference T1, R1
OBE DISCUSSION			
	Outcome Based Education, CO PO attainment and Blooms Taxonomy		

CONTENT DELIVERY (THEORY)			
1	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	Introduction to Contracting, contract document	CO 4	T2: 17.3
24	Different types of Contracts	CO 4	T2: 17.4, R2:7.8
25	Contract document- Security performance of contract, conditions of contract	CO 4	T2: 17.5-17.
26	Labour contract, negotiated contract. Contract document- Earnest money deposit & Security deposit.	CO 4	T1:15.5-15.6, R1:11.5
27	Conditions of Contract	CO 4	T1:15.5-15.6, R1:11.5
28	Types of tenders, Scrutinizing of tender, Accepting Tenders, Notice Inviting tender	CO 4	T1:15.7-15.8
29	Reinforcement bar bending schedule	CO 5	T2:13.1-13.2
30	Problems related to reinforcement bar bending.	CO 5	T2: 13.313.4
31	Problems related to bar bending schedule	CO 5	T2:17.117.2
32	Valuation of buildings- Sinking Fund, Deprecation, method of valuation.	CO 6	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
44-45	Long wall short wall method for a single room building.	CO 2	T1:1.5-1.6, R2: 4.3
PROBLEM SOLVING/ CASE STUDIES			
1	Long wall short wall method for a Two room building & Residential building.	CO 2	T1:2.1-2.2
2	Centre line Method for a single room building.	CO 2	T1:2.3-2.4
3	Problems on Road Estimating, Problems related to Mid-sectional area method.	CO 2	T1:2.5-2.6
4	Problems on Road Estimating, Problems related to Mean Sectional area method.	CO 2	T1:2.7.3-2.7.4, R3: 5.1
5	Problems on Road Estimating, Problems related to Prismoidal formula method.	CO 2	T1: 7.1-7.3, R1:2.4
6	Problems on Canal works- related to earthwork of canals for fully Excavation case.	CO 3	T1: 7.4-7.6, R2: 2.2
7	Problems on Canal works- related to earthwork of canals for Partly Excavation & Partly embankment case.	CO 3	T1: 9.3
8	Calculate the rate analysis for I-Class Brick work in foundation and plinth with 20 x 10 x 10 cm (nominal size) bricks with cement sand mortar 1:6 per cum	CO 3	T1: 9.4
9	Calculate the rate analysis for Random rubble masonry in super structure in 1: 6 cement sand mortar per cum.	CO 3	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	Explain the different engineering contracts with their advantages and disadvanteges.	CO 4	T1:11.7-11.8, R2: 7.10
12	Reinforcement quantity estimation from bar bending schedule	CO 5	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 5	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 6	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 6	T1:15.5-15.6, R1:11.5
DISCUSSION OF DEFINITION AND TERMINOLOGY			
1	General items of work in building – Standard units principles of working out quantities for detailed and abstract estimates – Approximate method of estimating. Detailed estimates of buildings	CO 1	T1:1.5, T2: 5.4, R3: 7.3
2	Earthwork for roads and canals.	CO 2	T1:4.5, T2: 5.4, R3: 7.2
3	Rate analysis - Working out data for various items of work over head.Rate analysis - Contingent charges. Contracts – Types of contracts – Contract documents – Conditions of contract.	CO 3, 4	T1:4.5, T2: 5.4, R3: 7.3
4	Reinforcement bar bending and bar requirement schedules.	CO 5	T1:4.5, T2: 5.4, R3: 7.3
5	Valuation of buildings, standard specifications for different items of building construction.	CO 6	T1:4.5, T2: 5.4, R3: 7.3

DISCUSSION OF QUESTION BANK			
1	General items of work in building – Standard units principles of working out quantities for detailed and abstract estimates – Approximate method of estimating. Detailed estimates of buildings	CO 1	R4:2.1
2	Earthwork for roads and canals	CO 2	T4:7.3
3	Rate analysis - Working out data for various items of work over head. Rate analysis - Contingent charges. Contracts – Types of contracts – Contract documents – Conditions of contract.	CO 3, CO4	R4:5.1
4	Reinforcement bar bending and bar requirement schedules.	CO 5	T1:7.5
5	Valuation of buildings, standard specifications for different items of building construction.	CO 6	T1: 4.1

Signature of Course Coordinator **HOD, CE**
Mr. Ch. Balakrishna, Assistant Professor

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

COURSE DESCRIPTION

Department	**CIVIL ENGINEERING**				
Course Title	**HYDRLOGY AND WATER RESOURCES ENGINEERING**				
Course Code	ACEB18				
Program	BTECH				
Semester	VI				
Course Type	CORE				
Regulation	R-18				
Course Structure	Theory			Practical	
	Lecture	Tutorials	Credits	Laboratory	Credits
	2	1	3	-	-
Course Coordinator	Ms. N Sri Ramya, Assistant Professor				

I COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites
B.Tech	ACEB14	V	Hydraulic Engineering
B.Tech	ACEB06	IV	Fluid Mechanics
B.Tech	AMEB03	II	Engineering 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	✓	Chalk & Talk	x	Assignments	x	MOOC
✓	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
0%	Remember
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), 05 marks for Quiz and 05 marks for Alternative Assessment Tool (AAT).

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

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

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

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

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

VI COURSE OBJECTIVES:

The students will try to learn:

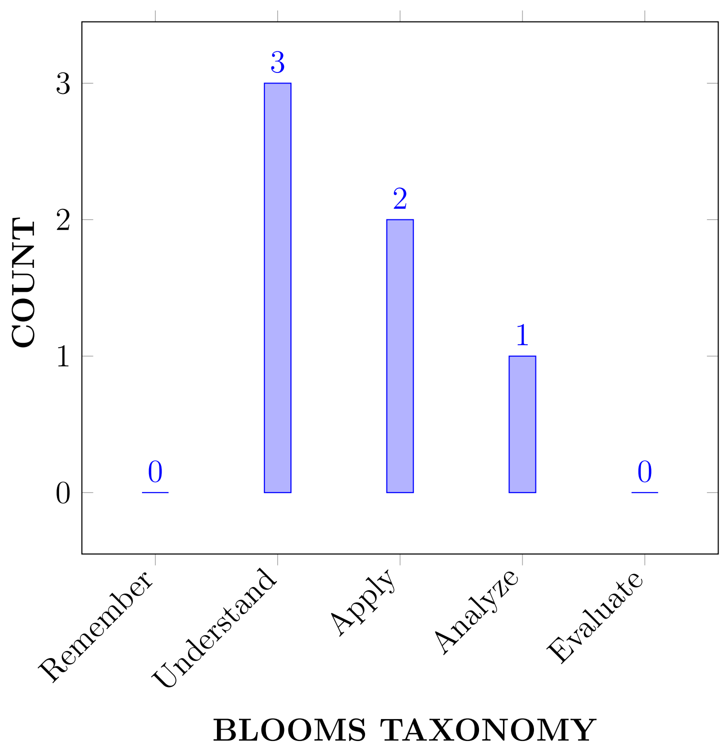
I	The fundamentals of hydrological cycle – on and below the surface of the earth.
II	The concept of ground water engineering and analytical techniques in ground water flow
III	The principles of irrigation types, methods and design-discharge required based on canal networks.
IV	The construction of hydraulic 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/Quiz/AAT
PO 2	**Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.	2	CIE/Quiz/AAT
PO 3	**Design/Development of Solutions:** Design solutions for complex Engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and Environmental considerations	1	CIE/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.	3	Assignments/ SEE /CIE, AAT, QUIZ
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	Assignments

3 = High; 2 = Medium; 1 = Low

X HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

PROGRAM SPECIFIC OUTCOMES		Strength	Proficiency Assessed by
PSO 1	Design and supervise sub-structures and 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.

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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**
Ms. N Sri Ramya, Assistant Professor

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

COURSE DESCRIPTION

Department	**CIVIL ENGINEERING**				
Course Title	**GEOTECHNICAL ENGINEERING**				
Course Code	ACEB19				
Program	B.Tech				
Semester	VI				
Course Type	Core				
Regulation	R-18				
Course Structure	Theory			Practical	
	Lecture	Tutorials	Credits	Laboratory	Credits
	2	1	3	-	-
Course Coordinator	Dr. V. Anand Reddy, Associate Professor				

I COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites
B.Tech	AMEB03	III	Engineering Mechanics
B.Tech	ACEB05	IV	Engineering Geology

II COURSE OVERVIEW:

Geotechnical engineering is the systematic application of techniques which allows construction with soil androck. This course features soil basics, including their derivation, identification and classification andemphasizes Principles of water flow in soils, settlement, heave, and shear strength of soils. The course alsodeals with materials, soil and rock that, by their very nature, exhibit varied and uncertain behavior due to theimprecise physical processes associated with the formation of these materials. Further, The course is usefulfor designing and development of different forms of foundations in industrial and residential constructions.

III MARKS DISTRIBUTION:

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

IV CONTENT DELIVERY / INSTRUCTIONAL METHODOLOGIES:

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

V EVALUATION METHODOLOGY:

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

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), 05 marks for Quiz and 05 marks for Alternative Assessment Tool (AAT).

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

Continuous Internal Examination (CIE):

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

Quiz - Online Examination

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

Alternative Assessment Tool (AAT)

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

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

VI COURSE OBJECTIVES:

The students will try to learn:

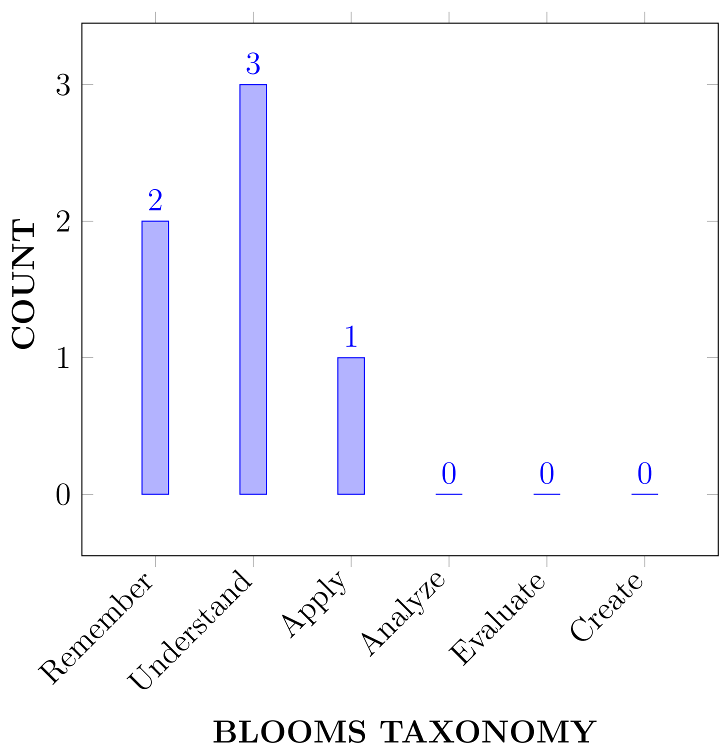
I	The fundamental knowledge on soils, importance in the design and construction process of massive structures.
II	The laboratory, field tests conducted on soils to identify the better ground to construction.
III	The methods employed for soil properties prediction, soil layers and its applications
IV	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 & COMPACTION**
	Boussinesq's theory for point load, uniformly loaded circular and rectangular areas, Westergaard's theory for point load condition, pressure bulb, variation of vertical stress under point load along vertical and horizontal plane, Newmark's influence chart for irregular areas. Mechanism of compaction, factors affecting compaction, effects of compaction on soil properties, field compaction equipment and compaction quality control.
MODULE IV	**CONSOLIDATION**
	Types of compressibility, immediate settlement, primary consolidation and secondary consolidation, stress history of clay, e-p and e-log p curves, normally consolidated soil, over and under consolidated soil, pre-consolidation pressure and its determination, Terzaghi's 1-D consolidation theory, coefficient of consolidation square root time and logarithm of time fitting methods, computation of total settlement and time rate of settlement.
MODULE V	**SHEAR STRENGTH OF SOILS**
	Importance of shear strength, Mohr's-Coulomb failure theories, types of laboratory tests for strength parameters, strength tests based on drainage conditions, strength envelops, shear strength of sands, dilatancy, critical void ratio, liquefaction, shear strength of clays.

TEXTBOOKS

1. Braja M. Das, “Principles of geotechnical engineering” Cengage learning publishers,2002.
2. VNS Murthy, “Soil mechanics and foundation engineering”, CBS publishers and distributors,2003.
3. Gopal Ranjan and ASR Rao, “Basic and Applied Soil Mechanics”, New age international Pvt. Ltd, New Delhi,2000.

REFERENCE BOOKS:

1. C. Venkataramiah, “Geotechnical engineering”, New Age International Pvt. Ltd,2002.
2. Manojdutta and Gulati, “Geotechnical engineering”, Tata Mc Graw hill publishers New Delhi,2005.
3. K.R .Arora, “Soil mechanics and foundation engineering”, standard publishers and distributors, New Delhi,2005.
4. B.C. Punmia, Ashok Kumar Jain and Arun Kumar Jain, “Soil mechanics and foundation”, Laxmi publications Pvt. Ltd, New Delhi,2005.

WEB REFERENCES:

1. http://nptel.ac.in/courses/105107120/1
2. http://www.nptel.ac.in/courses/105105105/
3. http://www.nptel.ac.in/courses/105105104

COURSE WEB PAGE:

1. https://onlinecourses.nptel.ac.in/noc22_ce03/unit?unit=17&lesson=19

XIX COURSE PLAN:

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

S.No	Topics to be covered	CO’s	Reference T1: 4.1
OBE DISCUSSION			
1	Discussion on OBE, PO’s, PSO’s and CO of subject Geotechnical Engineering		
CONTENT DELIVERY (THEORY)			
2	Introduction to geotechnical engineering, properties of Soils, Formation of soil and soil structures	CO 1	T4: 1.3-1.13, R1:4.2
3-4	Clay mineralogy and adsorbed water, Mass volume relationship	CO 1	T4: 6.5-6.12, R2:3.3

5-6	Relative density, Index properties of soils: grain sizes analysis	CO 1	T4:.3.15-3.16, T4:.3.3
7-8	Index properties of soils: grain sizes analysis, Sieve and hydrometer method of analysis	CO1	T4: 3.8-3.9 R2:3.5
9-10	Consistency limit and indices of soil	CO1	R2:3.6
11	I.S. classification of soils,	CO1	T4: 5.7
12	Permeability - soil water –capillary rise, Darcy's law	CO2	T4: 8.1-8.4
13.14	Flow of water through soil	CO2	T4: 8.9-8.10
15-16	Permeability and factors effecting, laboratory determination of coefficient of permeability	CO 2	T4: 8.6-8.7
17-18	Permeability of layered systems	CO2	T4: 8.9-8.10, R3:3.7
19-20	Seepage through soils –total, neutral and effective stresses quick sand conditions	CO2	T4: 9.11-9.12
21-22	Seepage through soils.	CO2	T4: 9.11-9.12
23-24	Flow nets, characteristics and uses	CO2	T4: 9.4-9.5
25	Stress distribution in soils – Boussinesq's theory for point loads and areas of different shapes	CO3	T4:11.3-11.9
26	Westergaard's theory for point loads and area of different shapes	CO3	T4:11.15-11.1
27-28	Newmark's influences chart	CO3	T4:11.3-11.9
29-30	Compaction- mechanism of compaction	CO4	T4:14.1-14.4
31-32	Factors effecting compaction of soils properties	CO4	T4:14.8-14.9
33-34	Effect of compaction on soil properties	CO4	T4:14.8-14.9
35-36	Field compaction equipment, Compaction control	CO4	T4:14.13-14.1
37-38	Consolidation –stress history of clay, e-p and e- log pcurves	CO5	T4:12.1-12.2
39-40	Magnitude and rates of 1-d consolidation	CO5	T4:12.4-12.5
41-42	Terzaghi's theory, shear strength of soils –Mohr and Coulomb failure theories	CO6	T4:13.1-13.2
43-44	Types of laboratory strength test, Shear strength of sands	CO6	T4:13.23-13.24, R2:5.2
45	Strength test based on drainage conditions, Critical void ratio of clay, Liquefaction and shear strength of clay	CO6	T4:13.22-13.23

PROBLEM SOLVING/ CASE STUDIES			
1	Problems of soil 3-phase relationships	CO1	T1,2 and R1
2	Problems on weight-volume relationships	CO1	T1,2 and R1
3	Problems on density-volume relationships	CO1	T1,2 and R1
4	Problems on Grain size analysis	CO1	T1,2 and R1
5	Problems on Capillary rise	CO2	T1,2 and R1
6	Problems on flow of water through soils	CO2	T1,2 and R1
7	Problems on permeability	CO2	T1,2 and R1
8	Problems on permeability of layered soils	CO2	T1,2 and R1
9	Problems on Total, neutral and effective stress	CO2	T1,2 and R1
10	Problems on Boussinesq's and Westergard's theories	CO3	T1,2 and R1
11	Problems on variation of vertical stress under point load along vertical and horizontal plane	CO3	T1,2 and R1
12	Problems on compaction	CO4	T1,2 and R1
13	Problems on primary consolidation and secondary consolidation	CO5	T1,2 and R1
14	Problems on shear strength of soils based on drainage conditions	CO6	T1,2 and R1
15	Problems on shear strength of sands, dilatancy and critical void ratio	CO6	T1,2 and R1
DISCUSSION OF DEFINITION AND TERMINOLOGY			
1	Module I (Void rstio and porosity)	CO 1	R1
2	Module II (Permeability and Darcy's Law)	CO2	R1
3	Module III(pressure bulb and compaction)	CO3 & CO4	R1
4	Module IV (consolidation)	CO5	T 1&2, R1
5	Module V (critical void ratio and liquefaction)	CO6	R1
DISCUSSION OF QUESTION BANK			
1	Module I (clay mineralogy and soil structure)	CO1	R1
2	Module II (permeability, Total, neutral and effective stress)	CO2	T 1&2, R1
3	Module III (variation of vertical stress under point load along vertical and horizontal plane and Mechanism of compaction)	CO 3 & CO4	T 1&2, R1

4	Module IV (Types of compressibility, immediate settlement, primary consolidation and secondary consolidation)	CO 5	T 1&2, R1
5	Module V (Mohr and coulomb failure theories and types of laboratory tests for determination of strength parameters)	CO 6	T 1&2, R1

Signature of Course Coordinator **HOD, CE**

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

COURSE DESCRIPTION

Department	**CIVIL ENGINEERING**				
Course Title	**DESIGN OF STEEL STRUCTURES AND DRAWING**				
Course Code	ACEB30				
Program	B.Tech				
Semester	VI				
Course Type	PROFESSIONAL ELECTIVE				
Regulation	R-18				
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	ACEB07	IV	Strength of Materials
B.Tech	ACEB12	V	Mechanics of Materials
B.Tech	ACEB13	V	Structural Engineering

II COURSE OVERVIEW:

Design of steel structures and drawing deals with the analysis and design of steel structural elements like tension members, compression members, beams and girders etc. This course will focus on mechanical properties of structural steel, concepts of elasticity and plasticity and limit state design. The course will help to enrich the knowledge of design in multi storeyed and industrial structures including bridges. The course will also enhance the knowledge or skill sets of the student for designing efficient, economic and durable steel structures.

III MARKS DISTRIBUTION:

Subject	SEE Examination	CIE Examination	Total Marks
Design of Steel Structures and Drawing	70 Marks	30 Marks	100

IV CONTENT DELIVERY / INSTRUCTIONAL METHODOLOGIES:

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

V EVALUATION METHODOLOGY:

The course will be evaluated for a total of 100 marks, with 30 marks for Continuous Internal Assessment (CIA) and 70 marks for Semester End Examination (SEE). Out of 30 marks allotted for CIA during the semester, marks are awarded by taking average of two 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
25%	Understand
50%	Apply
15%	Analyze

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

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

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

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

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

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

VI COURSE OBJECTIVES:

The students will try to learn:

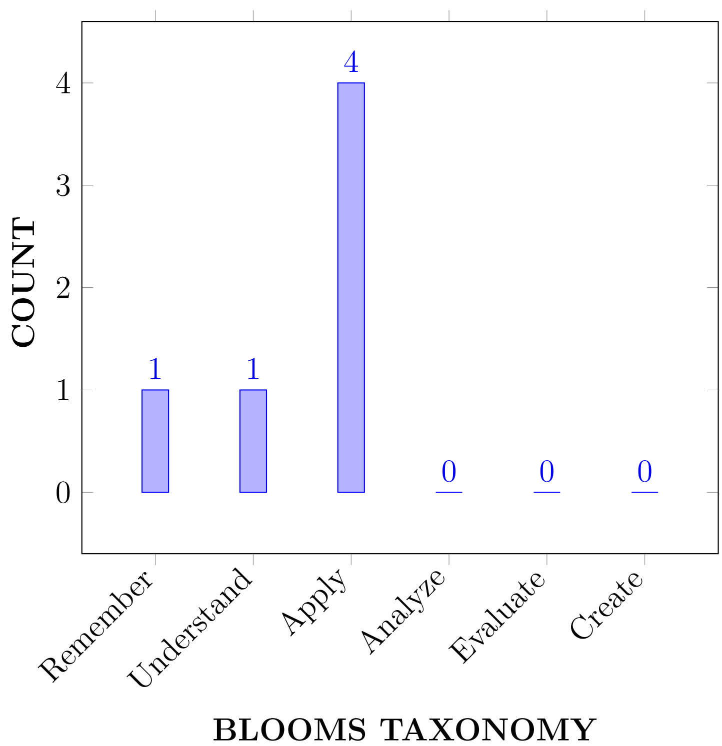
I	The concepts of limit state design and the behaviour of structural steel used in design and its properties.
II	The design of structural elements necessary for creating efficient and economic steel structures.
III	The design and drawing of multi storeyed industrial and residential structures including 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.	3

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

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

XIV PERCENTAGE OF KEY COMPETENCIES FOR CO – PO/ PSO

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	66.7	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 2	66.7	-	-	-	-	-	-	-	-	-	-	-	10.0	-	-
CO 3	66.7	40.0	10.0	45.5	-	-	-	-	-	-	-	-	40.0	-	-
CO 4	66.7	40.0	10.0	45.5	-	-	-	-	-	-	-	-	40.0	-	-
CO 5	66.7	40.0	10.0	45.5	-	-	-	-	-	-	-	-	40.0	-	-
CO 6	66.7	40.0	10.0	45.5	-	-	-	-	-	-	-	-	40.0	-	-

XV COURSE ARTICULATION MATRIX (PO / PSO MAPPING):

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

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

1 -$5 < C \leq 40\%$ – Low/ Slight

2 - $40\ \% < C < 60\%$ –Moderate

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

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

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 5	3	2	1	2	-	-	-	-	-	-	-	-	2	-	-
CO 6	3	2	1	2	-	-	-	-	-	-	-	-	2	-	-
TOTAL	18	8	4	8									9		
AVERAGE	3.0	2.0	1.0	2.0									2.0		

XVI ASSESSMENT METHODOLOGY-DIRECT:

CIE Exams	✓	SEE Exams	✓	Seminars	-
Laboratory Practices	-	Student Viva	-	Certification	-
Term Paper	-	5 Minutes Video	✓	Open Ended Experiments	-
Assignments	-	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
5-6	Understand loads and combinations loading wind loads on roof trusses.	CO 1	T1:10.2 R1: 1.6
7	Understand behavior of steel, local buckling.	CO 1	T1:10.1
8	Concept of limit state design – different limit states as per IS 800:2007.	CO 2	T1: 10.4-10.5 T3: 2.1 – 2.7
9	Concept of design strengths deflection limits, serviceability.	CO 2	T1: 11.1-11.8
10-11	Evaluate the bolted connections and efficiency of joint.	CO 3	T1: 11.10 -11.11
12	Analyze the prying action in bolted and welded joints.	CO 3	T1: 3.10-3.12
13-15	Understand the design of tension members and design strength of members.	CO 4	T1: 3.10 R1: 3.1 – 3.5
16-18	Understand the design of compression members, buckling class, slenderness ratio.	CO 4	T1: 5.1-5.3 T3: 6.1 – 6.5

19-20	Understand the strength design, laced and battened columns.	CO 4	T1: 5.4-5.9 R1: 4.1 – 4.8
21-22	Understand the design of column base, and slab base.	CO 4	T1: 5.11-5.13 R1: 9.3
23-24	Understand the design of beams, plastic moment.	CO 4	T1: 6.1-6.4 R1: 5.1 – 5.4
25-26	Analyse the bending and shear strength laterally supported beams.	CO 4	T1: 6.5-6.12 T2: 6.1 – 6.4
27-29	Understand the design, built up sections, large plates web buckling.	CO 4	T1: 6.12 R1: 5.5 – 5.8
30-31	Analyse the crippling and deflection of beams, design of purlin.	CO 4	T1: 12.6 T3: 7.12 – 7.15
32-33	Understand the design of eccentric connections with brackets.	CO 5	T1: 11.3-11.4 T2: 10.1 – 10.9
34-35	Analyse the beam end connections, web angle and design of truss joints.	CO 5	T1: 7.1-7.3
36-39	Understand the design of plate girders, optimum depth, and design of main section.	CO 6	T1: 7.4-7.8 R1: 7.1 – 7.3
40-42	Understand the design of end bearing stiffness and intermediate stiffness.	CO 6	T1: 7.6 R1: 7.4 – 7.6
43-45	Analyze the Connection between web and flange.	CO 6	T1: 7.6-7.8
PROBLEM SOLVING/ CASE STUDIES			
1	Calculate the strength of a bolt and strength of different bolted joints.	CO 3	T1: 11.10 -11.11
2	Design of bolted and welded connections for different joints.	CO 3	T1: 3.10-3.12
3	Calculate the strength of the given tension member in the steel structures.	CO 4, CO 5	T1: 3.10 R1: 3.1 – 3.5
4	Design of tension members subjected to tensile loads.	CO 4, CO 5	T1: 3.10 R1: 3.1 – 3.5
5	Calculate the strength of a given compression member of a rolled section and built-up section.	CO 4	T1: 5.1-5.3 T3: 6.1 – 6.5
6	Design of compression member for axial loads including built-up sections.	CO 4	T1: 5.4-5.9 R1: 4.1 – 4.8
7	Design built-up columns sections using lacings.	CO 4	T1: 5.4-5.9 R1: 4.1 – 4.8
8	Design built-up columns sections using battens.	CO 4	T1: 5.4-5.9 R1: 4.1 – 4.8
9	Design slab base as the foundation for the columns	CO 4	T1: 5.11-5.13 R1: 9.3
10	Calculate the strength of a given rolled beam section and built-up section.	CO 4	T1: 6.5-6.12 T2: 6.1 – 6.4
11	Design of laterally supported beam sections.	CO 4, CO 5	T1: 6.12 R1: 5.5 – 5.8
12	Design of laterally un supported beam sections	CO 4, CO 5	T1: 6.5-6.12 T2: 6.1 – 6.4
13	Design of bracket connections type I and II for joining steel members.	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, CO 4	T1:5.1 - 5,13
3	Design of beams and bending and shear strength laterally supported beams. Design of built-up sections, large plates web buckling, crippling and deflection of beams, design of purlin.	CO 3, CO 4	T1 6.1-6.12
4	Design of eccentric connections with brackets, beam end connections, web angles, design of truss joints.	CO 5	T1:7.1 - 7.3
5	Design of plate girders, optimum depth, design of main section, design of end bearing stiffness and intermediate stiffness. Connection between web and flange.	CO 6	T1: 7.1 - 7.8
DISCUSSION OF QUESTION BANK			
1	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

COURSE DESCRIPTION

Department	**CIVIL ENGINEERING**				
Course Title	**DESIGN OF CONCRETE STRUCTURES - I**				
Course Code	ACEB34				
Program	B.Tech				
Semester	VI	CE			
Course Type	Elective				
Regulation	IARE - R18				
Course Structure	Theory			Practical	
	Lecture	Tutorials	Credits	Laboratory	Credits
	3	-	3	-	-
Course Coordinator	Mr. Gude Ramakrishna, Assoiciate 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:

Design of concrete structure is 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, short and long columns with biaxial bending, slabs like one way, two way, continuous, 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
Design of concrete structures-I	70 Marks	30 Marks	100

IV DELIVERY / INSTRUCTIONAL METHODOLOGIES:

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

V EVALUATION METHODOLOGY:

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

Semester End Examination (SEE): The SEE is conducted for 70 marks of 3 hours duration. The syllabus for the theory courses is divided into FIVE modules and each module carries equal weightage in terms of marks distribution. The question paper pattern is as follows. Two full questions with "either" or "choice" will be drawn from each module. Each question carries 14 marks. There could be a maximum of two sub divisions in a question.

The expected percentage of cognitive level of the questions is broadly based on the criteria given in Table: 1.

Percentage of Cognitive Level	Blooms Taxonomy Level
33%	Remember
50 %	Understand
17 %	Apply
0 %	Analyze
0 %	Evaluate
0 %	Create

Continuous Internal Assessment (CIA):

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

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

Continuous Internal Examination (CIE):

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

Quiz - Online Examination

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

Alternative Assessment Tool (AAT)

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

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

VI COURSE OBJECTIVES:

The students will try to learn:

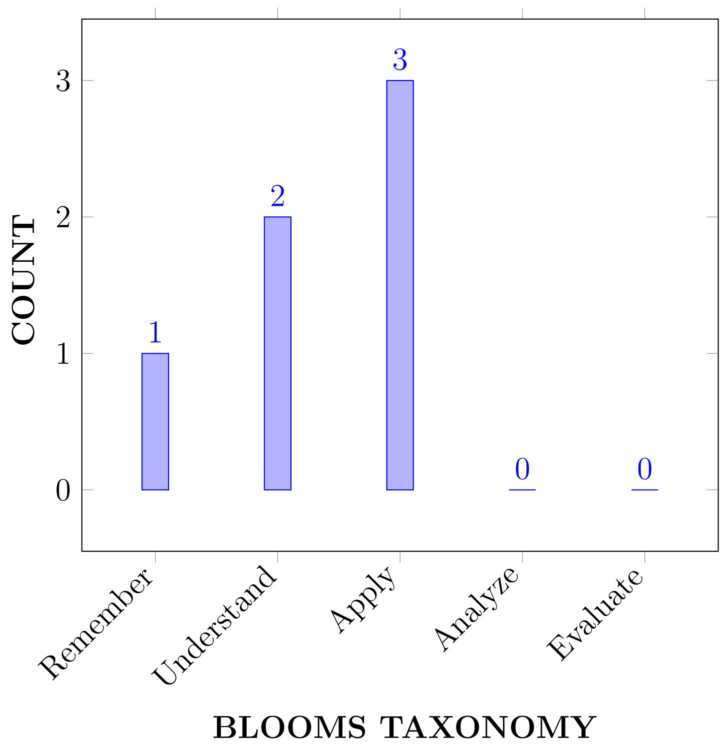
I	The basic design concepts for reinforced concrete structures starting with historical development to the latest limit state theory.
II	The Indian Standard codal provisions and refreshing the bending and shear theory.
III	The behavior of reinforced concrete components and systems subjected to gravity as well as lateral loads, designing of different structural members like beam, slab, column and footing.
IV	The utilization of advanced computer software packages for the analysis and design of structural components.

VII COURSE OUTCOMES:

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

CO 1	**Recall** basic concepts of reinforced concrete design, material stress–strain curves, and safety factors to know the properties of concrete structure..	Remember
CO 2	**Explain** the concept of Stress block parameters and use the design concept of working stress method, limit state methodfor designing different structural componentse .	Understand
CO 3	**Explain** the concept of bond, anchorage and development length and section for shear and torsion for safe designing of residential, commercial and industrial structures.	Understand
CO 4	**Solve** singly reinforced, doubly reinforced, T, L beam sections as per IS: 456–2000 for obtaining the reinforcement details in load bearing members.	Apply
CO 5	**Solve** One-way, Two-way, slabs sections as per IS: 456–2000for obtaining the reinforcement details in load bearing members.	Apply
CO 6	**Develop** the concept of Axial loading uni-axial and bi-axial bending of vertically loaded members, isolated and Combined footing to obtain reinforcement details.	Apply

COURSE KNOWLEDGE COMPETENCY LEVEL



VIII PROGRAM OUTCOMES:

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

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

IX HOW PROGRAM OUTCOMES ARE ASSESSED:

Program		Strength	Proficiency Assessed by
PO 1	**Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.	3	CIE/SEE/AAT
PO 2	**Problem analysis:** : Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.	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 5	**Modern Tool Usage:** Create, select, and apply appropriate techniques, resources, and modern Engineering and IT tools including prediction and modelling to complex Engineering activities with an understanding of the limitations.	1	CIE/SEE/AAT

PO 11	**Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.	1	CIE/SEE/AAT

3 = High; 2 = Medium; 1 = Low

X HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

Program		Strength	Proficiency Assessed by
PSO 1	**Design and Supervise:** Focus on Design and Supervise of Sub-Structures and Super Structures for Residential and Public Buildings, Industrial Structures, Irrigation Structures, Power Houses, Highways, Railways, Airways, Docs and Harbours	1	CIE/SEE/AAT

3 = High; 2 = Medium; 1 = Low

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

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

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

Course Outcomes	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key competencies matched.
CO 1	PO 1	**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

	PO3	**Understand** the Stress–Strain curves relation, Safety factors,**evaluate** Stress block parameters and**manage the design process** for individual structural members of a structure.	2
CO 2	PO2	**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	**Identify** material stress–strain curves, safety factors **information and validation** data collection of member by using experimental design and **Interpretation of results.** .	2
	PO 5	**Understand** limit state analysis and manage the **design process** , to obtain the **design section for shear** and apply them to determine the behaviour of elements of a structure.	2
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	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**.	3
	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**.	3
	PO 5	**Create, select**, and **apply** appropriate techniques, resources, and modern Engineering and IT tools for structural design of members.	2
	PO 11	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**.	3

	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	**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.	2
	PO 5	**Create, select**, and **apply** appropriate techniques, resources, and modern Engineering and IT tools for structural design of members.	3
	PO 11	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**.	3
	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 6	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	**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.	2
	PO 5	**Create, select**, and **apply** appropriate techniques, resources, and modern Engineering and IT tools for structural design of members.	3
	PO 11	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**.	3
	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

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	2	-	-	-	-	-	-	-	-	-	-	-	-
CO 2	-	2	1	-	-	-	-	-	-	-	-	-	-	-	-
CO 3	-	2	2	-	3	-	-	-	-	-	-	-	-	-	-
CO 4	2	-	3	-	3	-	-	-	-	-	3	-	2	-	-
CO 5	2	2	2	-	3	-	-	-	-	-	3	-	2	-	-
CO 6	2	2	2	-	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	66.6	30.0	20.0	-	-	-	-	-	-	-	-	-	-	-	-
CO 2	-	20.0	10.0	-	-	-	-	-	-	-	-	-	-	-	-
CO 3	-	20.0	20.0	-	-	-	-	-	-	-	-	-	-	-	-
CO 4	66.6	-	30.0	-	30.0	-	-	-	-	-	20.0	-	20.0	-	-
CO 5	66.6	20.0	20.0	-	30.0	-	-	-	-	-	20.0	-	20.0	-	-
CO 6	66.6	20.0	20.0	-	30.0	-	-	-	-	-	20.0	-	20.0	-	-

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	-	1	1	-	-	-	-	-	-	-	-	-	-	-	-
CO 3	-	1	1	-	-	-	-	-	-	-	-	-	-	-	-
CO 4	3	-	1	-	1	-	-	-	-	-	1	-	1	-	-
CO 5	3	1	1	-	1	-	-	-	-	-	1	-	1	-	-
CO 6	3	1	1	-	1	-	-	-	-	-	1	-	1	-	-
TOTAL	25	8	9	-	2	-	-	-	-	-	2	-	9	-	-
AVERAGE	2.78	1.0	1.0	-	1.0	-	-	-	-	-	1.0	-	1.0	-	-

XVI ASSESSMENT METHODOLOGY DIRECT:

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

XVII ASSESSMENT METHODOLOGY INDIRECT:

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

XVIII SYLLABUS:

MODULE-I	**DESIGN OF BEAMS**
	Concepts of RC Design –Limit state method, Material Stress–Strain curves, Safety factors, Characteristic values, Stress block parameter, IS-456:2000 - Working Stress Method. BEAMS: Limit state analysis and design of singly reinforced, doubly reinforced, T, and L beam sections.
MODULE-II	**SHEAR TORSION AND BOND**
	Limit state analysis and design of section for shear and torsion – concept of bond, anchorage and development length, I.S. code provisions. Design examples in simply supported and continuous beams, detailing Limit state design for serviceability for deflection, cracking and codal provision.
MODULE-III	**DESIGN OF SLABS**
	Design of One-way Slabs and Two-way slabs. Continuous slabs using I.S. coefficients, Cantilever slab or Canopy slab.
MODULE-IV	**DESIGN OF COLUMNS**
	Design of short columns for axial loads, uni-axial and bi-axial bending. I.S. Code provisions.
MODULE-V	**DESIGN OF FOOTINGS**
	Design of isolated square and rectangular footings for axially and eccentrically loaded columns, Design of combined footing.

TEXTBOOKS

1. Dr. B. C. Punmia, "Limit state design of reinforced concrete", Laxmi Publications, NewDelhi.

2. S. Unnikrishna Pillai and DevdasMenon, "Reinforced concrete design", Tata Mc. Graw Hill, New Delhi.

3. N. Krishna Raju and R. N. Pranesh, "Reinforced Concrete Design", New Age International Publishers, New Delhi.

4. P. C. Varghese, "Limit state design of reinforced concrete", Prentice Hall of India, New Delhi

REFERENCE BOOKS:

1. M. L. Gambhir, "Fundamentals of reinforced concrete design", Prince Hall of India Pvt. Ltd, New Delhi.
2. P. Purushotham, "Reinforced concrete structural elements – behavior, Analysis and design", Tata McGraw Hill, 1994.

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		
CONTENT DELIVERY (THEORY)			
1	Explanation about loading, working stress method, limit state method	CO 1	T1: 2.1 , R1:3.9
2	Material stress strain curves, safety factors	CO 1	T2: 1.7 R1:1.12.3
3	Philosophy of characteristic strength values waste	CO 1	T2: 1.10 R1:1.15
4	Stress block parameters for reinforced concrete rectangular section	CO 1	T2: 1.15 R1:1.16
5	The failure modes of reinforced structures under different load conditions	CO 1	T2: 1.17 R1:1.13.1
6	Recognizing key features of IS 456: 2000	CO 1	T2: 1.18 R1:1.13.2
7	Summarize working stress method, Limit state method in design	CO 2	T2:6.1 R1:2.3
8	Design of singly reinforced beams	CO 2	T2:6.3 R1:2.6.1
9	Design of singly reinforced beams	CO 2	T1:2.7.1-2.7.2
10	Design of singly reinforced beams	CO 2	T2: 1.20 R1:1.7.1
11	Design of doubly reinforced beams	CO 2	T2: 1.20 R1:1.7.1
12	Design of doubly reinforced beams	CO 3	T2: 1.20 R1:1.7.1
13	Design of T beam sections and L beam sections	CO 3	T1: 7.7, R3: 10.4
14	Design of T beam sections and L beam sections	CO 3	T2: 1.24 R1:1.17.3

15	Analysis and Design of section for shear	CO 3	T2:6.1 R1:2.3
16	Analysis and Design of section for shear	CO 3	T2:6.1 R1:2.3
17	Analysis and Design of section for torsion	CO 3	T2:6.3 R1:2.6.1
18	Analysis and Design of section for torsion	CO 4	T2:6.3 R1:2.6.1
19	Concept of bond, anchorage and development length	CO 4	T2:6.3 R1:2.6.1
20	Problems on development length	CO 4	T2:6.3 R1:2.6.1
21	Problems on development length	CO 4	T2:6.5 R1:2.6.2
22	Understand deflection limits in IS: 456–2000	CO 4	T2:7.3 R1:2.8
23	Calculate deflection (theoretically)	CO 4	T2:7.3 R1:2.8
24	Design and concept of one-way slabs	CO 4	T2:7.3 R1:2.8
25	Problems on one-way slabs	CO 4	T2:7.5,7.6 R1:2.9.2
26	Design and concept of two-way slabs.	CO 4	T2:7.5,7.6 R1:2.9.2
27	Problems on Two-way slabs.	CO 5	T2: 17.4, R2:7.8
28	Problems on Two-way slabs.	CO 5	T2:7.7 R1:2.10
29	Design concept of continuous slabs	CO 5	T2:7.7 R1:2.10
30	Calculate the I.S. coefficients for Cantilever slab	CO 5	T2:7.7 R1:2.10
31	Problems on Cantilever and Canopy slab.	CO 5	T2:7.7 R1:2.10
32	Design of Short columns	CO 5	T1:15.7-15.9
33	Problems on columns.	CO 5	T3:15.2 R1:8.2
34	Problems on columns.	CO 5	T2:15.7 R1:8.3.3
35	Design of Short columns under axial loads	CO 5	T2:7.11 R1:2.10.2
36	Common effluent treatment plants	CO 5	T3:15.2 R1:8.2

37	Problems on Short columns under axial loading	CO 5	T3:15.2 R1:8.2
38	Problems on Short columns under axial loading	CO 5	T1:15.7-15.8
39	Design of isolated (square, rectangular) and combined footings	CO 6	T2:5.18 R1:1.13.2
40	Design of isolated (square, rectangular) and combined footings	CO 6	T2:2.1 R1:7.9.2
41	Design of isolated (square, rectangular) and combined footings	CO 6	T2:5.19 R1:1.13.3
42	Problems on footings	CO 6	T2:5.18 R1:1.13.2
43	Design and types of staircase	CO 6	T2:6.1 R2:2.3
44	Problems on Design of staircase	CO 6	T2:6.1 R2:2.3
45	Problems on Design of staircase	CO 6	T2:1.2 R1:7.2
PROBLEM SOLVING/ CASE STUDIES			
1	Different methods of design for reinforced concrete structural elements.	CO 1	T1:2.1-2.2
2	Limiting strength of concrete and steel in Reinforced Concrete Beams.	CO 1	T1:2.3-2.4
3	Assumptions made in limit state of design in shear.	CO 2	T1:2.5-2.6
4	Factors influencing the short term deflection, long term deflection of RC beams.	CO 2	T1:2.7.3 R3: 5.1
5	Various remedial measures for control of cracking	CO 3	T1: 7.1-7.3, R1:2.4
6	The various methods of volume and strength reduction adopted for the industrial wast	CO 3	T1: 7.4, R2: 2.2
7	Reinforcement requirement for One-way slabs as per IS:456	CO 4	T1: 9.3
8	Need for corner reinforcement in two-way rectangular slabs whose corners are prevented from lifting up.	CO 4	T1: 9.4
9	Design strengths of steel in tension or bending compression and axial compression	CO 4	T1:9.5-9.6, R1: 6.4
10	Maximum slenderness ratio of reinforced columns allowed by IS:456-2000	CO 4	T1:11.1-11.2, R2: 9.15
11	Minimum diameter of bars used in longitudinal steel for columns	CO 5	T1:11.7-11.8, R2: 7.10

12	Methods available for design of columns subjected to P and M.	CO 5	T1: 1.1 -1.,
13	Advantages of providing a pedestal and explain about isolated footing.	CO 5	T1: 7.4-7.6
14	Method of determining the effective spans of stairs.	CO 6	T2:13.1-13.2
15	IS Recommendations regarding longitudinal reinforcements.	CO 6	T1:15.5-15.6
DISCUSSION OF DEFINITION AND TERMINOLOGY			
1	Difference between the singly and doubly reinforced beam and idealized stress-strain curve for concrete and steel.	CO 1	R4:2.1
2	Purpose of splicing of reinforcement, what are the different ways by which this can be achieved.	CO 2	T4:7.3
3	Check for Deflection control in the design of slabs, discuss the design procedure for one way slab.	CO 3	R4:5.1
4	Difference between behavior of a short and long column and maximum slenderness ratio of reinforced columns allowed by IS:456-2000.	CO 4, CO 5	T1:7.5
5	Specifications for diameter of transverse reinforcement and recommendations regarding longitudinal reinforcements.	CO 6	T1: 4.1
DISCUSSION OF QUESTION BANK			
1	Design of Beams	CO 1	R4:2.1
2	Shear Torsion and Bond	CO 2	T4:7.3
3	Design of Slabs	CO 3	R4:5.1
4	Design of Columns	CO 4, CO 5	T1:7.5
5	Design of footings	CO 6	T1: 4.1

Signature of Course Coordinator **HOD, CE**
Mr. Gude Ramakrishna, Associate Professor

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

COURSE DESCRIPTION

<table>
<tr><td>Department</td><td colspan="5">CIVIL ENGINEERING</td></tr>
<tr><td>Course Title</td><td colspan="5">RELATIONAL DATA BASE MANAGEMENT SYSTEM</td></tr>
<tr><td>Course Code</td><td colspan="5">ACSB34</td></tr>
<tr><td>Program</td><td colspan="5">B.Tech</td></tr>
<tr><td>Semester</td><td colspan="5">VI</td></tr>
<tr><td>Course Type</td><td colspan="5">ELECTIVE</td></tr>
<tr><td>Regulation</td><td colspan="5">R18</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>2</td><td>1</td><td>3</td><td>-</td><td>-</td></tr>
<tr><td>Course Coordinator</td><td colspan="5">Ms. K RASHMI,Assistant Professor</td></tr>
</table>

I COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites
-	-	-	-

II COURSE OVERVIEW:

The purpose of this course is to provide a clear understanding of fundamentals with emphasis on their applications to create and manage large data sets. It highlights on technical overview of database software to retrieve data from n database. The course includes database design principles, normalization, concurrent transaction processing,, security, recovery and file organization techniques

III MARKS DISTRIBUTION:

Subject	SEE Examination	CIE Examination	Total Marks
RELATIONAL DATA BASE MANAGEMENT SYSTEM	70 Marks	30 Marks	100

IV CONTENT DELIVERY / INSTRUCTIONAL METHODOLOGIES:

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

V EVALUATION METHODOLOGY:

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

Semester End Examination (SEE): The SEE is conducted for 70 marks of 3 hours duration. The syllabus for the theory courses is divided into FIVE modules and each module carries equal weightage in terms of marks distribution. The question paper pattern is as follows. Two full questions with "either" or "choice" will be drawn from each module. Each question carries 14 marks. There could be a maximum of two sub divisions in a question.

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

Percentage of Cognitive Level	Blooms Taxonomy Level
10%	Remember
40 %	Understand
50 %	Apply
0 %	Analyze
0 %	Evaluate
0 %	Create

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

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

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

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

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

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

VI COURSE OBJECTIVES:

The students will try to learn:

I	Acquire analytical thinking and identify efficient ways of designing database by encapsulating data requirements for business and organizational scenarios.
II	Develop expertise in database language SQL to develop sophisticated queries to extract information from large datasets.

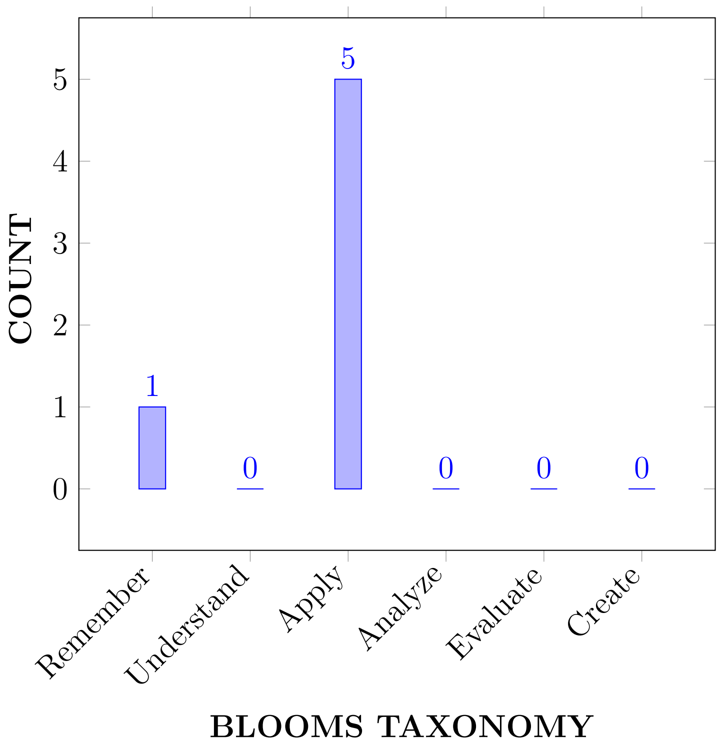
III	Enhance skills to develop and manage data in solving related engineering problems.

VII COURSE OUTCOMES:

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

CO 1	**Outline** the importance of database system and its functionalities using entity relationship model for data storage and management.	Remember
CO 2	**Illustrate** basic and relational operations to access data from the database.	Apply
CO 3	**Build** SQL queries for database creation, manipulation and data retrieval.	Apply
CO 4	**Identify** the appropriate normalization technique for controlling the redundancy of database.	Apply
CO 5	**Demonstrate** the ACID properties of transaction processing to preserve the database in a consistent state.	Apply
CO 6	**Make use of** concurrency control protocols to provide the congestion free transactions of data.	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	SEE / CIE / AAT
PO 2	**Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.	3	SEE / CIE / 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	3	SEE / 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.	3	SEE / CIE / 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.	1	SEE / CIE / 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	SEE / CIE / AAT

3 = High; 2 = Medium; 1 = Low

X HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

PROGRAM SPECIFIC OUTCOMES		Strength	Proficiency Assessed by
PSO 1	**Understand, design and analyze** computer programs in the areas related to Algorithms, System Software, Web design, Big data, Artificial Intelligence, Machine Learning and Networking.	3	SEE/AAT

PROGRAM SPECIFIC OUTCOMES		Strength	Proficiency Assessed by
PSO 3	**Make use of** modern computer tools for creating innovative career paths, to be an entrepreneur and desire for higher studies.	2	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	Define database, characteristics, functions of database management system and types of users to describe large sets of data with knowledge of mathematics, and Engineering Fundamentals..	2
CO 2	PO 1	Compare traditional File Processing System and a Database System for constructing a database using the knowledge of mathematics, science, and engineering fundamentals.	3
	PO 2	Compare traditional File Processing System and a Database System for constructing a database With Problem statement and system definition , Problem formulation and abstraction .	7
CO 3	PO 1	Describe data models, schemas, instances, view levels and database architecture for voluminous data storage using principles of mathematics, science, and engineering fundamentals.	3
	PO 2	Describe data models, schemas, instances, view levels and database architecture for voluminous data storage with Problem statement and system definition , Problem formulation and abstraction	2
CO 4	PO 2	Model the real world database systems using Entity Relationship Diagrams from the requirement specification with the Problem statement and system definition, Problem formulation and abstraction , Information and data collection, Model translation.	4

	PO 3	Model the real world database systems using Entity Relationship Diagrams from the requirement specification through Investigate and define a problem and identify constraints ,Understand customer and user needs, Manage the design process and evaluate outcomes.	4
	PO 4	Model the real world database systems using Entity Relationship Diagrams from the requirement specification by Understanding of contexts in which engineering knowledge can be applied, Understanding use of technical literature, Understanding of appropriate codes of practice and industry standards.	3
	PSO 1	Model the real world database systems using Entity Relationship Diagrams from the requirement specification by using sequence of steps.	1
CO 5	PO 1	Define the relational data model, its constraints and keys to maintain integrity of data using the knowledge of mathematics, science, and engineering fundamentals.	3
	PO 2	Define the relational data model, its constraints and keys to maintain integrity of data with the Problem statement and system definition, Problem formulation and abstraction , Information and data collection, Model translation.	4
CO 6	PO 1	Define the concept of Relational Algebra and Relational Calculus from set theory to represent queries with knowledge of mathematics, science and engineering fundamentals for capacitance calculation.	3

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

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	3	2	1	-	-	-	-	-	-	1	-	-	-	-	1
CO 2	3	2	1	1	3	-	-	-	-	1	-	-	-	-	-
CO 3	3	2	1	2	3	-	-	-	-	1	-	1	-	-	1
CO 4	3	2	1	2	-	-	-	-	-	1	-	1	-	-	-
CO 5	3	2	1	1	3	-	-	-	-	1	-	1	-	-	1
CO 6	3	2	1	-	-	-	-	-	-	1	-	3	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	100.0	60.0	60.0	0.0	0.0	0.0	0.0	0.0	0.0	40.0	0.0	37.5	66.66	0.0	50.0
CO 2	100.0	70.0	60.0	72.0	0.0	0.0	0.0	0.0	0.0	40.0	0.0	37.5	66.66	0.0	50.0
CO 3	100.0	80.0	80.0	0.0	0.0	0.0	0.0	0.0	0.0	40.0	0.0	37.5	66.66	0.0	50.0

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 4	100.0	60.0	60.0	0.0	0.0	0.0	0.0	0.0	0.0	40.0	0.0	37.5	66.66	0.0	50.0
CO 5	100.0	80.0	80.0	72.0	0.0	0.0	0.0	0.0	0.0	40.0	0.0	37.5	66.66	0.0	50.0
CO 6	100.0	80.0	80.0	72.0	0.0	0.0	0.0	0.0	0.0	40.0	0.0	37.5	66.66	0.0	50.0

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	3	-	-	-	-	-	-	1	-	1	3	-	2
CO 2	3	3	3	3	-	-	-	-	-	1	-	1	3	-	2
CO 3	3	3	3	-	-	-	-	-	-	1	-	1	3	-	2
CO 4	3	3	3	-	-	-	-	-	-	1	-	1	3	-	2
CO 5	3	3	3	3	-	-	-	-	-	1	-	1	3	-	2
CO 6	3	3	3	3	-	-	-	-	-	1	-	1	3	-	2
TOTAL	18	18	18	9	-	-	-	-	-	6	-	6	18	-	12
AVERAGE	3.0	3.0	3.0	3.0	-	-	-	-	-	1	-	1	3.0	-	2

XVI ASSESSMENT METHODOLOGY-DIRECT:

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

XVII ASSESSMENT METHODOLOGY-INDIRECT:

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

XVIII SYLLABUS:

MODULE I	**CONCEPTUAL MODELING INTRODUCTION**
	Introduction to Databases and Database Management System - Database system Applications Advantages of DBMS over File System - Data Models – Instances and schema - View of Data - Database Languages - DDL-DML - Database Users and Administrator - Database System Structure.
MODULE II	**RELATIONAL APPROACH**
	Database Design and ER diagrams – Attributes and Entity Sets – Relationships and Relationship Sets – Constraints - Keys - Design Issues - Entity-Relationship Diagram- Weak Entity Sets - Extended E-R Features- Database Design with ER model - Database Design for Banking Enterprise.
MODULE III	**SQL QUERY - BASICS, RDBMS - NORMALIZATION**
	SIntroduction to the Relational Model – Structure of RDBMS - Integrity Constraints over Relations – Enforcing Integrity Constraints – Querying Relational Data - Relational Algebra and Calculus. Introduction to SQL- Data Definition commands, Data Manipulation Commands, Basic Structure, Set operations Aggregate Operations - Join operations - Sub queries and correlated queries, SQL functions, views, Triggers, Embedded SQL.
MODULE IV	**TRANSACTION MANAGEMENT**
	Functional Dependencies– Introduction , Basic Definitions, Trivial and Non trivial dependencies, closure of a set of dependencies, closure of attributes, irreducible set of dependencies- Schema Refinement in Database Design- Problems Caused by Redundancy Decompositions – Problem Related to Decomposition — Lossless Join Decomposition – Dependency Preserving Decomposition - FIRST, SECOND, THIRD Normal Forms – BCNF –Multi valued Dependencies – Fourth Normal Form.
MODULE V	**DATA STORAGE AND QUERY PROCESSING**
	Transaction concept- Transaction state- Implementation of atomicity and Durability- Concurrent executions – Serializability, Recoverability; File Organization – Organization of records in file - Data Dictionary Storage – Indexing and Hashing – Basic Concepts , Ordered Indices,B+Tree Index files, B- tree index files.

TEXTBOOKS

1. Abraham Silberschatz, Henry F. Korth, S. Sudarshan, "Database System Concepts", McGraw-Hill 6th Edition, 2017.

REFERENCE BOOKS:

1. Ramez Elmasri, Shamkant B. Navathe, "Fundamental Database Systems", Pearson Education, 6th Edition, 2014. 2. Raghu Ramakrishnan, "Database Management System", Tata McGraw
2. Hector Garcia Molina, Jeffrey D. Ullman, Jennifer Widom, "Database System Implementation", Pearson Education, United States, 1st Edition, 2000.
3. Peter Rob, Corlos Coronel, "Database System, Design, Implementation and Management", Thompson Learning Course Technology, 5th Edition, 2003.

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1. http://www.web.stanford.edu/class/cs103x
2. http://www.saylor.org/course/cs202/.
3. http://www.cse.iitd.ernet.in/ bagchi/courses/discrete-book

COURSE WEB PAGE:

1. https://lms.iare.ac.in/index ?route=course/details& course id=84

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=84
CONTENT DELIVERY (THEORY)			
2-3	Introduction, Data base System Applications, Purpose of data base Systems, View of Data – Data Abstraction, Instances and Schemas Data Models,, Database Languages, Data base access for applications Programs	CO 1, ,CO 2	T2: 1.1- 1.5
4-6	Transaction Management component of DB architecture, Data base users, History of database systems, Database design, ER Diagrams.	CO 3, CO 4	T2: 1. 6 - 1.8,, 1.10,T1: 2.1
7	Entities, Attributes and entity sets, Relationships and relationship sets, Additional features of ER model, Conceptual design with ER model, Conceptual design for large enterprises	CO 1	T2: 1. 6 - 1.8,, 1.10,T1: 2.1

8– 14	Relational Model: Introduction to the Relational Model – Integrity Constraint Over relations, Enforcing Integrity constraints – Querying relational data	CO 5	T1:1.5, 1.4.2,1.4.3
15-20	Relational Algebra and Calculus: Relational Algebra – Selection and projection –set operations – renaming, Joins – Division	CO 2,CO 6	T1:1.4.3, 1.4.4,2.3.1, 2.3.2,2.3.6,2.3.7,2.3.8
21-25	Relational calculus – Tuple relational Calculus – Domain relational calculus – Expressive Power of Algebra and calculus.	CO 2	R2:4.3 T1:2.4.1, 2.4.2,2.4.3, 4.1
26-29	Form of Basic SQL Query – Examples of Basic SQL Queries Comparison Operators – Aggregative Operators, NULL values , Logical connectivity's – AND, OR and NOT, complex Integrity Constraints in SQL	CO 2,CO 3,CO 6	T1:3.1,3.2 R1:6.2-6.8
30-35	Introduction to Nested Queries – Correlated Nested Queries Set Comparison Operators – Aggregative Operators, Triggers and Active Data bases.	CO 3 ,CO 6	R1: 7.1-7.6
36-38	Introduction to Schema refinement – Problems Caused by redundancy ,Decompositions – Problem related to decomposition	CO 3,CO 6	R2:8.1
39-44	Functional dependencies, reasoning about FDS ,Lossless join Decomposition , Dependency preserving Decomposition	CO 3	R2:8.2, 8.3
45-48	Schema refinement in Data base Design, Normal Forms, MVDs, JDs	CO 4,CO 6	R2: 9.1-9.3
49-54	Transaction Management: Transaction Concept-Transaction State- Implementation of atomicity and Durability, Concurrent Executions, Serializability , Recoverability, Implementation of Isolation, Testing for Serializability.	CO 4	R2: 9.8, 9.9, 10.1, 10.2
55-59	Concurrency Control: Lock-Based Protocols –time Stamp Based protocols-,Validation Based Protocols-Multiple Granularity	CO 5,CO 6	T2:5.5, 5.9, 5.10
60	Recovery System-Failure Classification-storage Structure recovery and Atomicity-Log Based Recovery.Tree Structured Indexing: B+ Trees, Hashing	CO 5,CO 6	R2:10.4, 10.6,10.7
PROBLEM SOLVING/ CASE STUDIES			
1	Entity Sets and Attributes	CO1,CO 6	T2:2.1
2	Degree and Cardinality constraints of relationship	CO1	T2:2.3
3	Distributed Query Processing – Case Studies	CO1,CO 6	T2:2.3.1
4	Aggregation – Role in ER Model	CO 2	T2:7.2,7.3

5	Syntax and Semantics of Data log Languages	CO 2,CO 6	T2:10.3.1
6	Rules to convert ER model into relational models (Entity sets)	CO 2,CO 6	T2:13.3.2, 13.4.1
7	Triggers – Introduction	CO 2	T2:17.1.1, 17.1.3
8	Closure of Set of FDs	CO 2,CO 6	T2:18.3.4, 18.3.4.1
9	Update, insert and Delete Anomalies	CO 3	T2:22.12, 19.1.2
10	Join Dependencies and 5NF .	CO 3,CO 6	T2:18.4, 18.4.3
11	Cloud Storage Architectures-Cloud Data Models	CO 5,CO 6	T2:19.2, 18.4.4
12	SAP as an Applications of databases	CO 5,CO 6	T2:23.1.1, 23.1.3
DISCUSSION ON DEFINITION AND TERMINOLOGY			
1	Define Database Management System?	CO 1,CO 6	T2:18.3.4, 18.3.4.1
2	What is Hierarchical model?	CO 2,CO 6	T2:22.12, 19.1.2
3	Compare Logical data independence and physical data independence?	CO 3,CO 6	T2:18.4, 18.4.3
4	What are natural join operations?	CO 4,CO 6	T2:19.2, 18.4.4
5	Define Functional Dependency?	CO 5, CO6	T2:23.1.1, 23.1.3
DISCUSSION ON QUESTION BANK			
1	Why relational model became more popular comparing with other record based models?	CO 1, CO 2	T2:18.3.4, 18.3.4.1
2	Illustrate different set operations in Relational algebra with an example.	CO 2, CO 6	T2:22.12, 19.1.2
3	Define a View in SQL. Write about updates on views.	CO 3, CO6,	T2:18.4, 18.4.3
4	Explain ACID properties and Illustrate them through examples?	CO4, CO 6	T2:19.2, 18.4.4
5	Why do you need concurrency in Transactions?	CO 5, CO 6	T2:23.1.1, 23.1.3

Course Coordinator **HOD**, CE

Mrs. K Rashmi,Assistant Professor

INSTITUTE OF AERONAUTICAL ENGINEERING
(Autonomous)

Dundigal, Hyderabad - 500 043

CIVIL ENGINEERING

COURSE DESCRIPTION

Course Title	**Geotechnical Engineering Laboratory**				
Course Code	ACEB20				
Program	B.Tech				
Semester	VI	CE			
Course Type	Core				
Regulation	R-18				
Course Structure	Theory			Practical	
	Lecture	Tutorials	Credits	Laboratory	Credits
	-	-	-	2	1
Course Coordinator	Mr. M. Madhusudhan Reddy, Assistant Professor				

I COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites
B.Tech	ACEB19	VI	Geotechnical Engineering

II COURSE OVERVIEW:

The Geotechnical Engineering Laboratory intends to train the students in the field of testing of soils to determine their physical, index and engineering properties. This course enables the students to perform the most important tests including: soil classification, compaction, permeability, direct shear testing and cyclical triaxial testing; each experiment of soil testing is presented with brief introduction covering the important details of the experiment, the theory and the purpose for which it is to be performed, followed by the detailed explanation of apparatus required, procedure and specimen calculations.

III MARKS DISTRIBUTION:

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

IV DELIVERY / INSTRUCTIONAL METHODOLOGIES:

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

V EVALUATION METHODOLOGY:

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

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

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

Continuous Internal Assessment (CIA):

CIA is conducted for a total of 30 marks (Table 2), with 20 marks for continuous lab assessment during day to day performance, 10 marks for final internal lab assessment.

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

Continuous Internal Examination (CIE):

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

1. **Experiment Based**

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

2. **Programming Based**

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

VI COURSE OBJECTIVES:

The students will try to learn:

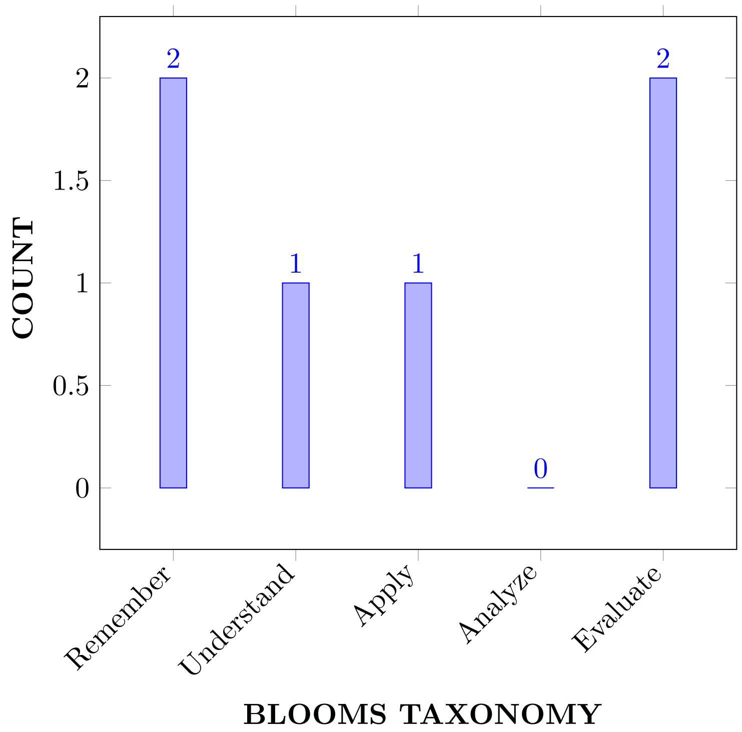
I	The concept behind the soil formation, type soil and the relationships between the soil mass and volume of voids and enables the students to perform moisture content, specific gravity and atterberg limits.
II	The procedure for soil classification through grain size distribution and classification of soil according to IS code.
III	The importance of determining the permeability and enables the students to perform permeability (constant head and variable head) test; so that students can estimate ground water flow, seepage through dams, rate of consolidation and settlement of structures.
IV	The behaviour of soil under different loading condition and enable the students derive the bearing capacity, design retaining walls, evaluate the stability of slopes and embankments, etc.

VII COURSE OUTCOMES:

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

CO 1	**Recall** the behaviour of soil with respect to water content (moisture content) for characterizing the permeability, compressibility and shear strength of soil.	Remember
CO 2	**Classify** the soils according to their grain size for determining the coefficient of uniformity and coefficient curvature upon to classify the soil according to IS code.	Understand
CO 3	**Select** the appropriate method to estimate the permeability of the layered soil for assessing drainage characteristics of soil, rate of consolidation and to predict rate of settlement of soil bed.	Apply
CO 4	**Determine** the maximum dry density through compaction and consolidation to increase the bearing capacity and stiffness of in-situ soil medium.	Evaluate
CO 5	**Recall** the importance of compressibility of the soil medium concept for taking necessary action to prevent the settlement of soil and foundation failures.	Remember
CO 6	**Evaluate** the strength of soil sub-grades and base course materials and enable appropriate selection of suitable pavement thickness for the anticipated traffic density.	Evaluate

COURSE KNOWLEDGE COMPETENCY LEVEL



VIII HOW PROGRAM OUTCOMES ARE ASSESSED:

Program		Strength	Proficiency Assessed by
PO 1	**Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.	3	Lab Exercises
PO 2	**Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.	2	Lab Exercises
PO 3	**Design/Development of Solutions:** Design solutions for complex Engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and Environmental considerations	2.5	Lab Exercises
PO 4	**Conduct Investigations of Complex Problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.	1.8	Lab Exercises
PO 6	**The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.	3	Lab Exercises

3 = High; 2 = Medium; 1 = Low

IX HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

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

3 = High; 2 = Medium; 1 = Low

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

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

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

COURSE OUTCOMES	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key Competencies
CO 1	PO 1	**Utilize** the knowledge of moisture content and understand how it **affects** shear strength, permeability and compressibility of soil using **scientific principles** and methodology.	3
	PO 2	**Identify** the problem regarding moisture content, collect required **information** (data collection) and **validate** the results using **experimental design**.	4
	PO 4	**Apply** the knowledge of **moisture content** and **specific gravity** in finding **engineering properties of soil**	4
CO 2	PO 1	**Apply** the knowledge of **engineering fundamentals** in **understanding** and **classifying** the soil using grain size distribution.	3
	PO 2	**Understand** the importance of **grain size distribution** in data collection and to **classify the soil** accordingly particle size distribution. The obtained results are also used for the **design of drainage filters**. It is also used for selecting **filling materials** for embankment, earthen dams, road sub-base etc. Particle size distribution is also used to estimate performance of grouting chemical injection.	5
	PO 3	**Recall** the procedure to **divide the soil** according to their grain size for finding soil classification and to find **index properties**, **shear strength**, **compressibility and consolidation** of soil	6
	PO 4	**Understand** the importance of **texture** and how it affects many soil properties, such as **infiltration, structure, porosity, water holding capacity, and chemical composition** of soil solids.	7
CO 3	PO 1	**Understand** the rate at which water flows through soil (for example, the **determination** of rate of **leakage** through an earth dam) (b) Compres sion (for example, the determination of the rate of settlement of a foundation and (c) Strength (for example, the evaluation of factors of safety of an embankment).	3

	PO 2	**Understand** the soil formation because soil being a **particulate material**, has many void spaces between the grains because of the irregular shape of the individual particles; thus, soil deposits are porous media. In general, all voids in soils are connected to **neighboring voids**.	3
	PO 4	**Understand** the flow of **water through soil** and path of flow from one point to another is considered to be a straight one, on a macroscopic scale and the velocity of flow is considered **uniform** at an effective value ; this path, in a **microscopic scale**, is invariably a tortuous and erratic one because of the **random arrangement** of soil particles, and the velocity of flow may vary considerably from point to point depending upon the size of the **pore and other factors**.	6
	PSO 1	**Understand** the concept of flow nets because it provide a general knowledge of the **regional groundwater** flow **patterns** that the hydrologist can use to determine such information as **areas of recharge and discharge**. Construction of a flow net is often used for solving groundwater flow problems where the geometry makes **analytical** solutions impractical.	6
CO 4	PO 1	The **deformation**, especially the vertical deformation, called **'settlement'** of the soil, should not be excessive and must be within tolerable or permissible limits and, The **shear strength** of the foundation soil should be adequate to withstand the stresses induced.	3
	PO 2	**Understand** the behaviour of soil under the loads usually encountered in geotechnical engineering practice, the **solid grains** as well as **pore water** may be considered to be **incompressible**. Thus, **compression** of pore air and expulsion of pore water are the primary sources of volume decrease of a soil mass subjected to stresses.	5
	PO 3	**Understand** the compressibility of a soil depends on the structural arrangement of the soil particles, and in **fine-grained soils**, the degree to which adjacent particles are bonded together. A structure which is more porous, such as a honey-combed structure, is more compressible than a dense structure.	5
	PO 4	**Recall** the concept of compressibility characteristics because these are usually found by performing an **oedometer test** in the laboratory on a "so-called" **undisturbed sample** of clay or on a **remoulded sample** of the same clay. The **pressure-void ratio** diagrams for these will be invariably different. This difference is attributed to the inevitable disturbance caused during remoulding.	5
	PO 6	**Understand** the relationship between the compressibility of a clay, as indicated by its **compression index**, and the liquid limit, by conducting experiments with **clays** from various parts of the world.	3

	PSO 1	**Understand** the **one-dimensional consolidation** concept, subject to the condition of constant **initial hydrostatic** excess pressure, is the type of consolidation that is of **major interest**. It applies in the **laboratory consolidation tests** and is usually assumed, although it generally is not strictly applicable, in the cases of consolidation in the field.	5
	PSO 2	**Understand** the process of applying one of the **fitting methods** may be repeated for different increments of **pressure** using the time-compression curves obtained in each case. The values of the coefficient of consolidation thus obtained will be found to be essentially decreasing with increasing effective stress	3
CO 5	PO 1	**Understand** the procedure for the computation of anticipated settlements is called **Settlement analysis'**. This analysis may be divided into three parts. The first part consists of obtaining the soil profile, which gives an idea of the depths of various characteristic zones of soil at the site of the structure, as also the relevant properties of soil such as **initial void ratio**, grain specific gravity, water content, and the consolidation and compressibility characteristics.	3
	PO 3	**Recall** the importance of **foundations** because all structures have to be placed on soil. The structure may undergo **settlement** depending upon the characteristics such as **compressibility** of the strata of soil on which it is founded.	4
	PO 6	**Understand** the concept of elastic as well as the **primary compression** effects occur more or less together in the case of **cohesionless soils** because of their high permeabilities. The resulting settlement is termed 'immediate settlement'	3
	PSO 1	**Understand** the importance of **California bearing ratio** (CBR) test because **strength** of the strata can be determined with CBR and it is defined as the rate of the **force per unit area** required to penetrate a soil mass with a standard circular plunger of 50 mm diameter at the rate of 1.25 mm/min to that required for the corresponding **penetration** of a standard material.	5
CO 6	PO 1	**Understand** the **shearing strength** of a soils because the soil is governed by the total **normal stress** on the failure plane. However, according to Terzaghi, it is the effective stress on the failure plane that governs the shearing strength and not the total stress.	3
	PO 2	**Understand** the importance of triaxial testing is a method used to determine the **stress-strain properties** of soils by subjecting soil samples to constant **lateral pressure** while increasing **vertical pressure**. This test measures stresses in three mutually **perpendicular directions**.Normally Triaxial test is the best method to evaluate the **shear strength** of soil. It gives reliable results but accuracy of the results depends mainly on initial moisture content, **confining pressure** and drainage conditions.	7

	PO 3	**Understand** the special case of a **triaxial compression test**; the **confining pressure** being zero. A **cylindrical soil** specimen, usually of the same standard size as that for the triaxial compression, is **loaded axially** by a compressive force until failure takes place. Since the specimen is laterally unconfined, the test is known as '**unconfined compression test**'.	6
	PO 4	**Understand** the importance of unconfined compression test because it is the most popular method of soil **shear** testing because it is one of the fastest and least **expensive** methods of measuring shear strength. It is used primarily for saturated, cohesive soils which is recovered from **thin-walled sampling tubes**.	4
	PO 6	**Understand** the behaviour of **undisturbed soils** because remoulded samples cannot be got for conducting triaxial or **unconfined compression tests**, the shear strength is determined by a device called the Shear Vane. The vane shear test may also conducted in the laboratory. The laboratory shear vane will be usually smaller in size as compared to the **field vane**.	4
	PSO 1	**Understand** the importance of **Pore water pressures** because it play an important role in determining the **strength of soil**. The change in pore water pressure due to change in applied stress is characterised by **dimensionless coefficients**, called 'Pore pressure coefficients' or 'Pore pressure parameters'	4
	PSO 2	**Understand** the **strength behaviour** of a soil becasue the strength depends of its **resistance** to shearing stresses. It is made up of basically the components; frictional due to friction between individual particles. Cohesive - due to adhesion between the soil particles	3

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

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

XIII PERCENTAGE OF KEY COMPETENCIES FOR CO – PO/ PSO

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	100	40	-	36.6	-	-	-	-	-	-	-	-	-	-	-
CO 2	100	50	60	63.6	-	-	-	-	-	-	-	-	-	-	-
CO 3	100	30	-	54.5	-	-	-	-	-	-	-	-	60	-	-
CO 4	100	50	50	45.5	-	60	-	-	-	-	-	-	50	100	-
CO 5	100	-	40	-	-	60	-	-	-	-	-	-	50	-	-
CO 6	100	70	60	36.3	-	80	-	-	-	-	-	-	40	100	-

XIV COURSE ARTICULATION MATRIX (PO / PSO MAPPING):

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

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

1 -5 <C$\leq$ 40% – Low/ Slight

2 - 40 % <C < 60% –Moderate

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

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	3	2	-	1	-	-	-	-	-	-	-	-	-	-	-
CO 2	3	2	3	3	-	-	-	-	-	-	-	-	-	-	-
CO 3	3	1	-	2	-	-	-	-	-	-	-	-	2	-	-
CO 4	3	2	2	2	-	3	-	-	-	-	-	-	2	3	-
CO 5	3	-	2	-	-	3	-	-	-	-	-	-	2	-	-
CO 6	3	3	3	1	-	3	-	-	-	-	-	-	2	3	-
TOTAL	18	10	10	9	-	9	-	-	-	-	-	-	8	6	-
AVERAGE	3	2	2.5	1.8	-	3	-	-	-	-	-	-	2	3	-

XV ASSESSMENT METHODOLOGY DIRECT:

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

XVI ASSESSMENT METHODOLOGY INDIRECT:

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

XVII SYLLABUS:

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

TEXTBOOKS

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2. Manojdutta and Gulati, "Geotechnical engineering", Tata Mc Graw hill publishers New Delhi,2005.
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XVIII COURSE PLAN:

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

S.No	Topics to be covered	CO's	Reference
1	Introduction to Geotechnical Engineering.	CO 1	R4: 788-816
2	Determination of Specific gravity of soil solids by Pycnometer and Density bottle method	CO 1	R4: 788-816
3	Determination of water content of soil solids oven drying and Pycnometer method.	CO 1	R4: 788-816
4	Determination of in-situ density by core cutter and sand replacement method	CO 2	R4: 788-816
5	Grain size analysis	CO 2	R4: 788-816
6	Determination of liquid limit of fine soil by Casagrande apparatus	CO 2	R4: 788-816
7	Determination of maximum dry density and optimum moisture content by Standard Proctor compaction method	CO 4	R4: 788-816
8	Determination of co-efficient of permeability by Constant head	CO 3	R4: 788-816
9	Determination of co-efficient of permeability by variable head method	CO 3	R4: 788-816
10	Determination of liquid limit of fine soil by Cone Penetration Method	CO 3	R4: 788-816
11	Determination of shear parameters by Direct shear test of soil	CO 5	R4: 788-816
12	Determination of unconfined compressive strength of soil	CO 6	R4: 788-816
13	Vane Shear Test	CO 6	R4: 788-816

XIX EXPERIMENTS FOR ENHANCED LEARNING (EEL):

S.No	Design Oriented Experiments
1	Demonstration of miscellaneous equipments such as Augers, Samplers, Rapid Moisture meter, Proctor's needle
2	Demonstration of Hydrometer Test
3	Demonstration of Free Swell Index and Swell Pressure Test
4	Demonstration of determination of relative density of sands

Signature of Course Coordinator **HOD,CE**
Mr. M. Madhusudhan Reddy, Assistant Professor

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

CIVIL ENGINEERING

COURSE DESCRIPTION

Course Title	**REINFORCED CONCRETE STRUCTURES DRAWING**				
Course Code	ACEB21				
Program	B.Tech				
Semester	VI	CE			
Course Type	Core				
Regulation	IARE - R18				
Course Structure	Theory			Practical	
	Lecture	Tutorials	Credits	Laboratory	Credits
	-	-	-	2	1
Course Coordinator	Mrs. Surbhi R. Tharewal, Assistant Professor				

I COURSE OVERVIEW:

Design of Reinforced Concrete Structures deals with methods of reinforced concrete construction; behavior and design of reinforced concrete beams and one-way slabs considering deflections, flexure, shear and anchorage; behavior and design of columns including slenderness effects; design of spread footings; design of lateral load resisting frames and walls for earthquake effects. Laboratory includes experiments and design sessions leading to development of a structural design project in reinforced concrete.

II COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites
B.Tech	ACEB11	IV	STRENGTH OF MATERIALS

III MARKS DISTRIBUTION:

Subject	SEE Examination	CIE Examination	Total Marks
Reinforced Concrete Structures Drawing	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:

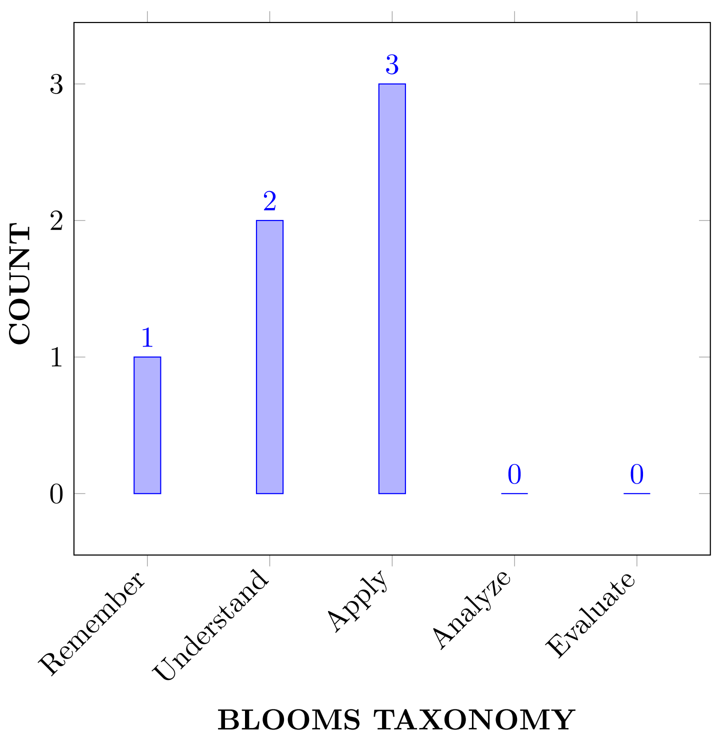
I	Understand reinforcement details of various concrete members.
II	Produce and interpret reinforcement details of various beams.
III	Develop reinforcement design of columns with lateral ties and spiral reinforcement.
IV	Interpret and produce reinforcement details of slabs, footings and staircase.

VII COURSE OUTCOMES:

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

CO 1	**Recall** basic concepts of reinforced concrete design, material stress–strain curves, and safety factors to know the properties of concrete structure.	Remember
CO 2	**Explain** the concept of Stress block parameters and use the design concept of working stress method, limit state method for designing different structural components	Understand
CO 3	**Explain** the concept of bond, anchorage and development length and section for shear and torsion for safe designing of residential, commercial and industrial structures.	Understand
CO 4	**Solve** singly reinforced, doubly reinforced, T, L beam sections as per IS: 456–2000 for obtaining the reinforcement details in load bearing members.	Apply
CO 5	**Solve** One-way, Two-way, slabs sections as per IS: 456–2000 for obtaining the reinforcement details in load bearing members.	Apply
CO 6	**Develop** the concept of Axial loading uni-axial and bi-axial bending of vertically loaded members, isolated and Combined footing to obtain reinforcement details.	Apply

COURSE KNOWLEDGE COMPETENCY LEVEL



VIII 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	CIA
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	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.	3	CIA

3 = High; 2 = Medium; 1 = Low

IX HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

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

3 = High; 2 = Medium; 1 = Low

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

COURSE OUTCOMES	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key Competencies
CO 1	PO 1	Recall the different components in the engineering structures (aircraft materials and bridges) for finding the hardness number by **using mathematics and engineering fundamentals.**	2

	PO 2	Design of trusses by the Use of modern engineering and IT tools including prediction and modeling to complex engineering activities with an **understanding of the limitations**	1
CO 2	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 **mathematical principles** and **engineering knowledge** for different loads for the design purpose.	2
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 **mathematical principles; engineering knowledge and document the results** to **support** their applications in **next-level courses** of the program **(own engineering discipline).**	4
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	Recall the different components in the engineering structures (multistoried structures and bridges) to determine the buckling and crushing load of columns by **using mathematics and engineering fundamentals.**	2
	PO 5	Design of columns by the Use of modern engineering and IT tools including prediction and modeling to complex engineering activities with an **understanding of the limitations**	1

CO 6	PO 1	Make use of advanced methods of analysis for solving engineering problems related to structures by applying the principles of **engineering fundamentals** and their **integration and support with other engineering disciplines, mathematics.**	2
	PO 2	Analyze the 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		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO 1	2	-	-	-	1	-	-	-	-	-	-	-	-	-	-
CO 2	2	3	-	-	1	-	-	-	-	-	-	-	-	2	-
CO 3	2	4	-	-	-	-	-	-	-	-	-	-	-	4	-
CO 4	2	4	-	-	1	-	-	-	-	-	-	-	-	-	-
CO 5	2	-	-	-	1	-	-	-	-	-	-	-	-	-	-
CO 6	2	4	-	-	-	-	-	-	-	-	-	-	-	-	-

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

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO 1	66.6	-	-	-	100	-	-	-	-	-	-	-	-		-
CO 2	66.6	30	-	-	100	-	-	-	-	-	-	-	-	100	-
CO 3	66.6	40	-	-	-	-	-	-	-	-	-	-	-	50	-
CO 4	66.6	40	-	-	100	-	-	-	-	-	-	-		-	-
CO 5	66.6	-	-	-	100	-	-	-	-	-	-	-		-	-
CO 6	66.6	40	-	-	-	-	-	-	-	-	-	-	-		-

XIII COURSE ARTICULATION MATRIX (PO – PSO MAPPING):

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

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

COURSE OUTCOMES	**PROGRAM OUTCOMES**												**PSO'S**		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO 1	3	-	-	-	3	-	-	-	-	-	-	-	-	-	-
CO 2	3	1.5	-	-	3	-	-	-	-	-	-	-	-	2	-
CO 3	3	2	-	-	-	-	-	-	-	-	-	-	-	3	-
CO 4	3	2	-	-	3	-	-	-	-	-	-	-	-	-	-
CO 5	3	-	-	-	3	-	-	-	-	-	-	-	-	-	-
CO 6	3	2	-	-	-	-	-	-	-	-	-	-	-	-	-
TOTAL	18	8	-	-	12	-	-	-	-	-	-	-	-	5	-
AVERAGE	3	2	-	-	3	-	-	-	-	-	-	-	-	3	-

XIV 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		4
CO 4	2	4	1	
CO 5	2		1	
CO 6	2	4		

XV ASSESSMENT METHODOLOGY DIRECT:

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

XVI ASSESSMENT METHODOLOGY INDIRECT:

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

XVII SYLLABUS:

WEEK I	**INTRODUCTION**
	Introduction to reinforced concrete structures.
WEEK II	**SIMPLY SUPPORTED BEAM**
	Detailing of simply supported beam.
WEEK III	**CONTINUOUS BEAM**
	Detailing of continuous beam
WEEK IV	**T-BEAM/ L-BEAM**
	Reinforcement details of T- Beam
WEEK V	**COLUMN WITH LATERAL TIES**
	Rectangular tied reinforcement details.
WEEK VI	**COLUMN WITH SPIRAL REINFORCEMENT**
	Round spiral reinforcement details.
WEEK VII	**BEAM COLUMN JOINT**
	Reinforcement details of exterior beam-column joint .
WEEK VIII	**SLAB WITH TORSIONAL REINFORCEMENT**
	Slab with torsional reinforcement.
WEEK IX	**FOOTINGS**
	Combined trapezoidal footing
WEEK X	**STAIRCASE**
	Plan of R.C.C staircase.
WEEK XI	**STAIRCASE**
	Sectional elevation of R.C.C staircase.
WEEK XII	**DUCTILE REINFORCEMENT**
	Ductile reinforcement details

TEXTBOOKS

1. Bhash C Sharma, Gurucharan Singh, "Civil Engineering Drawing", Standard Publishers, 2005.
2. Ajeet Singh, "Working with AUTOCAD 2000 with updates on AUTOCAD 200I", Tata- Mc Graw-Hill Company Limited, New Delhi, 2002.
3. Sham Tickoo Swapna D, "AUTOCAD for Engineers and Designers", Pearson Education, 2009.
4. Balagopal and Prabhu, "Building Drawing and Detailing", Spades publishing KDR building, Calicut, 1987.

REFERENCE BOOKS:

1. Malik R.S., Meo, G.S., "Civil Engineering Drawing", Computech Publication Ltd New Asian, 2009.

2. Sikka, V.B., "A Course in Civil Engineering Drawing", S. K. Kataria, Sons, 2013.

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 reinforced concrete structures.	CO 1	T2:2.3
2	Detailing of simply supported beam.	CO 1	R1:2.6
3	Detailing of continuous beam.	CO 2	T1:2.6
4	Reinforcement details of T- Beam	CO 3	T2:2.7 R1:2.18
5	Rectangular tied reinforcement details.	CO 4	T2:2.22
6	Round spiral reinforcement details.	CO 4	T2:2.25
7	Reinforcement details of exterior beam-column joint .	CO 5	T2:2.26
8	Slab with torsional reinforcement.	CO 5	T2:2.3
9	Combined trapezoidal footing	CO 5	R1:2.6
10	Plan of R.C.C staircase.	CO 6	T1:2.6
11	Sectional elevation of R.C.C staircase.	CO 6	R1:7.2
12	Ductile reinforcement details	CO 6	R1:7.3

XIX EXPERIMENTS FOR ENHANCED LEARNING (EEL):

S.No	Design Oriented Experiments
1	Ductile detailing of column
2	section and elevation of residential building
2	section and elevation of public building such as hospitals and school

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

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

COURSE DESCRIPTION

Department	**CIVIL ENGINEERING**				
Course Title	**ENVIRONMENTAL ENGINEERING**				
Course Code	ACEB22				
Program	B.Tech				
Semester	VII				
Course Type	CORE				
Regulation	R-18				
Course Structure	Theory			Practical	
	Lecture	Tutorials	Credits	Laboratory	Credits
	3	0	3	-	-
Course Coordinator	M. Madhusudhan Reddy, Assistant Professor				

I COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites
B.Tech	AHSB03	II	Engineering Chemistry
B.Tech	ACEB18	VI	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
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	✓	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
30%	Remember
40%	Understand
30%	Apply
0%	Analyze
0%	Evalaute
0%	Create

Continuous Internal Assessment (CIA):

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

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

Continuous Internal Examination (CIE):

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

Quiz - Online Examination

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

Alternative Assessment Tool (AAT)

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

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

VI COURSE OBJECTIVES:

The students will try to learn:

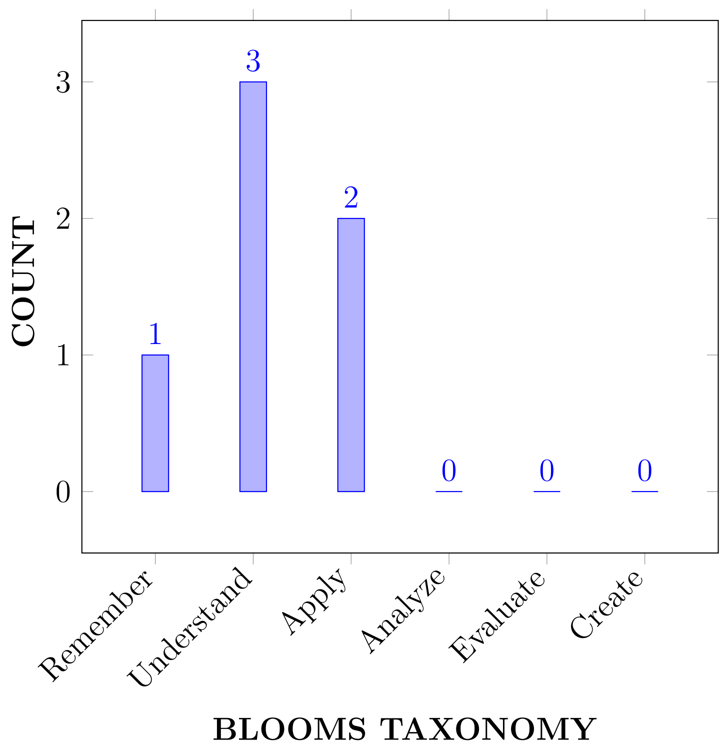
I	The quality and quantity of drinking water standards and know the demand of water for a particular community
II	The basic standards of water and study the procedure for determination
III	The conventional process of water and waste water treatment methods, and know the distribution system
IV	Ultimate disposal methods of wastewater, self-purification of rivers, sewage farming.

VII COURSE OUTCOMES:

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

CO 1	**Choose** an appropriate method of population forecast for ensuring quantity of water to meet future demand.	Remember
CO 2	**Estimate** the quantity of water for designing adequate distribution system and supply.	Apply
CO 3	**Make use of** different solid waste management techniques for disposing solid waste without polluting environment.	Understand
CO 4	**Utilize** the integrated waste management systems effectively for reducing impact of pollutions on human health and environment.	Understand
CO 5	**Develop** an effective sewerage system for decomposing and disposing solid waste without causing harm to human inhabitants and environment.	Apply
CO 6	**Identify** a suitable method of wastewater treatment for improving the quality of water.	Understand

COURSE KNOWLEDGE COMPETENCY LEVEL



VIII PROGRAM OUTCOMES:

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

IX HOW PROGRAM OUTCOMES ARE ASSESSED:

PROGRAM OUTCOMES		Strength	Proficiency Assessed by
PO 1	**Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.	3	CIE,AAT,SEE
PO 2	**Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.	1	CIE,AAT,SEE
PO 3	**Design/Development of Solutions:** Design solutions for complex Engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and Environmental considerations	1	CIE,AAT,SEE
PO 4	**Conduct Investigations of Complex Problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.	1	CIE,AAT,SEE

3 = High; 2 = Medium; 1 = Low

X HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

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

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

Course Outcomes	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key competencies matched.
	PSO 1	Understand the necessity of providing the screeners in sewage treatment plant and design the appropriate screeners using **engineering fundamentals**	1
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	3	-
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	7	-
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. Sources of water supply - intakes, infiltration galleries
MODULE II	**WATER TREATMENT AND DISTRIBUTION**
	Types of layouts of distribution systems, design of distribution systems using Hardy Cross and equivalent pipe methods. Components of Water Supply System - Service reservoirs, joints, valves - sluice valves, air valves, scour valves and check valves, water meters, laying and testing of pipe lines, pump house.
MODULE III	**SOLID WASTE MANAGEMENT**
	Solid Waste Management - Municipal Solid Waste (MSW), Composition and various chemical and physical parameters of MSW. Types of MSW: waste from commercial establishments and other urban areas, solid waste from construction activities, biomedical wastes. MSW management: Collection, transport, treatment and disposal of MSW. Effects of solid waste on environment: effects on air, soil, water surface and ground health hazards. Disposal of solid waste-segregation, reduction at source, recovery and recycle. Disposal methods- Integrated solid waste management. Hazardous waste: Types and nature of hazardous waste as per the HW Schedules of regulating authorities.
MODULE IV	**SEWAGE TREATMENT AND DISPOSAL**
	Characteristics of sewage, cycles of decay, decomposition of sewage, examination of sewage, B.O.D. and C.O.D. equations. Sewage and Storm water estimation - shapes and materials, design of sewers. Sewer appurtenances - manhole, inverted siphon, catch basins, flushing tanks, ejectors, pumps and pump houses. House drainage components requirements - sanitary fittings, traps, one pipe and two pipe systems of plumbing, ultimate disposal of sewage.
MODULE V	**OVERVIEW OF WASTEWATER TREATMENT**
	Lay out and general outline of various units in a Waste Water Treatment Plant – Steps involved in Primary Secondary, and Tertiary treatment of waste water. Sludge digestion tanks, factors effecting design of sludge digestion tank, sludge disposal by drying, septic tanks working principles and design - soak pits.

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.

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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	Course Objectives, Course Outcomes (CO), Program Outcomes (PO)		
CONTENT DELIVERY (THEORY)			
2	Backgroung and Introduction to Environmental Engineering	CO 1	T 2,3
3	Water Sources and Availability	CO 1	T 2,3 & R 1
4	Protected water supply and Water Us	CO 1	T 2,3 & R 1
5	Water Supply Key Issues and Concerns	CO 1	T 2,3 & R 1
6	Urban water services and water supply systems	CO 1	T 2,3 & R 1

7	Urban water services and water supply systems - II	CO 1	T 2,3 & R 1
8	Components of Water Demand	CO 1	T 2,3 & R 1
9	Fluctuations in Water Demand	CO 1	T 2,3 & R 1
10	Concept of Design Period and Design Population Need to Forecast Population Population Forecasting Methods	CO 1	T 2,3 & R 1
11	Demand Forecasting and Design Capacities	CO 1	T 2,3 & R 1
12	Water Sources and Collection of Water	CO 1	T 2,3 & R 1
13	Surface Water Intakes and infiltration galleries	CO 1	T 2,3 & R 2, 3
14	Water quality, testing and Drinking water standards	CO 1	T 2,3 & R 2, 3
15	Basic of Water Distribution System	CO 2	T 2,3 & R 2, 3
16	Water Distribution Networks	CO 2	T 2,3 & R 2, 3
17	Analysis of water Distribution Networks	CO 2	T 2,3 & R 2, 3
18	Service reservoirs, Joints and valves	CO 2	T 2,3 & R 2, 3
19	Components of Water Supply System	CO 2	T 2,3 & R 2, 3
20	Design of distribution systems	CO 2	T 2,3 & R 2, 3
21	Service reservoirs, Joints and valves	CO 2	T 2,3 & R 2, 3
22	Service reservoirs, Joints and valves-I	CO 2	T 1,2 & R 1, 2
23	Introduction to Municipal Solid Waste Management	CO 3	T 1,2 & R 1, 2
24	Composition and various chemical and physical parameters of MSW	CO 3	T 1,2 & R 1, 2
25	Waste Generation Aspects and types of MSW	CO 3	T 1,2 & R 1, 2
26	Waste Collection, Storage and Transport	CO 3	T 1,2 & R 1, 2
27	Waste Disposal	CO 4	T 1,2 & R 1, 2
28	Source Reduction, Product Recovery and Recycling	CO 4	T 1,2 & R 1, 2
29	Integrated Waste Management	CO 4	T 1,2 & R 1,3
30	Hazardour Waste: Management and Treatment	CO 4	T 1,2 & R 1,3

31	Characteristics of sewage, cycles of decay and decomposition of sewage	CO 5	T 1,2 & R 1,3
32	Examination of sewage, B.O.D. and C.O.D calculations	CO 5	T 1,2 & R 1,3
33	Sewage and Storm water estimation	CO 5	T 1,2 & R 1,3
34	Design of sewers and house drainage components requirements	CO 5	T 1,2 & R 1,3
35	Importance of water and wastewater treatment	CO 6	T 1,2 & R 1,3
36	Lay out and general outline of various units in a Waste Water Treatment Plant	CO 6	T 1,2 & R 1,3
37	Wastewater treatment plant: basic principals and Wastewater treatment plant: Preliminary treatment.	CO 6	T 1,2 & R 1,3
38	Wastewater treatment plant: Sedimentation and basics.	CO 6	T 1,2 & R 1,3
39	Tertiary treatment of waste water	CO 6	T 1,2 & R 1,3
40	Design of sludge digestion tank	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 6	T 1,2 & R 1,3
PROBLEM SOLVING/ CASE STUDIES			
1	Problems on population forecasts	CO 1	T 2,3 & R 1
2	Probnlems on design period and water demand	CO 1	T 2,3 & R 1
3	Problems on water quality and testing	CO 1	T 2,3 & R 1
4	Problems on drinking water standards	CO 1	T 2,3 & R 1
5	Problems on distribution systems using Hardy Cross method	CO 2	T 2,3 & R 2, 3
6	Problems on distribution systems using equivalent pipe method	CO 2	T 2,3 & R 2, 3
7	Problems on distribution systems	CO 2	T 2,3 & R 2, 3
8	Problems on solid waste management from commercial establishments and other urban areas	CO 3	T 2,3 & R 2, 3
9	Problems on treatment and disposal of MSW	CO 3	T 2,3 & R 2, 3
10	Problems on Integrated solid waste management	CO 3	T 1,2 & R 1, 2
11	Problems on characteristics of sewage	CO 4	T 1,2 & R 1, 2

12	Problems on secondary sedimentation	CO 6	T 1,2 & R 1, 2
13	Problems with BOD and COD equations	CO 5	T 1,2 & R 1, 2
14	Problems on sewage and storm water estimation	CO 5	T 1,2 & R 1,3
15	Problems with primary sedimentation	CO 6	T 1,2 & R 1,3
DISCUSSION OF DEFINITION AND TERMINOLOGY			
1	Define water demand and type of demand	CO 1	T 2,3 & R 1
2	Discribe solid waste management	CO 2	T 2,3 & R 2, 3
3	Define - sluice valves, air valves, scour valves and check valves	CO 3 & 4	T 2,3 & R 2, 3
4	Define BOD and COD equations	CO 5	T 2,3 & R 2, 3
5	List out the steps – steps involved in primary and secondary treatment	CO 6	T 2,3 & R 2, 3
DISCUSSION OF QUESTION BANK			
1	Write a note on protected water supply	CO 1	T 2,3 & R 1
2	Design of distribution systems using Hardy Cross and equivalent pipe methods.	CO 2	T 2,3 & R 2, 3
3	Write a note on Composition and various chemical and physical parametrs of muncipal soild waste	CO 3 & 4	T 2,3 & R 2, 3
4	List out the differeances between sewage and strom water	CO 5	T 2,3 & R 2, 3
5	List out septic tanks working principles	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	TRANSPORTATION ENGINEERING				
Course Code	ACEB23				
Program	B.TECH				
Semester	VII				
Course Type	CORE				
Regulation	R-18				
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	AHSB02	I	Linear Algebra and Calculus
B.Tech	ACEB01	III	Surveying and Geomatics

II COURSE OVERVIEW:

Transportation engineering is the application of technology and scientific principles to the planning, design, operation and management of facilities. Traffic control refers to the traffic engineering, regulation, management and safety with an integrated approach in traffic system. This course gives an overview on Transportation engineering with respect toconstruction and maintenance of highways as per IRC standards. This course also focuses on designing new transportation systems and infrastructures, including highways. Further the course is useful to solve the complex problems related to the traffic management by collecting and evaluating the data such as traffic flow, density, speed and volume.

III MARKS DISTRIBUTION:

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

IV CONTENT DELIVERY / INSTRUCTIONAL METHODOLOGIES:

✓	Power Point Presentations	✓	Chalk & Talk	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 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), 05 marks for Quiz and 05 marks for Alternative Assessment Tool (AAT).

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

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

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

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

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

VI COURSE OBJECTIVES:

The students will try to learn:

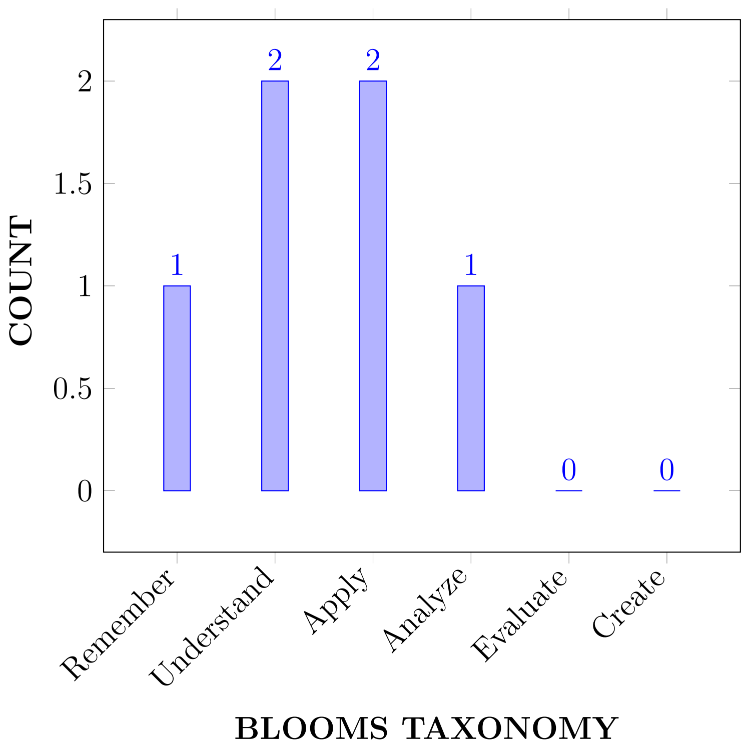
I	The highway planning process, surveys involved in planning and highway alignment.
II	The geometric design of highways and expressways based on different terrains.
III	The various traffic surveys to implement traffic regulation and control measures.
IV	The engineering properties of pavement materials used in construction of highway.

VII COURSE OUTCOMES:

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

CO 1	**Recall** the fundamentals of highway engineering for effective planning and development of highways based on the mission requirement.	Remember
CO 2	**Identify** highway intersection at urban areas for promoting continuous flow without congestions.	Apply
CO 3	**Identify** traffic signals at intersections for avoiding conflicts and promoting free flow of traffic.	Apply
CO 4	**Classify** the various traffic parameters considered in traffic study for regulating traffic at various controlled and uncontrolled intersections.	Analyze
CO 5	**Explain** the mechanical properties of pavement construction materials for enhancing serviceability and durability of highway pavements.	Understand
CO 6	**Explain** the stresses induced in rigid pavements considered for designing, CC pavements to improve their performance.	Understand

COURSE KNOWLEDGE COMPETENCY LEVEL



VIII PROGRAM OUTCOMES:

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

IX HOW PROGRAM OUTCOMES ARE ASSESSED:

PROGRAM OUTCOMES		Strength	Proficiency Assessed by
PO 1	**Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.	1	CIE/SEE/AAT
PO 3	**Design/Development of Solutions:** Design solutions for complex Engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and Environmental considerations	1	CIE/SEE/AAT
PO 4	**Conduct Investigations of Complex Problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.	1	CIE/SEE/AAT
PO 5	**Modern Tool Usage:**M Create, select, and apply appropriate techniques, resources, and modern Engineering and IT tools including prediction and modelling to complex Engineering activities with an understanding of the limitations	3	CIE/SEE/AAT

3 = High; 2 = Medium; 1 = Low

X HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

PROGRAM SPECIFIC OUTCOMES		Strength	Proficiency Assessed by
PSO 1	Design and Supervise Sub-Structures and Super Structures for Residential and Public Buildings, Industrial Structures, Irrigation Structures, Power Houses, Highways, Railways, Airways, Docs and Harbours.	2	CIE/SEE/AAT
PSO 2	Focus on Improving Performance of Structures with reference to Safety, Serviceability and Sustainable Green Building Technology.	3	CIE/SEE/AAT

3 = High; 2 = Medium; 1 = Low

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

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

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

Course Outcomes	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key competencies matched.
CO 1	PO 1	Explain the factors affecting highway alignment by using **Scientific principles and methodology.**	1
	PO 5	Select and apply appropriate techniques of traffic **simulation packages** for development of highways by understanding the limitations.	1
	PSO 1	Explain the classification of roads based on **structural design and material** knowledge by conducting various **traffic studies and design of pavement** using **Soil investigation and design of sub-structures** by **Engineering, procurement and construction** using **standard codes of practice.**	5
CO 2	PO 1	Understand importance of vertical and horizontal alignment by applying **scientific principles and methodology** to study the optimum speed of vehicles.	1
	PO 4	Understand contexts in which **engineering knowledge can be applied** for avoiding conflict on highways at intersections by using **appropriate codes of practice and industry standard.**	2
	PSO 2	Understand the fundamentals of intersections to **improve the performance of highways** in terms of **safety and serviceability of structure and research**	2
CO 3	PO 1	Understand the major causes and remedial measures to decrease the rate of accidents by applying **scientific principles and methodology**	1
	PO 3	Identify and Manage cost drivers designof parking facilities in urban areasto improve the free flow of traffic by applying **operation, maintenance and disposal techniques to Manage the design process and evaluate outcomes** of design	2

Course Outcomes	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key competencies matched.
	PO 4	Explain the contexts in which **engineering knowledge can be applied** for highway lightening on roads using **analytical methods and modeling techniques**	2
CO 4	PO 1	Understand the various traffic parameters for regulationg traffic flow by applying **scientific principles and methodology**	1
	PO 3	Identify and Manage traffic regulation and control in urban areas to improve the free flow of traffic at controlled intersections by applying **operation, maintenance and disposal techniques to Manage the design process and evaluate outcomes** of design	2
	PO 4	Explain the contexts in which **engineering knowledge can be applied** for regulatimng traffic flow on uncontrolled intersections using **analytical methods and modeling techniques**	2
CO 5	PO 3	Identify and Manage cost drivers in design and construction of highways to improve the free flow of traffic by applying **operation, maintenance and disposal techniques** to **Manage the design process and evaluate outcomes** of design	2
	PO 4	Identify, classify and describe the performance of pavement materials used in construction by **analytical methods and modeling techniquesto analyze engineering processes**	2
	PO 5	Select and apply appropriate techniques for construction of highways by understanding the requirements and limitations **simulation packages**	1
	PSO 1	Understand the various material testing procedures used for determining engineering properties of materials based on **structural design and material knowledge** and inputs from **Soil investigation and design of sub-structures** by **Engineering, procurement and construction** and Identify the factors causing traffic congestion in urban areas by conducting various **traffic studies and design of pavement** using standard **codes of practice**	5
	PSO 2	Focus on **improving performance of materials/structures** by testing with reference to **safety and serviceability of structures and research**	2
CO 6	PO 4	Understand **Knowledge of characteristics of particular materials** characteristics and **quality issues** of materials used in construction	2
	PO 5	Select and apply appropriate **Computer software** techniques for minimizing the stress developed in flexible and rigid pavements by understanding the requirements and limitations	1

Course Outcomes	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key competencies matched.
	PSO 2	Understand the factors affecting design and performance of rigid to **Improve the performance of structures** for increasing **safety and serviceability of structures and research**	2

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

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

XIV PERCENTAGE OF KEY COMPETENCIES FOR CO – PO/ PSO

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	33.3	-	-	-	100	-	-	-	-	-	-	-	50	-	-
CO 2	33.3		-	18.1	-	-	-	-	-	-	-		-	66.6	- -
CO 3	33.3	-	20	18.1	-	-	-	-	-	-	-		-	-	-
CO 4	33.3	-	20	18.1	-	-	-	-	-	-	-		-	-	-
CO 5	-	-	20	18.1	100	-	-	-	-	-	-	-	50	66.6	-
CO 6	-	-	-	18.1	100	-	-	-	-	-	-	-	-	66.6	-

XV COURSE ARTICULATION MATRIX (PO / PSO MAPPING):

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

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

1 -$5 < C \leq 40\%$ – Low/ Slight

2 - $40\% < C < 60\%$ –Moderate

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

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

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

XVI ASSESSMENT METHODOLOGY-DIRECT:

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

XVII ASSESSMENT METHODOLOGY-INDIRECT:

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

XVIII SYLLABUS:

MODULE I	**HIGHWAY DEVELOPMENT AND PLANNING**
	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**
	NMaterials 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

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

COURSE WEB PAGE:

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

XIX COURSE PLAN:

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

S.No	Topics to be covered	CO's	Reference T1: 4.1
OBE DISCUSSION			
1.	Outcome Based Education, CO PO attainment and Blooms Taxonomy		
CONTENT DELIVERY (THEORY)			
1-2	Classification of roads	CO 1	T1:2.4 T2:11.2
3-4	Road development in India	CO 1	T1:2.10
6-7	Current road projects in India	CO 1	T1:3.10
8	Highway alignment	CO 1	T1:3.1
9	Factors affecting alignment	CO 1	T1:3.1.2
10	Engineering surveys	CO 1	T1:3.2
11	Drawing and reports, highway project	CO 1	T1:3.4.2
12	Introduction, highway cross section elements	CO 2	T1:16.6.2
13	Sight distance elements	CO 2	T1:4.3 R3:2.1
14	Stopping sight distance	CO 2	T1: 4.3.2
15	Overtaking sight distance and intermediate sight distance	CO 2	T1: 4.3.3 R3:2.3
16	Design of horizontal alignment	CO 2	T1: 4.4
17	Design of vertical alignment	CO 2	T1: 4.5
18	Design of intersections	CO 2	T1:5.4
19	Traffic characteristics	CO 3	T1:5.2 T3:16.5
20	Traffic engineering studies	CO 3	T1:5.2.3 T2:1.2

21	Traffic flow and capacity	CO 3	T1:5.2.3 R2:4.1
22	Traffic regulation and control	CO 4	T1:5.3.2 T3:17.1
23	Design of parking facilities	CO 4	T1:5.5 T2:6.3
24	Highway lighting	CO 4	T1:5.6
25	Accident studies: causes and measures	CO 4	T1:5.2.1
26	Materials used in Highway Construction- Soils	CO 5	T1:6.1.1
27	Stone aggregates	CO 5	T1:6.2
28	Bituminous binders, bituminous paving mixes	CO 5	T1:6.3
29-30	Portland cement and cement concrete	CO 5	T1:6.2
31	Desirable properties, tests	CO 5	T1:6.3
32-33	Requirements for different types of pavements	CO 6	T1:7.1.1
34	Introduction; flexible pavements	CO 6	T1:7.2
35	Factors affecting design and performance	CO 6	T1:6.3 R2:1.1
36	Stresses in flexible pavements	CO 6	T1:7.3
37-38	Design of flexible pavements as per IRC	CO 6	T1:7.3.1 R2:6.1
39-40	Rigid pavements- components and functions	CO 6	T1:4.1 R1:6.5
41-42	Factors affecting design and performance of CC pavements	CO 6	T1:7.4.2
43	Stresses in rigid pavements	CO 6	T1:7.4.3 R2:4.1
44-45	Design of concrete pavements as per IRC; problems	CO 6	T1:7.4.5 R1:6.10
PROBLEM SOLVING/ CASE STUDIES			
1	Classification of roads	CO 1	T1:2.4 T2:11.2
2	Highway alignment	CO 1	T1:3.1
3	Sight distance elements	CO 2	T1:4.3 R3:2.1
4	Stopping sight distance	CO 2	T1: 4.3.2
5	Overtaking sight distance and intermediate sight distance	CO 2	T1: 4.3.3 R3:2.3
6	Design of horizontal alignment	CO 2	T1: 4.4
7	Design of vertical alignment	CO 2	T1: 4.5
8	Design of intersections	CO 3	T1:5.4
9	Traffic characteristics	CO 3	T1:5.2 T3:16.5
10	Traffic regulation and control	CO 4	T1:5.3.2 T3:17.1
11	Design of parking facilities	CO 4	T1:5.5 T2:6.3
12	Portland cement and cement concrete	CO 5	T1:6.2

13	Design of flexible pavements as per IRC	CO 5	T1:7.3.1 R2:6.1
14	Design of concrete pavements as per IRC; problems	CO 6	T1:7.4.5 R1:6.10
15	Stresses in rigid pavements	CO 6	T1:7.4.3 R2:4.1
	DISCUSSION OF DEFINITION AND TERMINOLOGY		
1	Classification of roads, Road development in India, Factors affecting alignment, Engineering surveys, Drawing and reports, highway project	CO 1,	T1:2.4-3.2 T2:11.2
2	Introduction, highway cross section elements Sight distance elements, Stopping sight distance, Overtaking sight distance and intermediate sight distance, Design of vertical alignment, Design of horizontal alignment	CO 2	T1:16.6.2-T1: 4.5
3	Traffic characteristics ,Traffic engineering studies, Traffic flow and capacity ,Traffic regulation and control, Accident studies: causes and measures, Highway lighting	CO 3, CO 4	T1:5.2 T3:16.5-T1:5.2.1
4	Materials used in Highway Construction- Soils, Stone aggregates, Portland cement and cement concrete	CO 5	T1:6.1.1-T1:6.2
5	Flexible pavements, Design of flexible pavements as per IRC, Stresses in rigid pavements	CO 6	T1:7.3-T1:7.4.3 R2:4.1
	DISCUSSION OF QUESTION BANK		
1	Calculate the lengths of National and State highways required in a district with a total area of 2000 km^2 , Developed, Semi-developed Undeveloped areas being 22, 35,15 percent of the respective district. The no of towns with population over 1.1, 0.2- 1.1, 0.1-0.6 and 0.1-0.2 lakhs are 2,5, 16 and 18 respectively in a district using second twenty year plan?	CO 1	T1:2.4-3.2 T2:11.2
2	A two lane road with design speed 80kmph has horizontal curve of radius 480m. Design the rate of superelevationfor mixed traffic. By how much should the outer edges of the pavement be raised with respect to the centre line, if the pavement is rotated with respect to the centre line	CO 2	T1:16.6.2-T1: 4.5
3	A vehicle moving at 40kmph speed was stopped by applying breaks and length of the skid mark was 12.2 m. if average skid resistance of the pavement is known to be 0.70. Determine the break efficiency of the test vehicle	CO 3, CO 4	T1:5.2 T3:16.5-T1:5.2.1
4	Explain in detail about aggregate crushing strength test according to IS 2386 part-IV	CO 5	T1:6.1.1-T1:6.2
5	Design the pavement for construction of a new bypass with the following data: 1. Two lane carriage way 2. Initial traffic in the year of completion of construction = 400 CVPD (sum of both directions) 3. Traffic growth rate = 7.5 percentage 4. Design life = 15 years 5. Vehicle damage factor based on axle load survey = 2.5 standard axle per commercial vehicle 6. Design CBR of subgrade soil = 4 percentage.	CO 6	T1:7.3-T1:7.4.3 R2:4.1

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

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

COURSE DESCRIPTION

Department	**CIVIL ENGINEERING**					
Course Title	**FOUNDATION ENGINEERING**					
Course Code	ACEB38					
Program	B.Tech					
Semester	VII					
Course Type	Professional Elective - IV					
Regulation	R-18					
Course Structure	Theory			Practical		
	Lecture	Tutorials	Credits	Laboratory	Credits	
	3	-	3	-	-	
Course Coordinator	Mr. K. Lokesh, Assistant Professor					

I COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites
B.Tech	ACEB05	IV	Engineering Geology
B.Tech	ACEB19	VI	Geotechnical Engineering

II COURSE OVERVIEW:

Foundation engineering is a branch of geotechnical engineering which applies soil mechanics, structural engineering and project serviceability requirements for design and construction of foundations for on shore, offshore, and in-land structures. This course addresses the design of shallow, deep and well foundations, the stability of slopes, stability of retaining walls and embankments against failure. The course also discusses the safety and serviceability considerations in the design of foundations.

III MARKS DISTRIBUTION:

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

IV CONTENT DELIVERY / INSTRUCTIONAL METHODOLOGIES:

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

V EVALUATION METHODOLOGY:

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

Semester End Examination (SEE): The SEE is conducted for 70 marks of 3 hours duration. The syllabus for the theory courses is divided into FIVE modules and each module carries equal weightage in terms of marks distribution. The question paper pattern is as follows. Two full questions with "either" or "choice" will be drawn from each module. Each question carries 14 marks. There could be a maximum of two sub divisions in a question.
The expected percentage of cognitive level of the questions is broadly based on the criteria given in below Table.

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

Continuous Internal Assessment (CIA):
CIA is conducted for a total of 30 marks (Table 2), with 20 marks for Continuous Internal Examination (CIE), 05 marks for Quiz and 05 marks for Alternative Assessment Tool in table

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	Complex Problem Solving
40%	40%	20%

VI COURSE OBJECTIVES:

The students will try to learn:

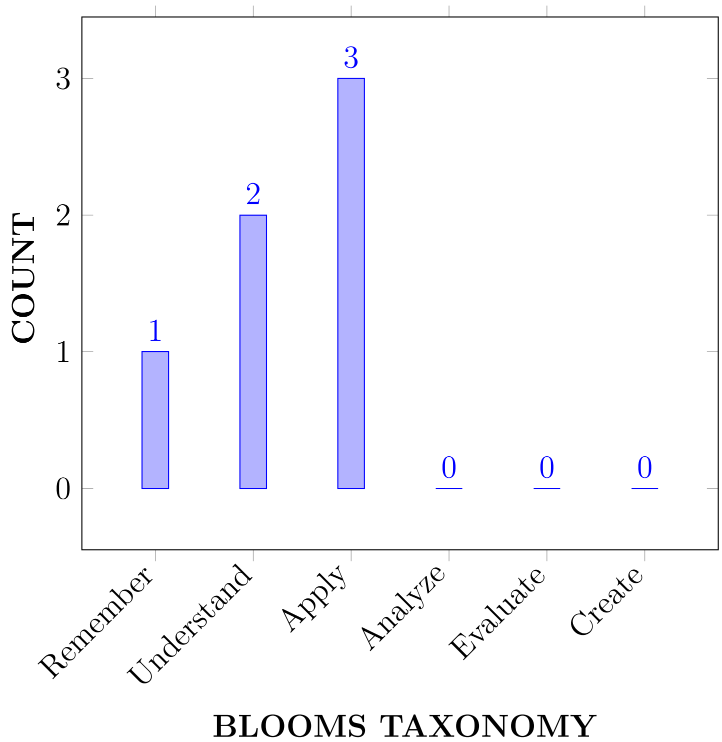
I	Understand various methods of soil exploration and field tests on soil, planning and preparation of soil investigation programme.
II	Analyze the stability of infinite and finite slopes
III	Calculate At rest, Active and Passive earth pressures of soil & analyze the stability of retaining wall against sliding, overturning and bearing capacity failures
IV	Calculate 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	**Recall** the methods of soil exploration and sampling for characterization of soils at different depth from ground level.	Remember
CO 2	**Summarize** the finite and infinite slopes of soil to provide the safety against slope failures.	Understand
CO 3	**Identify** the type of earth pressure to choose appropriate design parameters for construction of retaining walls.	Apply
CO 4	**Illustrate** the bearing capacity of an area to select the type of foundation for construction of residential, public and industrial structures.	Apply
CO 5	**Identify** the load carrying capacity and settlement of pile foundations for estimating bearing capacity in construction of various infrastructure projects, public and industrial structures.	Apply
CO 6	**Classify** different shapes and components of well foundations for construction of bridges and harbors.	Understand

COURSE KNOWLEDGE COMPETENCY LEVEL



VIII PROGRAM OUTCOMES:

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

IX HOW PROGRAM OUTCOMES ARE ASSESSED:

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

3 = High; 2 = Medium; 1 = Low

X HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

PROGRAM SPECIFIC OUTCOMES		Strength	Proficiency Assessed by
PSO 1	Design and Supervise Sub-Structures and Super Structures for Residential and Public Buildings, Industrial Structures, Irrigation Structures, Power Houses, Highways, Railways, Airways, Docs and Harbours.	2	Quiz

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

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

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

Course Outcomes	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key competencies matched.
CO 1	PO 1	Explain the methods of soil exploration, sampling and boring for soil properties by using the fundamental principles of **science and engineering.**	2
	PO 5	Explain the methods of soil exploration, sampling and boring for soil properties by using **modern tool usage**	1
CO 2	PO 2	**Identify** the failures of finite and infinite slopes of soil and **develop the solutions** for finding the factor of safety in slope construction.	2
	PO 3	Identify the failures of finite and infinite slopes for slope stability which will cause **health and safety and risk assessment issues.**	1
	PSO 1	Collect **geological survey, Material knowledge, Soil investigation** report and summarize the failures of finite and infinite slopes for slope stability by using related **Code of practices** for finding the factor of safety in **slope construction.**	5
CO 3	PO 1	Classify various earth pressure theories and stability of retaining walls for accretion of earth at different topological conditions by using **engineering fundamentals and scientific principles.**	2
	PO 4	Classify various earth pressure theories and stability of retaining walls for accretion of earth at different topological conditions by using **appropriate codes of practice and industry standards**	1
	PSO 1	Collect **geological survey data**, Material knowledge, and Soil investigation of various **earth pressure theories, stability and construction of retaining walls** for accretion of earth at different topological conditions using related **Code of practices.**	5
CO 4	PO 1	Identify the bearing capacity of shallow foundation by different methods for construction of residential, public and industrial structures by using **engineering fundamentals and scientific principles.**	2

Course Outcomes	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key competencies matched.
	PO 4	Identify the bearing capacity of shallow foundation by different methods for construction of residential, public and industrial structures by using **appropriate codes of practice and industry standards**	1
	PSO 1	Collect **geological survey data**, Material knowledge, and Soil investigation of various **earth pressure theories, stability and construction of retaining walls** for accretion of earth at different topological conditions using related **Code of practices.**	5
CO 5	PO 1	Identify the bearing capacity of deep foundations by different methods for construction of residential, public and industrial structures by using **engineering fundamentals and scientific principles.**	2
	PO 4	Identify the bearing capacity of deep foundation by different methods for construction of residential, public and industrial structures by using **appropriate codes of practice and industry standards**	1
	PSO 1	Collect **geological survey data**, Material knowledge, and Soil investigation of various **earth pressure theories, stability and construction of retaining walls** for accretion of earth at different topological conditions using related **Code of practices.**	5
CO 6	PO 1	Illustrate different shapes and components for sinking appropriate well in construction of bridges and harbours using **engineering fundamentals and scientific principles.**	2

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

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

XIV PERCENTAGE OF KEY COMPETENCIES FOR CO – PO/ PSO

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	66.6	-	-	-	100	-	-	-	-	-	-	-	-	-	-
CO 2	-	20	10	-	-	-	-	-	-	-	-	-	50	-	-

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 3	66.6	-	-	9.09	-	-	-	-	-	-	-		50	-	-
CO 4	66.6	-	-	9.09	-	-	-	-	-	-	-		50	-	-
CO 5	66.6	-	-	9.09	-	-	-	-	-	-	-		50	-	-
CO 6	66.6	-	-	-	-	-	-	-	-	-	-	-	-	-	-

XV COURSE ARTICULATION MATRIX (PO / PSO MAPPING):

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

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

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

XVI ASSESSMENT METHODOLOGY-DIRECT:

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

XVII ASSESSMENT METHODOLOGY-INDIRECT:

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

XVIII SYLLABUS:

MODULE I	**SOIL EXPLORATION**
	Need and methods of soil exploration, boring and sampling methods, pits and trenches, drifts and shafts, methods of boring, auger borings, wash borings, rotary drilling, percussion drilling, core drilling, types of soil samples, disturbed samples, undisturbed samples, design features affecting the sample disturbance, split spoon samplers, scraper bucket samplers, shell by tubes and thin walled samplers, piston samplers, preservation and handling of samples. penetration tests, monotonic and cyclic, field permeability tests, insitu tests using pressure meter, observation of ground water table, instrumentation in soil engineering, strain gauges, resistance and inductance type plate load test, pressure meter, geophysical methods, planning of programme and preparation of soil investigation report.
MODULE II	**SLOPE STABILITY**
	Infinite and finite earth slopes, types of failures, factor of safety of infinites slopes, stability analysis by Swedish arc method, standard method of slices, Bishop's Simplified method, Taylor's Stability number, and stability of slopes of earth dams under different conditions.
MODULE III	**EARTH PRESSURE THEORIES AND RETAINING WALLS**
	Rankine's theory of earth pressure, earth pressures in layered soils, Coulomb's earth pressure theory, Culmann's graphical method.Types of retaining walls, stability of retaining walls against overturning, sliding, bearing capacity and drainage from backfill.
MODULE IV	**SHALLOW AND DEEP FOUNDATIONS**
	Types, choice of foundation, location of depth, safe bearing capacity, Terzaghi, Meyerhof, Skempton and IS Methods. Safe bearing pressure based on N value, allowable bearing pressure, safe bearing capacity, plate load test, allowable settlements of structures, Analysis of foundation, individual, strip, combined footings and mat foundations conventional, elastic approach, soil structure interaction principles.Types of piles, load carrying capacity of piles based on static pile formulae in dynamic pile formulae, pile load tests, load carrying capacity of pile groups in sand clays, settlement of pile groups. Introduction to Foundations on expansive soils and marine foundations.
MODULE V	**WELL FOUNDATIONS**
	Different shapes of wells, components of well, sinking of well, tilts and shifts, principles of analysis and design, seismic influences, IRC guidelines.

TEXTBOOKS

1. B. M. Das, "Principles of foundation engineering" Cengage Learning, 2012.
2. Gopal Ranjan and A.S.R.Rao,"Basic and applied soil mechanics" New age international Pvt.Ltd. 2004.
3. V.N.S Murthy ,"Geotechnical Engineering: Principles and practices of soils mechanics and foundation engineering", Taylor & Francis Group, 2002.

REFERENCE BOOKS:

1. C. Venkataramiah, "Geotechnical engineering", New Age International Pvt.Ltd,2002.
2. Manojdutta and Gulati, "Geotechnical engineering", Tata McGraw hill publishers NewDelhi, 2005.

3. Garg, K.R.Arora,"Soil mechanics and foundation engineering", standard publishers and distributors, New Delhi,2005.

WEB REFERENCES:

1. www.nptel.ac.in/courses/105107120/1
2. www.nptel.ac.in/courses/105/105/105105176/
3. www.nptel.ac.in/courses/105/105/105105185/

COURSE WEB PAGE:

1. http://site.iugaza.edu.ps/afoul/files/2010/02/Environmental_book.pdf
2. https://libguides.rowan.edu/com

XIX COURSE PLAN:

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

S.No	Topics to be covered	CO's	Reference T1: 4.1
OBE DISCUSSION			
1	Discussion on OBE, CO's and CLO's of Foundation Engineering		
CONTENT DELIVERY (THEORY)			
2	Soil Exploration and Importance	CO 1	T 2,3
3	Sampling methods for field and laboratory investigation	CO 1	T 2,3 & R 1
4	Penetration test methods for site investigation	CO 1	T 2,3 & R 1
5	Pressure meter tests	CO 1	T 2,3 & R 1
6	Site investigation report	CO 1	T 2,3 & R 1
7	Stability of slopes	CO 1	T 2,3 & R 1
8	Methods for slope analysis	CO 1	T 2,3 & R 1
9	Analysis of finite slopes	CO 1, 2	T 2,3 & R 1
10	Analysis of finite slopes-I	CO 1	T 2,3 & R 1
11	Analysis of finite slopes-II	CO 1	T 2,3 & R 1
12	Stability of slopes of earth dam	CO 1	T 2,3 & R 1
13	Earth Pressure theories	CO 2	T 2,3 & R 2, 3
14	Earth pressure theories-I	CO 2	T 2,3 & R 2, 3
15	Introduction to Retaining walls	CO 2	T 2,3 & R 2, 3

16	Stability of retaining walls	CO 2	T 2,3 & R 2, 3
17	Construction of retaining walls	CO 2	T 2,3 & R 2, 3
18	Governing design parameters for retaining wall design	CO 2	T 2,3 & R 2, 3
19	Construction of retaining walls for emabankments	CO 2	T 2,3 & R 2, 3
20	Types of Foundations	CO 2	T 2,3 & R 2, 3
21	Shallow Foundations	CO 2	T 2,3 & R 2, 3
22	Shallow Foundations and SBC	CO 2	T 1,2 & R 1, 2
23	Shallow Foundations and methods of foundation design	CO 2	T 1,2 & R 1, 2
24	Shallow Foundation design methods	CO 2	T 1,2 & R 1, 2
25	Shallow Foundations design methods using IS codes	CO 2	T 1,2 & R 1, 2
26	Shallow Foundations design methods using IS code method	CO 3	T 1,2 & R 1, 2
27	Shallow Foundations design and various design parameters	CO 4	T 1,2 & R 1, 2
28	Types of deep foundations	CO 5	T 1,2 & R 1, 2
29	Pile load tests and design parameters	CO 4	T 1,2 & R 1,3
30	Well Foundations and caissons	CO 2& 4	T 1,2 & R 1,3
31	Well Foundations and types of wells	CO 4	T 1,2 & R 1,3
32	Various parameters for well foundation design	CO 4	T 1,2 & R 1,3
33	Special Cases on Foundations and design	CO 4	T 1,2 & R 1,3
34	Special Cases on Foundations for SW site	CO 2, 4	T 1,2 & R 1,3
35	Special Cases on Foundations for WW site	CO 4	T 1,2 & R 1,3
36	Special Cases on Foundations WW site - I	CO 2, 4	T 1,2 & R 1,3
37	Various parameters for well foundation design	CO 2, 4	T 1,2 & R 1,3
38	Well Foundations and caissons	CO 6	T 1,2 & R 1,3
39	Field problems for driving a well foundation	CO 6	T 1,2 & R 1,3

40	Design parameter and various parts involved in well foundation	CO 6	T 1,2 & R 1,3
41	Special types well foundations	CO 6	T 1,2 & R 1,3
42	Special type of well foundations and their applications	CO 5	T 1,2 & R 1,3
PROBLEM SOLVING/ CASE STUDIES			
1	Finite and Infinite slopes derivation for C and Phi soils	CO 1	T 2,3 & R 1
2	Stability of slopes using Swedish circle methods	CO 1	T 2,3 & R 1
3	Stability of slopes using method of slices and Bishop's simplified method	CO 1	T 2,3 & R 1
4	Slope protection of a earth dam	CO 1	T 2,3 & R 1
5	Stability of slopes using Taylors method	CO 2	T 2,3 & R 2, 3
6	Rankine theory of earth pressure derivation	CO 2	T 2,3 & R 2, 3
7	Active earth pressure of cohesive soils	CO 2, 4	T 2,3 & R 2, 3
8	Passive earth pressure of cohesive soils	CO 4	T 2,3 & R 2, 3
9	Active earth pressure of cohesive soils	CO 1, 3	T 2,3 & R 2, 3
10	Passive earth pressure of cohesive soils	CO 3	T 1,2 & R 1, 2
11	Terzaghi method for bearing capacity of strip footing	CO 3	T 1,2 & R 1, 2
12	Meryohoff method for bearing capacity of strip footing	CO 4	T 1,2 & R 1, 2
13	Effect of water table on bearing capacity of strip foundations	CO 4	T 1,2 & R 1, 2
14	Determination bearing capacity using PLT and SPT test methods	CO 6	T 1,2 & R 1,3
15	Bearing capacity from housels approach	CO 6	T 1,2 & R 1,3
DISCUSSION OF DEFINITION AND TERMINOLOGY			
1	Distinguish between disturbed and undisturbed samples	CO 1	T 2,3 & R 1
2	List various methods of drilling holes	CO 2,4	T 2,3 & R 2, 3
3	Explain how do you obtain undisturbed samples	CO 3	T 2,3 & R 2, 3
4	Over view on screens, grit chambers, skimming tanks and sedimentation tanks	CO 4	T 2,3 & R 2, 3
5	What is soil exploration What is Boring log	CO 6	T 2,3 & R 2, 3

DISCUSSION OF QUESTION BANK			
1	Distinguish between disturbed and undisturbed samples	CO 1	T 2,3 & R 1
2	Explain how do you obtain undisturbed samples	CO 1,2	T 2,3 & R 2, 3
3	List various methods of soil explorations	CO 3	T 2,3 & R 2, 3
4	List various methods of drilling holes	CO 4	T 2,3 & R 2, 3
5	The cone penetration resistance obtained in a clay soil in a CPT was 50 kg/cm2. Determine the undrained strength of clay. The total overburden pressure at the depth was 100 kN/m2.	CO 6	T 2,3 & R 2, 3

Signature of Course Coordinator **HOD, CE**

Mr. K. Lokesh, Assistant Professor

COURSE DESCRIPTION

Department	**Civil Engineering**				
Course Title	**DESIGN OF CONCRETE STRUCTURES - II**				
Course Code	ACEB42				
Program	B.Tech				
Semester	VII				
Course Type	Professional Elective-V				
Regulation	R-18				
Course Structure	Theory			Practical	
	Lecture	Tutorials	Credits	Laboratory	Credits
	3	-	3	-	-
Course Coordinator	Mr Gude Ramakrishna, Associate Professor				

I COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites
B.Tech	AMEB03	III	Engineering Mechanics
B.Tech	ACEB07	IV	Strength of Materials
B.Tech	ACEB34	VI	Design of Concrete Structures - I

II COURSE OVERVIEW:

This course aims to the continuation of analysis and design of reinforced concrete structures-I, design of selected advanced structures of concrete. This course covers the structural analysis and design of flat slab, retaining walls, combined footings, bunkers and silos and liquid retaining structures using IS code provisions.

III MARKS DISTRIBUTION:

Subject	SEE Examination	CIE Examination	Total Marks
Design of Concrete Structures - II	70 Marks	30 Marks	100

IV CONTENT DELIVERY / INSTRUCTIONAL METHODOLOGIES:

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

V EVALUATION METHODOLOGY:

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

Semester End Examination (SEE): The SEE is conducted for 70 marks of 3 hours duration. The syllabus for the theory courses is divided into FIVE modules and each module carries equal weightage in terms of marks distribution. The question paper pattern is as follows. Two full questions with "either" or "choice" will be drawn from each module. Each question carries 14 marks. There could be a maximum of two sub divisions in a question.
The expected percentage of cognitive level of the questions is broadly based on the criteria given in below Table.

Percentage of Cognitive Level	Blooms Taxonomy Level
%	Remember
33%	Understand
67 %	Apply
0 %	Analyze

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

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

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

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

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

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

VI COURSE OBJECTIVES:

The students will try to learn:

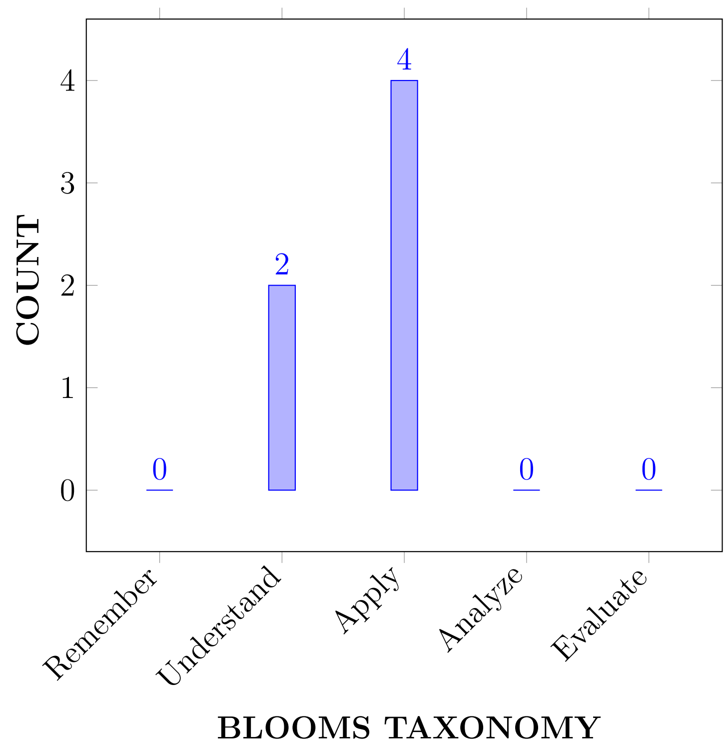
I	The analysis and design concepts for flat slabs.
II	The analysis and design of bunkers, silos.
III	The analysis and design of bunkers, silos.
IV	The design of, resting on the ground and elevated water tanks according to IS code
V	The design and detailing of cantilever retaining wall and understand the design principles of Counter fort retaining wall.

VII COURSE OUTCOMES:

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

CO 1	**Explain** the components of flat slab, Shear in flat slabs, components of bunker and silos for design of different components.	Understand
CO 2	**Design** concept of flat slab, concrete bunkers to evaluate the loads on members and obtain reinforcement details.	Apply
CO 3	**Explain** the types and loads on concrete chimneys, water tanks and retaining walls, for safe design of structure.	Understand
CO 4	**Design** concept of concrete chimneys for calculating compressive, tensile and flexural strengths	Apply
CO 5	**Design** concept of circular and rectangular water tank resting on the ground and Intz type water tank to obtain reinforcement details.	Apply
CO 6	**Design** procedure for retaining walls of cantilever and counterfort type to obtain reinforcement details.	Apply

COURSE KNOWLEDGE COMPETENCY LEVEL



VIII PROGRAM OUTCOMES:

Program Outcomes	
PO 1	**Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO 2	**Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO 3	**Design/Development of Solutions:** Design solutions for complex Engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and Environmental considerations
PO 4	**Conduct Investigations of Complex Problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO 5	**Modern Tool Usage:** Create, select, and apply appropriate techniques, resources, and modern Engineering and IT tools including prediction and modelling to complex Engineering activities with an understanding of the limitations
PO 6	**The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO 7	**Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO 8	**Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
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 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 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.	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.	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 2	Identify components of flat slab, information **and data collection** of member by analysing complex engineering problems and **validation.**	2
CO 2	PO 3	Design solutions for complex engineering problems, to **understand customer needs** for Shear in flat slabs,**manage the design process.**	3
	PO 4	Design, analysis of slab reinforcement and openings in flat slabs with **knowledge of characteristics of materials** and interpretation of **appropriate codes of practice and industry standards.**	3
	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
CO 3	PO 2	Identify, and analyse complex engineering problems for **validation** using substantiated conclusions by**interpretation of results.**	2
CO 4	PO 3	**Understand** the design concept of concrete bunkers of different shapes with **manage the design process** to obtain reinforcement details.	2
	PO 4	Design, analysis and interpretation of data **understanding of appropriate code** of practice to obtain reinforcement details for concrete bunkers and **translatethe information** in to the model and prototype system from the provided **ability to apply a systems approach to engineering problems.**	3
	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
CO 5	PO 2	Identify the **problem statement** and types of concrete chimneys collect the data to obtain reinforcement details and **Interpretation** of obtained values.	2
	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
CO 6	PO 3	Development of Solutions for concrete chimneys, **design process and evaluate** the loads on members and obtain reinforcement details.	1
	PO 4	Students also are responsible for evaluating the values as per **codal provisions** and which is then reflected in the final results.	1

	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

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

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

XIV PERCENTAGE OF KEY COMPETENCIES FOR CO – PO/ PSO

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	-	20	-	-	-	-	-	-	-	-	-		-	-	-
CO 2	-	-	20	27	-	-	-	-	-	-	-	-	100	-	-
CO 3	-	-	20	18	-	-	-	-	-	-	-	-	-	-	-
CO 4	-	-	20	27		-	-	-	-	-	-		100	-	-
CO 5	-	20	20	-	-	-	-	-	-	-	-	-	100	-	-
CO 6	-	-	10	9		-	-	-	-	-	-		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	-	-	-	-	-	-	-	-	-	-	-	-	
CO 2	-	-	1	1	-	-	-	-	-	-	-	-	3	-	-
CO 3	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 4	-	-	1	1	-	-	-	-	-	-	-	-	3	-	-
CO 5	-	1	1	-	-	-	-	-	-	-	-	-	3	-	-
CO 6	-	-	1	1	-	-	-	-	-	-	-	-	3	-	-
TOTAL	-	3	4	3	-	-	-	-	-	-	-	-	12	-	-
AVERAGE	-	1	1	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:

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

XVIII SYLLABUS:

MODULE I	**FLAT SLABS**
	Introduction- Components of flat slab – Direct Design method – Shear in flat slabs – Slab reinforcement - Openings in flat slabs - Design of a flat slab (Interior panel only).
MODULE II	**BUNKERS**
	Introduction – Components of bunker – Loads on Bunkers - Design of concrete bunkers of circular shape – (excluding staging) – Introduction to silos.
MODULE III	**CHIMNEYS**
	Introduction – Types of concrete chimneys – Components of chimneys . Loads on Chimneys - Design of concrete chimneys.
MODULE IV	**WATER TANKS**
	Introduction- Types of water tanks – Loads on water tanks -Design of circular and rectangular water tank resting on the ground, Design of Intz water tank (excluding staging)
MODULE V	**DESIGN OF RETAINING WALLS**
	Introduction – Types of retaining walls – Stability of cantilever retaining wall- Loads on retaining walls - Design of cantilever and counterfort retaining wall with horizontal back fill.

TEXTBOOKS

1. Dr. B. C. Punmia, Ashok Kumar Jain, Arun Kumar Jain. R.C.C Structures , Laxmi publications, New Delhi.
2. Varghese. Advanced RCC, PHI Publications, New DelhIT.
3. Krishna Raju., Structural Design and drawing (RCC and steel), Universities Press , New Delhi

REFERENCE BOOKS:

1. Sushil kumar. R.C.C Designs, standard publishing house.
2. N.C.Sinha and S.K.Roy.Fundamentals of RCC, S.Chand Publications, New Delhi.

WEB REFERENCES:

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

XIX COURSE PLAN:

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

S.No	Topics to be covered	CO's	Reference T1: 4.1
OBE DISCUSSION			
1	Course Objectives(CO),Course Outcomes(CO),Program Outcomes(PO)		
CONTENT DELIVERY (THEORY)			
2	Terminology related with flat slab.	CO 1	T1: 2.1, -3.9
3-4	I.S code provisions for flat slab construction.	CO 1	T2: 3.1-3.5.
5-8	Analysis of flat slab.	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	Openings in flat slab	CO 1	T2: 6.8-6.9
11	Components of bunker	CO 1	T2: 3.4, R1: 4.1
11-14	Types of loads applied on Bunkers.	CO 1	T2: 3.4, R1: 4.1
15-18	Design of concrete bunkers of circular shape	CO 1	T2: 3.4, R1: 4.1
19-22	Terminology and procedure related with silos.	CO 1	T2: 3.4, R1: 4.1
23	Introduction and terminology related to chimneys.	CO 2	T2: 3.4
24-26	Different types of concrete chimneys . .	CO 2	T2: 10.17
27-28	Components of chimneys.	CO 2	T2: 4.2
22	Understand deflection limits in IS: 456–2000	CO 2	T2: 5.1
29-30	Problems on I.S Code recommendations regarding Chimneys.	CO 3	T2: 5.2
39-43	I.S Code recommendations regarding detailing in water tanks.	CO 3	T2: 5.2
44-47	Analysis of water tanks and joints in water tanks.	CO 4	T2: 5.3
48	Circular tanks resting on ground.	CO 4	T1: 4.1-4.12
49-51	I.S Code method for design of circular tanks.	CO 4	T1: 4.15
52	Design of rectangular water tanks.	CO 4	T1: 6.3
53-54	water tank resting on the ground.	CO 5	T1: 6.6
55	Design of Intz water tank.	CO 5	T1: 6.6
56-58	Types of retaining walla, earth pressure on retaining walls.	CO 5	T1: 7.2
59	Loads on retaining walls	CO 6	T1: 7.3
60-61	Design of cantilever retaining wall.	CO 6	T1: 7.3
62-63	Design of counterfort retaining wall with horizontal back fill	CO 6	T1: 7.4,

PROBLEM SOLVING/ CASE STUDIES			
1	Design an interior panel of a flat slab for a live load of 5.5 kN/m^2. The slab is provided with a floor finish of 1 kN/m^2. The panels are 5 m x 5 m. Drops shall provided. Use M20 concrete and Fe 415 steel.	CO 1	R2:7.5
2	Design an interior panel of a flat slab with 7 m x 7 m dimensions, for a live load of 8 kN/m^2. Provide two-way reinforcement. Use M15 concrete.	CO 1	T2:3
3	Design an interior panel of a flat slab with 4.8 m x 3 m dimensions, for a super- imposed load of 7.75 kN/m^2. Provide two-way reinforcement. Use M15 concrete.	CO 2	R2:7.5
4	Design a rectangular bunker 16 m length and 9 m width supported on ten columns. It stores maize. Height of vertical portion = 5 m. Height of hopper =4m.	CO 2	R2:7.5
5	Design a rectangular bunker 18m length and 7.5 m width supported on ten columns. It stores grains. Height of vertical portion =5 m. Height of hopper =4m.	CO 2	T1: 4.1
6	Design the side wall of a circular bunker to store 40 tonnes of coal. The bunker has a mean diameter of 3.5m. Assume the density of coal as 900 kg/m^3 and angle of repose equal to 34^o. Assume M40 concrete and Fe 415 steel.	CO 3	T3:4.5
7	An R. C. chimney having a mean diameter of 3.25 metres is reinforced with fifty bars of 16 mm diameter. Assuming an effective wind pressure of 1200 N/m^2 on projected areas, determine the maximum stressres in concrete and steel at a section 30 meters from the top. Assume wt. of RCC= $24000N/m^3$.	CO 3	R4:5.2
8	Design a chimney of 45 m height, having external diameter of 3 m throughout the height. The chimney has fire brick lining of 100 mm thick, provide upto a height of 22 m above base, with an air gap of 100 mm. Assume the temperature of gases above surrounding air is 2400C. Take the coefficient of expansion of concrete and steel = 11 x 10-6 per degree C, and ES = 2.05 x $105N/mm^2$. Use M20 grade concrete mix.	CO 4	T2:5.2
9	An R. C. chimney having a mean diameter of 4.5 metres is reinforced with fifty bars of 16 mm diameter. Assuming an effective wind pressure of 900 N/m^2 on projected areas, determine the maximum stressres in concrete and steel at a section 32 meters from the top. Assume wt. of RCC= $24000N/m^3$.	CO 4	R2:7.5
10	Design a rectangular tank of size 6 m x 5 m x 4.5 m, resting on the ground, using approximate method of design. Use M25 concrete and Fe 415 steel.	CO 5	R2:7.5
11	Design the wall of a circular tank 8 m diameter and 4.5 m height. The tank is fixed at the base and resting on the round. Sketch the details.	CO 5	R2:7.5

12	Design the wall of a circular tank 6 m diameter and 4 m height. The tank is fixed at the base and resting on the round. Sketch the details.	CO 5	R2:7.5
13	A cantilever retaining wall has to retain earth 4 m high above ground level. The density of earth is 18 KN/m^3 and its angle of repose is 300. The earth is horizontal at top. The safe bearing capacity of soil is 180 KN/m^2 and coefficient of friction between soil and concrete is 0.55.	CO 6	R2:7.5
14	Design a R.C. C. retaining wall to retain earthen embankment 4.5m high above ground level. The embankment is surcharged at an angle of 15° to the horizontal. The weight of the earth and it's angle of repose are 18000 N/m3 and 30° respectively. Good foundation for the wall is available at a depth of 1.0 m below ground level where the permissible bearing capacity of soil may be taken as 160 KN/m^2. The value of the co-efficient of friction between concrete and soil (μ) may be taken as 0.62. Adopt M 20 grade of concrete and Fe 415 grade steel.	CO 6	R2:7.5
15	Design a suitable counterfort retaining wall to support a level backfill, 8 m high above the ground level on the toe side. Assume good soil for foundation at a depth of 1.5 m below the ground level with a safe bearing capacity of 160 kN/m^2 . Further assume the backfill to comprise granular soil with a unit weight of 16 kN/m^3 and an angle of shearing resistance of 30o . Assume the coefficient of friction between soil and concrete to be 0.5. Use M 25 and Fe 415 steel.	CO 6	R2:7.5
DISCUSSION OF DEFINITION AND TERMINOLOGY			
1	Preventation for punching of the column in flat slabs.	CO 1	R4:2.1
2	Forces acting on the walls of a bin	CO 2	T4:7.3
3	Factors that are governed stresses developed in design of chimneys.	CO 3,4	R4:5.1
4	Various types of joints in water tanks.	CO 5	T1:7.5
5	Structural action between cantilever and counterfort type retaining wall.	CO 6	T1: 4.1
DISCUSSION OF QUESTION BANK			
1	Flat Slabs	CO 1	R4:2.1
2	Bunkers	CO 2	T4:7.3
3	Chimneys	CO 3,4	R4:5.1
4	Water Tanks	CO 5	T1:7.5
5	Design of Retaining Walls	CO 6	T1: 4.1

Signature of Course Coordinator **HOD,CE**
Mr. Gude Ramakrishna, Associate Professor

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

CIVIL ENGINEERING

COURSE DESCRIPTION

Course Title	GLOBAL WARMING AND CLIMATE CHANGE				
Course Code	AHSB21				
Program	B.Tech				
Semester	VII	CE			
Course Type	Elective				
Regulation	IARE - R18				
Course Structure	Theory			Practical	
	Lecture	Tutorials	Credits	Laboratory	Credits
	3	-	3	-	-
Course Coordinator	Mr S. Selvaprakash, Assistant Professor				

I COURSE OVERVIEW:

This course provides students with a scientific foundation of anthropogenic climate change and an introduction to climate models. It focuses on fundamental physical processes that shape climate (e.g. solar variability, orbital mechanics, greenhouse gases, atmospheric and oceanic circulation, and volcanic and soil aerosols) and on evidence for past and present climate change. During the course they discuss material consequences of climate change, including sea level change, variations in precipitation, vegetation, storminess, and the incidence of disease. This course also examines the science behind mitigation and adaptation proposals.

II COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites
B.Tech	AHSB07	IV	ENVIRONMENTAL SCIENCES

III MARKS DISTRIBUTION:

Subject	SEE Examination	CIE Examination	Total Marks
Global Warming and Climate Change	70 Marks	30 Marks	100

IV DELIVERY / INSTRUCTIONAL METHODOLOGIES:

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

V EVALUATION METHODOLOGY:

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

Semester End Examination (SEE): The SEE is conducted for 70 marks of 3 hours duration. The syllabus for the theory courses is divided into FIVE modules and each module carries equal weightage in terms of marks distribution. The question paper pattern is as follows. Two full questions with "either" or "choice" will be drawn from each module. Each question carries 14 marks. There could be a maximum of two sub divisions in a question.

The expected percentage of cognitive level of the questions is broadly based on the criteria given in Table: 1.

Percentage of Cognitive Level	Blooms Taxonomy Level
10%	Remember
70 %	Understand
20 %	Apply
0 %	Analyze
0 %	Evaluate
0 %	Create

Continuous Internal Assessment (CIA):

CIA is conducted for a total of 30 marks (Table 2), with 20 marks for Continuous Internal Examination (CIE), 05 marks for Quiz and 05 marks for Alternative Assessment Tool in table

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:

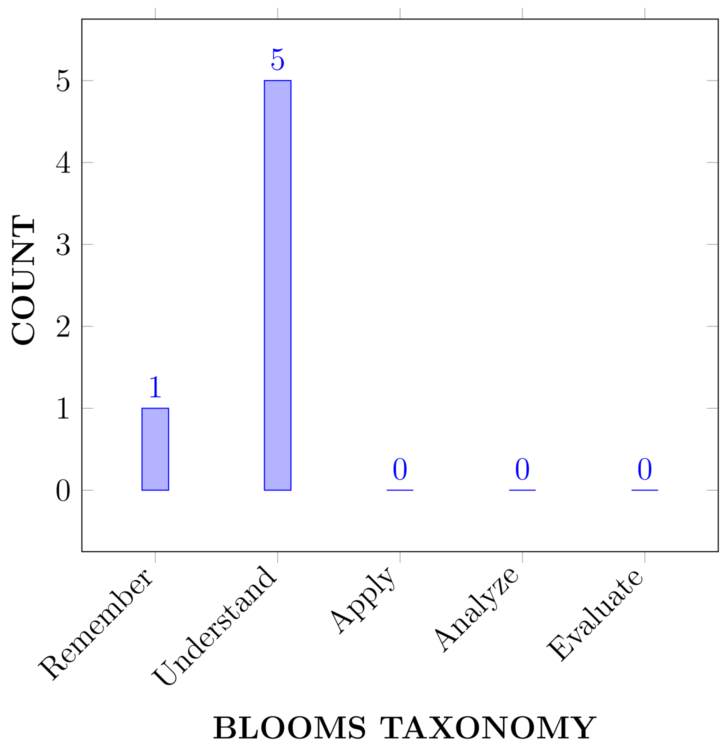
I	Understand the importance of Ozone layer in the atmosphere.
II	Comprehend composition of atmosphere.
III	Understand impacts of climate change on ecosystem.
IV	Understand initiatives taken by different countries to reduce emission of greenhouse gases.

VII COURSE OUTCOMES:

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

CO 1	**Recall** the concept of environmental system and green houses gases for Understanding climate change.	Understand
CO 2	**Understand** the ozone in environment and effect of green houses gases, radioactive effects for understand global warming effects.	Understand
CO 3	**Understand** atmosphere characteristics and pollution effects on atmosphere components.	Understand
CO 4	**Recall** Effects of past experiences due to climate change Changes of Temperature in the environment are Melting of ice pole,Agriculture, Forestry and Ecosystem, Water Resources.	Understand
CO 5	**Describe** consideration of uncertainties regional way and climate change mitigation means avoiding and reducing emission of heat trapping greenhouses gases. in the methods and Scenarios of climate changes and into the atmosphere to present the planet from warming to more extreme temperature.	Understand
CO 6	**Explain** Increased heat drought and outbreaks and minimum loss of life and property from climate change events. all linked to climate change have increased wildfires and protect public health and safety, increase public awareness of risk from climate change..	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	SEE/CIE, Quiz/AAT
PO 2	**Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.	1	SEE/CIE, Quiz/AAT
PO 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	SEE/ CIE, AAT, QUIZ
PO 7	**Environment and sustainability:** A Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.	3	SEE/ 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.	1	SEE/ CIE, AAT, QUIZ

3 = High; 2 = Medium; 1 = Low

IX HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

Program		**Strength**	**Proficiency Assessed by**
PSO 1	Design and Supervise Sub-Structures and Super Structures for Residential and Public Buildings, Industrial Structures, Irrigation Structures, Power Houses, Highways, Railways, Airways, Docs and Harbours.	1	Quiz
PSO 2	Focus on Improving Performance of Structures with reference to Safety, Serviceability and Sustainable Green Building Technology.	3	Quiz

3 = High; 2 = Medium; 1 = Low

X 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	✓	-	-	-	-	✓	✓	-	-	-	-	-	-	-	-

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

COURSE OUTCOMES	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key Competencies
CO 1	PO 1	**Understand the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization** to various climate change, ozone layer and green house gases	3
	PO 2	**Natural sciences** Analyze the performance of Effects of green houses gases and global warming	1
	PO 7	Determine the climate change and global warming parameters **using first principles and Engineering sciences.**	3
	PSO 2	Focus on Improving Performance of Structures with reference to Safety, Serviceability and **Sustainable Green Building Technology.**	3
CO 2	PO 1	**Understand the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization** to various climate change, ozone layer and green house gases	3
	PO 7	Determine the climate change and global warming parameters **using first principles and Engineering sciences.**	3
	PO 12	**Understand** Recognize the need for predisaster planning for climate and globalwarming change and also make use of broad knowledge of green houses building in dynamic present challange world.	1
CO 3	PO 1	**Understand the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization** to various climate change, ozone layer and green house gases	3
	PO 7	Determine the climate change and global warming parameters **using first principles and Engineering sciences.**	3
CO 4	PO 1	**Understand the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization** to various climate change, ozone layer and green house gases.	3
	PO 2	**Natural sciences** Analyze the performance of Effects of green houses gases and global warming	1
	PO 7	Determine the climate change and global warming parameters **using first principles and Engineering sciences.**	3

CO 5	PO 1	**Understand the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization** to various climate change, ozone layer and green house gases	3
	PO 7	Determine the climate change and global warming parameters **using first principles and Engineering sciences.**	3
CO 6	PO 1	**Understand the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization** to various climate change, ozone layer and green house gases	3
	PO 6	**Remember reasoning informed by the contextual knowledge to assess health, safety** and the consequent responsibilities relevant to the different climate condition and also global warming .	2
	PO 7	Determine the climate change and global warming parameters **using first principles and Engineering sciences.**	3

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

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

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	100	20	-	-	-	-	100	-	-	-	-		-	100	-
CO 2	100	-	-	-	-	-	100	-	-	-	-	20	-	-	-
CO 3	100	-	-	-	-	-	100	-	-	-	-	-	-	-	-
CO 4	100	20	-	-	-	-	100	-	-	-	-		-	-	-
CO 5	100	-	-	-	-	-	100	-	-	-	-	-	-	-	-
CO 6	100	-	-	-	-	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
2 - 40 % $<C < 60\%$ –Moderate
1-5 $<C \leq 40\%$ – Low/ Slight
3 - $60\% \leq C < 100\%$ – Substantial /High

COURSE	**PROGRAM OUTCOMES**												**PSO'S**		
OUTCOMES	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO 1	3	1	-	-	-	-	3	-	-	-	-		-	3	-
CO 2	3	-	-	-	-	-	3	-	-	-	-	1	-	-	-
CO 3	3	-	-	-	-	-	3	-	-	-	-	-	-	-	-
CO 4	3	1	-	-	-	-	3	-	-	-	-	-	-	-	-
CO 5	3	-	-	-	-	-	3	-	-	-	-	-	-	-	-
CO 6	3	-	-	-	-	2	3	-	-	-	-	-	-	-	-
TOTAL	24	2	-	-	-	4	24	-	-	-	-	1	1	6	-
AVERAGE	3	1	-	-	-	2	3	-	-	-	-	1	1	3	-

XV ASSESSMENT METHODOLOGY DIRECT:

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

XVI ASSESSMENT METHODOLOGY INDIRECT:

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

XVII SYLLABUS:

MODULE I	**EARTH'S CLIMATE SYSTEM**
	Role of ozone in environment, Ozone layer – Ozone depleting gases, Green House Effect – Radioactive effects of Greenhouse gases, The Hydrological cycle, Green House Gases and Global Warming, Carbon Cycle.

MODULE II	**ATMOSPHERE AND ITS COMPONENTS**
	Importance of Atmosphere – Physical and chemical characteristics of Atmosphere, Vertical structure of the atmosphere, Composition of the atmosphere,Atmospheric stability, Temperature profile of the atmosphere,Lapse rates, Temperature inversion, Effects of inversion on pollution dispersion.
MODULE III	**IMPACTS OF CLIMATE CHANGE**
	Causes of Climate change: Changes of Temperature in the environment, Melting of ice pole, sea level rise, Impacts of Climate Change on various sectors – Agriculture, Forestry and Ecosystem, Water Resources, Human Health, Industry, Settlement and Society. Methods and Scenarios, Projected Impacts for different regions, Uncertainties in the projected impacts of Climate Change, Risk of Irreversible Changes.
MODULE IV	**OBSERVED CHANGES AND ITS CAUSES**
	Climate change and Carbon credits, CDM – Initiatives in India-Kyoto Protocol, Paris Convention - Intergovernmental Panel on Climate change, Climate Sensitivity and Feedbacks. The Montreal Protocol – UNFCCC – IPCC – Global Climate Models (GCM) - Evidences of Changes in Climate and Environment- on a Global scale and in India.
MODULE V	**CLIMATE CHANGE AND MITIGATION MEASURES**
	Clean Development Mechanism, Carbon Trading – Examples of future clean technology, Biodiesel – Natural Compost, Eco-friendly plastic, Alternate Energy –Hydrogen, Bio-fules, Solar Energy, Wind and Hydroelectric Power. Mitigation Efforts in India and Adaptation funding. Key Mitigation Technologies and Practices – Energy Supply, Transport, Buildings, Industry, Agriculture, Forestry – Carbon sequestration, Carbon capture and storage (CCS), Waste (MSW and Bio-waste, Biomedical, Industrial waste) – International and Regional cooperation.

TEXTBOOKS

1. Dr. Sushil Kumar Dash, "Climate Change: An Indian Perspective (Environment and Development)", Cambridge University Press India Pvt Ltd, 2007.

2. Adaptation and mitigation of climate change – Scientific Technical Analysis, Cambridge University Press, Cambridge, 2006.

REFERENCE BOOKS:

1. Atmospheric Science, J.M. Wallace and P.V Hobbs, Elsevier/ Academic Press, 2006.

2. "Climate Change and Climate Variability on Hydrological Regimes", Jan C. Van Dam, Cambridge University Press, 2003.

XVIII COURSE PLAN:

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

S.No	**Topics to be covered**	**CO's**	**Reference T1: 4.1**
1-3	Role of ozone in environment, Ozone layer	CO 1, CO 2	T2: 1.1-1.5, T1: 4.1
4-5	Green House Effect Radioactive effects of Greenhouse gases	CO 1	T2: 2.1-2.2, R1: 3.1
6-7	Hydrological cycle	CO 1	T2: 2.3-2.4
8-9	Green House Gases and Global Warming, Carbon Cycle.	CO 1	T2: 2.5-2.6,
10-11	Importance of Atmosphere – Physical and chemical characteristics of Atmosphere	CO 2	T2: 3.3
12-13	Vertical structure of the atmosphere	CO 2	T2: 3.4
14-16	Composition of the atmosphere,Atmospheric stability, Temperature profile of the atmosphere,Lapse rates, Temperature inversion	CO 2	T2: 3.3
17-18	Effects of inversion on pollution dispersion.	CO 2	T2: 4.2
19-21	Changes of Temperature in the environment, Melting of ice pole, sea level rise, Impacts of Climate Change on various sectors	CO 3	T2: 5.1
22-24	Agriculture, Forestry and Ecosystem, Water Resources, Human Health, Industry, Settlement and Society	CO 3	T2: 5.2
25-26	Methods and Scenarios, Projected Impacts for different regions	CO 3	T2: 4.5
26-27	Uncertainties in the projected impacts of Climate Change, Risk of Irreversible Changes.	CO 3	T1: 4.1
28-31	DClimate change and Carbon credits, CDM Initiatives in India-Kyoto Protocol, Paris Convention - Intergovernmental Panel on Climate change, Climate Sensitivity and Feedbacks.	CO 4	T1: 4.2
32-33	The Montreal Protocol – UNFCCC – IPCC – Global Climate Models (GCM)	CO 4	T1: 4.3
34-36	Evidences of Changes in Climate and Environment- on a Global scale and in India.	CO 4	T2: 5.2
37-40	Clean Development Mechanism, Carbon Trading, – Examples of future clean technology, Biodiesel , – Natural Compost, Eco-friendly plastic, Alternate Energy	CO 5	T2: 5.2
41-42	Hydrogen, Bio-fules, Solar Energy, Wind and Hydroelectric Power. Mitigation Efforts in India and Adaptation funding.	CO 5	T2: 5.2
43-44	Key Mitigation Technologies and Practices – Energy Supply, Transport, Buildings, Industry, Agriculture, Forestry	CO 6	T1: 7.2

45-46	Carbon sequestration, Carbon capture and storage (CCS), Waste (MSW and Bio-waste, Biomedical, Industrial waste), International and Regional cooperation.	CO 6	R2:7.5

Signature of Course Coordinator **HOD,CE**
Mr. S Selvaprakash Assistant Professor

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

CIVIL ENGINEERING
COURSE DESCRIPTION

Course Title	**ENVIRONMENTAL ENGINEERING LABORATORY**				
Course Code	ACEB24				
Program	B.Tech				
Semester	VII	CE			
Course Type	CORE				
Regulation	IARE - R18				
Course Structure	Theory			Practical	
	Lecture	Tutorials	Credits	Laboratory	Credits
	-	-	-	3	1.5
Course Coordinator	Mr. K LOKESH, Assistant Professor				

I COURSE OVERVIEW:
The Environmental Engineering laboratory has gained significance in determining the physical and chemical properties of water along with its suitability as drinking water as per the Bureau of Indian Standards. This laboratory focuses on developing processes to improve the natural and built sustainable environment for all living beings.

II COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites
UG	ACEB22	VII	Environmental Engineering

III COURSE OVERVIEW:
The Environmental Engineering laboratory has gained significance in determining the physical and chemical properties of water along with its suitability as drinking water as per the Bureau of Indian Standards. This laboratory focuses on developing processes to improve the natural and built sustainable environment for all living beings.

IV MARKS DISTRIBUTION:

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

V DELIVERY / INSTRUCTIONAL METHODOLOGIES:

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

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

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

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

Continuous Internal Assessment (CIA):

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

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

Continuous Internal Examination (CIE):

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

1. **Experiment Based**

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

2. **Programming Based**

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

VII COURSE OBJECTIVES:

The students will try to learn:

I	The water quality standards and their relation to public health.
II	The characteristics of water in case of quality analysis
III	The complete water quality assessment for domestic and Industrial supplies
IV	To select appropriate treatment schemes to remove certain pollutants present in water or wastewater.

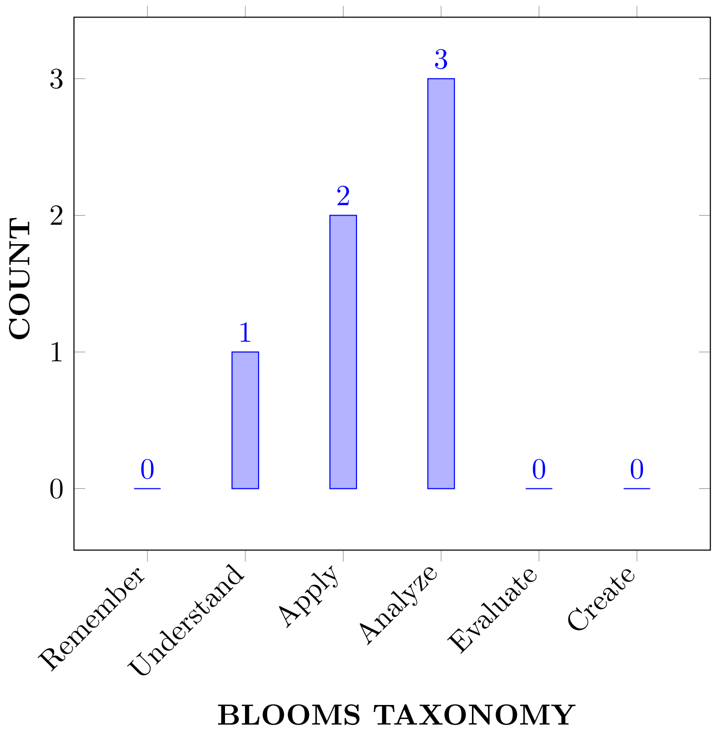
VIII COURSE OUTCOMES:

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

CO 1	**Demonstrate** the physical and chemical parameters of water and its suitability for drinking purposes and building construction.	Understand
CO 2	**Measure** the turbidity and conductivity of water for presence of suspended particles	Apply

CO 3	**Determine** the pH, alkalinity and acidity in water to check the presence of sufficient amount of alkalines and acids	Apply
CO 4	**Determine** the water for presence of chlorides, Iron, Nitrates and Phosphorous which induces salinity, color and toxicity.	Analyze
CO 5	**Determine** the optimum dosage of coagulant to remove impurities in the flocculation process	Analyze
CO 6	**Determine** dissolved oxygen content, BOD and COD in water for the survival of aquatic animals and amount of pollutants.	Analyze

COURSE KNOWLEDGE COMPETENCY LEVEL



IX HOW PROGRAM OUTCOMES ARE ASSESSED:

Program		Strength	Proficiency Assessed by
PO 1	**Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.	1	SEE
PO 3	**Design/Development of Solutions:** Design solutions for complex Engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and Environmental considerations	1	LAB Exercises
PO 6	**T**he engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.	2	LAB Exercises
PO 7	**Life-long learning:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development	3	SEE

3 = High; 2 = Medium; 1 = Low

X HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

Program		Strength	Proficiency Assessed by
PSO 2	Broadness and Diversity: Graduates will have a broad understanding of economic, environmental, societal, health and safety factors involved in infrastructural development, and shall demonstrate ability to function within multidisciplinary teams with competence in modern tool usage.	1	LAB Exercises

3 = High; 2 = Medium; 1 = Low

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

COURSE OUTCOMES	PO'S PSO'S	**Justification for mapping (Students will be able to)**	No. of Key Competencies
CO 1	PO 1	Acquaint with Engineering Knowledge on water quality standards in relation to public health safety	1
	PO 3	Provide safe water in promoting health and reducing societal poverty	2
CO 2	PO 1	The knowledge of Environmental Engineering fundamentals are used to estimate transparency of water and design treatment system including distribution systems.	1

	PO 6	Make use of Experimental tools for amounts of impurities will lead to a higher conductivity	1
CO 3	PO 1	Acquaint the knowledge of water treatment methods thoroughly, to produce specific water quality suitable for good public health	1
	PO 6	Assess the degree or level of water got treated during treatment of wastewater to judge health, safety, and cultural issues	3
	PSO 2	Develop safe infrastructure for mineral processing waste and contamination monitoring.	2
CO 4	PO 3	Applying the knowledge to design components for the public health .	2
	PSO 2	Apply the knowledge of functional behaviour of the system for designing a test cases for designing solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public safety	2
CO 5	PSO 2	Make use of source and Experimental tools in municipal water treatment for health factors	2
	PO 7	Demonstrate the knowledge of examination of water and waste water which has been contaminated for sustainable development	2
CO 6	PO 3	Design solutions for water treatment that meets the specified needs for the cultural, societal, environment, public health and safety	2
	PO 1	Engineering skills are required in maintenance of distribution system components and equipment affected by pollutants.	2
	PO 7	Engineering Demonstrate the sustainable development of environment by reducing pollutant contents	2

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

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

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

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO 1	33.3	-	20	-	-	-	-	-	-	-	-	-	-	-	-
CO 2	33.3	-	-	-	-	40	-	-	-	-	-	-	-	-	-
CO 3	33.3	-	-	-	-	60	-	-	-	-	-	-	-	20	-
CO 4	-	-	20	-	-	-	-	-	-	-	-	-	-	20	-
CO 5	-	-	-	-	-	-	66.7	-	-	-	-	-	-	20	-
CO 6	66.7	-	20	-	-	-	66.7	-	-	-	-	-	-	-	-

XIV COURSE ARTICULATION MATRIX (PO – PSO MAPPING):

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

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

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO 1	1	-	1	-	-	-	-	-	-	-	-	-	-	-	-
CO 2	1	-	-	-	-	1	-	-	-	-	-	-	-	-	-
CO 3	1	-	-	-	-	2	-	-	-	-	-	-	-	1	-
CO 4	-	-	1	-	-	-	-	-	-	-	-	-	-	1	-
CO 5	-	-	-	-	-	-	3	-	-	-	-	-	-	1	-
CO 6	2	-	1	-	-	-	3	-	-	-	-	-	-	-	-
TOTAL	5	-	3	-	-	3	6	-	-	-	-	-	-	3	-
AVERAGE	1.25	-	1	-	-	1.5	3	-	-	-	-	-	-	1	-

XV ASSESSMENT METHODOLOGY DIRECT:

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

XVI ASSESSMENT METHODOLOGY INDIRECT:

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

XVII SYLLABUS:

WEEK I	INTRODUCTION TO ENVIRONMENTAL ENGINEERING LABORATORY DETERMINATION OF PH AND TURBIDITY
	Introduction to environmental engineering. Do's and Don'ts in the lab. Batch I: To determine the pH of given samples using universal indicator, pH paper and digital pH meter Batch II: Determination of turbidity of the given sample using nephelometer in NTU.
WEEK II	**DETERMINATION OF PH AND TURBIDITY**
	Batch I: Determination of turbidity of the given sample using nephelometer in NTU. Batch II: To determine the pH of given samples using universal indicator, pH paper and digital pH meter
WEEK III	**DETERMINATION OF CONDUCTIVITY AND TOTAL DISSOLVED SOLIDS (ORGANIC AND INORGANIC)**
	Batch I: Determining the electrical conductivity of the given water sample. Batch II: Determination of total dissolved solids of the sample.
WEEK IV	**DETERMINATION OF CONDUCTIVITY AND TOTAL DISSOLVED SOLIDS (ORGANIC AND INORGANIC)**
	Batch I: Determination of total dissolved solids of the sample. Batch II: Determining the electrical conductivity of the given water sample
WEEK V	DETERMINATION OF ALKALINITY, ACIDITY OF WATER AND CHLORIDE AND IRON IN WATER
	Batch I: Determining the amount of alkalinity present in the given samples anddetermine the acidity of the given sample of water. Batch II: Determine the quantity of iron present in the given sample of water and determining the amount of chloride present in the given water sample by Mohr's method.
WEEK VI	DETERMINATION OF ALKALINITY,ACIDITY OF WATER AND CHLORIDE AND IRON IN WATER
	Batch I: Determine the quantity of iron present in the given sample of water and determining the amount of chloride present in the given water sample by Mohr's method. Batch II: Determining the amount of alkalinity present in the given samples and determine the acidity of the given sample of water.
WEEK VII	**DETERMINATION OF DISSOLVED OXYGEN AND NITRATES IN WATER**
	Batch I: Determine the nitrate nitrogen of the given sample of water. Batch II: Determine the quantity of dissolved oxygen present in the given sample(s) by using modified Winkler's (Azide modification) method.
WEEK VIII	**DETERMINATION OF DISSOLVED OXYGEN AND NITRATES IN WATER**
	Batch I: Determine the quantity of dissolved oxygen present in the given sample(s) by using modified Winkler's (azide modification) method Batch II: Determine the nitrate nitrogen of the given sample of water.
WEEK IX	**DETERMINATION OF OPTIMUM DOSE OF COAGULANT AND CHLORINE DEMAND**
	Batch I: Determining the optimum coagulant dosage for clarifying the given sample of water by using alum as the coagulant and performing the jar test experiment. Batch II : Determining the chlorine demand
WEEK X	**DETERMINATION OF OPTIMUM DOSE OF COAGULANT AND CHLORINE DEMAND**

	Batch I : Determining the chlorine demand Batch II: Determining the optimum coagulant dosage for clarifying the given sample of water by using alum as the coagulant and performing the jar test experiment.
WEEK XI	**DETERMINATION OF TOTAL PHOSPHORUS AND B.O.D.**
	Batch I: Determining the amount of B.O.D. exerted by the given sample Batch II: Determining the total phosphorus.
WEEK XII	**DETERMINATION OF TOTAL PHOSPHORUS AND B.O.D.**
	Batch I: Determining the total phosphorus Batch II: Determining the amount of B.O.D. exerted by the given sample.
WEEK XIII	**DETERMINATION OF C.O.D IN WATER .**
	Batch I: Determining the amount of C.O.D. exerted by the given sample Batch II: Determining the amount of C.O.D. exerted by the given sample.

TEXTBOOKS

1. G. Rich, —Environmental Systems Engineering‖, Tata McGraw-Hill, 1973.
2. Fair, Geyer, Okum, — Water and Wastewater Engineering: Water Supply and Wastewater Removal, John Wiley & Sons Canada, Limited, 3rd Edition, 2010.

REFERENCE BOOKS:

1. IS 3025 (Part 15)- 1984: Method of Sampling and Test (Physical and Chemical) for Water and Wastewater : Total Residue (total Solids, Dissolved and Suspended, First Revision.
2. E.D. Schrocder, —Water and Waste Treatment‖, Tata McGraw-Hill Education, 1977

XVIII COURSE PLAN:

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

S.No	Topics to be covered	CO's	Reference
1	DETERMINATION OF PH	CO 1,CO 3	T1:1.4,R1:1.2
2	DETERMINATION OF TURBIDITY	CO 1,CO 2	T1:1.5,R1:1.3
3	DETERMINATION OF CONDUCTIVITY	CO 2,CO 4	T2:12.2, R2:13.1
4	DETERMINATION OF TOTAL DISSOLVED SOLIDS	CO 3,CO 4	T2:12.3,R2:13
5	DETERMINATION OF ALKALINITY, ACIDITY OF WATER	CO 3,CO 4	T1:9.1,R2:3
6	DETERMINATION OF CHLORIDE AND IRON IN WATER	CO 3,CO 4	T1:9.1,R2:3
7	DETERMINATION OF DISSOLVED OXYGEN	CO 2 CO 4	T2:1.9, R2:1.8
8	DETERMINATION NITRATES IN WATER	CO 2 CO 4	T2:2, R2:1.9
9	DETERMINATION OF OPTIMUM DOSE OF COAGULANT	CO 4 CO 5	T2:1.4, R1:1.2
10	DETERMINATION OF CHLORINE DEMAND	CO 4 CO 5	T2:1.7, R2:1.3
11	DETERMINATION OF TOTAL PHOSPHORUS	CO 4 CO 5	T1:1.4, R1:1.

12	DETERMINATION OF B.O.D	CO 5 CO 6	T1:7.1, R2:3.8
13	DETERMINATION OF C.O.D	CO 5 CO 6	T1:8.1, R2:1.8

XIX EXPERIMENTS FOR ENHANCED LEARNING (EEL):

S.No	Design Oriented Experiments
1	Evaluate the chemical water quality of a local pond,
2	Conduct tests to evaluate coagulant dose for settling
3	Groundwater contamination and remediation
4	Water and air quality sensors and modeling

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

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

CIVIL ENGINEERING
COURSE DESCRIPTION

Course Title	TRANSPORTATION ENGINEERING LABORATORY				
Course Code	ACEB25				
Program	B.Tech				
Semester	VII	CE			
Course Type	CORE				
Regulation	IARE - R18				
Course Structure	Theory			Practical	
	Lecture	Tutorials	Credits	Laboratory	Credits
	-	-	-	3	1.5
Course Coordinator	Mr.B.Suresh, Assistant Professor				

I 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.

II COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites	Credits
UG	ACEB03	III	Surveying and Geomatics Laboratory	1.5

III MARKS DISTRIBUTION:

Subject	SEE Examination	CIE Examination	Total Marks
Transportation 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 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	The geometric design of highways and expressways based on different terrains.
II	The engineering properties of pavement materials used in construction of highway.
III	The various traffic surveys to implement traffic regulation and control measures.

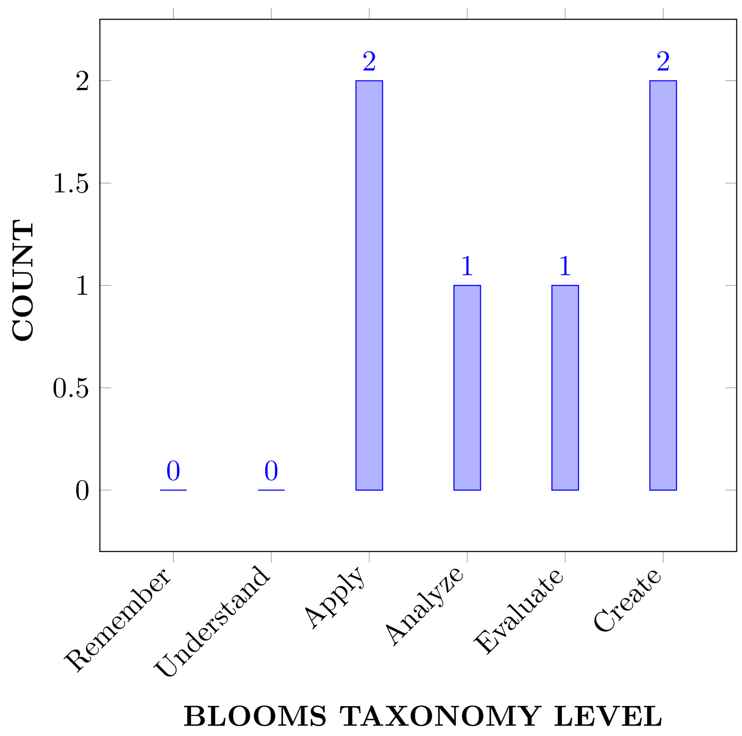
VII COURSE OUTCOMES:

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

CO 1	**Apply** the fundamentals of highway engineering for effective planning and development of highways .	Apply
CO 2	**Identify** the mechanical properties of pavement construction materials for enhancing serviceability and durability of highway pavements .	Apply

CO 3	**Analyze** the factors affecting pavements deterioration and the remedial measures to enhance life time of rigid and flexible pavements.	Analyze
CO 4	**Explain** the stresses induced in rigid pavements considered for designing CC pavements to improve their Understand	Evaluate
CO 5	**Design** the flexible and rigid pavements as per IRC guidelines for enhancing serviceability and durability of expressways.	Create
CO 6	**Choose** the balancing techniques for effective balancing of Flexible and rigid pavements.	Create

COURSE COURSE KNOWLEDGE COMPETENCY LEVEL:



VIII HOW PROGRAM OUTCOMES ARE ASSESSED:

Program outcomes		Strength	Proficiency Assessed by
PO 1	**Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.	2	Lab Exercises/CIA/SEE
PO 2	**Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences	2	Lab Exercises/CIA/SEE
PO 5	**Modern Tool Usage:** Create, select, and apply appropriate techniques, resources, and modern Engineering and IT tools including prediction and modelling to complex Engineering activities with an understanding of the limitations	2	Lab Exercises/CIA/SEE
PO 9	**Individual and team work:**Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.	2	Lab Exercises/CIA/SEE

3 = High; 2 = Medium; 1 = Low

IX HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

Program		Strength	Proficiency Assessed by
PSO 1	Understand, analyze, design and supervise sub-structures and superstructures of residential and public buildings, industrial structures, irrigation structures, powerhouses, highways, railways, airways, docks 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 effective planning and highway development (understanding) their importance and apply the **principles of Mathematics and Engineering**	2
	PO 2	Understand the given **problem statement and apply data validation techniques to solve** (complex) specific engineering problems related highway development	3
CO 2	PO 1	Identify (knowledge) suitable methods involved for testing highway materials using in solving (complex) engineering problems by applying the principles of **principles of Mathematics and Engineering**	2

	PO 2	Understand the given **problem statement and apply data validation techniques to solve** (complex) specific engineering problems related to suitable identification of material for construction of pavements.	3
CO 3	PO 1	Recall (knowledge) the basic steps involved in design of flexible and rigid pavements (apply), implementing (complex) various techniques using **principles of Mathematics and Engineering**	2
	PO 5	Create, select, and apply suitable **Computer software and simulation packages**for understanding of the limitations of design.	2
CO 4	PO 1	Recall (knowledge) the basic steps involved in calculating stress induced in pavements by applying (complex) techniques using **principles of Mathematics and Engineering**	2
	PSO 1	Apply (knowledge) Design and Supervise Sub-Structures and Super Structures for Residential and Public Buildings, (apply) for analyzing stress in pavements section by applying the **Structural design and materials knowledge** through standard **Codes of practices**	2
CO 5	PO 1	Identify (knowledge) suitable methods involved in designing, of pavements **Computer software and simulation packages** / solving (complex) engineering problems by applying the principles of **mathematics and engineering fundamentals**	2
	PO 5	Create, select, and apply suitable **Computer software and simulation packages**for understanding of the limitations of design in terms of serviceability and durability according to IRC	2
	PO 9	Recall the fundamental of IRC design of pavements in terms of serviceability and durability of pavements and generate new ideas on recycling **materials** will help the **Ability to work with all levels of people in an organization.**	2
CO 6	PO 1	Identify (knowledge) suitable balancing methods involved in designing, of pavements **Computer software and simulation packages** / solving (complex) engineering problems by applying the principles of **mathematics and engineering fundamentals** .	2
	PO 5	Create, select, and apply suitable **Computer software and simulation packages**for understanding of the limitations of design in terms of serviceability and durability according to IRC	2
	PSO 1	Apply (knowledge) Design and Supervise Sub-Structures and Super Structures for Residential and Public Buildings, (apply) for analyzing stress in pavements section by applying the **Structural design and materials knowledge** through standard **Codes of practices**	2

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
	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

XII ASSESSMENT METHODOLOGY DIRECT:

CIE Exams	PO 1, PO 2, PO 5, PO 9 PSO 1	SEE Exams	PO 1, PO 2, PO 5, PO 9 PSO 1	Seminars	-
Laboratory Practices	PO 1, PO 2, PO 5, PO 9	Student Viva	PO 1,PO 2, PO 5,PO 9	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 TRANSPORTATION LABORATORY – I**
	Introduction to transportation material laboratory. Do's and Don'ts in materials lab.
WEEK II	**AGGREGATE CRUSHING STRENGTH TEST**
	Measurement of Aggregate crushing test.
WEEK III	**AGGREGATE IMPACT TEST**
	Measurement of Aggregate Impact test.
WEEK IV	**SPECIFIC GRAVITY AND WATER ABSORPTION TEST**
	Calculation of specific gravity and water absorption test..
WEEK V	**ABRASION AND ATTRITION TEST OF COARSE AGGREGATES**
	To perform Abrasion and Attrition test of coarse aggregates.
WEEK VI	**SHAPE TESTS OF COARSE AGGREGATES**
	Measurement of percentage of Flakiness in coarse aggregates. Measurement of percentage of Elongation in coarse aggregates

WEEK VII	**PENETRATION AND DUCTILITY TEST OF BITUMINOUS MATERIALS**
	To find the Penetration and ductility value of bitumen sample.
WEEK VIII	**SOFTENING POINT OF BITUMEN MATERIALS**
	To find the softening point value of bituminous materials..
WEEK IX	**FLASH AND FIRE POINT TEST OF BITUMEN MATERIALS**
	To find the flash point value of bitumen sample.
WEEK X	**NORMAL CONSISTENCY OF FINENESS OF CEMENT**
	To perform test and find the normal consistency of fineness of cement.
WEEK XI	**INITIAL SETTING TIME AND FINAL SETTING TIME OF CEMENT**
	To find the initial and final setting time of cement.
WEEK XII	**SPECIFIC GRAVITY AND SOUNDNESS OF CEMENT**
	To find the specific gravity and soundness of cement.

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1. Khanna, S.K., Justo, C.E.G and Veeraragavan, A, "Highway Engineering", Nem Chand & Bros, Revised 10 th Edition, 2017..
2. Kadiyalai, L.R., "Traffic Engineering and Transport Planning", Khanna Publishers, 2013.

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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.

XV COURSE PLAN:

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

S.No	Topics to be covered	CO's	Reference
1	INTRODUCTION TO TRANSPORTATION LABORATORY – I	CO 1, CO 2,CO 3, CO 4,CO 5, CO 6	T1:2.1.5 T2:2.3
2	AGGREGATE CRUSHING STRENGTH TEST	CO 1, CO 2,CO 3, CO 4,CO 5, CO 6	T2:2.1.5 R1:2.6
3	AGGREGATE IMPACT TEST	CO 1, CO 2,CO 3, CO 4,CO 5, CO 6	T1:2.6 R3:3.6.5
4	SPECIFIC GRAVITY AND WATER ABSORPTION TEST	CO 1, CO 2,CO 3, CO 4,CO 5, CO 6	T2:2.7 R2:2.18
5	ABRASION AND ATTRITION TEST OF COARSE AGGREGATES	CO 1, CO 2,CO 3, CO 4,CO 5, CO 6	T2:2.22 R3:3.1.1
6	SHAPE TESTS OF COARSE AGGREGATES	CO 1, CO 2,CO 3, CO 4,CO 5, CO 6	T1:2.5.1 T2:2.25

7	PENETRATION AND DUCTILITY TEST OF BITUMINOUS MATERIALS	CO 1, CO 2,CO 3, CO 4,CO 5, CO 6	T2:2.26 R3:2.55
8	SOFTENING POINT OF BITUMEN MATERIALS	CO 1, CO 2,CO 3, CO 4,CO 5, CO 6	T2:2.3 R3:2.6
9	FLASH AND FIRE POINT TEST OF BITUMEN MATERIALS	CO 1, CO 2,CO 3, CO 4,CO 5, CO 6	T2:2.3 R1:2.6
10	NORMAL CONSISTENCY OF FINENESS OF CEMENT	CO 1, CO 2,CO 3, CO 4,CO 5, CO 6	T1:2.6
11	INITIAL SETTING TIME AND FINAL SETTING TIME OF CEMENT	CO 1, CO 2,CO 3, CO 4,CO 5, CO 6	T2:2.7 R1:2.18

XVI 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.

Prepared by: **HOD,CE**

Mr. B.Suresh, Assistant professor

INSTITUTE OF AERONAUTICAL ENGINEERING
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Dundigal, Hyderabad - 500 043

COURSE DESCRIPTION

Department	**CIVIL ENGINEERING**				
Course Title	**PRESTRESSED CONCRETE STRUCTURES**				
Course Code	ACEB46				
Program	B.Tech				
Semester	VIII				
Course Type	PROFESSIONAL ELECTIVE				
Regulation	IARE - R18				
Course Structure	Theory			Practical	
	Lecture	Tutorials	Credits	Laboratory	Credits
	3	-	3	-	-
Course Coordinator	Mr. K. Tarun Kumar, Assistant Professor Professor				

I COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites
B.Tech	ACEB34	VI	Design of Concrete Structures - I
B.Tech	ACEB30	VI	Design of Steel Structures 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:

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
25%	Understand
50%	Apply
15%	Analyze

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

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

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

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

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

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

VI COURSE OBJECTIVES:

The students will try to learn:

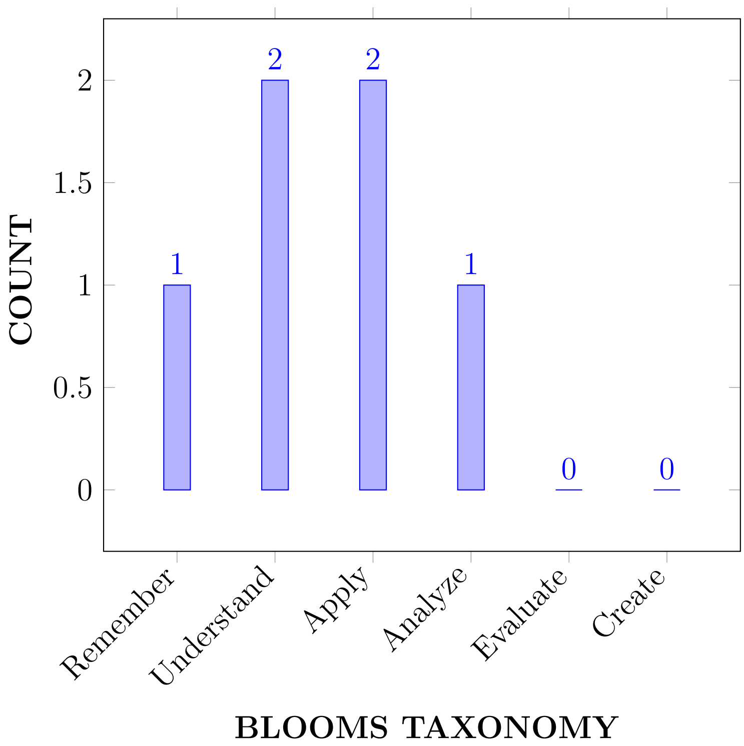
I	The concepts of prestressed concrete structures and the behaviour of these structures subjected to loads for the design purpose.
II	The design of structural elements necessary for creating efficient and economic prestressed concrete structures.
III	The design and drawing of multi storeyed industrial 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	**Recall** the concepts of stresses and strains developed within the structures subjected to different loads and their combinations for understanding the behavior of prestressed concrete structures.	Remember
CO 2	**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 3	**Estimate** the losses in the prestress and post tensioned members for the efficient design of prestressed concrete structures.	Analyse
CO 4	**Design** prestressed and post tensioned structural elements using Indian standard code method.	Apply
CO 5	**Explain** the concepts of transfer of prestress in pre and post tensioned members by bond and transmission length using Indian standard code method.	Understand
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.
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	Recall (knowledge) the concepts of stresses and strains developed within the structures subjected to different loads and their combinations by applying the principles of **mathematics and engineering fundamentals**.	2
CO 2	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
CO 3	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
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

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

CO 4	2	4	1	5	-	-	-	-	-	-	-	-	4	-	-
CO 5	2	-	-	-	-	-	-	-	-	-	-	-	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	0.0	0.0	0.0
CO 2	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 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	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	0.0	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 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	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 2	3	-	-	-	-	-	-	-	-	-	-	-	1	-	-
CO 3	3	2	-	-	-	-	-	-	-	-	-	-	2	-	-
CO 4	3	2	1	2	-	-	-	-	-	-	-	-	2	-	-
CO 5	3	-	-	-	-	-	-	-	-	-	-	-	2	-	-
CO 6	3	2	1	2	-	-	-	-	-	-	-	-	2	-	-
TOTAL	18	6	2	4									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**
	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.

REFERENCE BOOKS:

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

3. N. Rajagopalan, "Prestressed Concrete", Narosa Publishing House.

WEB REFERENCES:

1. https://nptel.ac.in/courses/105106118

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)			
2-3	Historic development of pre-stressing technology, general principles of pre-tensioning and post-tensioning	CO1	T1: 1 R1: 1.1
4-5	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
6-7	Characteristics, Methods and Systems of pre-stressing.	CO 1	T1: 1.5 R1:1.2
11,12	Pre-tensioning and Post-tensioning methods.	CO 2	T1: 2.1-2.2 R1:3.1-3.4
8-10	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
11-12	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
13-15	Loss of prestress due to Relaxation of stress in steel	CO 2	T1: 4.1-4.2 R1:4.7-4.9
16-19	Slip in anchorage, frictional losses.	CO 3	T1: 4.3-4.4 R1:4.10-4.13
20-22	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
23-25	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
26-27	Cable profile and cable layout.	CO 3	T1: 5.1-5.2 R1:5.9
28-30	SHEAR: General Considerations, Principal tension and compression	CO 3	T1: 5.3-5.4 R1:7.1-7.3
31-32	Analysis of rectangular and I beam for shear	CO 4	T1: 6.1- 6.2 R1:7.4-7.6
33-34	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
37-38	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
57-58	Short term deflections of uncracked beams and Problems.	CO 6	T1: 8.3-8.4 R1:10.6
44-45	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: 6.5-6.12 T2: 6.1 – 6.4
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 T2: 6.1 – 6.4

13	Short term deflections of uncracked beams	CO 5	T1: 11.3-11.4 T2: 10.1– 10.9
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**
Mr. K. Tarun Kumar, 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">NON CONVENTIONAL ENERGY SOURCES</td></tr>
<tr><td>Course Code</td><td colspan="5">AEEB56</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">Open Elective</td></tr>
<tr><td>Regulation</td><td colspan="5">R-18</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. K Devender Reddy, Assistant Professor</td></tr>
</table>

I COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites
B.Tech	AEEB04	I	Basic Electrical and Electronics Engineering

II COURSE OVERVIEW:

This course envisages the renewable source of energy available in nature and to expose the students on sources of energy crisis, principle of operation of solar photo voltaic cell, different solar energy collectors and storage methods. It facilitates the study of wind turbines, geothermal energy, ocean, biomass, direct energy conversion systems. It concludes the knowledge of renewable energy resources for electrical applications

III MARKS DISTRIBUTION:

Subject	SEE Examination	CIE Examination	Total Marks
Non Conventional Energy sources	70 Marks	30 Marks	100

IV CONTENT DELIVERY / INSTRUCTIONAL METHODOLOGIES:

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

V EVALUATION METHODOLOGY:

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

Semester End Examination (SEE): The SEE is conducted for 70 marks of 3 hours duration. The syllabus for the theory courses is divided into FIVE modules and each module carries equal weightage in terms of marks distribution. The question paper pattern is as follows. Two full questions with "either" or "choice" will be drawn from each module. Each question carries 14 marks. There could be a maximum of two sub divisions in a question.

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

Percentage of Cognitive Level	Blooms Taxonomy Level
%	Remember
50%	Understand
33.33%	Apply
16.66%	Analyze

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

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

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

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

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

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

VI COURSE OBJECTIVES:

The students will try to learn:

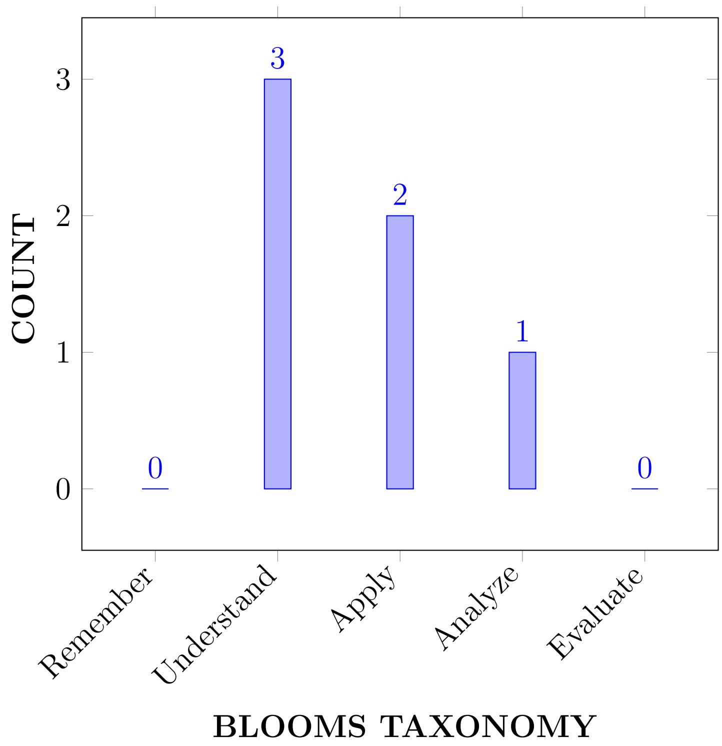
I	The environmental and economics related to renewable energy sources in comparison with fossil fuels.
II	The basic characteristics of renewable energy sources and technologies for their utilization.
III	The managerial skills to assess feasibility and drive strategies for alternative sources of energy.

VII COURSE OUTCOMES:

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

CO 1	**Understand** the need of energy conversion and the various methods of energy storage .	Understand
CO 2	**Analyze** the major parameters of sun movement, solar radiation and tracking systems for calculation of solar insolation.	Analyze
CO 3	**Identify** different concentrating collectors for conversion of solar energy into thermal energy.	Apply
CO 4	**Explain** the concepts involved in wind energy conversion system using vertical and horizontal wind mills.	Understand
CO 5	**Illustrate** the operational methods of ocean and tidal energy for electrical energy conversion	Understand
CO 6	**Utilize** the mechanisms for direct energy conversion and geothermal energies into electricity.	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

Program Outcomes	
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.	3	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

PROGRAM OUTCOMES		Strength	Proficiency Assessed by
PO 7	**Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.	3	Assignments

3 = High; 2 = Medium; 1 = Low

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

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

XI JUSTIFICATIONS FOR CO – PO/ PSO MAPPING -DIRECT:

Course Outcomes	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key competencies matched.
CO 1	PO 1	Recall the **basics of mathamatics, engineering sciences and other sciences** to understand energy storage methods	1
	PO 2	Understand the need of energy conversion using **basics fundamentals and engineering sciences.**	3
	PO 7	Understand the need of energy conversion using **basics fundamentals and engineering sciences.**	2
CO 2	PO 3	Analyze the major parameters of Sun tracking system for calculation of solar insolation for specified needs with appropriate consideration for the **public health, societal and environmental considerations**	3
	PO 7	Understand the need of energy conversion using **basics fundamentals and engineering sciences.**	2
CO 3	PO 2	Identify different concentrating collectors for conversion of solar energy into heat with the **knowledge of engineering sciences and mathematics**	3
	PO 7	Understand the need of energy conversion using **basics fundamentals and engineering sciences.**	2
CO 4	PO 1	Illustrate the concepts involved in wind energy conversion using **engineering fundamentals**	1
	PO 3	Explain the horizontal and vertical axis wind mills for specified needs with appropriate consideration for the **public health, societal and environmental** considerations.	3

Course Outcomes	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key competencies matched.
	PO 7	Understand the impact of the renewable energy sources on environment for **societal and sustainable development.**	2
CO 5	PO 3	Demonstrate the operational methods of ocean energy for electrical energy conversion for **public health, societal and environmental** considerations	3
	PO 7	Understand the impact of the renewable energy sources on environment for **societal and sustainable development**	2
CO 6	PO 3	Demonstrate the mechanisms for conversion of geothermal energies into electricity for **public health, societal and environmental considerations**	3
	PO 7	Understand the impact of the renewable energy sources on environment for **societal and sustainable development**	2

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

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

XIII PERCENTAGE OF KEY COMPETENCIES FOR CO – PO/ PSO

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

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	1	1	-	-	-	-	3	-	-	-	-	-	-	-	
CO 2	-	-	1	-	-	-	3	-	-	-	-	-	-	-	-
CO 3	-	1	-	-	-	-	3	-	-	-	-	-	-	-	-
CO 4	-	-	1	-	-	-	3	-	-	-	-	-	3	-	-
CO 5	-	-	1	-	-	-	3	-	-	-	-	-	-	-	-
CO 6	-	-	1	-	-	-	3	-	-	-	-	-	-	-	-
TOTAL	1	3	4	-	-	-	18	-	-	-	-	-	-	-	-
AVERAGE	1	1	1	-	-	-	3	-	-	-	-	-	-	-	-

XV ASSESSMENT METHODOLOGY-DIRECT:

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

XVI ASSESSMENT METHODOLOGY-INDIRECT:

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

XVII SYLLABUS:

MODULE I	**PRINCIPLES OF SOLAR RADIATION**
	Role and potential of new and renewable source, the solar energy option, Environmental impact of solar power, physics of the sun, the solar constant, extraterrestrial and terrestrial solar radiation, solar radiation on titled surface, instruments for measuring solar radiation and sun shine, solar radiation data.
MODULE II	**SOLAR ENERGY COLLECTION AND SOLAR ENERGY STORAGE AND APPLICATIONS**
	Flat plate and concentrating collectors, classification of concentrating collectors, orientation and thermal analysis, advanced collectors. Different methods, Sensible, latent heat and stratified storage, solar ponds. Solar Applications- solar heating/cooling technique, solar distillation and drying, photovoltaic energy conversion
MODULE III	**WIND ENERGY AND BIO-MASS**
	Wind Energy: Sources and potentials, horizontal and vertical axis windmills, performance characteristics, Betz criteria. Bio-Mass: Principles of Bio-Conversion, Anaerobic/aerobic digestion, types of Bio-gas digesters, gas yield, combustion characteristics of bio-gas, utilization for cooking, I.C. Engine operation and economic aspects.

MODULE IV	**GEOTHERMAL ENERGY AND OCEAN ENERGY**
	Geothermal Energy: Resources, types of wells, methods of harnessing the energy, potential in India Ocean Energy: OTEC, Principle's utilization, setting of OTEC plants, thermodynamic cycles. Tidal and wave energy: Potential and conversion techniques, mini-hydel power plants, and their economics.
MODULE V	**DIRECT ENERGY CONVERSION**
	Need for DEC, Carnot cycle, limitations, principles of DEC

TEXTBOOKS

1. G.D. Rai, "Non-Conventional Energy Sources", TMH, 3rd Edition 2009.
2. Twidell & Weir, "Renewable Energy Sources", CRC Press, 1st Edition, 2008.
3. Renewable Energy sources and emerging technologies by D.P. Kothari, K.C. Singhal

REFERENCE BOOKS:

1. John Twidell, "Renewable Energy Resources" Taylor & Francis group, 4th Edition
2. G. N. Tiwari and M K. Ghosal, "Renewable Energy Resources" Narosa Publishing House, 2004
3. K.M. Mital, "Non-conventional Energy Systems" A H Wheeler Publishing Co Ltd, 1999

WEB REFERENCES:

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

COURSE WEB PAGE:

1. https://www.iare.ac.in/?q=pages/btech-course-descriptions-iare-r18-0

XVIII COURSE PLAN:

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

S.No	Topics to be covered	CO's	Reference
OBE DISCUSSION			
1	Lecture on Outcome Based Education.		
CONTENT DELIVERY (THEORY)			
2	Role and potential of renewable energy sources	CO 1	T1: 1.2
3	Environmental impacts of solar power	CO 1	T1: 1.4
4	Physics of the sun, solar constant	CO 2	T1: 2.2
5	Solar radiation and solar radiation on titled surface	CO 2	T1: 2.4
6	Instruments for measuring solar radiation, sun shine and solar radiation data	CO 2	T1: 2.6
7	Pyranometer and pyrheliometer	CO 2	T1: 2.6
8	Flat plate collectors	CO 3	T1: 3.3
9	Parabolic trough collector and power tower receiver	CO 3	T1: 3.7
10	Parabolic dish and Fresnel lens collector	CO 3	T1: 3.7
11	Solar heating methods	CO 3	T1: 4.2

12	Solar pond	CO 1	T1: 4.3
13	Solar photovoltaic cell	CO 1	T1: 4.3
14	Applications of solar energy	CO 3	T1: 5.2
15	Solar distillation and drying	CO 1	T1: 5.8
16	Source and potential of wind energy and horizontal axis wind mill	CO 4	T1: 6.2-6.8
17	Vertical axis wind mill and Betz criteria	CO 4	T1: 6.8
18	Principle of Bio- conversion and anaerobic digestion	CO 1	T1: 7.2
19	Fixed dome biogas plants	CO 1	T1: 7.9
20	Floating drum biogas plants	CO 1	T1: 7.9
21	Low-cost polyethylene tube digester	CO 1	T1: 7.10
22	Balloon biogas plants	CO 1	T1: 7.10
23	Horizontal biogas plants	CO 1	T1: 7.10
24	Earth-pit biogas Plants	CO 1	T1: 7.10
25	Ferro-cement biogas Plants	CO 1	T1: 7.10
26	Industrial Digester	CO 1	T1: 7.10
27	Combustion characteristics of bio-gas	CO 1	T1: 7.24
28	Bio gas utilization for cooking	CO 1	T1: 7.24
29	I.C. Engine operation and economic aspects	CO 1	T1: 7.24
30	Geothermal sources	CO 6	T1: 8.1
31	Types of wells	CO 6	T1: 8.16
32	Geothermal harnessing methods	CO 6	T1: 8.10
33	OTEC principles	CO 5	T1: 9.2
34	Utilization of OTEC plants	CO 5	T1: 9.2
35	Setting of OTEC plants	CO 5	T1: 9.5
36	Thermodynamic cycles	CO 5	T1: 9.3
37	Tidal energy potential and conversion techniques	CO 5	T1: 9.3
38	Wave energy potential and conversion techniques	CO 5	T1: 9.4
39	Mini-hydel power plants and their economics	CO 5	T1: 9.5
40	Principles of DEC	CO 6	T1: 10.1
41	Carnot cycle	CO 6	T1: 10.2
DEFINATIONS AND TERMINOLOGY			
42	Role and potential of various renewable energy source	CO 1	T1, R1
43	Physics of sun and various solr collectors	CO2, 3	T1, R1
44	Wind and biomass energy conversion systems	CO 4	T1, R1
45	Operational methods of ocean and tidal energy conversion systems	CO5	T1, R1
46	Direct and geothermal energy conversion systems	CO 6	T1, R1

TUTORIAL QUESTION BANK			
47	Principle of Solar Radiation	CO 1, 02	T1, R1
48	Solar Energy Collection and Solar Energy Storage and Applications	CO3	T1, R1
49	Wind Energy and Bio mass	CO4	T1, R1
50	Geothermal Energy and Ocean Energy	CO5, 06	T1, R1
51	Direct Energy Conversion	CO 6	T1, R1

Signature of Course Coordinator **HOD,CE**