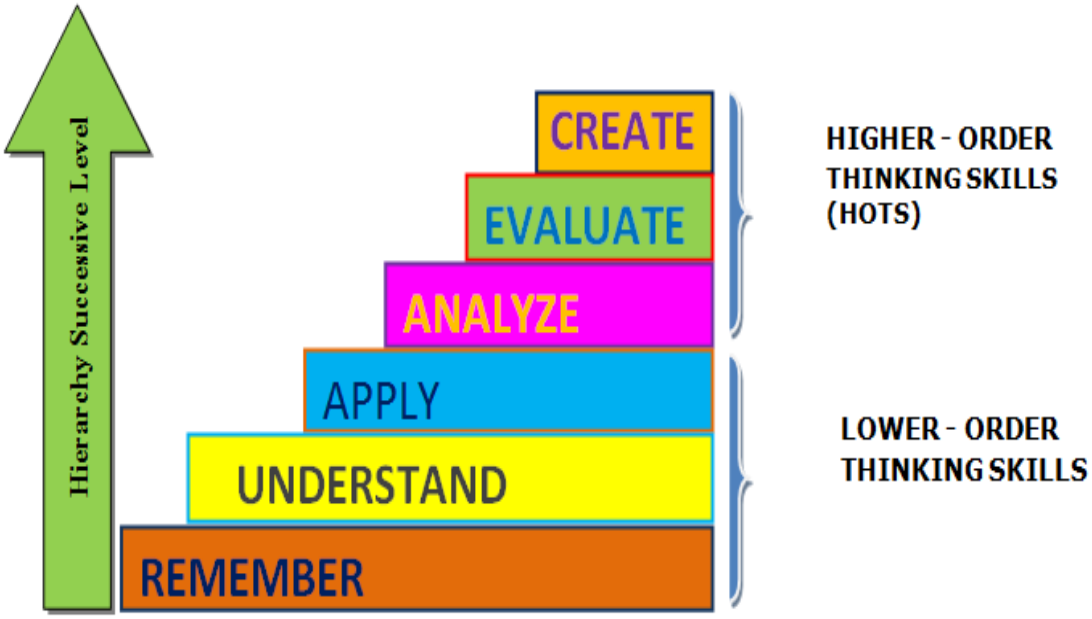
COURSE DESCRIPTOR BOOKLET

B.Tech

CIVIL ENGINEERING

(Accredited by NBA)

R-16 REGULATIONS



BLOOM'S TAXONOMY OF LEARNING OUTCOMES

.....Moving Towards Perfection in Engineering

INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

Approved by AICTE; Affiliated to JNTUH and Accredited by NAAC with 'A' Grade
Dundigal, Hyderabad - 500 043

I SEMESTER

INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)
Dundigal, Hyderabad -500 043

CIVIL ENGINEERING

COURSE DESCRIPTOR

Course Title	**ENGLISH FOR COMMUNICATION**				
Course Code	AHS001				
Programme	B.Tech				
Semester	I	AE | ME | CE			
	II	CSE | IT | ECE | EEE			
Course Type	Foundation				
Regulation	IARE - R16				
Course Structure	**Theory**			**Practical**	
	Lectures	**Tutorials**	**Credits**	**Laboratory**	**Credits**
	3	-	3	2	1
Chief Coordinator	Ms B Anand Lakshmi, Associate Professor				
Course Faculty	Dr Prudhvi Raju, Associate Professor Ms P B Esther Rani, Assistant Professor Ms Jayshree Naidu, Assistant Professor Ms Shirisha Deshpande, Assistant Professor Mr. Sudhakar Medi, Assistant Professor Mr Kondal, Assistant Professor				

I. COURSE OVERVIEW:

In view of the growing importance of English as a tool for global communication and the consequent emphasis on training students to acquire communicative competence, this Engineering English has been designed to develop linguistic and communicative competence of the students. In the classroom the focus should be on the skills of reading, writing, listening and speaking. The teacher can ask comprehension questions to stimulate discussion and based on the discussions students can be made to write short paragraphs/ essays etc.

II. COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites
-	-	-	Standard applicability of grammar and vocabulary

III. MARKS DISTRIBUTION:

Subject	SEE Examination	CIA Examination	Total Marks
English for Communication	70 Marks	30 Marks	100

IV. DELIVERY / INSTRUCTIONAL METHODOLOGIES:

✔	Chalk & Talk	✔	Quiz	✘	Assignments	✘	MOOCs
✔	LCD / PPT	✔	Seminars	✘	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 units and each unit carries equal weightage in terms of marks distribution. The question paper pattern is as follows. Two full questions with "either" or "choice" will be drawn from each unit. Each question carries 14 marks. There could be a maximum of two sub divisions in a question.

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

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

Continuous Internal Assessment (CIA):

CIA is conducted for a total of 30 marks (Table 1), with 25 marks for Continuous Internal Examination (CIE), 05 marks for Quiz/ Alternative Assessment Tool (AAT).

Table 1: Assessment pattern for CIA

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

Continuous Internal Examination (CIE):

Two CIE exams shall be conducted at the end of the 8th and 16th week of the semester respectively. The CIE exam is conducted for 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 / Alternative Assessment Tool (AAT):
Two Quiz exams shall be online examination consisting of 25 multiple choice questions and are be answered by choosing the correct answer from a given set of choices (commonly four). Marks shall be awarded considering the average of two quizzes for every course. The AAT may include seminars, assignments, term paper, open ended experiments, five minutes video and MOOCs.

VI. HOW PROGRAM OUTCOMES ARE ASSESSED:

Program Outcomes (POs)		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	Term paper
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	Seminar Listening Test Speaking Test Presentation (Technical / Review: Movie/Book)
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.	2	Five minutes video

3 = High; 2 = Medium; 1 = Low

VII. HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

Program Specific Outcomes (PSOs)		Strength	Proficiency assessed by
PSO 1	**Engineering Knowledge**: Graduates shall demonstrate sound knowledge in analysis, design, laboratory investigations and construction aspects of civil engineering infrastructure, along with good foundation in mathematics, basic sciences and technical communication.	-	-
PSO 2	**Broadness and Diversity**: Graduates will have a broad understanding of economical, 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.	-	-
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.	2	Written Test – Verbal Aptitude for Placement and Higher studies

3 = High; 2 = Medium; 1 = Low

VIII. COURSE OBJECTIVES (COs):

The course should enable the students to:	
I	Communicate in an intelligible English accent and pronunciation.
II	Use the four language skills i.e., Listening, Speaking, Reading and Writing effectively.
III	Develop the art of writing simple English with correct spelling, grammar and punctuation.

IX. COURSE LEARNING OUTCOMES (CLOs):

CLO Code	CLO's	At the end of the course, the student will have the ability to:	PO's Mapped	Strength of Mapping
AHS001.01	CLO 1	Understand the value of English as an international language and try to improve the knowledge regarding language skills and elements to be perfect in their usage.	PO 10	1
AHS001.02	CLO 2	Develop the ability to listen effectively in order to analyze the language used in descriptions and narrations.	PO 9	2
AHS001.03	CLO 3	Paraphrase listening skills for different purposes with special emphasis on intensive listening.	PO 9	2
AHS001.04	CLO 4	Interpret how to contextualize the use of language for different purposes.	PO 9 PO 10	2
AHS001.05	CLO 5	Ability to comprehend speaking skills for different purposes with special emphasis on intensive listening	PO 9, PO 10, PO 11	3
AHS001.06	CLO 6	Express fluently without any grammatical mistakes and also give presentations with proper modulation.	PO 10	3
AHS001.07	CLO 7	Translate the importance of critical reading to get information from the context with the help of root words and contextual clues.	PO 10	3
AHS001.08	CLO 8	Grasp the importance of reading skills for focused and selective information at various levels of professional career.	PO 10	3
AHS00.09	CLO 9	Summarize the topic to write different types of argumentative, narrative, descriptive and persuasive paragraphs and essays.	PO 9, PO 10	3
AHS001.10	CLO 10	Infer the use of language for developing behavioral skills.	PO 9, PO 10, PO 11, PSO 3	2
AHS001.11	CLO 11	Translate the importance of reading techniques and applying it to literary texts.	PO 11	3
AHS001.12	CLO 12	Ability to learn and understand techniques of grammar to apply in the functions of English language	PO 10	2
AHS001.13	CLO 13	Remember to use the knowledge of grammar and vocabulary in writing more meaningfully.	PO 10	3
AHS001.14	CLO 14	Infer the importance of language and applying to learn to be sensitive according to the needs of the society.	PO 9, PO 10, PO 11, PSO 3	2
AHS001.15	CLO 15	Develop writing skills in order to apply in day to day life.	PO 9, PO 10	3
AHS001.16	CLO 16	Understand the importance of written communication for the future correspondence throw out the career of the students.	PO 9, PO 10	3
AHS001.17	CLO 17	Develop the ability to analyze the results of experiments and be competent in writing reports, work in teams in real time situations	PO 9, PO 10	3
AHS001.18	CLO 18	Understand the value of writing skills to be a responsive, attentive and empathetic writer in order to face the real-world situations	PO 9, PO 10	3
AHS001.19	CLO 19	Infer the importance of vocabulary and writing as an essential ability in the real-time situations for those who desire to advance their career.	PO 11, PSO 3	2

3 = High; 2 = Medium; 1 = Low

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

CLOs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CLO 1										1					
CLO 2									2						
CLO 3									2						
CLO 4									2	1					
CLO 5									3	3	1				
CLO 6										3					
CLO 7										3					
CLO 8										3					
CLO 9									3	3					
CLO 10									2	3	2				1
CLO 11											3				
CLO 12										2					
CLO 13										3					
CLO 14									1	1	3				1
CLO 15									3	3					
CLO 16									3	3					
CLO 17									3	3					
CLO 18									3	3					
CLO 19											2				2

3 = High; 2 = Medium; 1 = Low

XI. ASSESSMENT METHODOLOGIES – DIRECT

CIE Exams	PO 9, PO 10, PO11, PSO 3	SEE Exams	PO 9, PO 10, PO11, PSO 3	Assignments	-	Seminars	PO 10
Laboratory Practices	PO 9, PO 10, PO11, PSO 3	Student Viva	PO 10	Mini Project	-	Certification	-
Term Paper	PO 9						

XII. ASSESSMENT METHODOLOGIES - INDIRECT

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

XIII. SYLLABUS

Unit-I	LISTENING SKILLS
Significance, essentials, barriers and effectiveness of listening; Listening to dialogues, conversation, discussions, monologues; Listening to sounds, silent letters, stressed syllables in English; Listening for the gist of the text, for identifying the topic, general meaning and specific information; Listening for multiple choice questions, positive and negative comments for interpretation. Note: instructions in theory and practice in the lab.	
Unit-II	**SPEAKING SKILLS**
Significance, essentials, barriers and effectiveness of speaking; Simple oral or casual interaction, dialogue, conversation; Debates: Differences between disagreeing and being disagreeable; Brief presentations; Role plays; Generating talks based on visual or written prompts; Addressing a small group or a large formal gathering; Speaking about present, past experiences and future plans; Arguing out a topic without verbal fights; Paper presentation. Note: instructions in theory and practice in the lab.	
Unit-III	**READING SKILLS**
Techniques of reading: Skimming, scanning, intensive and extensive reading; Reading comprehension: Exercises for multiple choice questions and contextual meaning- values in Dr. Kalam. Vocabulary enrichment and grammar exercises based on selective readings: Power of dreams- vision to mission- prose passage for intellectual and emotional comments; Reading for the gist of a text, for specific information, for information transfer and interpretation.	
Unit-IV	**WRITING SKILLS**
Significance, essentials and effectiveness of writing; Writing emails; Writing paragraphs: Comparing, contrasting, presentations with an introduction, body and conclusion; Writing formal and informal letters: Letter of invitation, accepting, declining, requesting, cover letter enclosing a CV.	
Unit-V	**GRAMMAR AND VOCABULARY**
Punctuation, parts of speech, articles, prepositions, tenses, concords, phrasal verbs; Forms of verbs: Regular and irregular, direct and indirect speech, change of voice; prefixes, suffixes, Synonyms, antonyms, one word substitutes, idioms and phrases, technical vocabulary.	
Text Books:	
1. Meenakshi Raman, Sangeetha Sharma, "Technical Communication Principles Practices", Oxford University Press, New Delhi, 3rd Edition , 2015.	
Reference Books:	
1. Norman Whitby, "Business Benchmark: Pre-Intermediate to Intermediate – BEC Preliminary", Cambridge University Press, 2nd Edition, 2008. 2. Devaki Reddy, Shreesh Chaudhary, "Technical English", Macmillan, 1st Edition, 2009. 3. Rutherford, Andrea J, "Basic Communication Skills for Technology", Pearson Education, 2nd Edition, 2010. 4. Raymond Murphy, " Essential English Grammar with Answers", Cambridge University Press, 2nd Edition 5. Dr. N V Sudershan, "President Kalam's Call to the Nation", Bala Bharathi Publications, Secunderabad, 1st Edition, 2003.	

XIV. COURSE PLAN:

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

Lecture No	Topics to be covered	Course Learning Outcomes (CLOs)	Reference
1	Explain the importance of English Language as a tool for global communication and emphasis to acquire communicative competence	CLO 1	T1:1.1
2	Recognize the importance of English as the global language.	CLO 1	T1:1.1
3	Identify the learning levels and their competencies	CLO 1	T1:1.1-1.5
4-7	Recall the functions of punctuation and practice exercises	CLO 6, CLO12	R3:5
8	Develop the ability to understand that speaking skills are essential to be a responsive, attentive and empathetic speaker in order to face the real-world situations.	CLO 5, CLO 14	R2:1.1
9-11	Apply the knowledge of preparation for oral presentation	CLO 6	R4:2.21
12	Identify common errors in the language through the concept of word formation	CLO 13, CLO 19	R4:60.1
13-15	Prepare the students to be aware of the importance of commonly used technical vocabulary	CLO 19	R4:1.1-2.1
16	Infer the concept of grammatical ambiguity & sentence construction	CLO 6, CLO 12	R4:4.2
17	Recognize the concept of "Subject-Verb agreement", to familiarize the students with the usage of "Concord"	CLO 6	R3:1.3
18-22	Identify and understand conventional signs, prefixes, suffixes, Synonyms, antonyms, one word substitutes used by writers to make their meaning clear to the reader	CLO 13	R4:47.1
23	Appraise the students in order to acquire the knowledge of sentence structure	CLO 6	R4:42.1
24-25	Learn to use the vocabulary in writing more meaningfully	CLO 13	R3:4.4
26-27	Infer the difference between phrases and idioms & learn to use them in sentences	CLO 13	R3:4.2
28	To make the students learn and identify commonly used technical vocabulary.	CLO 13	R4:1.3
29	Understand the significance, essentials, and effectiveness of reading	CLO 7, CLO 8	T1:2.4
30	Interpret derivatives, and standard abbreviations in English through reading skills	CLO 11	T1:27.2
31-33	Infer the gist of the text, for identifying the topic through reading skills	CLO 11	R4:5.8
34	Apply the general meaning and specific information through writing skills	CLO 16	T1:2.7
35	Analyze and Interpret multiple choice questions, positive and negative comments through comprehension passages	CLO 17	T1:2.6
36	Identify passage for intellectual and emotional comments; reading for the gist of a text.	CLO 11	T1:4.15
37	Associate the students to identify their common errors in the language	CLO 9	R2:3
38	Understand the importance of proper punctuation, creating coherence, organizing principles of paragraphs in documents to foster the writing skills of the students	CLO 17	R2:3
39	Evaluate Letter writing-formal and Informal writing and E-mail writing.	CLO 19	T1:4.13
40	To make learners aware of the selection of language to make presentations and prepare the students for an effective presentation giving them necessary inputs	CLO 18	T1:4.13
41	Distinguish writing skills such as describing, defining,	CLO 17	T1:4.13

Lecture No	Topics to be covered	Course Learning Outcomes (CLOs)	Reference
	classifying, writing introduction and conclusion.		
42-43	Evaluate writing skills through creating coherence, organizing principles of paragraphs in documents.	CLO 9	T1:3.10
44-45	Understand the importance of vocabulary enrichment and grammar exercises to foster the writing skill of the students.	CLO 19	T1:4.13

XV. GAPS IN THE SYLLABUS - TO MEET INDUSTRY / PROFESSION REQUIREMENTS:

S NO	Description	Proposed actions	Relevance with POs	Relevance with PSOs
1	Construct basic and intermediate skills in English language.	Seminars	PO 10	PSO 3
2	Preparation of power-point slides, which include videos, animations, pictures, graphics for better understanding theory and practical work.	Seminars / NPTEL	PO 9	PSO 3
3	To build confidence for communicating in English and create interest for the life-long learning of English language.	Guest lecture	PO 10	PSO 3

Prepared by:
Ms. B Anand Lakshmi, Associate Professor

HOD, FRESHMAN ENGINEERING

INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)
Dundigal, Hyderabad -500 043

CIVIL ENGINEERING

COURSE DESCRIPTOR

Course Title	**LINEAR ALGEBRA AND ORDINARY DIFFERENTIAL EQUATION**				
Course Code	AHS002				
Programme	B.Tech				
Semester	I	AE | CSE | IT | ECE | EEE | ME | CE			
Course Type	Foundation				
Regulation	IARE - R16				
Course Structure	**Theory**			**Practical**	
	Lectures	**Tutorials**	**Credits**	**Laboratory**	**Credits**
	3	1	4	-	-
Chief Coordinator	Ms. P Rajani, Assistant Professor				
Course Faculty	Dr. M Anita, Professor Mr. J Suresh Goud, Assistant Professor Ms. P Srilatha, Assistant Professor Ms. C Rachana, Assistant Professor Ms. B Praveena, Assistant Professor				

I. COURSE OVERVIEW:

The course focuses on more advanced Engineering Mathematics topics which provide with the relevant mathematical tools required in the analysis of problems in engineering and scientific professions. The course includes Types of matrices, difference calculus methods and differential equations. The mathematical skills derived from this course form a necessary base to analytical and design concepts encountered in the program.

II. COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites
-	-	-	-

III. MARKS DISTRIBUTION:

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

IV. DELIVERY / INSTRUCTIONAL METHODOLOGIES:

✔	Chalk & Talk	✔	Quiz	✘	Assignments	✘	MOOCs
✔	LCD / PPT	✔	Seminars	✘	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 units and each unit carries equal weightage in terms of marks distribution. The question paper pattern is as follows. Two full questions with "either" or "choice" will be drawn from each unit. Each question carries 14 marks. There could be a maximum of two sub divisions in a question.

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

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

Continuous Internal Assessment (CIA):
CIA is conducted for a total of 30 marks (Table 1), with 25 marks for Continuous Internal Examination (CIE), 05 marks for Quiz/ Alternative Assessment Tool (AAT).

Table 1: Assessment pattern for CIA

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

Continuous Internal Examination (CIE):
Two CIE exams shall be conducted at the end of the 8th and 16th week of the semester respectively. The CIE exam is conducted for 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 / Alternative Assessment Tool (AAT):
Two Quiz exams shall be online examination consisting of 25 multiple choice questions and are be answered by choosing the correct answer from a given set of choices (commonly four). Marks shall be awarded considering the average of two quizzes for every course. The AAT may include seminars, assignments, term paper, open ended experiments, five minutes video and MOOCs.

VI. HOW PROGRAM OUTCOMES ARE ASSESSED:

Program Outcomes (POs)		Strength	Proficiency assessed by
PO 1	**Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.	3	Presentation on real-world problems
PO 2	**Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences	2	Seminar
PO 4	**Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.	1	Term Paper

3 = High; 2 = Medium; 1 = Low

VII. HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

Program Specific Outcomes (PSOs)		Strength	Proficiency assessed by
PSO 1	**Engineering knowledge:** Graduates shall demonstrate sound knowledge in analysis, design, laboratory investigations and construction aspects of civil engineering infrastructure, along with good foundation in mathematics, basic sciences and technical communication	1	Seminar
PSO 2	**Broadness and diversity:** Graduates will have a broad understanding of economical, 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.	-	-
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	-	-

3 = High; 2 = Medium; 1 = Low

VIII. COURSE OBJECTIVES (COs):

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

IX. COURSE LEARNING OUTCOMES (CLOs):

CLO Code	CLO's	At the end of the course, the student will have the ability to:	PO's Mapped	Strength of Mapping
AHS002.01	CLO 1	Demonstrate knowledge of matrix calculation as an elegant and powerful mathematical language in connection with rank of a matrix.	PO 1	1
AHS002.02	CLO 2	Finding rank by reducing the matrix to Echelon and Normal forms.	PO 1	3

CLO Code	CLO's	At the end of the course, the student will have the ability to:	PO's Mapped	Strength of Mapping
AHS002.03	CLO 3	Determine inverse of the matrix by Gauss Jordon Method.	PO 1	3
AHS002.04	CLO 4	Apply the method of LU Decomposition and solve the simultaneous equations.	PO 2	2
AHS002.05	CLO 5	Use the method of LU factorization real world problems such as circuit designing and solving complex circuits	PO 2	3
AHS002.06	CLO 6	Use the method of LU factorization real world problems such as economize and accumulate sums in double precision Computer Programme.	PO 2	2
AHS002.07	CLO 7	Interpret the Eigen values and Eigen vectors of matrix for a linear transformation and use properties of Eigen values	PO 4	1
AHS002.08	CLO 8	Understand the concept of Eigen values in real world problems of control field where they are pole of closed loop system.	PO 4	1
AHS002.09	CLO 9	Apply the concept of Eigen values in real world problems of mechanical systems where Eigen values are natural frequency and mode shape.	PO4	1
AHS002.10	CLO 10	Use the system of linear equations and matrix to determine the dependency and independency.	PO 2	2
AHS002.11	CLO 11	Determine a modal matrix, and reducing a matrix to diagonal form.	PO 1	3
AHS002.12	CLO 12	Evaluate inverse and powers of matrices by using Cayley-Hamilton theorem.	PO 1	3
AHS002.13	CLO 13	Solving differential equations of first order.	PO 1	3
AHS002.14	CLO 14	Finding orthogonal trajectories of Cartesian and polar equations.	PO 1, PO 2	2
AHS002.15	CLO 15	Apply the first order differential equations in real world problems such as Newton's Law of cooling and Law of natural growth and decay	PO 2	2
AHS002.16	CLO 16	Solving Second and higher order differential equations with constant coefficients.	PO 2	2
AHS002.17	CLO 17	Apply the second order differential equations for real world problems of electrical circuits and simple harmonic motion.	PO 4	1
AHS002.18	CLO 18	Apply the Mean value theorems for the single variable functions.	PO 1, PO 2	2
AHS002.19	CLO 19	Understand the basic concepts of Partial Differential equations.	PO 1, PO 2	2
AHS002.20	CLO 20	Determine Jacobian for the coordinate transformation	PO 1, PO 2	2
AHS002.21	CLO 21	Apply the technique of Jacobian and inverse Jacobian relation to real world problems such as kinematics and inverse kinematic solutions of robot manipulators.	PO 4	1

CLO Code	CLO's	At the end of the course, the student will have the ability to:	PO's Mapped	Strength of Mapping
AHS002.22	CLO 22	Understand the techniques of multidimensional change –of –variables to transform the coordinates by utilizing the Jacobian.	PO 1	3
AHS002.23	CLO 23	Apply maxima and minima for functions of several variable's and Lagrange's method of multipliers	PO 1	3
AHS002.24	CLO 24	Understand the concept and acquire the knowledge for attempting the competitive exams	PO 4	1

3 = High; 2 = Medium; 1 = Low

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

CLOs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CLO 1	1												1		
CLO 2	2												1		
CLO 3	3												1		
CLO 4		2													
CLO 5		3													
CLO 6		2													
CLO 7				1									1		
CLO 8				1											
CLO 9				2									1		
CLO 10		2											1		
CLO 11	3														
CLO 12	3														
CLO 13	3														
CLO 14	1	2											1		
CLO 15		2													
CLO 16		2													
CLO 17				1									1		

CLOs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CLO 18	1	2											1		
CLO 19	1	2											1		
CLO 20	1	2											1		
CLO 21				1											
CLO 22	3														
CLO 23	3														
CLO 24				1											

3 = High; 2 = Medium; 1 = Low

XI. ASSESSMENT METHODOLOGIES – DIRECT

CIE Exams	PO 1, PO 2	SEE Exams	PO 1, PO2, PO 4	Assignments	-	Seminars	PO 2
Laboratory Practices	-	Student Viva	-	Mini Project	-	Certification	-
Term Paper	PO 4						

XII. ASSESSMENT METHODOLOGIES - INDIRECT

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

XIII. SYLLABUS

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

Unit-IV	HIGHER ORDINARY LINEAR DIFFERENTIAL EQUATIONS AND THEIR APPLICATIONS
Linear differential equations of second and higher order with constant coefficients, non homogeneous term of the type $f(x)=e^{ax}, \sin ax, \cos ax$ and $f(x)=x^n, e^{ax}v(x), x^n v(x)$; Method of variation of parameters; Applications to electrical circuits and simple harmonic motion.	
Unit-V	**FUNCTIONS OF SINGLE AND SEVERAL VARIABLES**
Mean value theorems: Rolle's theorem, Lagrange's theorem, Cauchy's theorem and generalized mean value theorems-without proofs. Functions of several variables: Functional dependence, Jacobian, maxima and minima of functions of two variables without constraints and with constraints; Method of Lagrang multipliers.	
Text Books:	
1. Kreyszig, "Advanced Engineering Mathematics", John Wiley & Sons Publishers, 9th Edition, 2014. 2. B. S. Grewal, "Higher Engineering Mathematics", Khanna Publishers, 42nd Edition, 2012.	
Reference Books:	
1. RK Jain & SRK Iyengar, "Advanced Engineering Mathematics", Narosa Publishers, 5th Edition, 2016. 2. Ravish R Singh, Mukul Bhatt, "Engineering Mathematics-1", Tata Mc Graw Hill Education, 1st Edition, 2009. 3. Srimanthapal & Suboth C.Bhunia, "Engineering Mathematics", Oxford Publishers, 3rd Edition, 2015.	

XIV. COURSE PLAN:

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

Lecture No	Topics to be covered	Course Learning Outcomes (CLOs)	Reference
1	Theory of Matrices Introduction of matrices	CLO 1	T1:22.5 R1:2.3
2-3	Real and complex matrices	CLO 2	T1:22.5 R1:2.4
4-6	Find rank by echelon and normal form	CLO 2	T1:22.6 R1:2.6
7	Gauss-Jordan method	CLO 4	T1:22.7 R1:4.4
8	LU decomposition method	CLO 4	T1:22.7 R1:4.10
9-12	Cayley Hamilton theorem	CLO 7	T1:22.8 R1:4.15
13-16	Eigen values and Eigen vectors	CLO 9	T1:22.9 R1:5.4
17-18	Diagonalisation	CLO 9	T1:22.9 R1:5.8
19--22	Differential equations Introduction of first order differential equations	CLO 11	T1:23.10 R1:6.8
23-24	Orthogonal trajectories	CLO 11	T1:23.10 R1:6.13
25-26	Applications	CLO 13	T1:23.9 R1:7.5
27-30	Second and Higher order differential equations with constant coefficients	CLO 11	T1:23.10 R1:7.5
31-34	Method of variation of parameters	CLO 9	T1:23.10 R1:8.1

Lecture No	Topics to be covered	Course Learning Outcomes (CLOs)	Reference
35-36	Applications of second order differential equations	CLO 14	T1:23.1 R1:9.2
37	Differential Calculus Methods Verification of Rolle's Theorem to the given functions	CLO 14	T1:23.1 R1:9.4
38-39	Verification of Lagrange's Mean value theorem to the given functions	CLO 14	T1:23.1 R1:9.9
40	Verification of Cauchy's mean value theorem to the given functions	CLO 14	T1:23.1 R1:9.10
41	Functional dependence for two and three functions	CLO 14	T2:27.5 R1:10.2
42-43	Maxima and minima of functions of two variables without constraints	CLO 17	T2:27.7 R1:11.3
44-45	Lagranges method of undetermined multipliers	CLO 17	T2:27.8 R1:11.6

XV. GAPS IN THE SYLLABUS - TO MEET INDUSTRY / PROFESSION REQUIREMENTS:

S No	Description	Proposed actions	Relevance with P0s	Relevance with PSOs
1	To improve standards and analyze the concepts.	Guest lecture	PO 1	PSO 1
2	Conditional probability, Sampling distribution, correlation, regression analysis and testing of hypothesis	Seminars / NPTEL	PO 4	PSO 1
3	Encourage students to solve real time applications and prepare towards competitive examinations.	NPTEL	PO 2	PSO 1

Prepared by:
Ms. P Rajani, Assistant Professor

HOD, FRESHMAN ENGINEERING

INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)
Dundigal, Hyderabad -500 043

CIVIL ENGINEERING

COURSE DESCRIPTOR

Course Title	**ENGINEERING CHEMISTRY**				
Course Code	AHS005				
Programme	B. Tech				
Semester	I	AE | CIVIL | CSE | ECE | EEE | IT | ME			
Course Type	Foundation				
Regulation	IARE - R16				
Course Structure	**Theory**			**Practical**	
	Lectures	**Tutorials**	**Credits**	**Laboratory**	**Credits**
	3	-	3	2	1
Chief Coordinator	Ms. V Anitha Rani, Associate Professor				
Course Faculty	Dr. C Mahendar, Professor Mr. M Praveen, Assistant Professor Mr. B Raju, Assistant Professor Ms. M Malathi, Assistant Professor Mr. G Mahesh Kumar, Assistant Professor Ms. T Mallika, Assistant Professor Ms. M Lakshmi Prasanna, Assistant Professor Ms. M Swathi, Assistant Professor				

I. COURSE OVERVIEW:

The primary objective of an Engineering Chemistry course is to introduce the students to the concepts and applications of chemistry in engineering. It should cultivate in them an ability to identify chemistry in each piece of finely engineered products used in households and industry. It aims to strengthen the fundamental concepts of chemistry and then builds an interface with their industrial applications. It deals with applied and industrially useful topics, such as water technology, engineering materials, electrode potential and cells, fuels, polymers and corrosion. Water and its treatment for various purposes, engineering materials such as plastics, composites, ceramic, abrasives, their preparation, properties and applications, conventional and non-conventional energy sources, nuclear, solar, various batteries, combustion calculations, corrosion and control of metallic materials.

II. COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites
-	-	-	Basic principles of chemistry

III. MARKS DISTRIBUTION:

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

IV. DELIVERY / INSTRUCTIONAL METHODOLOGIES:

✔	Chalk & Talk	✔	Quiz	✔	Assignments	✘	MOOCs
✔	LCD / PPT	✔	Seminars	✘	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 units and each unit carries equal weightage in terms of marks distribution. The question paper pattern is as follows. Two full questions with "either" or "choice" will be drawn from each unit. Each question carries 14 marks. There could be a maximum of two sub divisions in a question.

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

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

Continuous Internal Assessment (CIA):
CIA is conducted for a total of 30 marks (Table 1), with 25 marks for Continuous Internal Examination (CIE), 05 marks for Quiz/ Alternative Assessment Tool (AAT).

Table 1: Assessment pattern for CIA

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

Continuous Internal Examination (CIE):
Two CIE exams shall be conducted at the end of the 8th and 16th week of the semester respectively. The CIE exam is conducted for 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 / Alternative Assessment Tool (AAT):
Two Quiz exams shall be online examination consisting of 25 multiple choice questions and are be answered by choosing the correct answer from a given set of choices (commonly four). Marks shall be awarded considering the average of two quizzes for every course. The AAT may include seminars, assignments, term paper, open ended experiments, five minutes video and MOOCs.

VI. HOW PROGRAM OUTCOMES ARE ASSESSED:

Program Outcomes (POs)		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	Seminar
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	Seminar
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	Presentation on real-world problems

3 = High; 2 = Medium; 1 = Low

VII. HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

Program Specific Outcomes (PSOs)		Strength	Proficiency assessed by
PSO 1	**Engineering knowledge:** Graduates shall demonstrate sound knowledge in analysis, design, laboratory investigations and construction aspects of civil engineering infrastructure, along with good foundation in mathematics, basic sciences and technical communication.	1	Seminar
PSO 2	**Broadness and diversity:** Graduates will have a broad understanding of economical, 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.	-	-
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.	-	-

3 = High; 2 = Medium; 1 = Low

VIII. COURSE OBJECTIVES (COs):

The course should enable the students to:	
I	Apply the electrochemical principles in batteries.
II	Understand the fundamentals of corrosion and development of different techniques in corrosion control.
III	Analysis of water for its various parameters and its significance in industrial, applications.
IV	Improve the fundamental science and engineering principles relevant to materials.

IX. COURSE LEARNING OUTCOMES (CLOs):

CLO Code	CLO's	At the end of the course, the student will have the ability to:	PO's Mapped	Strength of Mapping
AHS005.01	CLO 1	Extrapolate the knowledge of electrolytic cell, electrochemical cell, electrode potential and reference electrodes.	PO 1	3
AHS005.02	CLO 2	Use of primary and secondary batteries in various fields such as automobiles, railways, medical devices, aircrafts and day to day life.	PO 1 PO 2	1
AHS005.03	CLO 3	Explain the characteristic factors of a metal and environment influencing the rate of corrosion.	PO 1 PO 7	2
AHS005.04	CLO 4	Use appropriate methods such as protective, metallic and organic coatings to control corrosion in metals.	PO 1 PO 7	2
AHS005.05	CLO 5	Evaluate the quality and utility of suitable water for industrial as well as domestic applications.	PO 1 PO 7	3
AHS005.06	CLO 6	Use innovative methods to improve the quality of soft water for Potable and industrial purpose at cheaper cost.	PO 1 PO 7	2
AHS005.07	CLO 7	Understand the concepts of polymers for viscoelastic nature of polymer materials in real-time application.	PO 1 PO 7	1
AHS005.08	CLO 8	Demonstrate the ability to use polymeric materials for engineering problems in different domains.	PO 1 PO 7	1
AHS005.09	CLO 9	Justify the immense importance of basic constructional material, Portland cement in civil engineering works.	PO 1	1
AHS005.10	CLO 10	Describe various instruments used for measuring various properties of lubricants in industries.	PO 1	3
AHS005.11	CLO 11	Understand refractory use in metallurgical furnaces, kilns and other equipments.	PO 1	2
AHS005.12	CLO 12	Demonstrate comprehensive knowledge of conventional fuel properties on engine performance.	PO 1	2
AHS005.13	CLO 13	Understand the importance of cracking, knocking in IC engines and operations involved in petroleum refining for real-time application.	PO 1 PO 2	2
AHS005.14	CLO 14	Describe the physical and chemical properties of alternate fuels like natural gas, LPG and CNG.	PO 1	1
AHS005.15	CLO 15	Determine efficiency of the fuel in terms of calorific value and combustion reactions of the fuel.	PO 1	2
AHS005.16	CLO 16	Understand the concepts of electro chemistry in solar cell, Fuel cells and batteries for real-time application.	PO 1	2
AHS005.17	CLO 17	Understand the concepts of corrosion control methods in pipeline leaks and ruptures as real-time application.	PO 1 PO 7	2
AHS005.18	CLO 18	Understand the concepts of water technology in applications of image recognition for real-time water level and surface velocity.	PO 1 PO 7	2

3 = High; 2 = Medium; 1 = Low

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

Course Learning Outcomes (CLOs)	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CLO 1	3														
CLO 2	2	1													
CLO 3	2						2						1		
CLO 4	2						2						1		
CLO 5	3						3						1		
CLO 6	2						2						1		
CLO 7	2						1								
CLO 8	1						1								
CLO 9	1												1		
CLO 10	3														
CLO 11	2														
CLO 12	2														
CLO 13	3	1													
CLO 14	1														
CLO 15	2														
CLO 16	2														
CLO 17	2						2								
CLO 18	2						2								

3 = High; 2 = Medium; 1 = Low

XI. ASSESSMENT METHODOLOGIES – DIRECT

CIE Exams	PO 1,PO 2, PO 7	SEE Exams	PO 1,PO 2 PO 7	Assignments	PO 2	Seminars	PO 1, PO 2
Laboratory Practices	PO 1	Student Viva	-	Mini Project	-	Certificatior	-
Term Paper	-						

XII. ASSESSMENT METHODOLOGIES - INDIRECT

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

XIII. SYLLABUS

Unit-I	ELECTROCHEMISTRY AND BATTERIES
Electrochemistry: Basic concepts of electrochemistry; Conductance: Specific, equivalent and molar conductance and effect of dilution on conductance; Electrochemical cells: Galvanic cell (daniel cell); Electrode potential; Electrochemical series and its applications; Nernst equation; Types of electrodes: Calomel electrode, quinhydrone electrode; Batteries: Classification of batteries, primary cells (dry cells) and secondary cells (lead-acid battery, Ni-Cd cell), applications of batteries, numerical problems.	
Unit-II	**CORROSION AND ITS CONTROL**
Corrosion: Introduction, causes and effects of corrosion; Theories of corrosion: Chemical and electrochemical corrosion with mechanism; Factors affecting the rate of corrosion: Nature of the metal and nature of the environment; Types of corrosion: Waterline and crevice corrosion; Corrosion control methods: Cathodic protection- sacrificial anodic protection and impressed current cathodic protection; Surface coatings: Metallic coatings, methods of application of metallic coatings-hot dipping(galvanizing, tinning), electroplating(copper plating); Organic coatings: Paints, its constituents and their functions.	
Unit-III	**WATER TECHNOLOGY**
Water: Sources and impurities of water, hardness of water, expression of hardness-units; Types of hardness: Temporary hardness, permanent hardness and numerical problems; Estimation of temporary and permanent hardness of water by EDTA method; Determination of dissolved oxygen by Winkler's method; Boiler troubles: Priming, foaming, scales, sludges and caustic embrittlement. Treatment of water: Internal treatment of boiler feed water- carbonate, calgon and phosphate conditioning, softening of water by Zeolite process and Ion exchange process; Potable water-its specifications, steps involved in the treatment of potable water, sterilization of potable water by chlorination and ozonization, purification of water by reverse osmosis process.	
Unit-IV	**MATERIALS CHEMISTRY**
Materials chemistry: Polymers-classification with examples, polymerization-addition, condensation and co-polymerization; Plastics: Thermoplastics and thermosetting plastics; Compounding of plastics; Preparation, properties and applications of polyvinyl chloride, Teflon, Bakelite and Nylon-6, 6; Rubbers: Natural rubber its process and vulcanization; Elastomers: Buna-s and Thiokol rubber; Fibers: Characteristics of fibers, preparation properties and applications of Dacron; Characteristics of fiber reinforced plastics; Cement: Composition of Portland cement, setting and hardening of Portland cement; Lubricants: Classification with examples; Properties: Viscosity, flash, fire, cloud and pour point; Refractories: Characteristics and classification with examples.	
Unit-V	**FUELS AND COMBUSTION**
Fuel: Definition, classification of fuels and characteristics of a good fuels; Solid fuels: Coal; Analysis of coal: Proximate and ultimate analysis; Liquid fuels: Petroleum and its refining; Cracking: Fixed bed catalytic cracking; Knocking: Octane and cetane numbers; Gaseous fuels: Composition, characteristics and applications of natural gas, LPG and CNG; Combustion: Calorific value: Gross Calorific Value(GCV) and Net Calorific Value(NCV), calculation of air quantity required for complete combustion of fuel, numerical problems.	
Text Books:	
1. P. C. Jain and Monica Jain, "Engineering Chemistry", Dhanpat Rai Publishing Company, 15th Edition, 2015.	

2. Shashi Chawla, "Text Book of Engineering Chemistry" Dhanat Rai and Company, 1st Edition 2011
Reference Books:
1.B. Siva Shankar, "Engineering Chemistry", Tata McGraw Hill Publishing Limited, 3rd Edition, 2015. 2. S. S. Dara, Mukkanti, "Text of Engineering Chemistry", S. Chand & Co, New Delhi, 12th Edition, 2006. 3. C. V. Agarwal, C. P. Murthy, A. Naidu, "Chemistry of Engineering Materials", Wiley India, 5thEdition, 2013. 4.R. P. Mani, K. N. Mishra, "Chemistry of Engineering Materials", Cengage Learning, 3rd Edition, 2015.

XIV.COURSE PLAN:

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

Lecture No	Topics to be covered	CLOs	Reference
1	Understands the concept of electrochemistry. Differentiate the electronic conductors and electrolytes.	CLO 1	T1:5.1,6.3
2	Define the terms specific, equivalence and molar conductance. Explain the dilution effect on these conductance	CLO 1	T1:5.5
3	Understands the concept of specific, equivalence and molar conductance. Define the EMF of the cell. Demonstrate the Daniel cell.	CLO 1	T2:6.1,6.2, 6.3
4	Describe the construction and chemical reactions of different electrodes. Use the Calomel	CLO 1	T2:11,12.2.1
5	Quinhydrone electrodes in calculation of potential of the single electrode.	CLO 1	T1:6.7(4)
6	Derive the relation between cell reaction and emf of the single electrodes.	CLO 1	T2:3.4
7	Use the standard potential values of elements from electrochemical series.	CLO 1	T2:5,5.1
8	Define the battery; differentiate the primary and secondary batteries. Demonstrate the construction of the dry cell.	CLO 2	T2:16,17.1
9	Identify the anode, cathode and electrolyte in different types of secondary batteries. Employ the applications of different types of batteries.	CLO 2	T2:17.3
10	Identify the anode, cathode and electrolyte in different types of secondary batteries. Employ the applications of different types of batteries.	CLO 2	T2:17.4
11	Define corrosion and its disadvantages.	CLO 3	T2:1.1
12	Explain the mechanism of oxidation corrosion when dry gases attack on metal.	CLO 3	T2:2.1
13	Explain the mechanism of hydrogen evolution type and oxygen absorption type corrosion.	CLO 3	T2:2.2
14	Distinguish the types of corrosion.	CLO 3	T2:2.4.5
15	Analyze the effect of different factors on rate of corrosion.	CLO 3	T2:5,5.1,5.2
16	Explain the process of cathodic protection with examples.	CLO 4	T2:6.4
17	Use the methods of application of metallic coatings and Relate the galvanization and tinning	CLO 4	T1:17.1
18	Explain the process of electroplating. Apply the organic coatings for control of corrosion.	CLO 4	T1:8.6 T2:6.3.3
19	List the various sources of water, Differentiate the temporary and permanent hardness and give its units.	CLO 5	T2:3,4,5
20	Calculate the total, permanent and temporary hardness of	CLO 5	T2:6

Lecture No	Topics to be covered	CLOs	Reference
	sample hard water by using EDTA		
21	Calculate the dissolved oxygen in water by Winkler's method	CLO 5	T1:1.14(4)
22-23	Recognize the boiler troubles.	CLO 5	T2:9.2,9.5
24	Discuss the internal treatment methods of boiler feed water. Name the different chemicals used in internal treatment.	CLO 6	T2:12,12.4, 12.2,12.3
25	Explain the process of zeolite and analyze the advantages and disadvantages.	CLO 6	T2:11.2
26	Explain ion-exchange process.	CLO 6	T2:11.3,13
27	Demonstrate the treatment of potable water Purification of potable water. Describe the process of reverse osmosis	CLO 6	T2:13,14 (d)
28	Define monomer and polymer Explain the mechanism of different types of Chain and step growth polymerization.	CLO 7	T2:2,2.2,4,4.1,4.2,4.7
29	Distinguish the thermoplastic and thermo set plasitcs. Illustrate the compounding of plastics.	CLO 7	T1:3.14,3.13.12
30	Identify the preparation, properties and applications of different thermo and thermo set plastics.	CLO 8	T2:2.3,2.7,2.8
31	Identify the preparation, properties and applications of thermo set plastics. Explain about natural rubber.	CLO 8	T2:3,3.1,3.2, 3.3
32	Explain the preparation, properties and applications of synthetic rubbers.	CLO 8	T1:3.24 T2:4.2
33	Explain the preparation, properties and applications of fibers.	CLO 8	T1:3.28 R4:114
34	Generalize the process of setting and hardening reactions of cement	CLO 9	T2:9.3.2, 9.3.3
35	Define the term lubricant and it's classification.	CLO 10	T2:7.4
36	Compare the different types of lubricants based on their properties.	CLO 10	T2:7.5
37	Name the different types of refractories. Discuss the characteristics and applications of refractories.	CLO 11	T2:8.2,8.3
38	Define the fuel with examples. Categorize the different types of fuels.	CLO 12	T2:5.2,5.3
39	Analyze the different types of coals. Explain the significance of proximate analysis of coal.	CLO 12	T2:5.7,5.8,5.8.1
40	Explain the significance of Ultimate analysis of coal.	CLO 12	T2:5.8.2
41	Identify the chemical constituents of petroleum. Describe the refining of petroleum. Define the term cracking. Distinguish the fixed bed and catalytic cracking.	CLO 13	T1:2.18,2.19 2.19(a)
42	Evaluate the octane and cetane rating of the petrol and diesel.	CLO 13	T1:2.23
43	Identify the chemical constituents of the gaseous fuel. Discuss the characteristics of natural gas. Compare the LPG and CNG.	CLO 14	T1:2.28,2.26 T2:5.14.1 R4:247
44	Explain the combustion process of different chemical constituents present in the fuel. Differentiate the HCV and LCV.	CLO 15	T2:5.4,5.5
45	Evaluate the air quantity required for complete combustion of fuel.	CLO 15	T2:5.4.1, 6.5

XIV. GAPS IN THE SYLLABUS - TO MEET INDUSTRY / PROFESSION REQUIREMENTS:

S No	Description	Proposed actions	Relevance with POs	Relevance with PSOs
1	Galvanic cell, batteries-lead acid cells, Crevice corrosion, cathodic protection, galvanizing, Electroplating.	Seminars / Guest Lectures / NPTEL	PO 1	PSO 1
2	Softening techniques, plastics, cement, refining of petroleuim.	Seminars / Guest Lectures / NPTEL	PO 1	PSO 1
3	Thiokol rubber, EDTA method, Dissolved oxygen, Viscosity, P^H meter.	Assignments / Laboratory Practices	PO 1	PSO 1

Prepared by:
Ms. V Anitha Rani, Associate Professor

HOD, FRESHMAN ENGINEERING

INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)
Dundigal, Hyderabad -500 043

CIVIL ENGINEERING

COURSE DESCRIPTOR

Course Title	APPLIED PHYSICS				
Course Code	AHS007				
Programme	B.Tech				
Semester	I	AE | ME | CE			
Course Type	Foundation				
Regulation	IARE - R16				
Course Structure	**Theory**			**Practical**	
	Lectures	**Tutorials**	**Credits**	**Laboratory**	**Credits**
	3	1	4	-	-
Chief Coordinator	Dr. Rizwana, Professor				
Course Faculty	Mr. K Saibaba, Assistant Professor				

I. COURSE OVERVIEW:

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

II. COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites
-	-	-	Basic principles of physics

III. MARKS DISTRIBUTION:

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

IV. DELIVERY / INSTRUCTIONAL METHODOLOGIES:

✔	Chalk & Talk	✔	Quiz	✔	Assignments	✘	MOOCs
✔	LCD / PPT	✔	Seminars	✘	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 units and each unit carries equal weightage in terms of marks distribution. The question paper pattern is as follows. Two full questions with "either" or "choice" will be drawn from each unit. Each question carries 14 marks. There could be a maximum of two sub divisions in a question.

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

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

Continuous Internal Assessment (CIA):

CIA is conducted for a total of 30 marks (Table 1), with 25 marks for Continuous Internal Examination (CIE), 05 marks for Quiz/ Alternative Assessment Tool (AAT).

Table 1: Assessment pattern for CIA

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

Continuous Internal Examination (CIE):

Two CIE exams shall be conducted at the end of the 8th and 16th week of the semester respectively. The CIE exam is conducted for 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 / Alternative Assessment Tool (AAT):

Two Quiz exams shall be online examination consisting of 25 multiple choice questions and are be answered by choosing the correct answer from a given set of choices (commonly four). Marks shall be awarded considering the average of two quizzes for every course. The AAT may include seminars, assignments, term paper, open ended experiments, five minutes video and MOOCs.

VI. HOW PROGRAM OUTCOMES ARE ASSESSED:

Program Outcomes (POs)		Strength	Proficiency assessed by
PO 1	**Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.	3	Presentation on real-world problems
PO 2	**Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences	2	Seminar
PO 4	**Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.	1	Term Paper

3 = High; 2 = Medium; 1 = Low

VII. HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

Program Specific Outcomes (PSOs)		Strength	Proficiency assessed by
PSO 1	**Engineering knowledge:** Graduates shall demonstrate sound knowledge in analysis, design, laboratory investigations and construction aspects of civil engineering infrastructure, along with good foundation in mathematics, basic sciences and technical communication.	2	Seminar
PSO 2	**Broadness and diversity:** Graduates will have a broad understanding of economical, 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.	-	-
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.	-	-

3 = High; 2 = Medium; 1 = Low

VIII. COURSE OBJECTIVES (COs):

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

IX. COURSE LEARNING OUTCOMES (CLOs):

CLO Code	CLO's	At the end of the course, the student will have the ability to:	PO's Mapped	Strength of Mapping
AHS007.01	CLO 1	Recall the basic principles of physics.	PO 1 , PO 2	3
AHS007.02	CLO 2	Apply the concepts and principles in solving the problems of physics.	PO 1 , PO 4	3
AHS007.03	CLO 3	Acquire knowledge of basic terms related to dielectric materials and different polarization mechanisms.	PO 1 , PO 4	3
AHS007.04	CLO 4	Review properties of different magnetic materials and magnetization based on orientation of domains.	PO 1 , PO 2	2
AHS007.05	CLO 5	Recollect basic principles of acoustics of buildings and modern architectural acoustic techniques.	PO 1 , PO 2	2
AHS007.06	CLO 6	Explain production, properties and applications of ultrasonic waves	PO 1 , PO 2	2
AHS007.07	CLO 7	Review the basic concepts of system of forces.	PO 1 , PO 4	1
AHS007.08	CLO 8	Analyze different law of forces and condition of equilibrium.	PO 2 , PO 4	1
AHS007.09	CLO 9	Discuss different types and laws of friction.	PO 2 , PO 4	2
AHS007.10	CLO 10	Interpret applications of friction.	PO 1 , PO 2	2
AHS007.11	CLO 11	Describe rotational motion of rigid bodies and moment of inertia of some of the regular shapes.	PO 1 , PO 4	3
AHS007.12	CLO 12	Identify and apply theorems of moment of inertia.	PO 1 , PO 2	3
AHS007.13	CLO 13	Correlate different concept of physics with day to day life applications.	PO 1	2
AHS007.14	CLO 14	Understand the technical importance of moment of inertia of regular and irregular bodies.	PO 2	2
AHS007.15	CLO 15	Identify the modern engineering devices based on basic principles of forces and friction.	PO 4	1

3 = High; 2 = Medium; 1 = Low

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

CLOs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CLO 1	3	2											2		
CLO 2	2			2									1		
CLO 3	3			1									2		
CLO 4	1	3													
CLO 5	3	2													
CLO 6	3	2											2		
CLO 7	2			1									2		

CLOs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CLO 8		2		1											
CLO 9		1		1									2		
CLO 10	3	2											1		
CLO 11	2			1											
CLO 12	3	2											2		
CLO 13	2														
CLO 14		2											1		
CLO 15				1											

3 = High; 2 = Medium; 1 = Low

XI. ASSESSMENT METHODOLOGIES – DIRECT

CIE Exams	PO1,PO2	SEE Exams	PO1,PO4	Assignments	PO4	Seminars	PO2
Laboratory Practices	PO1,PO2	Student Viva	-	Mini Project	-	Certification	-
Term Paper	PO 4						

XII. ASSESSMENT METHODOLOGIES - INDIRECT

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

XIII. SYLLABUS

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

Unit-IV	FRICTION
Friction: Types of friction, limiting friction, laws of friction, angle of repose, equilibrium of body laying on rough inclined plane, Application of friction: ladder friction, wedge friction, screw friction.	
Unit-V	**DYNAMICS OF RIGID BODIES - MOMENT OF INERTIA**
Rotational motion, torque, angular momentum, relation between torque and angular momentum, angular momentum of system of particles, moment of inertia, expression for moment of inertia, radius of gyration, theorems on moment of inertia, moment of inertia of thin rod, rectangular lamina, circular disc.	
Text Books:	
1. Dr. K. Vijaya Kumar, Dr. S. Chandralingam, "Modern Engineering Physics", Chand & Co. New Delhi, 1st Edition, 2010. 2. R. C Hibbler, "Engineering mechanics", Prentice Hall, 12th Edition, 2009.	
Reference Books:	
1. R. K. Gaur, S. L. Gupta, "Engineering Physics", Dhanpat Rai Publications, 8th Edition, 2001. 2. Timoshenko, D. H. Young, "Engineering mechanics", Tata Mc Graw Hill, 5th Edition, 2013. 3. Hitendra K Malik, A. K. Singh, "Engineering Physics", Mc Graw Hill Education, 1stEdition,2009. 4. S. S. Bhavikatti, "A text book of Engineering mechanics", New age international, 1st Edition, 2012.	

XIV. COURSE PLAN:

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

Lecture No	Topics to be covered	Course Learning Outcomes (CLOs)	Reference
1	Acquire knowledge of basic terms related to dielectric materials.	CLO 1	T1:13.5 R1:1.3
2	Discuss different polarization mechanisms in dielectrics	CLO 2	T1:13.5 R1:1.3
3-4	Derive expression for total electric field at a given point inside dielectrics.	CLO 32	T1:13.5 R1:1.3
5	Acquire knowledge of basic terms related to magnetic materials.	CLO 3	T1:14.7 R1:3.4
6	Describe magnetic moment in an atom in terms of Bohr Magneton	CLO 3	T1:15.7 R1:4.10
7-8	Classify different magnetic materials based on electron theory.	CLO 4	T1:16.8 R1:4.15
9	Examine the spontaneous magnetization in ferromagnets based on orientation of domains	CLO 4	T1:16.9 R1:5.4
10	Explain the basic terms related to acoustics of buildings	CLO 5	T1:17.9 R1:5.8
11	Analyze the Sabine's formula of reverberation time	CLO 5	T1:18.10 R1:6.8
12	Calculate the absorption coefficient of a surface	CLO 6	T1:19.10 R1:6.13
13	Identify remedies for factors affecting architectural acoustics	CLO 6	T1:19.9 R1:7.5
14-15	Recall basics of ultrasonics	CLO 5	T1:23.10 R1:7.5
16	Explain the production of ultrasonics by Magnetostriction method	CLO 6	T1:23.10 R1:8.1
17	Explain the production of ultrasonics by Piezoelectric method	CLO 6	T1:23.1 R1:9.2
18-19	Review the properties of ultrasonics	CLO 6	T1:23.1 R1:9.4
20	Discuss the applications of ultrasonics	CLO 6	T1:23.1 R1:9.9

Lecture No	Topics to be covered	Course Learning Outcomes (CLOs)	Reference
21	Identify the principle of forces	CLO 7	T1:23.1 R1:9.10
22	Recall different system of forces	CLO 7	T2:27.5 R1:10.2
23	Acquire knowledge of force systems in space	CLO 7	T2:27.7 R1:11.3
24-25	Analyze parallel forces in plane	CLO 8	T2:27.8 R1:11.6
26	Correlate couples in systems	CLO 8	T2:27.12 R1:11.7
27-28	Apply Lami's theorem to problems	CLO 8	T2:27.12 R1:11.8
29	Analyze triangle law of forces	CLO 8	T2:27.12 R1:11.9
30	Analyze polygon law of forces	CLO 7	T2:27.12 R1:11.10
31-32	Recognize condition of equilibrium	CLO 9	T2:27.14 R1:12.3
33	Understand friction	CLO 9	T2:27.1 R1:12.7
34-35	Discuss limiting friction	CLO 9	T2:27.17 R1:12.15
36	Analyze laws of friction	CLO 10	T2:27.18 R1:12.19
37-38	Describe angle of repose	CLO 10	T2:27.19 R2:14.4
39	Identify equilibrium of body laying on rough inclined plane	CLO 10	T2:27.20 R2:14.5
40-41	Solve problems on friction	CLO 10	T2:30.19 R2:14.5
42-43	Understand ladder friction	CLO 10	T2:30.20 R2:15.5
44-45	Discuss wedge friction	CLO 10	T2:32.19 R2:16.5
46-47	Describe screw friction	CLO 10	T2:32.20 R2:16.5
48-49	Explain basic concept rotational motion	CLO 11	T2:33.1 R2:16.6
50-51	Derive relation between torque and angular momentum	CLO 11	T2:34.1 R2:17.1
52-53	Acquire the knowledge of moment of inertia	CLO 12	T2:35.2 R2:17.2
54-55	Examine radius of gyration	CLO 11	T2:36.1 R2:18.1
56-57	Understand theorems on moment of inertia	CLO 12	T2:38.19 R2:16.5
58-59	Calculate moment of inertia of thin rod, Rectangular lamina	CLO 12	T2:39.19 R2:16.5
60	Calculate moment of inertia of circular disc	CLO 12	T2:40.19 R2:16.5

XV. GAPS IN THE SYLLABUS - TO MEET INDUSTRY / PROFESSION REQUIREMENTS:

S No	Description	Proposed Actions	Relevance With POs	Relevance With PSOs
1	To improve standards and analyze the concepts.	Seminars	PO 1	PSO 1
2	Conditional probability, Sampling distribution, correlation, regression analysis and testing of hypothesis	Seminars / NPTEL	PO 4	PSO 1
3	Encourage students to solve real time applications and prepare towards competitive examinations.	Guest lecture	PO 2	PSO 1

Prepared by:
Mr. K Saibaba, Assistant Professor

HOD, FRESHMAN ENGINEERING

INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)
Dundigal, Hyderabad -500 043

CIVIL ENGINEERING

COURSE DESCRIPTOR

Course Title	ENGINEERING DRAWING				
Course Code	AME001				
Program	B.Tech				
Semester	I	AE| ME|CE			
Course Type	Core				
Regulation	IARE - R16				
Course Structure	**Theory**			**Practical**	
	Lectures	**Tutorials**	**Credits**	**Laboratory**	**Credits**
	2		4	3	4
Chief Coordinator	Prof. B.V. S. N. Rao, Professor				
Course Faculty	Ms. P Shruthilaya, Assistant Professor. Mr. G. Sarat Raju, Assistant Professor.				

I. COURSE OVERVIEW:

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

II. COURSE PRE-REQUISITES:

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

III. MARKSDISTRIBUTION:

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

IV. DELIVERY / INSTRUCTIONAL METHODOLOGIES:

✔	Chalk & Talk	✔	Quiz	✔	Assignments	✘	MOOCs
✔	LCD / PPT	✔	Seminars	✘	Mini Project	✔	Videos
✘	Open Ended Experiments						

V. EVALUATION METHODOLOGY:

The SEE is conducted for 70 marks of 3 hours duration. The question paper pattern is as follows: two full questions with 'either' 'or' choice will be drawn from each unit. Each question carries 14 marks. There could be a maximum of two sub divisions in a question. All the drawing related courses are evaluated in line with laboratory courses. The distribution shall be 30 marks for internal evaluation (20 marks for day–to–day work, and 10 marks for internal tests) and 70 marks for semester end lab examination. There shall be ONE internal test for 10 marks in each semester.

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

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

VI. HOW PROGRAM OUTCOMES ARE ASSESSED:

Program Outcomes (POs)		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	Assignments
PO 2	**Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences	2	Term paper, Seminars
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

3 = High; 2 = Medium; 1 = Low

VII. HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

Program Specific Outcomes (PSOs)		Strength	Proficiency assessed by
PSO 1	**Engineering knowledge:** Graduates shall demonstrate sound knowledge in analysis, design, laboratory investigations and construction aspects of civil engineering infrastructure, along with good foundation in mathematics, basic sciences and technical communication.	2	Lecture, Assignments.
PSO 2	**Broadness and diversity:** Graduates will have a broad understanding of economical, 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.	-	Assignments
PSO 3	**Self-Learning and service:** Graduates will be motivated for continuous self-learning in engineering practice and/ or pursue	-	-

Program Specific Outcomes (PSOs)		Strength	Proficiency assessed by
	research in advanced areas of civil engineering in order to offer engineering services to the society, ethically and responsibly.		

3 = High; 2 = Medium; 1 = Low

VIII. COURSE OBJECTIVES (COs):

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

IX. COURSE LEARNING OUTCOMES (CLOs):

CLO Code	CLO's	At the end of the course, the student will have the ability to:	PO's Mapped	Strength of Mapping
AME001.01	CLO 1	Understand the BIS conventions of engineering drawing with basic concepts, ideas and methodology	PO 1	3
AME001.02	CLO 2	Recognize the need of single stroke lettering in defining the components	PO 1	3
AME001.03	CLO 3	Understand the different line types according to BIS standards to engineering drawings.	PO 1	3
AME001.04	CLO 4	Sketch the various types of polygons for applying in solid modeling	PO 2	2
AME001.05	CLO 5	Discuss the various types of scales for engineering application like maps, buildings, bridges.	PO 2	2
AME001.06	CLO 6	Visualize parabolic and elliptical profiles in buildings and bridges	PO 2	2
AME001.07	CLO 7	Visualize cycloidal and involute profiles in developing new products like gears and other engineering applications.	PO 4	1
AME001.08	CLO 8	Solve specific geometrical problems in plane geometry involving points and lines.	PO 4	1
AME001.09	CLO 9	Understand the theory of projection in planes located in various quadrants and apply in manufacturing processes.	PO 2	2
AME001.10	CLO 10	Understand the orthographic projection concepts in solid modeling and apply the concepts in the areas of design.	PO 2	2
AME001.11	CLO 11	Apply the terminology of development of surfaces in the area of chimneys and chutes.	PO 1	3
AME001.12	CLO 12	Visualize the components by isometric projection by representing three dimensional objects in two dimensions in technical and engineering drawings.	PO 1	3
AME001.13	CLO 13	Interpret plumbing drawings typically found in construction by using transformation of projection.	PO 1	3
AME001.14	CLO 14	Convert the orthographic views into pictorial views by using transformation of projection.	PO 1, PO 2	3
AME001.15	CLO 15	Convert the pictorial views into orthographic views by using transformation of projection..	PO 2	2

3 = High; 2 = Medium; 1 = Low

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

(CLOs)	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CLO 1	3												1		
CLO 2	3												1		
CLO 3	3												1		
CLO 4		2													
CLO 5		2				1									
CLO 6		2													
CLO 7				1											
CLO 8				1											
CLO 9		2											1		
CLO 10		2											1		
CLO 11	3					1									
CLO 12	3														
CLO 13	3														
CLO 14	3	2											1		
CLO 15		2													

3 = High; 2 = Medium; 1 = Low

XI. ASSESSMENT METHODOLOGIES–DIRECT

CIE Exams	PO 1	SEE Exams	PO 1	Assignments	PO 2	Seminars	PO 2
Laboratory Practices	PO 2	Student Viva	-	Mini Project	-	Certification	-
Term Paper				Project			

XII. ASSESSMENT METHODOLOGIES-INDIRECT

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

XIII. SYLLABUS

UNIT-I	FUNDAMENTALS OF ENGINEERING DRAWING, SCALES AND CURVES
Introduction to engineering drawing: Drawing instruments and accessories, types of line, lettering practice and rules of dimensioning, geometrical constructions, basic geometrical shapes; Scales: Types	

of scales, units of length and their conversion, construction of scales, plain scale, diagonal scale, vernier scale; Curves used in engineering practice and their constructions; Conic sections, construction of ellipse parabola and hyperbola, special curves, construction of cycloid, epicycloids, hypocycloid and involutes..	
UNIT-II	**ORTHOGRAPHIC PROJECTION, PROJECTION OF PLANES**
Orthographic projection: Principles of orthographic projections, conventions, first and third angle projections, projection of points, projection of lines, lines inclined to single plane, lines inclined to both the planes, true lengths and traces; Projection of planes: Projection of regular planes, planes inclined to one plane, planes inclined to both planes, projection of planes by auxiliary plane projection method.	
UNIT-III	**PROJECTION OF SOLIDS**
Projection of solids: Projections of regular solid, prisms, cylinders, pyramids, cones. Solids inclined to one plane, solids inclined to both planes, projection of solid by auxiliary Page | 5 plane projection method.	
UNIT-IV	**DEVELOPMENT OF SURFACES, ISOMETRIC PROJECTIONS**
Development of surfaces: Development of lateral surface of right regular solids, prisms, cylinders, pyramids and cones; Isometric projections: Principle of isometric projection, isometric scale, isometric projections and isometric views, isometric projections of planes, prisms, cylinders, pyramids, and cones.	
UNIT-V	**TRANSFORMATION OF PROJECTIONS**
Transformation of projections: Conversion of isometric views to orthographic views and conversion of orthographic views to isometric views..	
Text Books:	
1. N. D. Bhatt, "Engineering Drawing", Charotar Publications, 49thEdition, 2012. 2. C. M. Agrawal, Basant Agrawal, "Engineering Drawing'', Tata McGraw Hill, 2ndEdition, 2013.	
Reference Books:	
1. K.Venugopal, "Engineering Drawing and Graphics", New Age Publications, 2ndEdition, 2010. 2. K. C. John, "Engineering Drawing", PHI Learning Private Limited", 2nd Edition, 2009. 3. Dhananjay. A. Johle, "Engineering Drawing", Tata McGraw Hill, 1st Edition, 2008.	

XIV. COURSE PLAN:

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

Lecture No	Topics to be covered	Course Learning Outcomes (CLOs)	Reference
1	Principles of engineering drawing – various drawing instruments and their uses. (general exercises).	CLO 1	T1:1.1
2	Conventions in Drawing – Lettering – BIS	CLO 2	T1:1.1
3	Geometrical constructions.	CLO 2	T1: 2.1
4	Construction of various scales for engineering use-Plain and diagonal	CLO 2	T1:2.2 R1: 2.2.3
5	Construction of various scales for engineering use- Vernier scales	CLO 1	T1: 2.3
6	Construction of various curves.-general method	CLO 2	T1: 3.1
7	Construction of various curves- ellipse, parabola & hyperbola	CLO1	T1:3.3
8	Construction of various curves cycloid, epicycloids, hypocycloid and involutes.	CLO 2	T1:3.4, R1: 4.1
9	Projection of points and lines inclined to single plane.	CLO 2	T1: 4.1
10	Projection of lines inclined to both planes	CLO1	T1: 4.3
11	Projection of planes-simple position.	CLO 1	T1: 4.3.2
12	Projection of planes- inclined to a both planes.	CLO1	T1:4.3
13	Projection of solids inclined to single plane.	CLO 2	T1: 4.4
14	Projection of solids inclined to a both planes.	CLO 2	T1: 5.2
15	Projection of solids Auxiliary plane method	CLO 2	T1: 5.2.3
16	Draw the development of surfaces	CLO 1	T1: 6.1
17	Draw the isometric projections	CLO 2	T1: 8.1

Lecture No	Topics to be covered	Course Learning Outcomes (CLOs)	Reference
18	Convert the pictorial views to orthographic views	CLO 2	T1:8.1.2

XV. GAPS IN THE SYLLABUS - TO MEET INDUSTRY / PROFESSION REQUIREMENTS:

S No	Description	Proposed actions	Relevance with POs	Relevance with PSOs
1	Increase ability to communicate with people.	Seminars	PO 1, PO 2,	PSO 1
2	Learn to take data and transform it into graphic drawings	Guest Lectures	PO4, PO 5	PSO 2
3	Students will become familiar with office practices and standards.	Assignments / Laboratory Practices	PO9, PO10	PSO 3

Prepared by:
Ms. P Shruthilaya, Assistant Professor.

HOD, CIVIL ENGINEERING

II SEMESTER

INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)
Dundigal, Hyderabad -500 043

CIVIL ENGINEERING

COURSE DESCRIPTOR

Course Title	**COMPUTER PROGRAMMING**				
Course Code	ACS001				
Programme	B.Tech				
Semester	I	CSE | IT| ECE | EEE			
	II	AE | CE| ME			
Course Type	Foundation				
Regulation	IARE - R16				
Course Structure	**Theory**			**Practical**	
	Lectures	**Tutorials**	**Credits**	**Laboratory**	**Credits**
	3	1	4	4	2
Chief Coordinator	Dr. K Srinivasa Reddy, Professor & HOD, IT				
Course Faculty	Ms N Jayanthi Dr. G Ramu Dr. J Sirisha Devi Dr. K Suvarchala Ms. B Rekha Ms. B Padmaja Ms. G Geetha Reddy Ms. K Laxmi Narayanamma Mr. R M Norullah				

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
-	-	-	Basic Mathematics and Logical Thinking

III. MARKSDISTRIBUTION:

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

IV. DELIVERY / INSTRUCTIONAL METHODOLOGIES:

✔	Chalk & Talk	✔	Quiz	✔	Assignments	✘	MOOCs
✔	LCD / PPT	✔	Seminars	✘	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 fiveunits and each unit carries equal weightage in terms of marks distribution. The question paper pattern is as follows. Two full questions with "either" or "choice" will be drawn from each unit. Each question carries 14 marks. There could be a maximum of two sub divisions in a question.

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

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

Continuous Internal Assessment (CIA):
CIA is conducted for a total of 30 marks (Table 1), with 25 marks for Continuous Internal Examination (CIE), 05 marks for Quiz/ Alternative Assessment Tool (AAT).

Table 1: Assessment pattern for CIA

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

Continuous Internal Examination (CIE):
Two CIE exams shall be conducted at the end of the 8th and 16th week of the semester respectively. The CIE exam is conducted for 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 / Alternative Assessment Tool (AAT):
Two Quiz exams shall be online examination consisting of 25 multiple choice questions and are be answered by choosing the correct answer from a given set of choices (commonly four). Marks shall be awarded considering the average of two quizzes for every course. The AAT may include seminars, assignments, term paper, open ended experiments, five minutes video and MOOCs.

VI. HOW PROGRAM OUTCOMES ARE ASSESSED:

Program Outcomes (POs)		Strength	Proficiency assessed by
PO 1	**Engineering knowledge**: Apply the knowledge of mathematics, science, engineeringfundamentals, and an engineering specialization to the solution of complex engineering problems.	3	Assignments
PO 2	**Problem analysis**: Identify, formulate, review research literature, and analyze complexengineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences	3	Assignments
PO 3	**Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.	2	Seminars, Viva
PO 4	**Conduct investigations of complex problems**: Use research-based knowledge and researchmethods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.	1	5 minutes video

3 = High; 2 = Medium; 1 = Low

VII. HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

Program Specific Outcomes (PSOs)		Strength	Proficiency assessed by
PSO 1	**Engineering knowledge:** Graduates shall demonstrate sound knowledge in analysis, design, laboratory investigations and construction aspects of civil engineering infrastructure, along with good foundation in mathematics, basic sciences and technical communication.	2	Projects
PSO 2	**Broadness and diversity:** Graduates will have a broad understanding of economical, 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	3	Lectures, Assignments
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	5 minutes video

3 = High; 2 = Medium; 1 = Low

VIII. COURSE OBJECTIVES (COs):

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

IX. COURSE LEARNING OUTCOMES (CLOs):

CLO Code	CLO's	At the end of the course, the student will have the ability to:	PO's Mapped	Strength of Mapping
ACS001.01	CLO 1	Identify and understand the working of key components of a computer system.	PO 1, PO 4	2
ACS001.02	CLO 2	Analyze a given problem and develop an algorithm to solve the problem.	PO 2, PO 3	3
ACS001.03	CLO 3	Describe the fundamental programming constructs and articulate how they are used to develop a program with a desired runtime execution flow.	PO 2, PO 4	2
ACS001.04	CLO 4	Gain knowledge to identify appropriate C language constructs to write basic programs.	PO 1, PO 3	3
ACS001.05	CLO 5	Identify the right data representation formats based on the requirements of the problem.	PO 2,PO 3	3
ACS001.06	CLO 6	Describe the operators, their precedence and associativity while evaluating expressions in program statements..	PO 1, PO 4	2
ACS001.07	CLO 7	Understand branching statements, loop statements and use them in problem solving.	PO 1,PO 4	2
ACS001.08	CLO 8	Learn homogenous derived data types and use them to solve statistical problems.	PO 2, PO 3	3
ACS001.09	CLO 9	Understand procedural oriented programming using functions.	PO 2	3
ACS001.10	CLO 10	Understand how recursion works and write programs using recursion to solve problems.	PO 1, PO 2	3
ACS001.11	CLO 11	Differentiate call by value and call by reference parameter passing mechanisms.	PO 2	3
ACS001.12	CLO 12	Understand pointers conceptually and apply them in C programs.	PO 1	3
ACS001.13	CLO 13	Distinguish homogenous and heterogeneous data types and apply them in solving data processing applications.	PO 3	2
ACS001.14	CLO 14	Explain the concept of file system for handling data storage and apply it for solving problems.	PO 1, PO 3	3
ACS001.15	CLO 15	Differentiate text files and binary files and write the simple C programs using file handling functions. Searching, Sorting.	PO 2	3
ACS001.16	CLO 16	Apply the concepts to solve real-time applications using the features of C language.	PO 2	3
ACS001.17	CLO 17	Possess the knowledge and skills for employability and to succeed in national and international level competitive examinations.	PO 1, PO 4	2

3 = High; 2 = Medium; 1 = Low

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

CLOs	Program Outcomes POs												Program Specific Outcomes PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CLO 1	3			1										3	
CLO 2		3	2										2		1
CLO 3		3		1									2		

CLOs	Program Outcomes POs												Program Specific Outcomes PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CLO 4	3			1									2		
CLO 5		3	2										2	3	
CLO 6	3			1											1
CLO 7	3			1										3	
CLO 8		3	2										2		
CLO 9		3												3	
CLO 10	3	3											2		1
CLO 11		3												3	
CLO 12	3												2	3	
CLO 13			2										2		
CLO 14	3		2											3	1
CLO 15		3												3	
CLO 16		3												3	
CLO 17	3			1									2		

3 = High; 2 = Medium; 1 = Low

XI. ASSESSMENT METHODOLOGIES–DIRECT

CIE Exams	PO 1, PO2, PO 3, PO 4	SEE Exams	PO 1, PO2, PO 3, PO 4	Assignments	PO 2	Seminars	PO 3
Laboratory Practices	PO 1	Student Viva	PO 3	Mini Project	-	Certification	-
Term Paper	-						

XII. ASSESSMENT METHODOLOGIES-INDIRECT

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

XIII. SYLLABUS

UNIT-I	INTRODUCTION
Introduction to computers: Computer systems, computing environments, computer languages, creating and running programs, algorithms, flowcharts; Introduction to C language: History of C, basic structure of C programs, process of compiling and running a C program, C tokens, keywords, identifiers, constants, strings, special symbols, variables, data types; Operators and expressions: Operators, arithmetic, relational and logical, assignment operators, increment and decrement operators, bitwise and conditional operators, special operators, operator precedence and associativity, evaluation of expressions, type conversions in expressions, formatted input and output.	
UNIT-II	**CONTROL STRUCTURES**
Control structures: Decision statements; if and switch statement; Loop control statements: while, for and do while loops, jump statements, break, continue, goto statements; Arrays: Concepts, one dimensional arrays, declaration and initialization of one dimensional arrays, two dimensional arrays, initialization and accessing, multi dimensional arrays; Strings concepts: String handling functions, array of strings.	
UNIT-III	**ARRAYS AND FUNCTIONS**
Functions: Need for user defined functions, function declaration, function prototype, category of functions, inter function communication, function calls, parameter passing mechanisms, recursion, passing arrays to functions, passing strings to functions, storage classes, preprocessor directives. Pointers: Pointer basics, pointer arithmetic, pointers to pointers, generic pointers, array of pointers, pointers and arrays, pointers as functions arguments, functions returning pointers.	
UNIT-IV	**STRUCTURES, UNIONS AND POINTERS**
Structures and unions: Structure definition, initialization, accessing structures, nested structures, arrays of structures, structures and functions, passing structures through pointers, self referential structures, unions, bit fields, typedef, enumerations; Dynamic memory allocation: Basic concepts, library functions.	
UNIT-V	**FILE HANDLING AND BASICALGORITHMS**
Files: Streams, basic file operations, file types, file opening modes, file input and output functions, file status functions, file positioning functions, command line arguments.	
Text Books:	
1. Stephen G. Kochan, "Programming in C", Addison-Wesley Professional, 4th Edition, 2014. 2. B. A. Forouzan, R. F. Gillberg, "C Programming and Data Structures", Cengage Learning, India, 3rd Edition, 2014.	
Reference Books:	
1. W. Kernighan Brian, Dennis M. Ritchie, "The C Programming Language", PHI Learning, 2nd Edition, 1988. 2. Yashavant Kanetkar, "Exploring C", BPB Publishers, 2nd Edition, 2003. 3. E. Balagurusamy, "Programming in ANSI C", Mc Graw Hill Education, 6th Edition, 2012. 4. Schildt Herbert, "C: The Complete Reference", Tata Mc Graw Hill Education, 4th Edition, 2014. 5. R. S. Bichkar, "Programming with C", Universities Press, 2nd Edition, 2012. 6. Dey Pradeep, Manas Ghosh, "Computer Fundamentals and Programming in C", Oxford University Press, 2nd Edition, 2006.	

XIV. COURSE PLAN:

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

Lecture No	Topics to be covered	Course Learning Outcomes (CLOs)	Reference
1 – 2	Introduction to Computers: computer systems, computing environments.	CLO 1	T2:1.1-1.2
3 – 4	Computer languages, creating and running programs, program development.	CLO 1	T2:2.1-2.2
5 – 6	Algorithms, flowcharts	CLO 2	T2:1.4-1.5
7 – 8	Introduction to C Language: background, C programs.	CLO 3	T2:2.1-2.2
9 – 10	Identifiers, data types, Input/output, variables, constants, Operators (arithmetic, relational, logical, bitwise etc).	CLO 3	T2: 2.3- 2.6,7
11 – 12	Expressions, precedence and associativity, expression evaluation, type conversions	CLO 6	T2:3.1-3.5
13 – 14	Statements - selection statements (making decisions) – if statement, switch statement.	CLO 7	T2: 5.2-5.3
15 – 16	Repetition statement (loops)-while, dowhile statements, for statements, loop examples	CLO 7	T2: 6.1-6.6
17 – 18	Other statements related to looping – break, continue, go to, simple C program examples.	CLO 7	T2: 6.7
19 – 20	Arrays- Concepts, using arrays in C, declaration and initialization of one dimensional array, C program example. Two dimensional arrays, initialization and accessing, multi dimensional arrays, C program example.	CLO 8	T2: 8.1-8.3,8.7-8.8
21-22	Strings – Strings concepts: String handling functions, array of strings, C program examples.	CLO 8	T2: 11.1-11.5
23-- 24	Functions- Need for user defined functions, function declaration, function prototype. Category of functions, inter function communication, function calls, parameter passing mechanisms.	CLO 9	T2: 4.1-4.5
25	Recursion, passing arrays to functions, passing strings to functions, Storage classes and preprocessor commands.	CLO 10	T1:7 T2:6.9 T2:G.1
26-27	Pointer basics, pointer arithmetic, pointers to pointers, generic pointers. Pointer applications-Arrays and pointers, pointer arithmetic and arrays, passing an array to a function.	CLO 12	T1:1.0
28 – 29	Array of pointers, pointers and arrays, pointers as functions arguments, functions returning pointers	CLO 12	T2:10.3-10.5
30 – 31	Structures – declaration, initialization, accessing structures, operations on structures.	CLO 13	T1:8
32 – 33	Complex structures, structures and functions, passing structures through pointers, self-referential structures.	CLO 13	T2: 12.3-12.4
34 – 35	Unions, C programming examples, Bit fields, typedef, enumerations.	CLO 13	T2:12.4 T2:12.1- 12.2
36 -- 38	Dynamic memory allocation: Basic concepts, library functions	CLO 13	T2:2.1-2.2
39 – 40	Files: Concept of a file, streams, types of files and file opening modes.	CLO 14	R3:12.1-12.3
41 – 42	File input/output functions (standard input/output functions for files).	CLO 14	R3:12.4

Lecture No	Topics to be covered	Course Learning Outcomes (CLOs)	Reference
43 – 44	File status functions (error handling), positioning functions, C program examples.	CLO 15	R3:12.5
45	Command-line arguments.	CLO 15	R3:12.7

XV. GAPS IN THE SYLLABUS - TO MEET INDUSTRY / PROFESSION REQUIREMENTS:

S No	Description	Proposed actions	Relevance with POs	Relevance with PSOs
1	Updating latest version and new features of the C language	Laboratory Sessions	PO5	PSO2
2	Familiarizing the role of C language in developing system level programs.	Assignments / Industrial visits	PO1,PO2	PSO2
3	Familiarizing different areas where C language can be used.	Seminars	PO12	PSO3
4	Solving different problems and Practicing various debugging strategies to become a good programmer	Extra Lab Sessions, Participating in Coding contests	PO2	PSO3

Prepared by:
N Jayanthi, Assistant Professor

HOD, CSE

INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)
Dundigal, Hyderabad -500 043

CIVIL ENGINEERING

COURSE DESCRIPTOR

Course Title	**COMPUTATIONAL MATHEMATICS AND INTEGRAL CALCULUS**				
Course Code	AHS003				
Programme	B.Tech				
Semester	I	CSE | IT| ECE | EEE			
	II	AE| ME | CE			
Course Type	Foundation				
Regulation	IARE - R16				
Course Structure	**Theory**			**Practical**	
	Lectures	**Tutorials**	**Credits**	**Laboratory**	**Credits**
	3	1	4	-	-
Chief Coordinator	Ms. V Subba Laxmi Assistant Professor				
Course Faculty	Dr. S Jagadha, Professor Ms. L Indira, Assistant Professor Mr. Ch Somashekar, Assistant Professor Ms. P Rajani, Assistant Professor Ms. B Praveena, Assistant Professor				

I. COURSE OVERVIEW:

The course focuses on more advanced Engineering Mathematics topics which provide with the relevant mathematical tools required in the analysis of problems in engineering and scientific professions. The course includes types of interpolation, curve fitting, numerical solutions of ordinary differential equations, multiple integrals, vector calculus and special functions. The mathematical skills derived from this course form a necessary base to analytical and design concepts encountered in the program.

II. COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites
-	-	-	Differentiation, integration and properties of vectors

III. MARKS DISTRIBUTION:

Subject	SEE Examination	CIA Examination	Total Marks
Computational Mathematics and Integral calculus	70 Marks	30 Marks	100

IV. DELIVERY / INSTRUCTIONAL METHODOLOGIES:

✔	Chalk & Talk	✔	Quiz	✘	Assignments	✘	MOOCs
✔	LCD / PPT	✔	Seminars	✘	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 units and each unit carries equal weightage in terms of marks distribution. The question paper pattern is as follows. Two full questions with "either" or "choice" will be drawn from each unit. Each question carries 14 marks. There could be a maximum of two sub divisions in a question.

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

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

Continuous Internal Assessment (CIA):
CIA is conducted for a total of 30 marks (Table 1), with 25 marks for Continuous Internal Examination (CIE), 05 marks for Quiz/ Alternative Assessment Tool (AAT).

Table 1: Assessment pattern for CIA

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

Continuous Internal Examination (CIE):
Two CIE exams shall be conducted at the end of the 8th and 16th week of the semester respectively. The CIE exam is conducted for 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 / Alternative Assessment Tool (AAT):
Two Quiz exams shall be online examination consisting of 25 multiple choice questions and are be answered by choosing the correct answer from a given set of choices (commonly four). Marks shall be awarded considering the average of two quizzes for every course. The AAT may include seminars, assignments, term paper, open ended experiments, five minutes video and MOOCs.

VI. HOW PROGRAM OUTCOMES ARE ASSESSED:

Program Outcomes (POs)		Strength	Proficiency assessed by
PO 1	**Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.	3	Presentation on real-world problems
PO 2	**Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences	2	Seminar
PO 4	**Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.	1	Term Paper

3 = High; 2 = Medium; 1 = Low

VII. HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

Program Specific Outcomes (PSOs)		Strength	Proficiency assessed by
PSO 1	**Engineering Knowledge**: Graduates shall demonstrate sound knowledge in analysis, design, laboratory investigations and construction aspects of civil engineering infrastructure, along with good foundation in mathematics, basic sciences and technical communication.	1	Seminar
PSO 2	**Broadness and Diversity**: Graduates will have a broad understanding of economical, 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.	-	-
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.	-	-

3 = High; 2 = Medium; 1 = Low

VIII. COURSE OBJECTIVES (COs):

The course should enable the students to:	
I	Enrich the knowledge of solving algebraic, transcendental and differential equation by numerical methods.
II	Apply multiple integration to evaluate mass, area and volume of the plane .
III	Analyze gradient, divergence and curl to evaluate the integration over a vector field.
IV	Understand the Bessels equation to solve them under special conditions with the help of series solutions.

IX. COURSE LEARNING OUTCOMES (CLOs):

CLO Code	CLO's	At the end of the course, the student will have the ability to:	PO's Mapped	Strength of Mapping
AHS003.01	CLO 1	Solve the algebraic and transcendental equations using bisection method, method of false position and Newton-Raphson method.	PO 1	3
AHS003.02	CLO 2	Apply numerical methods to interpolate the functions of values for equal intervals using finite differences.	PO2	3
AHS003.03	CLO 3	Understand the Newton-Raphson method to the real-world problem for a finite barrier quantum well.	PO 4	1
AHS003.04	CLO 4	Evaluate the functional value by using Lagrange's interpolation formula for unequal intervals.	PO2	2
AHS003.05	CLO 5	Understand the Lagrange's interpolation in real-world problem for neural network learning.	PO 4	1
AHS003.06	CLO 6	Apply method of least squares to fit linear and non linear curves.	PO1, PO 2	2
AHS003.07	CLO 7	Solve differential equation using single step method- Taylor"s series.	PO 1	3
AHS003.08	CLO 8	Solve differential equation using multi step methods- Euler's, Modified Euler's and Runge Kutta methods.	PO 1	2
AHS003.09	CLO 9	Understand the multistep methods in real-worl problem for real time Aircraft dynamics.	PO 4	1
AHS003.10	CLO 10	Understand the Runge-Kutta method in real-world problem for embedding the sensor signals into the iterative computation.	PO 4	1
AHS003.11	CLO 11	Evaluate double integral and triple integrals .	PO 1	2
AHS003.12	CLO 12	Utilize the concept of change order of integration to evaluate double integrals.	PO 1,PO2	2
AHS003.13	CLO 13	Determine the area and volume of a given curves using double and triple integration.	PO 2	3
AHS003.14	CLO 14	Understand transformation of co-ordinate system from plane to plane.	PO 1	3
AHS003.15	CLO 15	Analyze scalar and vector fields and compute the gradient, divergence and curl.	PO 2	3
AHS003.16	CLO 16	Understand integration of vector function .	PO 1	2
AHS003.17	CLO 17	Evaluate line, surface and volume integral of vectors.	PO 1	3
AHS003.18	CLO 18	Use Vector integral theorems to facilitate vector integration.	PO 2	2
AHS003.19	CLO 19	Analyze the concept of vector calculus in real-world problem for fluid dynamics.	PO 4	1
AHS003.20	CLO 20	Solve the Differential Equations by series solutions.	PO 1	3
AHS003.21	CLO 21	Understand Gamma function to evaluate improper integrals.	PO 2	2
AHS003.22	CLO 22	Analyze Bessel's function and study its properties	PO 1	3
AHS003.23	CLO 23	Analyze Bessel's function as a Solution to Schrödinger equation in a cylindrical function of the second kind.	PO 4	1
AHS003.24	CLO 24	Understand gamma function to find application diverse areas as quantum physics.	PO 4	1
AHS003.25	CLO 25	Possess the knowledge and skills for employability and to succeed in national and International level competitive examinations.	PO 4	1

3 = High; 2 = Medium; 1 = Low

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

CLOs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CLO 1	3												1		
CLO 2		3											1		
CLO 3				1									1		
CLO 4		2													
CLO 5				1											
CLO 6	2	2													
CLO 7	3														
CLO 8	2														
CLO 9				1									1		
CLO 10				1									1		
CLO 11	2														
CLO 12	2	2													
CLO 13		3													
CLO 14	3												1		
CLO 15		3													
CLO 16	2														
CLO 17	3												1		
CLO 18		2											1		
CLO 19				1									1		
CLO 20	3												1		
CLO 21		2													
CLO 22	3														
CLO 23				1											
CLO 24				1											
CLO 25				1											

3 = High; 2 = Medium; 1 = Low

XI. ASSESSMENT METHODOLOGIES – DIRECT

CIE Exams	PO 1 PO 2 PO 4	SEE Exams	PO 1 PO 2 PO 4	Assignments	-	Seminars	PO 2
Laboratory Practices	-	Student Viva	-	Mini Project	-	Certification	-
Term Paper	PO 4						

XII. ASSESSMENT METHODOLOGIES - INDIRECT

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

XIII. SYLLABUS

UNIT-I	ROOT FINDING TECHNIQUES AND INTERPOLATION
Root finding techniques: 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 .	
UNIT-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 method, modified Euler's method and Runge-Kutta method for first order differential equations .	
UNIT-III	**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.	
UNIT-IV	**VECTOR CALCULUS**
Scalar and vector point functions; Gradient, divergence, curl and their related properties; Solenoidal and irrotational vector point functions; Scalar potential function; Laplacian operator; Line integral, surface integral and volume integral; Vector integral theorems: Green's theorem in a plane, Stoke's theorem and Gauss divergence theorem without proofs.	
UNIT-V	**SPECIAL FUNCTIONS**
Gamma function, properties of gamma function; Ordinary point and regular singular point of differential equations; Series solutions to differential equations around zero, Frobenius method about zero; Bessel"s differential equation: Bessel functions properties, recurrence relations, orthogonality, generating function, trigonometric expansions involving Bessel functions.	
Text Books:	
1. Erwin Kreyszig, "Advanced Engineering Mathematics", John Wiley & Sons Publishers, 9th Edition, 2014. 2. B. S. Grewal, "Higher Engineering Mathematics", Khanna Publishers, 43rd Edition, 2012.	
Reference Books:	
1. T.K.V Iyengar, B.Krishna Gandhi, "Mathematical methods", S. Chand & Co., 6th Edition, 2014. 2. R K Jain, S R K Iyengar, "Advanced Engineering Mathematics", Narosa Publishers, 5th Edition, 2016. 3. S. S. Sastry, "Introduction Methods of Numerical Analysis", Prentice-Hall of India Private Limited, 5th Edition, 2012.	

XIV. COURSE PLAN:

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

Lecture No	Topics to be covered	Course Learning Outcomes (CLOs)	Reference
1	Define Algebraic and Transcendental equations	CLO 1	T1:22.5 R1:2.3
2	Explain Bisection method to find the root of an equation.	CLO 1	T1:22.5 R1:2.4
3	Explain Method of False Position to to find root an equation.	CLO 1	T1:22.6 R1:2.6
4	Explain Newton-Raphson method to find root of an equation.	CLO 3	T1:22.7 R1:4.4
5	Define interpolation of the given data.	CLO 2	T1:22.7 R1:4.10
6	Explain symbolic relations the between the operators.	CLO 2	T1:22.8 R1:4.15
7	Define Newton's forward interpolation formula for evenly spaced intervals..	CLO 2	T1:22.9 R1:5.4
8	Define Newton's backward interpolation formula for evenly spaced intervals.	CLO 2	T1:22.9 R1:5.8
9	Define Gauss forward interpolation formula for evenly spaced intervals..	CLO 2	T1:23.10 R1:6.8
10	Define Gauss backward interpolation formula for evenly spaced intervals.	CLO 2	T1:23.10 R1:6.13
11	Demonstrate Lagrange's formula for unequal intervals.	CLO 5	T1:23.9 R1:7.5
12	Describe the best fit of a straight line by method of least squares.	CLO 6	T1:23.10 R1:7.5
13	Describe the best fit of a second degree parabola by method of least squares	CLO 6	T1:23.10 R1:8.1
14	Describe the best fit of an exponential curve by method of least squares	CLO 6	T1:23.1 R1:9.2
15	Describe the best fit of a power curve by method of least squares	CLO 6	T1:23.1 R1:9.4
16	Solve the ordinary differential equation by Taylors series method.	CLO 6	T1:23.1 R1:9.9
17	Solve the ordinary differential equation by Euler's Method-Euler's modified method.	CLO 8	T1:23.1 R1:9.10
18	Solve the ordinary differential equation by Runge-Kutta Method.	CLO 8	T2:27.5 R1:10.2
19	Evaluate double and triple integrals.	CLO 8	T2:27.7 R1:11.3
20	Use the Change of order of integration cartesian and polar form.	CLO 12	T2:27.8 R1:11.6
21	Explain Transformation of co-ordinate system	CLO 11	T2:27.12 R1:11.7
22	Use double integration for finding the area.	CLO 14	T2:27.12 R1:11.8
23	Use triple integration for finding the volume.	CLO 14	T2:27.12 R1:11.9
24	Define vector calculus and vector fields and their properties	CLO 19	T2:27.12 R1:11.10
25	Determine Gradient, divergent and curl of vector fields.	CLO 19	T2:27.14 R1:12.3

Lecture No	Topics to be covered	Course Learning Outcomes (CLOs)	Reference
26	Solve line integral along smooth path and find work done .	CLO 17	T2:27.1 R1:12.7
27	Evaluate surface integral.	CLO 17	T2:27.17 R1:12.15
28	Use Green's theorem to evaluate line integrals along simple closed contours on the plane.	CLO 17	T2:27.18 R1:12.19
29	Use Stokes' theorem to give a physical interpretation of the curl of a vector field .	CLO 17	T2:27.19 R2:14.4
30	Use the divergence theorem to give a physical interpretation of the divergence of a vector field	CLO 17	T2:27.19 R2:14.5
31	Explain gamma function s for improper integrals and gamma properties .	CLO 21	T2:27.19 R2:14.5
32	Define Ordinary and regular point of a differential equation.	CLO 23	T2:27.20 R2:14.5
33	Determine the solution of ordinary differential equations in series form.	CLO 23	T2:27.20 R2:14.5
34	Explain Frobenius Method about zero.	CLO 20	T2:27.19 R2:14.5
35	Define Bessel's Differential equation.	CLO 22	T2:27.19 R2:14.5
36-37	Explain Bessel's differential functions and properties.	CLO 22	T2:27.19 R2:14.5
38-39	Explain Recurrence relations for Bessels function.	CLO 23	T2:27.19 R2:14.5
40-42	Explain Orthogonality of Bessel's function.	CLO 23	T2:27.20 R2:14.5
43-44	Explain Generating function of Bessel's function.	CLO 23	T2:27.20 R2:14.5
45	Explain trigonometric expansions of Bessel's function.	CLO 23	T2:27.19 R2:14.5

XV. GAPS IN THE SYLLABUS - TO MEET INDUSTRY / PROFESSION REQUIREMENTS:

S No	Description	Proposed actions	Relevance with POs	Relevance with PSOs
1	To improve standards and analyze the concepts.	Seminars	PO 1	PSO 1
2	Newton Raphson method, Lagranges interpolation, method of least square and Runge-kutta method	Seminars / NPTEL	PO 2	PSO 1
3	Encourage students to solve real time applications and prepare towards competitive examinations.	NPTEL	PO 4	PSO 1

Prepared by:
Mr. V Subba Laxmi, Assistant Professor

HOD, FRESHMAN ENGINEERING

INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)
Dundigal, Hyderabad -500 043

CIVIL ENGINEERING

COURSE DESCRIPTOR

Course Title	**MODERN PHYSICS**				
Course Code	AHS008				
Programme	B.Tech				
Semester	II	AE | ME | CE			
Course Type	Foundation				
Regulation	IARE - R16				
Course Structure	**Theory**			**Practical**	
	Lectures	**Tutorials**	**Credits**	**Laboratory**	**Credits**
	3	1	4	3	2
Chief Coordinator	Mr. A Chandra Prakash, Assistant Professor				
Course Faculty	Dr. Rizwana, Professor Ms. S Charvani, Associate Professor Mr. K Saibaba, Assistant Professor				

I. COURSE OVERVIEW:

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

II. COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites
-	-	-	Basic principles of physics

III. MARKS DISTRIBUTION:

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

IV. DELIVERY / INSTRUCTIONAL METHODOLOGIES:

✔	Chalk & Talk	✔	Quiz	✔	Assignments	✘	MOOCs
✔	LCD / PPT	✔	Seminars	✘	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 units and each unit carries equal weightage in terms of marks distribution. The question paper pattern is as follows. Two full questions with "either" or "choice" will be drawn from each unit. Each question carries 14 marks. There could be a maximum of two sub divisions in a question.

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

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

Continuous Internal Assessment (CIA):
CIA is conducted for a total of 30 marks (Table 1), with 25 marks for Continuous Internal Examination (CIE), 05 marks for Quiz/ Alternative Assessment Tool (AAT).

Table 1: Assessment pattern for CIA

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

Continuous Internal Examination (CIE):
Two CIE exams shall be conducted at the end of the 8th and 16th week of the semester respectively. The CIE exam is conducted for 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 / Alternative Assessment Tool (AAT):
Two Quiz exams shall be online examination consisting of 25 multiple choice questions and are be answered by choosing the correct answer from a given set of choices (commonly four). Marks shall be awarded considering the average of two quizzes for every course. The AAT may include seminars, assignments, term paper, open ended experiments, five minutes video and MOOCs.

VI. HOW PROGRAM OUTCOMES ARE ASSESSED:

Program Outcomes (POs)		Strength	Proficiency assessed by
PO 1	**Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.	3	Presentation on real-world problems
PO 2	**Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences	2	Seminar
PO 4	**Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.	1	Term Paper

3 = High; 2 = Medium; 1 = Low

VII. HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

Program Specific Outcomes (PSOs)		Strength	Proficiency assessed by
PSO 1	**Engineering knowledge:** Graduates shall demonstrate sound knowledge in analysis, design, laboratory investigations and construction aspects of civil engineering infrastructure, along with good foundation in mathematics, basic sciences and technical communication.	1	Seminar
PSO 2	**Broadness and diversity:** Graduates will have a broad understanding of economical, 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.	-	-
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.	-	-

3 = High; 2 = Medium; 1 = Low

VIII. COURSE OBJECTIVES (COs):

The course should enable the students to:	
I	Develop strong fundamentals of crystal structures and properties.
II	Meliorate the knowledge of theoretical and technological aspects of lasers.
III	Correlate principles with applications of the x-ray diffraction and defects in crystals.
IV	Enrich knowledge in modern engineering principles of interference and diffraction.

IX. COURSE LEARNING OUTCOMES (CLOs):

CLO Code	CLO's	At the end of the course, the student will have the ability to:	PO's Mapped	Strength of Mapping
AHS008.01	CLO 1	Recall the basic principles of physics and apply these concepts of physics in solving the real-time problems.	PO 1 , PO 2	3
AHS008.02	CLO 2	Acquire knowledge of basic terms related to crystals, crystal systems, Bravais lattices and Miller Indices.	PO 1 , PO 4	3
AHS008.03	CLO 3	Discuss in detail different crystal structures and calculate their packing factors.	PO 1 , PO 4	3
AHS008.04	CLO 4	Describe different X-ray diffraction in research and development for the study of internal structures of materials.	PO 1 , PO 2	2
AHS008.05	CLO 5	Identify various types of defects in crystals and their effect on structure sensitive properties.	PO 1 , PO 2	2
AHS008.06	CLO 6	Understand the basic principles involved in the production of Laser light and also real-time applications of lasers.	PO 1 , PO 2	2
AHS008.07	CLO 7	Explain the principle involved in working of different types of laser systems.	PO 1 , PO 4	1
AHS008.08	CLO 8	Analyze basic laws of physics to correlate the mechanism of sensors in day to day life. Principle of sensor along with their applications.	PO 2 , PO 4	1
AHS008.09	CLO 9	Understand the importance of various sensors in real-time applications like measurement of pressure in aeronautics, detecting submarines in acoustics.	PO 2 , PO 4	2
AHS008.10	CLO 10	Recollect basic principle, construction, types and attenuation of optical fibers.	PO 1 , PO 2	2
AHS008.11	CLO 11	Apply properties of optical fibers in various real-time applications like measurement of pressure, temperature , displacement etc.,	PO 1 , PO 4	3
AHS008.12	CLO 12	Understand the importance of optical fibers in real-time communication system.	PO 1 , PO 2	3
AHS008.13	CLO 13	Interpret phenomenon of interference in thin films using Newton's rings experiment.	PO 1 , PO 4	3
AHS008.14	CLO 14	Identify difference in diffraction phenomenon due to single slit and N-slits.	PO 2 , PO 4	1
AHS008.15	CLO 15	Apply different laws of radiation to understand the phenomenon behind production of light.	PO 1 , PO 4	2

3 = High; 2 = Medium; 1 = Low

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

Course Learning Outcomes (CLOs)	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CLO 1	3	2											1		
CLO 2	2			2									1		
CLO 3	3			1									1		
CLO 4	1	3													
CLO 5	3	2													
CLO 6	3	2											1		
CLO 7	2			1									1		
CLO 8		2		1											
CLO 9		1		1									1		
CLO 10	3	2											1		
CLO 11	2			1											
CLO 12	3	2											1		
CLO 13	2			1											
CLO 14		1		2									1		
CLO 15	3			2											

3 = High; 2 = Medium; 1 = Low

XI. ASSESSMENT METHODOLOGIES – DIRECT

CIE Exams	PO 1,PO 2	SEE Exams	PO 1,PO 4	Assignments	PO 4	Seminars	PO 2
Laboratory Practices	PO 1,PO 2	Student Viva	-	Mini Project	-	Certification	-
Term Paper	PO 4						

XII. ASSESSMENT METHODOLOGIES - INDIRECT

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

XIII. SYLLABUS

UNIT-I	CRYSTALLOGRAPHY AND CRYSTAL STRUCTURES
Crystallography and crystal structures: Space lattice, unit cell, lattice parameters, crystal systems, Bravais lattices, directions and planes in crystals, Miller indices, interplanar spacing of orthogonal crystal systems, atomic radius, coordination number and packing factor of SC, BCC, FCC, NaCl and diamond structures.	
UNIT-II	**X-RAY DIFFRACTION AND DEFECTS IN CRYSTALS**
X-ray diffraction: Bragg's law, Laue method, powder method and applications; Defects in crystals: Concepts of point defects, vacancies, substitutional, interstitial, frenkel, schottky defects, line defects and Burger's vector.	
UNIT-III	**LASERS AND SENSORS**
Lasers: Characteristics of lasers, spontaneous and stimulated emission of radiation, metastable state, population inversion, lasing action, ruby laser, semiconductor diode laser and applications of lasers. Sensors: Introduction, basic principles, sensor materials and applications: principle of pressure, optical, acoustic and thermal sensing.	
UNIT-IV	**FIBER OPTICS**
Fiber optics: Principle and construction of an optical fiber, acceptance angle, numerical aperture, types of optical fibers (Single mode, multimode, step index, graded index), attenuation in optical fibers, application of optical fibers and optical fiber communication system with block diagram.	
UNIT-V	**INTERFERENCE AND DIFFRACTION**
Interference: Phase difference, path difference, coherence, conditions for constructive and destructive interference, interference in thin films due to reflected light, Newton rings experiment. Diffraction: Introduction, differences between interference and diffraction, types of diffraction, Fraunhofer diffraction due to single slit, N-slits, diffraction grating experiment.	
Text Books:	
1. V. Rajendran, "Engineering Physics", Tata Mc Graw Hill Book Publishers, 1st Edition, 2010. 2. Dr. K. Vijaya Kumar, Dr. S. Chandralingam, "Modern Engineering Physics", S. Chand & Co., New Delhi, 1st Edition, 2010.	
Reference Books:	
1. P. K. Palanisamy, "Engineering Physics", Scitech Publishers, 4th Edition, 2014. 2. R. K. Gaur, S. L. Gupta, "Engineering Physics", Dhanpat Rai Publications, 8th Edition, 2001. 3. A. J. Dekker, "Solid State Physics", Macmillan India ltd, 1st Edition, 2000. 4. Hitendra K. Malik, A. K. Singh, "Engineering Physics", Mc Graw Hill Education, 1st Edition, 2009.	

XIV. COURSE PLAN:

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

Lecture No	Topics to be covered	Course Learning Outcomes (CLOs)	Reference
1	Acquire knowledge of basic terms related to crystal structures.	CLO 2	T1:13.5 R1:1.3
2	Discuss different crystal systems.	CLO 2	T1:13.5 R1:1.3
3	Identify and sketch various planes in the crystal using the	CLO 3	T1:13.5 R1:1.3

Lecture No	Topics to be covered	Course Learning Outcomes (CLOs)	Reference
	Miller indices concept.		
4	Derive and calculate the distance between two adjacent parallel planes.	CLO 3	T1:14.7 R1:3.4
5	Determine co-ordination Number and packing Factor of SC structure.	CLO 3	T1:15.7 R1:4.10
6	Determine co-ordination Number and packing Factor of BCC structure.	CLO 3	T1:16.8 R1:4.15
7	Determine co-ordination Number and packing Factor of FCC structure.	CLO 3	T1:16.9 R1:5.4
8	Determine co-ordination Number and packing Factor of DC structure.	CLO 3	T1:17.9 R1:5.8
9	Discuss in detail NaCl structure.	CLO 2	T1:18.10 R1:6.8
10	Analyze the concept of X-ray diffraction in crystals using Bragg's law.	CLO 4	T1:19.10 R1:6.13
11	Apply Bragg's law to Laue method.	CLO 4	T1:19.9 R1:7.5
12	Determine crystal structure using powder method and discuss its applications.	CLO 4	T1:23.10 R1:7.5
13	Illustrate point defects like vacancies, substitutional and interstitial defects.	CLO 5	T1:23.10 R1:8.1
14	Recall basics of Frenkel and Schottky defects.	CLO 5	T1:23.1 R1:9.2
15	Understand the concept of edge dislocation.	CLO 5	T1:23.1 R1:9.4
16	Understand the concept of screw dislocation..	CLO 5	T1:23.1 R1:9.9
17	Find the magnitude of Burger's vector.	CLO 5	T1:23.1 R1:9.10
18	Apply Bragg's law for finding parameters related to crystal structures.	CLO 5	T2:27.5 R1:10.2
19	Review basic phenomena's of laser	CLO 6	T2:27.7 R1:11.3
20	Acquire knowledge of basic terms related to lasers	CLO 6	T2:27.8 R1:11.6
21	Explain the construction of ruby laser	CLO 6	T2:27.12 R1:11.7
22	Explain the working of Ruby laser	CLO 7	T1:19.9 R1:7.5
23	Explain the principle and working of semiconductor diode laser and also Discuss the uses of lasers.	CLO 7	T1:23.10 R1:7.5
24	Understand the basic principle in sensors.	CLO 8	T1:23.10 R1:8.1
25	Analyze different sensing materials.	CLO 8	T1:23.1 R1:9.2
26	Recognize functioning of sensors in different fields.	CLO 8	T1:23.1 R1:9.4
27	Recognize functioning of sensors in different fields.	CLO 9	T1:23.1 R1:9.9
28	Recall the principle of fiber optics.	CLO 10	T1:23.1 R1:9.10
29	Derive relation for acceptance angle.	CLO 10	T2:27.5 R1:10.2

Lecture No	Topics to be covered	Course Learning Outcomes (CLOs)	Reference
30	Calculate numerical aperture.	CLO 10	T2:27.20 R2:14.5
31	Classify optical fibers based on modes.	CLO 11	T2:30.19 R2:14.5
32	Classify optical fibers based on the refractive index profile.	CLO 11	T2:30.20 R2:15.5
33-34	Identify losses in fibers.	CLO 11	T2:32.19 R2:16.5
35-37	Examine the application of fibers.	CLO 12	T2:32.20 R2:16.5
38	Understand optical fiber communication system.	CLO 12	T2:33.1 R2:16.6
39-41	Solve problems in optical fibers.	CLO 12	T2:34.1 R2:17.1
42-43	Recall the basic principle of interference.	CLO 13	T2:35.1 R2:17.1
44-45	Describe interference in thin films.	CLO 13	T2:36.1 R2:18.1
46-48	Demonstrate the formation of Newton rings.	CLO 13	T2:38.19 R2:16.5
49	Demonstrate the formation of Newton rings.	CLO 14	T2:39.19 R2:16.5
50-53	Understand the phenomenon of diffraction.	CLO 14	T2:40.19 R2:16.5
54-55	Examine Fraunhofer diffraction due to single slit	CLO 14	T2:41.19 R2:16.5
56-57	Examine Fraunhofer diffraction due to single slit	CLO 15	T2:42.19 R2:16.5
58-59	Examine Fraunhofer diffraction due to N slits.	CLO 15	T2:42.19 R2:16.5
60	Identify Diffraction grating experiment	CLO 15	T2:42.19 R2:16.5

XV. GAPS IN THE SYLLABUS - TO MEET INDUSTRY / PROFESSION REQUIREMENTS:

S No	Description	Proposed actions	Relevance with POs	Relevance with PSOs
1	To improve standards and analyze the concepts.	Seminars	PO 1	PSO 1
2	Conditional probability, Sampling distribution, correlation, regression analysis and testing of hypothesis	Seminars / NPTEL	PO 4	PSO 1
3	Encourage students to solve real time applications and prepare towards competitive examinations.	NPTEL	PO 2	PSO 1

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HOD, FRESHMAN ENGINEERING

INSTITUTE OF AERONAUTICAL ENGINEERING

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CIVIL ENGINEERING

COURSE DESCRIPTOR

Course Title	**ENVIRONMENTAL STUDIES**				
Course Code	AHS009				
Programme	B.Tech				
Semester	II	AE | CSE | IT | ECE | EEE | ME | CE			
Course Type	Foundation				
Regulation	IARE - R16				
Course Structure	**Theory**			**Practical**	
	Lectures	**Tutorials**	**Credits**	**Laboratory**	**Credits**
	3	-	3	-	-
Chief Coordinator	Ms. M Lakshmi Prasanna, Assistant Professor				
Course Faculty	Dr. C Mahendar, Professor Ms. V Anitha Rani, Associate Professor Mr. B Raju, Assistant Professor Ms. M Praveen, Assistant Professor Ms. M Malathi, Assistant Professor Mr. G Mahesh Kumar, Assistant Professor Ms. T Mallika, Assistant Professor Ms. M Swathi, Assistant Professor				

I. 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.

II. COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites
-	-	-	Basic Principles of Environmental Studies

III. MARKS DISTRIBUTION:

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

IV. DELIVERY / INSTRUCTIONAL METHODOLOGIES:

✔	Chalk & Talk	✔	Quiz	✔	Assignments	✘	MOOCs
✔	LCD / PPT	✔	Seminars	✘	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:

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

Continuous Internal Assessment (CIA):
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).

Table 1: Assessment pattern for CIA

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

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

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

Alternative Assessment Tool (AAT)
This AAT enables faculty to design own assessment patterns during the CIA. The AAT converts the classroom into an effective learning 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.

The AAT chosen for this course is given in section XI.

VI. HOW PROGRAM OUTCOMES ARE ASSESSED:

Program Outcomes (POs)		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	Seminar
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	Seminar
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.	1	Real-time applications
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	Real-time applications

3 = High; 2 = Medium; 1 = Low

VII. HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

Program Specific Outcomes (PSOs)		Strength	Proficiency assessed by
PSO 1	**Engineering knowledge:** Graduates shall demonstrate sound knowledge in analysis, design, laboratory investigations and construction aspects of civil engineering infrastructure, along with good foundation in mathematics, basic sciences and technical communication.	1	Seminar
PSO 2	**Broadness and diversity:** Graduates will have a broad understanding of economical, 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.	-	-
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.	-	-

3 = High; 2 = Medium; 1 = Low

VIII. COURSE OBJECTIVES (COs):

The course should enable the students to:	
I	Analyze the interrelationship between living organism and environment
II	Understand the importance of environment by assessing its impact on the human world
III	Enrich the knowledge on themes of biodiversity, natural resources, pollution control and waste management
IV	Understand the constitutional protection given for environment

IX. COURSE LEARNING OUTCOMES (CLOs):

CLO Code	CLO's	At the end of the course, the student will have the ability to:	PO's Mapped	Strength of Mapping
AHS009.01	CLO 1	Understand and realize the importance of multi-disciplinary nature of the environment in day to day life	PO 1, PO 3	2
AHS009.02	CLO 2	Describe various types of ecosystems its components and inter-relationship between man and environment	PO 1, PO 3	2
AHS009.03	CLO 3	Examine how pollutants move through various levels in an ecosystem in our daily life	PO 1, PO 3, PO 7	2
AHS009.04	CLO 4	Explain the pathways of relevant chemical elements through the components of the biosphere in real world applications	PO 1, PO 3, PO 7	2
AHS009.05	CLO 5	Understand the relevance and importance of the natural resources in the sustenance of life on earth and living standard.	PO 1, PO 3, PO 5, PO 7	2
AHS009.06	CLO 6	Develop an understanding of the natural resources problems and ethical issues facing humans and the environment	PO 1, PO 3, PO 7	2
AHS009.07	CLO 7	Correlate the exploitation and utilization of conventional and non-conventional resources.	PO 1, PO 3, PO 5,PO 7	2
AHS009.08	CLO 8	Demonstrate the level of chemical usage in agricultural development and its impact in our daily life	PO 1, PO 5, PO 7	2
AHS009.09	CLO 9	Understand the concept of growing energy needs in the world in terms of consumption of energy	PO 1, PO 7	2
AHS009.10	CLO 10	Establish knowledge and existence of endemic, extinct, endangered and threatened species, types and values of biodiversity	PO 1, PO 5, PO 7	2
AHS009.11	CLO 11	Describe our country as mega biodiversity nation in terms of hotspots	PO 1, PO 7	2
AHS009.12	CLO 12	Explain on threats and innovative methods for conservation of biodiversity.	PO 1, PO 3, PO 7	2
AHS009.13	CLO 13	Establish a foundation on different pollutants and pollutions in the environment.	PO 1, PO 3, PO 5, PO 7	2
AHS009.14	CLO 14	Ability to use methods, and strategies to investigate and interpret the pollution problems	PO 3, PO 5, PO 7	2
AHS009.15	CLO 15	Use innovative methods to control the level of water pollution in our day to day life.	PO 3, PO 5, PO 7	2
AHS009.16	CLO 16	Acquire Knowledge on global effects and how to interpret with global environmental problem in our daily life	PO 1, PO 7	2
AHS009.17	CLO 17	Acquire knowledge and skills about health and safety protocols when working with polluted environment in day to day life	PO 1, PO 7	2

AHS009.18	CLO 18	Describe the role of government and legal aspects in environmental protection.	PO 7	1
AHS009.19	CLO 19	Knowledge of proper decontamination techniques for solid waste management.	PO 3, PO 7	2
AHS009.20	CLO 20	Understand the importance of EIA for developmental activities to have minimum negative impacts on people	PO 1, PO 7	2
AHS009.21	CLO 21	Prepare entry level for future generations to meet sustainable development.	PO 7	1

3 = High; 2 = Medium; 1 = Low

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

(CLOs)	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CLO 1	3		1													
CLO 2	3		1													
CLO 3	2		2				1									
CLO 4	2		2				1									
CLO 5	3		1		1		1									
CLO 6	2		2				1									
CLO 7	3		1		1		1									
CLO 8	2				1		1									
CLO 9	3						1									
CLO 10	3				1		1									
CLO 11	2						1									
CLO 12	2		2				1									
CLO 13	3		2		2		2									
CLO 14			2		1		1						1			
CLO 15			2		1		1						1			
CLO 16	2						1									
CLO 17	2						1									
CLO 18							1									
CLO 19			1				2									
CLO 20	1						1									
CLO 21							2									

3 = High; 2 = Medium; 1 = Low

XI. ASSESSMENT METHODOLOGIES – DIRECT

CIE Exams	PO1,PO3 PO5,PO7	SEE Exams	PO1,PO3 PO5,PO7	Assignments	PO1	Seminars	PO1 PO3
Laboratory Practices	-	Student Viva	-	Mini Project	-	Certification	-
Term Paper	-						

XII. ASSESSMENT METHODOLOGIES - INDIRECT

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

XIII. 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; Biomagnifications	
Unit-II	**NATURAL RESOURCES**
Natural resources: Classification of resources, living and nonliving resources; Water resources: Use and over utilization of surface and ground water, floods and droughts, dams, benefits and problems; 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; 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: Climate change, 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, wild life 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.	
Text Books:	
1. Benny Joseph (2005)., Environmental Studies, New Delhi, Tata McGraw Hill Publishing co. Ltd 2. Erach Bharucha (2005)., Textbook of Environmental Studies for Undergraduate Courses, Hyderabad, Universities Press.	
Reference Books:	
1. Anji Reddy .M (2007), Textbook of Environmental Sciences and Technology, Hyderabad, BS Publications.	

2. Anjaneyulu.(2004), Introduction to Environmental Sciences, BS Publications
3. Anubha Kaushik(2006).,Perspectives in Environmental Science, 3rd Edition, New Delhi, New age international.
4. Tyler Miller, Scott Spoolman, "Environmental Science", Cengage Learning, 14th Edition, 2012.

XIV. COURSE PLAN:

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

Lecture No	Topic/s to be covered	Course Learning Outcomes (CLOs)	Reference
1	Summarize about environment and its importance.	CLO 1	T2: 1.1.1, 1.1.2,1.1.3, 1.2.1,1.2.2 R3:1.1-1.3
2	Discuss environment and importance of ecosystems	CLO 1	R1: 1.1,1.2 R3:1.1-1.3
3	Provides the information regarding ecosystem and applicability.	CLO 1	T2:3.2 R1:1.6.1,1.6.2 R3:1.6,1.7
4	Provides the information regarding ecosystem and applicability	CLO 1	T2:3.2 R1:1.6.1,1.6.2 R3:1.6,1.7
5	Acquire knowledge of how all the animals are competing with their food requirements and also understand the various trophic levels in the food chain.	CLO 2	T2:3.6.1-3.6.3 R1:1.7.1,1.7.2, 1.7.3 R3:1.7.1,1.7.2
6	Describe the flow of energy through the various components of ecosystem	CLO 2	T2:3.4 R1:1.8 R3:1.7.5
7	Examine the importance a of nutrients and flow of nutrients in ecosystem	CLO 3	T2:3.4.1-3.4.4 R1:1.9,1.10 R3:1.7.6
8	Examine the importance a of nutrients and flow of nutrients in ecosystem	CLO 3	T2:3.4.1-3.4.4 R2:1.9,1.10 R3:1.7.6
9	Summarize about the toxicity of heavy metals on the biotic and a biotic components.	CLO 4	R1:1.11 R3:1.7.3
10	Distinguish about different types of natural resources and their applicability and illustrate the utility of renewable resources efficiency	CLO 5	R1:2.1 R3:2.1
11	Describe the impact of over utilization of underground and surface water	CLO 5	R1:2.3,2.4.1, 2.4.2,2.4.3 R3:2.2
12	Discuss the disaster manage mental plans	CLO 6	R1:2.4.4 R3:2.2.4,2.2.5
13	Describe the benefits and property dams	CLO 6	R1:2.4.5 R3:2.3
14	Illustrate the uses of mineral resources	CLO 2 CLO 6	R1:2.5 R3:2.4
15	Enumerate the application of the solar energy in modern days	CLO 6	R1:3.1 R3:2.5
16	Enumerate the application of the wind energy in modern days	CLO 6	R1:3.3.1.5 R3:2.5
17	Illustrate the definition and importance of biodiversity	CLO 6	T2:4.1 R1:4.1 R3:3.1

Lecture No	Topic/s to be covered	Course Learning Outcomes (CLOs)	Reference
18	Acquire the genetic diversity, species and ecosystem diversity	CLO 7	T2:4.1.1,4.1.2, 4.1.3 R1:4.2 R3:3.2
19	Describe the ecological values and consumptive use of ecosystem	CLO 7	T2:4.3 R1:4.3 R3:3.3
20	Recall India is mega diversity nation	CLO 7	T2:4.5 R3:3.4
21	Discuss the hot spot center in and around	CLO 7	T2:4.6 R1:4.6 R3:3.4
22	Analyze the information regarding different causes for loss of biodiversity	CLO 7	T2:4.7 R1:4.4 R3:3.5
23	Analyze various reasons for conflict of species	CLO 7	T2:4.7 R3:3.5.3
24	Illustrate different methods to protect the biodiversity	CLO 7	T2:4.9 R1:4.5 R3:3.7
25	Correlate national biodiversity act	CLO 8	T2:4.9 R1:4.5 R3:3.7
26	Explain the meaning of environmental pollution and classification.	CLO 9	T2:5.1 R1:5.1 R3:4.1
27	Analyze the important pollutants in air pollutants	CLO 9	T2:5.2.1 R1:5.3 R3:4.2
28	Enumerate the sources types and effects of water pollution	CLO 9	T2:5.2.2 R1:5.4 R3:4.6
29	Correlate the sources types and effects of soil pollution	CLO 9	T2:5.2.3 R1:5.5 R3:4.8
30	Analyze the noise quality and permissible levels	CLO 9	T2:5.2.5 R1:5.7 R3:4.13
31	Describe the various methods commonly employed for the disposal of solid waste.	CLO 9	T2:5.3 R1:7.7
32	Identify To understand the recent trends in e- waste management practices.	CLO 10	R1:5.10.6 R3:4.16.3
33	Understand concept of climate change and impacts.	CLO 10	T2:6.6.1 R1:6.5 R3:5.5
34	Summarize the remedial measures of ozone depletion	CLO 10	T2:6.6.4 R1:6.6 R3:5.6,5.7
35	Evolve strategies to environmental issues	CLO 10	R1:6.8 R3:5.10
36	Describe the role of government and legal aspects in environmental protection	CLO 10	T2:6.9-6.14 R1:7.2,7.3,7.4, R3:7.3,7.4,7.5, 7.6,7.7
37	Discuss the silent features of the hazardous waste management	CLO 11	R1:7.9 R3:7.10
38	Understand the importance of EIA for developmental activities	CLO 12	T2:6.14 R3:6.3,6.4

Lecture No	Topic/s to be covered	Course Learning Outcomes (CLOs)	Reference
39	Understand the importance of EIA for developmental activities	CLO 12	T2:6.14 R1:10.1 R3:6.3,6.4
40	State the aim and objectives of sustainable development	CLO 12	T2:6.1 R1:10.5 R3:8.3
41	State the aim and objectives of sustainable development	CLO 13	T2:6.1 R1:10.5 R3:8.3
42	Enumerate population and its explosion	CLO 15	T2:7.2 R1:10.3 R3:8.2
43	State the aim and objectives of sustainable development	CLO 19	T2:7.2.2.2 R1:10.8 R3:8.6
44	Acquire knowledge of environmental education	CLO 18	T2:7.3 R1:10.6 R3:8.4
45	Summarize the environmental ethics and objectives of green buildings	CLO 21	T2:6.5 R1:10.10,10.12 R3:8.10,8.12

XV. GAPS IN THE SYLLABUS - TO MEET INDUSTRY / PROFESSION REQUIREMENTS:

S No	Description	Proposed actions	Relevance with POs	Relevance with PSOs
1	Types of ecosystem, Energy flow, Biomagnification	Seminars / Field visit	PO 1	-
2	Dams ,Mining Activities, Alternative energy resources	Seminars / NPTEL	PO 3	PSO 1
3	Sources of pollution EIA Methodology, Green building	Guest Lecture	PO 7	-

Prepared by:
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HOD, FRESHMAN ENGINEERING

INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

Dundigal, Hyderabad -500 043

CIVIL ENGINEERING

COURSE DESCRIPTOR

Course Title	**ENGINEERING MECHANICS**				
Course Code	AME002				
Programme	B.Tech				
Semester	II	AE|ME|CE			
Course Type	Core				
Regulation	IARE - R16				
Course Structure	**Theory**			**Practical**	
	Lectures	**Tutorials**	**Credits**	**Laboratory**	**Credits**
	3	1	4	-	-
Chief Coordinator	Dr. D. Govardhan, Professor.				
Course Faculty	MS. P Shruthilaya, Assistant Professor.				

I. COURSE OVERVIEW:

The aim of Engineering Mechanics is to introduce students to the fundamental concepts and principles applied by engineers -whether civil, mechanical, aeronautical, etc. This course introduces the concepts of engineering based on forces in equilibrium. Topics include concentrated forces, distributed forces, forces due to friction, inertia, work –energy principle and vibrations as they apply to machines, structures, and systems. It is the branch of science for analyzing force systems that acts upon the bodies either at rest or in motion.

II. COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites
-	-	-	Basic concepts of physics and mathematics

III. MARKS DISTRIBUTION:

Subject	SEE Examination	CIA Examination	Total Marks
Engineering mechanics	70 Marks	30 Marks	100

IV. DELIVERY / INSTRUCTIONAL METHODOLOGIES:

✔	Chalk & Talk	✔	Quiz	✔	Assignments	✘	MOOCs
✔	LCD / PPT	✔	Seminars	✘	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 units and each unit carries equal weightage in terms of marks distribution. The question paper pattern is as follows. Two full questions with "either" or "choice" will be drawn from each unit. Each question carries 14 marks. There could be a maximum of two sub divisions in a question.

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

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

Continuous Internal Assessment (CIA):
CIA is conducted for a total of 30 marks (Table 1), with 25 marks for Continuous Internal Examination (CIE), 05 marks for Quiz/ Alternative Assessment Tool (AAT).

Table 1: Assessment pattern for CIA

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

Continuous Internal Examination (CIE):
Two CIE exams shall be conducted at the end of the 8th and 16th week of the semester respectively. The CIE exam is conducted for 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 / Alternative Assessment Tool (AAT):
Two Quiz exams shall be online examination consisting of 25 multiple choice questions and are be answered by choosing the correct answer from a given set of choices (commonly four). Marks shall be awarded considering the average of two quizzes for every course. The AAT may include seminars, assignments, term paper, open ended experiments, five minutes video and MOOCs.

VI. HOW PROGRAM OUTCOMES ARE ASSESSED:

Program Outcomes (POs)		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	Assignments
PO 2	**Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences	2	Term paper, Seminars
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

3 = High; 2 = Medium; 1 = Low

VII. HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

Program Specific Outcomes (PSOs)		Strength	Proficiency assessed by
PSO 1	**Engineering knowledge:** Graduates shall demonstrate sound knowledge in analysis, design, laboratory investigations and construction aspects of civil engineering infrastructure, along with good foundation in mathematics, basic sciences and technical communication.	2	Lecture, Assignments.
PSO 2	**Broadness and diversity:** Graduates will have a broad understanding of economical, 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.	-	-
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.	-	-

3 = High; 2 = Medium; 1 = Low

VIII. COURSE OBJECTIVES (COs):

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

IX. COURSE LEARNING OUTCOMES (CLOs):

CLO Code	CLO's	At the end of the course, the student will have the ability to:	PO's Mapped	Strength of Mapping
AME002.01	CLO 1	Understand the concepts of kinematics of the particles and rectilinear motion.	PO1	3
AME002.02	CLO 2	Demonstrate knowledge of ability to identify & apply fundamentals to solve problems like motion curves, rigid body motion and fixed axis rotation.	PO1	2
AME002.03	CLO 3	Explore knowledge & ability to solve various particle motion problems.	PO2	2
AME002.04	CLO 4	Derive the D' Alembert's principle and apply it to various field problems of kinetic motion.	PO2	1
AME002.05	CLO 5	Discuss the nature of relation between force and mass under the influence of time.	PO4	2
AME002.06	CLO 6	Develop the relations for motion of body in lift and on inclined plane.	PO2	2
AME002.07	CLO 7	Determine the impact, impulse and impulsive forces occurring in the system.	PO1	3
AME002.08	CLO 8	Understand the inter relationship between impulse-momentum and virtual work and an ability to use such relationships to solve practical problems.	PO1	2
AME002.09	CLO 9	Knowledge of the lifting machines and simple framed structures equilibrium criteria, and the knowledge of the equilibrium condition systems.	PO2	2
AME002.10	CLO 10	Determine the effect of law of conservation of energy and its consideration in field problems.	PO4	1
AME002.11	CLO 11	Discuss the application of work energy method to particle motion.	PO1	2
AME002.12	CLO 12	Develop the work energy relations and apply to connected systems.	PO2	2
AME002.13	CLO 13	Understand the fixed axis rotation theory and solving the field problems by application of work energy method.	PO1	3
AME002.14	CLO 14	Introduction to concepts of vibration and explain the relation between simple harmonic motion and the equilibrium systems.	PO4	3
AME002.15	CLO 15	Derive the expressions for the concepts of simple, compound and torsional pendulums.	PO2	2
AME002.16	CLO 16	Explore the use of modern engineering tools, software and equipment to prepare for competitive exams, higher studies etc.	PO4	1

3 = High; 2 = Medium; 1 = Low

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

Course Learning Outcomes (CLOs)	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CLO 1	3															
CLO 2	2												1			
CLO 3		2														
CLO 4		1											2			
CLO 5				2												
CLO 6		2														
CLO 7	3															
CLO 8	2															
CLO 9		2											2			
CLO 10				1												
CLO 11	2															
CLO 12		2														
CLO 13	3															
CLO 14				3									1			
CLO 15		2														
CLO 16				1												

3 = High; 2 = Medium; 1 = Low

XI. ASSESSMENT METHODOLOGIES – DIRECT

CIE Exams	PO1 PO2 PO4	SEE Exams	PO1 PO2 PO4	Assignments	PO1 PO4	Seminars	PO2
Laboratory Practices	-	Student Viva	-	Mini Project	-	Certification	-
Term Paper	PO2						

XII. ASSESSMENT METHODOLOGIES - INDIRECT

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

XIII. SYLLABUS

UNIT-I	KINEMATICS OF PARTICLES- RECTILINEAR MOTION
Motion of a particle – Rectilinear motion – motion curves – Rectangular components of curvilinear motion Kinematics of Rigid Body - Types of rigid body motion - Angular motion - Fixed Axis Rotation.	
UNIT-II	**KINETICS OF PARTICLE**
Introduction-Definitions of Matter, body, particle, mass, weight, inertia, momentum. Newton's law of motion. Relation Between force & mass. Motion of a particle in rectangular coordinates. D'Alembert's Principle.Motion of Lift. Motion of body on an inclined plane. Motion of connected Bodies.	
UNIT-III	**IMPULSE AND MOMENTUM, VIRTUAL WORK**
Impulse And Momentum: Introduction- Impact, Momentum, Impulse & Impulsive forces, Units. Law of conservation of Momentum, Newton's law of collision of elastic bodies- coefficient of Restitution. Recoil of Gun. Impulse Momentum Equation. **VIRTUAL WORK:** Introduction – Principle of virtual work – Applications – Beams, Lifting machines, Simple framed structures.	
UNIT-IV	**WORK ENERGY METHOD**
Law of conservation of Energy, Application of Work Energy Method to particle motion and connected system- Work energy applied to Connected Systems - Work energy applied to Fixed Axis Rotation	
UNIT-V	**MECHANICAL VIBRATIONS**
Definitions and Concepts – Simple Harmonic Motion – Free vibrations, simple and Compound Pendulums – Torsion Pendulum – Free vibrations without damping: General cases.	
Text Books:	
1. R.C. Hibbler, "Engineering Mechanics", Prentice Hall, 12th Edition, 2009. 2. Engineering Mechanics - Statics and Dynamics by Ferdinand.L. Singer / Harper International Edition. 3. Engineering Mechanics/ S. Timoshenko and D.H. Young, Mc Graw Hill Book Company.	
REFERENCES:	
1. S. Bhavikatti, "A Text Book of Engineering Mechanics", New Age International, 1st Edition, 2012. 2. A.K Tayal ,"Engineering Mechanics", Uma Publications, 14th Edition, 2013. 3. R.K. Bansal "Engineering Mechanics", Laxmi Publications, 8th Edition, 2013. 4. Engg. Mechanics / KL Kumar / Tata McGraw Hill. 5. Engg. Mechanics / S.S. Bhavikati & K.G. Rajasekharappa. 6. Basudeb Bhattacharya, "Engineering Mechanics", Oxford University Press, 2nd Edition, 2014. 7. K. Vijay Reddy, J. Suresh Kumar, "Singer's Engineering Mechanics, Statics and Dynamics", B S Publishers, 1st Edition, 2013.	

XIV. COURSE PLAN:

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

Lecture No	Topics to be covered	Course Learning Outcomes (CLOs)	Reference
1-2	Motion of a particle – Rectilinear motion	CLO1	T2:7.3
3-5	motion curves – Rectangular components of curvilinear motion	CLO1	T2:7.5,7.6 R1:2.9.2
6-8	Kinematics of Rigid Body	CLO1	T2:7.7 R1:2.10
9	Types of rigid body motion - Angular motion	CLO2	T2:7.7 R1:2.10
10	Fixed Axis Rotation	CLO2	T2:7.11 R1:2.10.2
11	Introduction-Definitions of Matter, body, particle, mass, weight, inertia, momentum.	CLO3	T2:7.11 R1:2.32

Lecture No	Topics to be covered	Course Learning Outcomes (CLOs)	Reference
12-13	Newton's law of motion. Relation Between force & mass.	CLO3	T2:15.2 R1:8.2
14-15	Motion of a particle in rectangular coordinates.	CLO3	T2:15.7 R1:8.3.3
16-17	D'Alembert's Principle.	CLO4	T2:15.13 R1:8.7.2
18-20	Motion of Lift. Motion of body on an inclined plane. Motion of connected Bodies	CLO5	T2:15.13 R1:8.7.2
21	Introduction- Impact, Momentum, Impulse & Impulsive forces, Units.	CLO6	T2:15.16 R1:8.7.3
22-24	Law of conservation of Momentum	CLO6	T1:11.9 R2:12.24
25-26	Newton's law of collision of elastic bodies	CLO7	T1:11.9 R3:12.25
27-28	Coefficient of Restitution. Recoil of Gun. Impulse Momentum Equation.	CLO8	T1:3.2 R3:3.2
29	Introduction – Principle of virtual work – Applications.	CLO8	T1:3.3.1 R3:3.2
30	Beams, Lifting machines, Simple framed structures	CLO9	T2:16.5 R1:8.10
31	Law of conservation of Energy.	CLO10	T2:16.9 R1:8.11.1
32-33	Application of Work Energy Method to particle motion and connected system.	CLO11	T2:16.9 R1:8.11.2
34-35	Work energy applied to Connected Systems.	CLO12	T2:16.8 R1:8.12.1
36-39	Work energy applied to Fixed Axis Rotation.	CLO13	T2:16.8 R1:8.12.2
40	Definitions and Concepts**.**	CLO14	T2:16.11 R1:8.14
41-42	Simple Harmonic Motion – Free vibrations	CLO15	T2:16.11 R1:8.20
43-44	Simple and Compound Pendulums – Torsion Pendulum	CLO15	T2:16.12 R1:8.19
45-48	Free vibrations without damping: General cases.	CLO16	T2:16.12 R1:8.77

XV. GAPS IN THE SYLLABUS - TO MEET INDUSTRY / PROFESSION REQUIREMENTS:

S NO	Description	Proposed actions	Relevance with POs	Relevance with PSOs
1	Banking angle theory for curvilinear motion	Guest lecturers/NPTEL	PO1	PSO1
2	Different types of loads on beams	Seminars	PO2	PSO1
3	Application of vibration theory to field problems	Guest lecturers/Seminars	PO4	PSO1

Prepared by:

Ms. P Shruthilaya, Assistant Professor.

HOD, CE

III SEMESTER

INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)
Dundigal, Hyderabad -500 043

CIVILENGINEERING

COURSE DESCRIPTOR

Course Title	**STRENGTH OF MATERIALS – I**				
Course Code	ACE001				
Program	B.Tech				
Semester	III	CE			
Course Type	Core				
Regulation	IARE - R16				
Course Structure	**Theory**			**Practical**	
	Lectures	**Tutorials**	**Credits**	**Laboratory**	**Credits**
	3	1	4	3	2
Chief Coordinator	Dr. M. Venu, Professor.				
Course Faculty	Dr. M. Venu, Professor. Ms.J.Cici Jennifer Raj, Assistant Professor.				

I. COURSE OVERVIEW:

The Civil Engineers are required to design structures like building, beams, dams, bridges, etc. The loads coming onto 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 calculations of (a) shear force diagrams and bending moment diagram for different type of beams, (b) bending and shear stresses in beams, (c) slope and deflection of beams using various methods are covered in depth. Besides, the important calculations of principal stresses and principal strains and the consequent theory of failures for prediction of the strength of the materials are also discussed. Eventually, through this course content engineers can design the structures for safety and serviceability.

II. COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites
UG	AHS002	I	Linear Algebra and OrdinaryDifferential Equations
UG	AME002	II	Engineering Mechanics

III. MARKSDISTRIBUTION:

Subject	SEE Examination	CIA Examination	Total Marks
STRENGTH OF MATERIALS - 1	70 Marks	30 Marks	100

IV. DELIVERY / INSTRUCTIONAL METHODOLOGIES:

✔	Chalk & Talk	✔	Quiz	✔	Assignments	✘	MOOCs
✔	LCD / PPT	✔	Seminars	✔	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 fiveunits and each unit carries equal weightage in terms of marks distribution. The question paper pattern is as follows. Two full questions with "either" or "choice" will be drawn from each unit. Each question carries 14 marks. There could be a maximum of two sub divisions in a question.

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

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

Continuous Internal Assessment (CIA):
CIA is conducted for a total of 30 marks (Table 1), with 25 marks for Continuous Internal Examination (CIE), 05 marks for Quiz/ Alternative Assessment Tool (AAT).

Table 1: Assessment pattern for CIA

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

Continuous Internal Examination (CIE):
Two CIE exams shall be conducted at the end of the 8th and 16th week of the semester respectively. The CIE exam is conducted for 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 / Alternative Assessment Tool (AAT):
Two Quiz exams shall be online examination consisting of 25 multiple choice questions and are be answered by choosing the correct answer from a given set of choices (commonly four). Marks shall be awarded considering the average of two quizzes for every course. The AAT may include seminars, assignments, term paper, open ended experiments, five minutes video and MOOCs.

VI. HOW PROGRAM OUTCOMES ARE ASSESSED:

Program Outcomes (POs)		Strength	Proficiency assessed by
PO 1	**Engineering knowledge**: Apply the knowledge of mathematics, science, engineeringfundamentals, and an engineering specialization to the solution of complex engineering problems.	3	Assignments/ Exams
PO 2	**Problem analysis**: Identify, formulate, review research literature, and analyze complexengineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences	3	Assignments /Exams
PO3	**Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations	3	Assignments /Mini Projects
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	Open ended experiments
PO 7	**Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.	2	Seminars

3 = High; 2 = Medium; 1 = Low

VII. HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

Program Specific Outcomes (PSOs)		Strength	Proficiency assessed by
PSO 1	**Engineering knowledge:** Graduates shall demonstrate sound knowledge in analysis, design, laboratory investigations and construction aspects of civil engineering infrastructure, along with good foundation in mathematics, basic sciences and technical communication	2	Open ended experiments
PSO 2	**Broadness and Diversity:** Graduates will have a broad understanding of economical, environmental, societal, health and safety factors involved in infrastructural development, and shalldemonstrate ability to function within multidisciplinary teams with competence in modern tool usage.	1	Seminar
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 offerengineering services to the society, ethically and responsibly.	1	Seminar

3 = High; 2 = Medium; 1 = Low

VIII. COURSE OBJECTIVES (COs):

The course should enable the students to:	
I	Relate mechanical properties of a material with its behavior under various load types
II	Apply the concepts of mechanics to find the stresses at a point in a material of a structural member
III	Analyze a loaded structural member for deflections and failure strength.
IV	Evaluate the stresses and strains in materials and deflections in beam members.

IX. COURSE LEARNING OUTCOMES (CLOs):

CLO Code	CLO's	At the end of the course, the student will have the ability to:	PO's Mapped	Strength of Mapping
ACE001.01	CLO 1	Calculate the stress and strain developed in any structural member due to applied external load.	PO 1 PO2	3
ACE001.02	CLO 2	Calculate the normal and tangential stresses on an inclined section a bar of under uni-axial,biaxial, pure shear and plain stress conditions.	PO 1 PO 4	2
ACE001.03	CLO 3	Predict the strain energy and their applications like sudden load, uniform load and impact load.	PO 3	1
ACE001.04	CLO 4	Evaluate the principal stress and principal strain at a point of a stressed member and draw theMohr's circle of stresses.	PO 1 PO 7	2
ACE001.05	CLO 5	Understand failure of a material using various theories of failure, and their relative applications.	PO 3	1
ACE001.06	CLO 6	Differentiate the types of beam and the various loading and support condition upon them.	PO 1 PO 2	3
ACE001.07	CLO 7	Apply the formulae for beams under different loading condition.	PO 1 PO 2,	2
ACE001.08	CLO 8	Draw shear force diagram and bending moment diagram for different type of beams.	PO 3	1
ACE001.09	CLO 9	Derive the pure bending equation, and on its basis explain the existence of normal stresses.	PO 7	1
ACE001.10	CLO 10	Analyze the pure bending equation and on its basis.	PO1	1
ACE001.11	CLO 11	Explain the existence of shear stresses in the different layers of the beam.	PO1	1
ACE001.12	CLO 12	Evaluate the section modulus for various beam cross-sections.	PO1	1
ACE001.13	CLO 13	Explain the importance of section modulus for various beam cross-sections.	PO7	2
ACE001.14	CLO 14	Derive the torsion equations and pure torsion.	PO1	1
ACE001.15	CLO 15	Explain the design procedures of shafts and their theories of failure applications.	PO2	1
ACE001.16	CLO 16	Understand the types of springs and explain their different conditions.	PO1	1
ACE001.17	CLO 17	Analyze the close and open coiled helical springs under various conditions.	PO1	1
ACE001.18	CLO 18	Differentiate the types of column under the various end conditions.	PO2	1
ACE001.19	CLO 19	Analyze the columns under the various formulas like Euler's formulae, Rankine'sandGordon formula.	PO1	2
ACE001.20	CLO 20	Calculate the columns under the various formulas like empirical formulae, straight line formula andperry's formula.	PO1	3
ACE001.21	CLO 21	Understand the laterally loaded struts under concentrated and uniformly distributed loads.	PO2	3
ACE001.22	CLO 22	Calculate the laterally loaded struts under various loading conditions.	PO1	3

3 = High; 2 = Medium; 1 = Low

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

CLOs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CLO 1	3	3											3	3	2
CLO 2	3			2									3	2	
CLO 3			2											2	1
CLO 4	3						2							3	
CLO 5			1										3		
CLO 6	3	3													
CLO 7	3	2		2											
CLO 8			2												
CLO 9							2						2		2
CLO 10	2													1	
CLO 11	1														
CLO 12	2												1		
CLO 13															1
CLO 14	1												1		
CLO 15		2													
CLO 16	2														
CLO 17	1														
CLO 18		2													
CLO 19	2														
CLO 20	3														
CLO 21		2		2											
CLO 22	3		2												

3 = High; 2 = Medium; 1 = Low

XI. ASSESSMENT METHODOLOGIES–DIRECT

CIE Exams	PO 1,PO2, PO3, PO4, PO 7	SEE Exams	PO 1,PO2 PO3, PO4,PO 7	Assignments	PO 2	Seminars	PO1, PO 2
Laboratory Practices	PO 1	Student Viva	-	Mini Project	-	Certification	-
Term Paper	-						

XII. ASSESSMENT METHODOLOGIES-INDIRECT

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

XIII. SYLLABUS

Unit-I	**STRESSES AND STRAINS (SIMPLE AND PRINCIPAL)**
Introduction:Concept of stress and strain, elasticity and plasticity, Hooke‘s law, stress-strain diagram for mild steel, Poisson‘s ratio, volumetric strain, elastic module and the relationship between them bars of varying section, composite bars, temperature stresses; Strain energy, modulus of resilience, modulus of toughness; stresses on an inclined section of a bar under axial loading; compound stresses; Normal and tangential stresses on an inclined plane for biaxial stresses; Two perpendicular normal stresses accompanied by a state of simple shear; Mohr‘s circle of stresses; Principal stresses and strains; Analytical and graphical solutions. Theories of Failure: Introduction, various theories of failure, maximum principal stress theory, maximum principal strain theory, strain energy and shear strain energy theory.	
Unit-II	**SHEAR FORCE AND BENDING MOMENT**
Shear force and Bending moment: Definition of beam – Types of beams – Concept of shear force and bending moment – S.F and B.M diagrams for cantilever, simply supported and overhanging beams subjected to point loads, uniformly distributed load, uniformly varying loads and combination of these loads – Point of contraflexure – Relation between S.F., B.M and rate of loading at a section of a beam.	
Unit-III	**FLEXURAL AND SHEAR STRESSES IN BEAMS**
Flexural Stresses: Theory of simple bending – Assumptions – Derivation of bending equation: M/I = f/y = E/R- Neutral axis – Determination of bending stresses – Section modulus of rectangular and circular sections (Solid and Hollow), I,T, Angle and Channel sections – Design of simple beam sections. Shear Stresses: Derivation of formula – Shear stress distribution across various beam sections like rectangular, circular, triangular, I, T angle sections.	
Unit-IV	**TORSION OF CIRCULAR SHAFTS**
Torsion of Circular Shafts: Theory of pure torsion- derivation of torsion equations: - assumptions made in the theory of pure torsion - torsional moment of resistance - polar section modulus - power transmitted by shaft - combined bending and torsion and end thrust - design of shafts according to theories of failure. Introduction to springs- types of springs - deflection of close and open coiled helical springs under axial pull and axial couple - springs in series and parallel - carriage or leaf springs.	
Unit-V	**COLUMNS AND STRUCTS (BUCKLING)**
Columns and Struts: Types of columns, short, medium and long columns, axially loaded compression members, crushing load, Euler‘s theorem for long columns, assumptions, derivation of Euler‘s critical load formulae for various end conditions. Equivalent length of a column, slenderness ratio, Euler‘s critical stress, limitations of Euler‘s theory, Rankine‘s and Gordon formula, long columns subjected to eccentric loading, secant formula, empirical formulae, straight line formula and Prof. Perry‘s formula. Laterally loaded struts, subjected to uniformly distributed and concentrated loads, maximum bending moment and stress due to transverse and lateral loading.	

Text Books:
1 F. Beer, E. R. Johnston, J. De Wolf, "Mechanics of Materials", Tata McGraw-Hill Publishing Company Limited, New Delhi, Indian 1st Edition, 2008. 2 B. C. Punmia, Ashok Kumar Jain, Arun Kumar Jain, "Mechanics of Materials", Laxmi Publications Private Limited, New Delhi, 4th Edition, 2007. 3 R. K. Rajput, "Strength of Materials: Mechanics of Solids", S. Chand & Co Limited, New Delhi, 3rd Edition, 2007.
Reference Books:
1.J. M. Gere, S.P. Timoshenko, "Mechanics of Materials", CL Engineering, USA, 5thEdition,2000. 2 .E. G. Popov, "Engineering Mechanics of Solids", Pearson Education, India, 2ndEdition,2015.

XIV.COURSE PLAN:

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

Lecture No	Topic/s to be covered	CLOs	Reference
1-2	Elasticity and plasticity – Typesofstresses and strains – Hooke'law	CLO 1	T1: 1.1-3, 2.1-5
3-4	Stress – strain diagram for mild steel– Working stress – Factor of safety	CLO 2	T1: 2.4
5-6	Bars of varying section	CLO 2	T1: 2.6-14
7-8	Composite bars – Temperature stresses	CLO 3	T1: 2.15-20
9-10	Lateral strain, Poisson's ratio and volumetric strain – Elasticmoduliand the relationship betweenthem	CLO 3	T1: 3.1-.3
11-12	Strain Energy, Resilience – Gradual, sudden, impact and shock loadings –simple applications	CLO 3	T1: 3.5-14
13-14	Principal stresses and strains; Analytical and graphical solutions. Theories of Failure: Introduction, various theories of failure, maximum principal stress theory, maximum principal strain theory, strain energy and shear strainenergy theory	CLO 4, CLO 5	T1: 6.1-5
15-16	Definition of beam – Types of beams– Concept of shear force and bending moment	CLO 6	T1: 9.1-5
17-19	S.F and B.M diagrams for cantilever, subjected to point loads, uniformly distributed load, uniformly varying loads and combination of these load– Point of contra flexure	CLO 7	T1: 9.6-7
20-22	S.F and B.M diagrams simply supported subjected to point loads, uniformly distributed load, uniformly varying loads and combination ofthese loads – Point of contra flexure	CLO 7	T1: 9.6-7
23-25	S.F and B.M diagrams for overhanging beams subjected to point loads, uniformly distributed load, uniformly varying loads and combination of these loads – Pointof contra flexure	CLO 7	T1: 9.6-7
26	Relation between S.F., B.M and rate of loading at a section of a beam	CLO 8	T1:9.6-11
27-28	Theory of simple bending – Assumptions – Derivation of bending equation: M/I= f/y = E/R	CLO 9	T1: 10.1-5
29-30	Neutral axis – Determination of bending stresses	CLO 11	T1: 10.5-7
31-32	Section modulus of rectangular and circular sections (Solid and Hollow), I,T, Angle and Channel sections	CLO 12	T1: 10.7
33-34	Design of simple beam sections	CL0 13	T1: 10.7
35-39	Derivation of formula – Shear stress distribution across various beam sections like rectangular, circular, triangular, I, T angle sections	CL0 13	T1: 11.1-7

Lecture No	Topic/s to be covered	CLOs	Reference
40-42	Introduction, Explain theory of pure torsion and assumptions made in pure torsion	CLO 14	T4: 2.1 -2.2
42-45	Define torsional moment of resistance and polar section modulus. Derive power transmitted by shafts and its efficiency	CLO 14	T4: 2.3 -2.6
46-47	Derive expression for strain energy stored in a body due to torsion	CLO 14	T4: 2.7 - 2.9
48-49	Strength of shaft for varyingsections, composite shafts and problems	CLO 15	T4: 3.1 -3.6
50-52	Introduction, types of springs. Derive expressions for stiffness and efficiency for springs connected in series and parallel and problems	CLO 16	T4: 3.8 - 3.10
53-54	Derive the expressions for maximum shear stress induced in wire, expression for deflection of spring, expression for stiffness of springs	CLO 16	T4: 4.1 - 4.6
55-56	Brief explanation on leaf springs	CLO 17	T4: 4.6
57-58	Columns & struts: Introduction, explain types of columns- long, medium and short. Brief explanation on axially compression members. Define crushing load	CLO 18, CLO 19, CLO 20,	T4: 6.1 - 6.3
59-60	Explain Euler's theorem for long columns - assumptions, limitations, derivation of Euler's critical load for	CLO 21, CLO 22, CLO 23	T4: 7.1 - 7.6

XIV. GAPS IN THE SYLLABUS - TO MEET INDUSTRY / PROFESSION REQUIREMENTS:

S No	Description	Proposed actions	Relevance with POs	Relevance with PSOs
1	The internal behavior of the material with the externally appliedloading including thermal loads.	Seminars /Guest Lectures /NPTEL	PO 1, PO 4	PSO 1, PSO 2
2	Analysis of structure especially for building moments and shear force and decision makingofanalysis.	Seminars /Guest Lectures /NPTEL	PO 1	PSO 1, PSO 2
3	Torsional effects in the structure and failure criteria of the compressionmembers.	Seminars/ Assignments	PO 1, PO 4	PSO 3

Prepared by:
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HOD, CIVIL ENGINEERING

INSTITUTE OF AERONAUTICAL ENGINEERING

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Dundigal, Hyderabad -500 043

CIVILENGINEERING

COURSE DESCRIPTOR

Course Title	**SURVEYING**				
Course Code	ACE002				
Programme	B.Tech				
Semester	III	CE			
Course Type	Core				
Regulation	IARE - R16				
Course Structure	**Theory**			**Practical**	
	Lectures	**Tutorials**	**Credits**	**Laboratory**	**Credits**
	3	1	4	3	2
Chief Coordinator	Mr. B Suresh, Assistant Professor				
Course Faculty	Mr. B Suresh, Assistant Professor Mr. P Vinay Kumar, Assistant Professor				

I. 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 objective, 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, GPS surveying and laser scanning have supplemented (and to a large extent supplanted) the traditional optical instruments.

II. COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites
UG	AHS002	I	Linear algebra and ordinary differential equations

III. MARKSDISTRIBUTION:

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

IV. DELIVERY / INSTRUCTIONAL METHODOLOGIES:

✔	Chalk & Talk	✔	Quiz	✔	Assignments	✘	MOOCs
✔	LCD / PPT	✘	Seminars	✘	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 units and each unit carries equal weightage in terms of marks distribution. The question paper pattern is as follows. Two full questions with "either" or "choice" will be drawn from each unit. Each question carries 14 marks. There could be a maximum of two sub divisions in a question.

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

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

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CIA is conducted for a total of 30 marks (Table 1), with 25 marks for Continuous Internal Examination (CIE), 05 marks for Quiz/ Alternative Assessment Tool (AAT).

Table 1: Assessment pattern for CIA

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

Continuous Internal Examination (CIE):
Two CIE exams shall be conducted at the end of the 8th and 16th week of the semester respectively. The CIE exam is conducted for 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 / Alternative Assessment Tool (AAT):
Two Quiz exams shall be online examination consisting of 25 multiple choice questions and are be answered by choosing the correct answer from a given set of choices (commonly four). Marks shall be awarded considering the average of two quizzes for every course. The AAT may include seminars, assignments, term paper, open ended experiments, five minutes video and MOOCs.

VI. HOW PROGRAM OUTCOMES ARE ASSESSED:

Program Outcomes (POs)		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	Presentation on real-world problems
PO 2	**Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences	1	Presentation on real-world problems
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	1	Open Ended Experiments

3 = High; 2 = Medium; 1 = Low

VII. HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

Program Specific Outcomes (PSOs)		Strength	Proficiency assessed by
PSO 1	**Engineering knowledge:** Graduates shall demonstrate sound knowledge in analysis, design, laboratory investigations and construction aspects of civil engineering infrastructure, along with good foundation in mathematics, basic sciences and technical communication	2	Assignments
PSO 2	**Broadness and Diversity:** Graduates will have a broad understanding of economical, 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.	3	Open Ended Experiments
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.	-	-

3 = High; 2 = Medium; 1 = Low

VIII. COURSE OBJECTIVES (COs):

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

IX. COURSE LEARNING OUTCOMES (CLOs):

CLO Code	CLO's	At the end of the course, the student will have the ability to:	PO's Mapped	Strength of Mapping
ACE002.01	CLO 1	Analyze the sources of errors in linear measurements.	PO 1	2
ACE002.02	CLO 2	Evaluate the corrections for true length, true area and true volumes of calculated data	PO 1	2
ACE002.03	CLO 3	Determine the errors in chain and tape length	PO 1	2
ACE002.04	CLO 4	Obtain directions of a surveying line with a prismatic compass.	PO 2	1
ACE002.05	CLO 5	Determine the bearing angles by a prismatic compass	PO 2	1
ACE002.06	CLO 6	Draw a traverse and calculate area enclosed within the traverse.	PO 2	1
ACE002.07	CLO 7	Measure the corrected bearing angles without local attraction	PO 2	1
ACE002.08	CLO 8	Differentiate the whole circle and quadrant bearing systems	PO 5	1
ACE002.09	CLO 9	Draw cross section and prepare a contour maps for road works, rail works, canals etc.	PO 2	1
ACE002.10	CLO 10	Predict Reduced Levels with reference to a common assumed datum	PO 2	1
ACE002.11	CLO 11	sketch the profile the of land from the reduced levels	PO 1	2
ACE002.12	CLO 12	Differentiate the basic concepts in leveling such as datum and bench mark etc.	PO 1	2
ACE002.13	CLO 13	Calculate the volume of earth work, the sectional areas of the cross- section	PO 1	2
ACE002.14	CLO 14	Compute an area of filed which is surrounded by irregular boundaries	PO 2, PO 5	1
ACE002.15	CLO 15	Calculate an area by latitudes and departures of a closed traverse	PO 2	1
ACE002.16	CLO 16	Explain the importance of theodolite and the principle of measuring angles in horizontal and vertical plains.	PO 2	1
ACE002.17	CLO 17	Understand the components of theodolite and errors in elimination of parallax	PO 1	2
ACE002.18	CLO 18	Calculate the error of closure in a closed traverse	PO 1	2
ACE002.19	CLO 19	Differentiate the advantages of global positioning system and geographical information	PO 2, PO 5	1
ACE002.20	CLO 20	Analyze the basic principle of total station in recording the field data.	PO 2	1
ACE002.21	CLO 21	Derive an equation for calculation of heights and distances using principles of tacheomertic survey	PO 1	2
ACE002.22	CLO 22	Derive an equation for calculation of heights and distances using principles of triangulation survey	PO 5	1
ACE002.23	CLO 23	Advanced Surveying: Basic principles of total station, global positioning system and geographic information system.	PO 5	1

3 = High; 2 = Medium; 1 = Low

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

CLOs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CLO 1	3												2		
CLO 2	3														
CLO 3	1														
CLO 4		2											2		
CLO 5		2													
CLO 6		1												2	
CLO 7		2													
CLO 8					2										
CLO 9		1													
CLO 10		2													
CLO 11	3													2	
CLO 12	3														
CLO 13	2														
CLO 14		1			2								2		
CLO 15		1													
CLO 16		2											2		
CLO 17	3														
CLO 18	2												2		
CLO 19		2			2										
CLO 20	2														
CLO 21	3												2		
CLO 22					1										
CLO 23					1									2	

3 = High; 2 = Medium; 1 = Low

XI. ASSESSMENT METHODOLOGIES–DIRECT

CIE Exams	PO 1; PO2; PO5	SEE Exams	PO 1; PO2; PO5	Assignments	PO 2	Seminars	-
Laboratory Practices	PO 5	Student Viva	-	Mini Project	-	Certification	-
Term Paper	-						

XII. ASSESSMENT METHODOLOGIES-INDIRECT

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

XIII. SYLLABUS

UNIT-I	INTRODUCTION, LINEAR AND ANGULAR MEASUREMENTS
Definitions, primary divisions of surveying, objectives, principles and classifications, plan and map, errors due to wrong scale. Linear and angular measurements; Direct and in direct methods, use of chain and tape, errors inchaining, meridians, azimuths and bearings, declination, dip, computation of angle, errors due to local attraction..	
UNIT-II	**LEVELING AND CONTOURING**
Leveling: Concept and terminology, temporary and permanent adjustments, method of leveling, height of instrument and rise and fall method; Contouring: Characteristics and uses of contours; Methods of conducting contour surveys and their plotting.	
UNIT-III	**COMPUTATION OF AREAS AND VOLUMES:**
Computation of areas directly from field measurements methods, computation of areas along irregular boundaries and regular boundaries. Embankments and cutting for a level section and two level sections with and without transverse slopes, determination of the capacity of reservoir, volume of barrow pits.	
UNIT-IV	**THEODOLITE AND TRAVERSE SURVEYING**
Theodolite, description of transit theodolite, definitions and terms, temporary and permanent adjustments, measurement of horizontal and vertical angles. Trigonometric leveling height and distance problems, traverse survey and methods of traversing, closing errors in traversing	
UNIT-V	**TACHEOMETRIC AND ADVANCED SURVEYING**
Tachometry: Stadia and tangential methods of tachometry. Distance elevation and depression formulae for staff held in vertical and inclined position. Curves: Definition, types of curves, design and setting out, simple andcompound curves. Advanced Surveying: Basic principles of total station, global positioning system and geographic information system	
Text Books:	
1. Dr. K. R. Arora, "Surveying Volume-1", Standard book house, New Delhi, 13th Edition, 2012. 2. S. K. Duggal, "SurveyingVolume-2", Tata McGraw-Hill Education Private Limited, India,New Delhi, 3rd Edition, 2009.	
Reference Books:	
1. R. Subramanian, "Surveying and Leveling", Oxford University Press, New Delhi. 2nd Edition, 2012. 2. M. James, Anderson Edward Mikhail, "Surveying Theory and Practice", Tata McGraw Hill, NewDelhi, 7th Edition, 2000. 3. Arthur R Benton, Philip J Taety, "Elements of Plane Surveying", McGraw-Hill Education, New Delhi.8th Edition, 2000.	

XIV. COURSE PLAN:

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

Lecture No	Topics to be covered	Course Learning Outcomes (CLOs)	Reference
1	Understand the objective of survey and primary division.	CLO 1	T1:1.3
2	Remember Principles of survey and classification of survey.	CLO 2	T1:1.4
3	Understand the concept of chain survey and terminology instruments used in it.	CLO 3	T1:1.6
4-5	Recall types of chains, errors while using it.	CLO 2	T1.3.4
6-7	Identify the problems on error due to chain.	CLO 6	T1.3.5
8-9	Remember the concept of Ranging, traversing using chain..	CLO 7	T1.3.8
10	Understand types in compass, principle and objective.	CLO 9	T1.3.10
11	Remember the terminology and adjustments in compass surveying	CLO 10	T1.3.15
12-13	Recall types of bearings in compass survey.	CLO 11	T1.3.16
14	Understand errors in closed traverse	CLO 12	T1.3.18
15-16	Identify the purpose of chain and cross staff survey	CLO 13	T1.3.19
17	Recall different types of scales used in surveying	CLO 11	T1.3.21
18	Remember different methods for distance measurement	CLO 10	T1.3.22
19	Recall difference between a plan and a map	CLO 14	T1.2.2.1
20	Remember chaining on un even ground and errors in chain	CLO 14	T1.2.2.2
21	Understand errors in tape and obstacles in chaining	CLO 12	T1.2.24
22-23	Understand azimuth and bearings and measurement of angles using compass	CLO 14	T1.2.8.6
24-25	Remember magnetic dip and declination and different types of bearing systems	CLO 14	T1.2.8.8
26	Remember leveling, terminology and their definitions and different instruments used in leveling	CLO 17	T1.9.1
27	Understand temporary adjustments in leveling	CLO 17	T1.9.3
28-30	Understand permanent adjustments and focusing	CLO 19	T1.9.4
31-32	Recall different methods of leveling	CLO 19	T1.9.10
33-34	Recall steps in leveling and problems	CLO 20	T1.9.22
35-36	Remember contour	CLO 20	T1.9.25
37-38	Recall characteristics of contour	CLO 21	T1.10.1
39	Recall methods of locating contour	CLO 22	T1.10.4
40-41	Understand contour gradient	CLO 23	T1.1.5
42	Recall use of contours	CLO 23	T1.10.10
43	Recall computation of areas and volumes.	CLO 23	T1.16.2
44	Remember computation of area using different methods of regular and irregular areas	CLO 23	T1.16.4
45	Understand the calculation of volume of different type pits	CLO 23	T1.16.6
46	Recall a level section, two level section and respective problems	CLO 23	T1.16.8
47-48	Remember to calculate volume of a reservoir	CLO 23	T1.17.1
49	Understand theodolite and traverse surveying description	CLO 18	T1.14.1
50	Remember the terminology in theodolite and traverse surveying	CLO 23	T1.14.4
51	temporary adjustments in theodolite	CLO 18	T1.14.6
52	permanent adjustments in theodolite, measuring horizontal angles in theodolite	CLO 23	T1.14.8
53-54	Trigonometric leveling height and distance problems, traverse survey and methods of traversing, closing errors in traversing	CLO 20	T2.1.1-1.5
55	Uses of theodolites in theodolite and errors in theodolites.	CLO 23	T1.14.18
56	Remember the trigonometric leveling in theodolite	CLO 20	T1.14.19
57	Distance elevation and depression formulae for staff held in vertical and inclined position in tacheometric survey	CLO 23	T1.5.2
58	Remember definition, types of curves, design and setting out, simple and compound curves	CLO 23	T2.8.3

Lecture No	Topics to be covered	Course Learning Outcomes (CLOs)	Reference
59-60	Recall Advanced Surveying Basic principles of total station, global positioning system and geographic information system.	CLO 19	T2.8.5; R1.9.2

XV. GAPS IN THE SYLLABUS - TO MEET INDUSTRY / PROFESSION REQUIREMENTS:

S No	Description	Proposed actions	Relevance with POs	Relevance with PSOs
1	Compute irregular area and volume of a field by the method of chain triangulation, closed traverse to identify the basic errors.	Seminars	PO 1	PSO 1
2	Sketch the profile of land using the levelling instruments and justification of result through algebraic checks	Seminars / NPTEL	PO 5	PSO 1
3	To perform smart work with the application of total station in real life experience to reduce the manual errors involved in reading and recording of measured data	NPTEL	PO 2	PSO 1

Prepared by:
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HOD, CIVIL ENGINEERING

INSTITUTE OF AERONAUTICAL ENGINEERING

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Dundigal, Hyderabad -500 043

CIVIL ENGINEERING

COURSE DESCRIPTOR

Course Title	**ENGINEERING GEOLOGY**				
Course Code	ACE003				
Programme	B.Tech				
Semester	III	CE			
Course Type	Core				
Regulation	IARE - R16				
Course Structure	**Theory**			**Practical**	
	Lectures	**Tutorials**	**Credits**	**Laboratory**	**Credits**
	3	0	3	3	2
Chief Coordinator	Mr. Y. Ravi Kumar, Assistant Professor				
Course Faculty	Ms. J. Hymavathi, Assistant Professor Mr. Y. Ravi Kumar, Assistant Professor				

I. COURSE OVERVIEW:

This course covers the study of physical geology, structural geology and petrology also the importance of geology from civil engineering point of view. It deals weathering of common rocks like granite and with reference to dams and reservoirs. This course also covers study of minerals, properties, role of properties in their identification. This course also deals with study of rocks, classification and their identification, study of common geological structures like folds, faults and unconformities. This course also deals the methods of investigating subsurface features by geophysical methods such as gravity methods, electrical methods, seismic methods and geothermal methods. Finally this course addresses study and selection of site for dams and reservoirs, improvement of competence of the site by grouting, water tightness, and design considerations of constructing tunnels and lining of tunnels.

II. COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites	Credits
UG	AHS009	II	Environmental Studies	3
UG	AHS005	I	Engineering Chemistry	3

III. MARKSDISTRIBUTION

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

IV. DELIVERY / INSTRUCTIONAL METHODOLOGIES:

✔	Chalk & Talk	✔	Quiz	✔	Assignments	✘	MOOCs
✔	LCD / PPT	✔	Seminars	✘	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 modules carries equal weightage in terms of marks distribution. The question paper pattern is as follows. Two full questions with "either" or "choice" will be drawn from each module. Each question carries 14 marks. There could be a maximum of two sub divisions in a question.

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

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

Continuous Internal Assessment (CIA):
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).

Table 1: Assessment pattern for CIA

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 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.

The AAT chosen for this course is given in section XI.

VI. HOW PROGRAM OUTCOMES ARE ASSESSED:

Program Outcomes (POs)		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	Assignments / Exams
PO 3	**Design/development of solutions**: Design solutions for complex engineering problems anddesign 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	Assignments / Exams
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	Seminars
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	Assignments / Exams

3 = High; 2 = Medium;1 = Low

VII. HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

Program Specific Outcomes (PSOs)		Strength	Proficiency assessed by
PSO 1	**Engineering knowledge:** Graduates shall demonstrate sound knowledge in analysis, design, laboratory investigations and construction aspects of civil engineering infrastructure, along with good foundation in mathematics, basic sciences and technical communication.	1	Assignments/ Exams
PSO 2	**Broadness and diversity:** Graduates will have a broad understanding of economical, 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	Assignments/ Exams
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.	-	-

3 = High; 2 = Medium;1 = Low

VIII. COURSE OBJECTIVES (COs):

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

IX. COURSE LEARNING OUTCOMES (CLOs):

CLO Code	CLO's	At the end of the course, the student will have the ability to:	PO's Mapped	Strength of Mapping
ACE003.01	CLO 1	Know the importance of geology in civil engineering.	PO1, PO 6	1
ACE003.02	CLO 2	Distinguish weathered rocks from fresh rocks	PO 3, PO 6, PO 7	2
ACE003.03	CLO 3	Understand the effects of weathering on dams, reservoirs and tunnels.	PO 3, PO 6, PO 7	2
ACE003.04	CLO 4	Understand the case histories of failure of some Civil Engineering constructions due to Geological draw backs.	PO 3, PO 6, PO 7	1
ACE003.05	CLO 5	Identify and classify rock using basic geologic classification systems	PO 1, PO 6	1
ACE003.06	CLO 6	Study the minerals by their physical properties, chemical composition, optical properties and X- ray properties.	PO 3	1
ACE003.07	CLO 7	Study the rocks by their physical properties, chemical composition, optical properties and X- ray properties.	PO 3	1
ACE003.08	CLO 8	Understand the geological classification of rocks into Igneous, Sedimentary and Metamorphic rocks, their identification based on structure and texture.	PO 6	1
ACE003.09	CLO 9	Identify the major types of rock-forming minerals and rock under both field and laboratory conditions.	PO 3, PO 6	1
ACE003.10	CLO 10	Understand the importance of various associated geological structures like folds, faults, joints and unconformities present at site for foundations.	PO 3, PO 6, PO 7	1
ACE003.11	CLO 11	Identify subsurface information and groundwater potential sites through geophysical investigations.	PO 3, PO 6	1
ACE003.12	CLO 12	Understand to select a suitable site for dams and reservoirs to avoid seepage, silting and Tilting.	PO 3, PO 6, PO 7	2
ACE003.13	CLO 13	Understand internal geological processes (e.g. faults, earthquakes, volcanoes) and how they affect engineering studies.	PO 1, PO 3, PO 6, PO 7	1
ACE003.14	CLO 14	Locate various subsurface mines and rock bodies by applying geophysical investigations such as Gravity methods, magnetic methods, Electrical methods, seismic methods, radio metric methods and geothermal methods.	PO 1, PO 3, PO 6	1
ACE003.15	CLO 15	Understand the structural and lithological considerations for tunnel construction to avoid leakage and falling of rock parts	PO 3, PO 6, PO 7	2
ACE003.16	CLO 16	Understanding of impact of engineering solutions on the society and also will be aware of contemporary issues	PO 1, PO 6	1
ACE003.17	CLO 17	Apply geological principles for mitigation of natural hazards and select sites for dams and tunnels.	PO 3, PO 6, PO 7	1
ACE003.18	CLO 18	Possess the knowledge and skills for employability.	PO 1	2

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

Course Learning Outcomes (CLOs)	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CLO 1	1					1							1		
CLO 2			2			3	2								
CLO 3			3			2	2							1	
CLO 4			1			2	1								
CLO 5	1					1							1	1	
CLO 6															
CLO 7															
CLO 8						1								1	
CLO 9			2			1									
CLO 10			2			2	1							2	
CLO 11			1			2								1	
CLO 12			3			2	1							1	
CLO 13	1		1			2	1						1	1	
CLO 14	1		2			1							1		
CLO 15			3			1	2							1	
CLO 16	1					2							1	2	
CLO 17			2			1	1							1	
CLO 18	2												1		

XI. ASSESSMENT METHODOLOGIES–DIRECT

CIE Exams	PO 1, PO3, PO6, PO7	SEE Exams	PO 1, PO3, PO6, PO7	Assignments	PO 1, PO 2	Seminars	PO 6
Laboratory Practices	PO 6	Student Viva	-	Mini Project		Certification	-
Term Paper	-						

XII. ASSESSMENT METHODOLOGIES-INDIRECT

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

XIII. SYLLABUS

UNIT-I	WEATHERING OF ROCKS
Introduction: Importance of geology from civil engineering point of view. Brief study of case histories of failures of some civil engineering constructions due to geological draw backs. Importance of physical geology, petrology and structural geology. Weathering of rocks: Its effect over the properties of rocks importance of weathering with reference to dams, reservoirs and tunnels weathering of common rock like granite.	
UNIT - II	**MINERALOGY AND PETROLOGY**
Mineralogy: Definition of mineral, importance of study of minerals, different methods of study of minerals. Advantages of study of minerals by physical properties. Role of study of physical properties of minerals in the identification of minerals. Study of physical properties of following common rock forming minerals: Feldsper, Quartz, Flint, Jasper, Olivine, Augite, Hornblende, Muscovite, Biotite, Asbestos, Chlorite, Kyanite, Garnet, Talc, Calcite. Study of other common economics minerals such as Pyrite, Hematite, Magnetite, Chrorite, Galena, Pyrolusite, Graphite, Magnesite, and Bauxite. Petrology: Definition of rock, geological classification of rocks into igneous, sedimentary and metamorphic. Dykes and Sills, common structures and textures of igneous, sedimentary and metamorphic rocks. Megascopic study of Granite, Dolerite, Basalt, Pegmatite, Laterite, Conglomerate, Sand Stone, Shale, Limestone, Gneiss, Schist, Quartzite, Marble and Slate. Rock excavation, stone aggregates.	
UNIT-III	**STRUCTURAL GEOLOGY**
Indian stratigraphy, palaeontology and geological time scale, out crop, strike and dip study of common geological structures associating with the rocks such as fold, faults unconformities, and joint types. Ground water: Water table, common types of ground water movement, ground water exploration. Earth quakes, their causes and effects, shield hazards, water in landslides their causes and effects, measures to be taken to prevent their occurrence. Importance of study of ground water, earthquake and landslides.	
UNIT-IV	**GEOLOGY OF DAMS AND RESERVOIRS**
Types of dams and bearing of Geology of site in their selection, Geological Considerations in the selection of a dam site. Factors contributing to the success of a reservoir,Geological factors influencing water tightness and life of reservoirs, Geo hazards, ground subsidence. Geophysicalstudies: Importance of geophysical studies Principles of geophysical study by Gravity methods, Magnetic methods, Electrical methods, Seismic methods, Radio metric methods and geothermal method. Special importance of Electrical resistivity methods and seismic refraction methods. Improvement of competence of sites by grouting etc. Fundamental aspects of Rock mechanics and Environmental Geology.	
UNIT-V	**TUNNELS**
Purpose of tunneling, Effects of Tunneling on the ground, Role of Geological Considerations (ie. Litho logical, structural and ground water) in tunneling over break and lining in tunnels, Tunnels in rock, subsidence over old mines, mining substances.	
Text Books	
1.N. Chennkesavulu, “Engineering Geology”, Mc Milan India Private Limited, New Delhi, India, 2.Venkat Reddy, “Engineering Geology”, Vikas Publications, New Delhi, India, 2nd Edition, 2011. 3.VasudevKanithi, “Engineering Geology”, University Press, 1st Edition, 2013. 4. Gokhale, “Principles of Engineering Geology”, BS Publications, 2009.	
Reference Books	
1. F.G. Bell, “Fundamentals of Engineering Geology”, Butterworth’s Publications, 3rd Edition, New Delhi, 1992. 2. K. V. G. K. Gokhale, “Principles of Engineering Geology”, BS Publications, New Delhi, India, 5th Edition, 5th Edition, 2008.	

XIV. COURSE PLAN:

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

Lecture No	Topics to be covered	CourseLearning Outcomes (CLOs)	Reference
1	To introduce the subject and importance.	CLO 1	T2:24.6 T2:24.8
2	To know the importance of geology.	CLO 1	T1:12.14
3	To know various case histories of failures of some major constructions due to geological drawbacks.	CLO 1	T2:3.10 T2:24.7
4-5	Able to understand various branches of geology.	CLO 2	T2:3.11 T2:3.12
6-7	To know the process of weathering.	CLO 2	T2:3.11 T2:3.12
8-9	To avoid failures due to weathering.	CLO 2	T1:16.6.2
10-11	To avoid reservoir failures due to weathering.	CLO 3	T2:26.9
12-13	To know how the granite respond to weathering.	CLO 3	T2:26.11
14	To understand the importance of minerals and study.	CLO 2	T1:16.7
15-16	To understand the different methods of study of minerals.	CLO 3	T2:26
17-18	Ability to identify the mineral based on their physical properties.	CLO 4	T2:20.4
19	Ability to study on different physical properties of minerals such as feldspar, quartz, flint minerals.	CLO 4	T2:23.4
20	Ability to identify jasper, olivine, hornblende and augiteminerals.	CLO 4	T2:20.9
21-22	Ability to identify muscovite, biotite, asbestos, chlorite and kyanite minerals.	CLO 5	T2:5.13
23-24	Ability to identify Garnet, Talc	CLO 5	T2:5.13
25-26	Ability to study on common Economic minerals such as Pyrite, Hematite, Magnetite, Chrorite, Galina	CLO 6	T2:21.12
27	Ability to study on common Economic minerals such as Pyrolusite, Graphite, magnesite, Bauxite.	CLO 6	T1:6.5
28-30	To know about petrology ,definition of rock, classification of rock	CLO 7	T1:21.3 T1:21.4 T2:21.5
31-33	Ability to study about distinguishing features of sand stone, shale, limestone, gneiss, schist	CLO 7	T3:27.2
34-36	Ability to understand the importance of Richter scale , precautions to be taken for building construction in seismic areas	CLO 7	T3:27.9
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	CLO 8	T1:12.6.2
40-42	Ability to understand the importance of ground water , earth quakes and land slides	CLO 8	T1:12.7.2
43-44	Ability to understand the importance of geology of dams and reservoirs and types of dams	CLO 9	T1:12.8.2
45-46	Ability to understand the importance bearing capacity of geology of site in their selection	CLO 9	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	CLO 9	T1:7.2.5
50-51	Ability to understand the importance of factors contributing to the success of a reservoir.	CLO 11	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.	CLO 11	T1:8.4.2 R1:1.3.4
54	Ability to understand the importance of geophysical studies, principles of geophysical study in gravity methods,	CLO 12	T1:8.8

Lecture No	Topics to be covered	CourseLearning Outcomes (CLOs)	Reference
	magnetic and electric methods.		
55	Ability to understand the importance of seismic, radiometric and geothermal methods.	CLO 13	T1:8.12.2
56	Ability to understand the importance of electrical resistivity methods, seismic refraction methods.	CLO 14	T5:23.22
57	Ability to understand the importance of improvement of competence of sites by grouting etc…, fundamental aspects of rock mechanics and environmental geology.	CLO 15	T5:25.15 R2:4.7
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.	CLO 16	T5:32.17
59	Ability to understand the importance of over break and Lining in tunnels.	CLO 17	T1:10.7
60	Ability to understand the importance of tunnels in rock, subsidence over old mines, mining substances.	CLO 18	T1:8.4.2 R1:2.4

XV. GAPS IN THE SYLLABUS - TO MEET INDUSTRY / PROFESSION REQUIREMENTS:

S. No.	Description	Proposed actions	Relevance with POs	Relevance with PSOs
1	Explore and identify the rock and suggest the suitability of rock for construction.	Seminars	PO 1	PSO 1
2	Importance of earthquake, groundwater and environment on the properties of rock.	Seminars / NPTEL	PO 2	PSO 1
3	Explore the rock profile using various geophysical studies which aids in calculating the load carrying capacity of a rock at a site.	NPTEL	PO 3	PSO 1

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HOD, CIVIL ENGINEERING

INSTITUTE OF AERONAUTICAL ENGINEERING

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CIVIL ENGINEERING

COURSE DESCRIPTOR

Course Title	**BASIC ELECTRICAL AND ELECTRONICS ENGINEERING**				
Course Code	AEE018				
Programme	B. Tech				
Semester	III	CE | ME | AE			
Course Type	Foundation				
Regulation	IARE - R16				
Course Structure	**Theory**			**Practical**	
	Lectures	**Tutorials**	**Credits**	**Laboratory**	**Credits**
	3	1	4	-	-
Chief Coordinator	Mr. N Shivaprasad, Assistant Professor				
Course Faculty	Mr. N Shivaprasad, Assistant Professor Mr. S Srikanth, Assistant Professor Mr. B Muralidhar Nayak, Assistant Professor Ms. B Manogna, Assistant Professor Ms. B Navothna, Assistant Professor				

I. COURSE OVERVIEW:

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. It also 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.

II. COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites
-	-	-	-

III. MARKS DISTRIBUTION:

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

IV. DELIVERY / INSTRUCTIONAL METHODOLOGIES:

✔	Chalk & Talk	✔	Quiz	✔	Assignments	✘	MOOCs
✔	LCD / PPT	✔	Seminars	✘	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 units and each unit carries equal weight age in terms of marks distribution. The question paper pattern is as follows. Two full questions with "either" or "choice" will be drawn from each unit. Each question carries 14 marks. There could be a maximum of two sub divisions in a question.

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

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

Continuous Internal Assessment (CIA):
CIA is conducted for a total of 30 marks (Table 1), with 25 marks for Continuous Internal Examination (CIE), 05 marks for Quiz/ Alternative Assessment Tool (AAT).

Table 1: Assessment pattern for CIA

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

Continuous Internal Examination (CIE):
Two CIE exams shall be conducted at the end of the 8th and 16th week of the semester respectively. The CIE exam is conducted for 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 / Alternative Assessment Tool (AAT):
Two Quiz exams shall be online examination consisting of 25 multiple choice questions and are be answered by choosing the correct answer from a given set of choices (commonly four). Marks shall be awarded considering the average of two quizzes for every course. The AAT may include seminars, assignments, term paper, open ended experiments, five minutes video and MOOCs.

VI. HOW PROGRAM OUTCOMES ARE ASSESSED:

Program Outcomes (POs)		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	Seminar
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	Five Minutes Video
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	Assignment

3 = High; 2 = Medium; 1 = Low

VII. HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

Program Specific Outcomes (PSOs)		Strength	Proficiency assessed by
PSO 1	**Engineering knowledge:** graduates shall demonstrate sound knowledge in analysis, design, laboratory investigations and construction aspects of civil engineering infrastructure, along with good foundation in mathematics, basic sciences and technical communication.	1	Seminar
PSO 2	**Broadness and diversity:** graduates will have a broad understanding of economical, 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.	-	-
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.	-	-

3 = High; 2 = Medium; 1 = Low

VIII. COURSE OBJECTIVES (COs):

The course should enable the students to:	
I	Understand Kirchhoff laws and their application in series and parallel circuits.
II	Discuss principle and operation of measuring instruments.
III	Analyze the characteristics of alternating quantities, electrical machines.
IV	Illustrate the V-I characteristics of various diodes and bi-polar junction transistor.

IX. COURSE LEARNING OUTCOMES (CLOs):

CLO Code	CLO's	At the end of the course, the student will have the ability to:	PO's Mapped	Strength of Mapping
AEE018.01	CLO 1	Analyze the circuits using Kirchhoff's current and Kirchhoff's voltage law.	PO1	3
AEE018.02	CLO 2	Use star delta transformation for simplifying complex circuits.	PO1	3
AEE018.03	CLO 3	Generalize operation and principle of measuring instruments.	PO2	3

CLO Code	CLO's	At the end of the course, the student will have the ability to:	PO's Mapped	Strength of Mapping
AEE018.04	CLO 4	Demonstrate the working principle of DC motor, DC generator and transformer.	PO2	3
AEE018.05	CLO 5	Describe the construction of machines and transformer.	PO2	2
AEE018.06	CLO 6	Classify the types of DC machines.	PO2	2
AEE018.07	CLO 7	Derive the EMF equation of DC generator, transformer and Torque equation of DC motor.	PO2	2
AEE018.08	CLO 8	Discuss the principle of operation of induction motor.	PO2	2
AEE018.09	CLO 9	Explain the construction and characteristics of alternator.	PO4	2
AEE018.10	CLO 10	Explain the construction and characteristics of 3-phase induction motor.	PO2	1
AEE018.11	CLO 11	Compare the operation of half wave, full wave and bridge rectifiers.	PO4	2
AEE018.12	CLO 12	Differentiate the operation of Diodes and transistors.	PO2	2
AEE018.13	CLO 13	Apply the concept of diodes in converting AC to DC rectification process.	PO1	2
AEE018.14	CLO 14	Distinguish the different configurations of transistor.	PO4	2
AEE018.15	CLO 15	Examine the voltage, current and frequency of electric network using CRO.	PO1	3
AEE018.16	CLO 16	Apply the knowledge of electromagnetic laws and basic concepts of electronics.	PO2	3
AEE018.17	CLO 17	Process the knowledge and skills for employability and to succeed national and international level competitive examinations.	PO2	3

3 = High; 2 = Medium; 1 = Low

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

CLOs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CLO 1	3	3													
CLO 2															
CLO 3		3											1		
CLO 4		3											1		
CLO 5		2											1		
CLO 6		2											1		
CLO 7		2											1		
CLO 8		2											1		
CLO 9				2											

CLOs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CLO 10		1											1		
CLO 11				2									1		
CLO 12		2											1		
CLO 13	2														
CLO 14				2											
CLO 15	3														
CLO 16		3													
CLO 17		3													

3 = High; 2 = Medium; 1 = Low

XI. ASSESSMENT METHODOLOGIES – DIRECT

CIE Exams	PO1,PO2, PO4	SEE Exams	PO1,PO2 PO4	Assignments	PO4	Seminars	PO1
Laboratory Practices	-	Student Viva	-	Mini Project	-	Certification	-
Term Paper	-						

XII. ASSESSMENT METHODOLOGIES - INDIRECT

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

XIII. SYLLABUS

UNIT -I	ELECTRICCIRCUITS,ELECTROMAGNETISM AND INSTRUMENTS	Classes: 10
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.		
UNIT -II	**DC MACHINES**	**Classes: 10**
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.		
UNIT -III	**ALTERNATING QUANTITIES AND AC MACHINES**	**Classes: 08**
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.		
UNIT-IV	**SEMICONDUCTOR DIODE AND APPLICATIONS**	**Classes: 09**
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.		
UNIT-V	**BIPOLAR JUNCTION TRANSISTOR AND APPLICATIONS**	**Classes: 08**
Bipolar junction: DC characteristics, CE, CB, CC configurations, biasing, load line, transistor as an amplifier.		
Text Books:		
1. A Chakrabarti, "Circuit Theory", Dhanpat Rai Publications, 6th Edition, 2004. 2. K S Suresh Kumar, "Electric Circuit Analysis", Pearson Education, 1st Edition, 2013. 3. Willianm Hayt, Jack E Kemmerly S M Durbin, "Engineering Circuit Analysis", Tata McGraw Hill, 7th Edition, 2010. 4. J P J Millman, C C Halkias, Satyabrata Jit, "Millman"s Electronic Devices and Circuits", Tata McGraw Hill, 2nd Edition, 1998. 5. R L Boylestad, Louis Nashelsky, "Electronic Devices and Circuits", PEI / PHI, 9th Edition, 2006. 6. R L Boylestad, Louis Nashelsky, "Electronic Devices and Circuits", PEI / PHI, 9th Edition, 2006.		
Reference Books:		
1. David A Bell, "Electric Circuits", Oxford University Press, 9th Edition, 2016. 2. U A Bakshi,Atul P Godse "Basic Electrical and Electronics Engineering", Technical Publications, 9th Edition, 2016. 3. A Bruce Carlson, "Circuits", Cengage Learning, 1st Edition, 2008. 4. M Arshad, "Network Analysis and Circuits", Infinity Science Press, 9th Edition, 2016.		

XIV.COURSE PLAN:

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

Lecture No	Topics to be covered	Course Learning Outcomes (CLOs)	Reference
1	Discuss the basic definitions of voltage, current, power and energy	CLO 1	T2: 1.2-1.8 R2:1.1
2	Understand the concept of Ohm's Law	CLO 1	T2: 1.9 R2:1.5
3	Discuss different elements in power systems and sources	CLO 1	T2:1.10 R2:1.2&1.4
4-5	Describe voltage-current relationship of resistive networks, inductive networks, capacitive networks	CLO 1	T2: 2.3-2.5 R2:1.6
6	Explain Kirchhoff's laws for electrical networks	CLO 1	T2: 1.12 R2:1.14
7-8	Understand series, parallel circuits	CLO 1	T2: 2.6 R2:1.7&1.8
9	Derive the formula for Star delta and delta star transformations techniques.	CLO 2	T2: 2.7 R2:1.12
10	Analyze networks using reduction techniques.	CLO 2	T2: 2.6 R2:1.7&1.8

Lecture No	Topics to be covered	Course Learning Outcomes (CLOs)	Reference
11	Understand the concept of faradays laws	CLO 3	T2: 1.11 R2:6.2
12	Understand working of different measuring instruments	CLO 3	T2: 10.4 R2:4.0
13-14	Understand working of different measuring instruments	CLO 3	T2: 10.5.1.1 R2:4.0
15-16	Understand working of different measuring instruments	CLO 3	T2: 10.5.1.3 R2:4.0
17	Discuss what is a DC machine	CLO 4	T2: 7.1 R2:5.2
18	Understand the working principle of DC machine	CLO 4	T2: 7.6 R2:5.3
19-20	Demonstrate the cross section view of a DC machine	CLO 5	T2: 7.2 R2:5.4
21-22	Derive the mathematical equation of EMF induced in a DC generator	CLO 7	T2: 7.6.1 R2:5.7
23	Classify the types of DC generator	CLO 6	T2: 7.6.3 R2:5.10,5.11,5.12 ,5.13,5.14
24	Understand the working principle of DC motor	CLO 4	T2: 7.7 R2:5.16
25	Classify the types of DC motor	CLO 6	T2: 7.7.6 R2:5.21,5.22,5.23 ,5.24
26	Derive mathematical equation of torque generated in a DC motor	CLO 7	T2:7.7.5 R2:5.20
27	Understand the applications of DC motor	CLO 4	T2: 7.7.6.1-7.7.6.3 R2:5.31
28	Understand the three point starter	CLO 4	T2: 7.7.7 R2:5.25
29	Understand the concepts of alternating quantities	CLO 4	T2: 4.1 R2:2.1
30	Understand the representation of sinusoidal quantity and analyzing	CLO 4	T2: 4.5-4.6 R2:2.2
31	Understand three phase systems	CLO 4	T2: 5.2.4.1-5.2.4.2 R2:3.2
32	Understand the working principle of Transformer	CLO 4	T2: 6.5 R2:602
33	Derive mathematical equation of EMF induced in a single phase transformer	CLO 7	T2: 6.6.1 R2:6.6
34-35	Understand the percentage efficiency and voltage regulation	CLO 7	T2: 6.9-6.10 R2:6.13&6.15
36	Understand the working principle of induction motor	CLO 8	T2: 9.3 R2:7.2
37	Analyze the speed torque characteristics	CLO 9	T2: 9.3.1 R2:7.8
38	Understand the working principle of Alternator	CLO 9	T2: 8.4 R2:7.11
39-40	Derive the mathematical equation of EMF induced in a Alternator	CLO 9	T2: 8.4 R2:7.13
41-42	Analyze the percentage efficiency of an alternator.	CLO 9	T2: 8.8 R2:7.16

Lecture No	Topics to be covered	Course Learning Outcomes (CLOs)	Reference
42-43	Analyze the percentage voltage regulation of alternator.	CLO 9	T2: 8.8 R2:7.21
44-47	Understand the functioning of P-N Junction diode	CLO 12	T4: 4.11 R2:8.1
48–50	Understand and analyze P -N diode as half wave rectifier, full wave rectifier, bridge rectifier and filters	CLO 11	T4: 4.23 R2:8.8,8.17,8.18, 8.19
51-53	Understand the functioning of Zener diode as a voltage regulator.	CLO 12	T4: 4.19,5.2 R2:8.22.5
54	Analyze simple problems on diodes.	CLO 12	T4: 4.23 R2:8.23
55-56	Understand the concept of bipolar junction: DC characteristics,	CLO 14	T4: 6.4-6.5 R2:9.1
57-59	Examine CE, CB, CC configurations.	CLO 14	T4: 6.6 R2:9.21,9.22,9.23
60	Analyze biasing and load line,	CLO 14	T4: 6.3 R2:9.3
61-63	Model Transistor as an amplifier	CLO 14	T4: 6.7 R2:9.5
64-65	Analyze simple problems on transistors.	CLO 14	T4: 6.6 R2:9.7

XV.GAPS IN THE SYLLABUS - TO MEET INDUSTRY / PROFESSION REQUIREMENTS:

S No	Description	Proposed actions	Relevance with POs	Relevance with PSOs
1	To improve standards and analyze the concepts.	Guest lectures	PO2	PSO1
2	Voltage - Current relationship for passive elements for different input signals - ramp, saw tooth and triangular.	Seminars / NPTEL	PO1	PSO1
3	Resistance color coding	NPTEL	PO1	PSO1

Prepared by:
Mr. N Shivaprasad Assistant Professor

HOD, CE

INSTITUTE OF AERONAUTICAL ENGINEERING

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CIVIL ENGINEERING

COURSE DESCRIPTOR

Course Title	**PROBABILITY AND STATISTICS**				
Course Code	AHS010				
Programme	B.Tech				
Semester	II	CSE | IT			
	III	ME | CE			
Course Type	Foundation				
Regulation	IARE - R16				
Course Structure	**Theory**			**Practical**	
	Lectures	**Tutorials**	**Credits**	**Laboratory**	**Credits**
	3	1	4	-	-
Chief Coordinator	Mr. J Suresh Goud, Assistant Professor				
Course Faculty	Ms. P Srilatha, Assistant Professor Ms. B Praveena, Assistant Professor				

I. COURSE OVERVIEW:

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

II. COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites
-	-	-	Basic principles of statistics

III. MARKS DISTRIBUTION:

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

IV. DELIVERY / INSTRUCTIONAL METHODOLOGIES:

✔	Chalk & Talk	✔	Quiz	✔	Assignments	✘	MOOCs
✔	LCD / PPT	✔	Seminars	✘	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 units and each unit carries equal weightage in terms of marks distribution. The question paper pattern is as follows. Two full questions with "either" or "choice" will be drawn from each unit. Each question carries 14 marks. There could be a maximum of two sub divisions in a question.

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

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

Continuous Internal Assessment (CIA):
CIA is conducted for a total of 30 marks (Table 1), with 25 marks for Continuous Internal Examination (CIE), 05 marks for Quiz/ Alternative Assessment Tool (AAT).

Table 1: Assessment pattern for CIA

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

Continuous Internal Examination (CIE):
Two CIE exams shall be conducted at the end of the 8th and 16th week of the semester respectively. The CIE exam is conducted for 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 / Alternative Assessment Tool (AAT):
Two Quiz exams shall be online examination consisting of 25 multiple choice questions and are be answered by choosing the correct answer from a given set of choices (commonly four). Marks shall be awarded considering the average of two quizzes for every course. The AAT may include seminars, assignments, term paper, open ended experiments, five minutes video and MOOCs.

VI. HOW PROGRAM OUTCOMES ARE ASSESSED:

Program Outcomes (POs)		Strength	Proficiency assessed by
PO 1	**Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.	3	Presentation on real-world problems
PO 2	**Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences	2	Seminar
PO 4	**Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.	1	Term Paper

3 = High; 2 = Medium; 1 = Low

VII. HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

Program Specific Outcomes (PSOs)		Strength	Proficiency assessed by
PSO 1	**ENGINEERING KNOWLEDGE:** Graduates shall demonstrate sound knowledge in analysis, design, laboratory investigations and construction aspects of civil engineering infrastructure, along with good foundation in mathematics, basic sciences and technical communication.	1	Seminar
PSO 2	**BROADNESS AND DIVERSITY:** Graduates will have a broad understanding of economical, 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.	-	-
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.	-	-

3 = High; 2 = Medium; 1 = Low

VIII. COURSE OBJECTIVES (COs):

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

IX. COURSE LEARNING OUTCOMES (CLOs):

CLO Code	CLO's	At the end of the course, the student will have the ability to:	PO's Mapped	Strength of Mapping
AHS010.01	CLO 1	Understand the basic concepts of probability and random variables.	PO 1	3
AHS010.02	CLO 2	Analyze the concepts of discrete and continuous random variables, probability distributions, expectation and variance.	PO 1	3
AHS010.03	CLO 3	Use the concept of random variables in real-world problem like graph theory, machine	PO 1	3

		learning, Natural language processing.		
AHS010.04	CLO 4	Apply the binomial distribution and poisson distribution to find mean and variance.	PO 2	2
AHS010.05	CLO 5	Understand binomial distribution to the phenomena of real-world problem like sick versus healthy.	PO 2	2
AHS010.06	CLO 6	Use poission distribution in real-world problem to predict soccer scores.	PO 2	2
AHS010.07	CLO 7	Apply the inferential methods relating to the means of normal distributions.	PO 4	1
AHS010.08	CLO 8	Understand the mapping of normal distribution in real-world problem to analyze the stock market.	PO 4	1
AHS010.09	CLO 9	Explain multiple random variables and the covariance of two random variables.	PO 2	2
AHS010.10	CLO 10	Understand the concept of multiple random variables in real-world problems aspects of wireless communication system.	PO 2	2
AHS010.11	CLO 11	Calculate the correlation coefficient to the given data.	PO 1	3
AHS010.12	CLO 12	Understand the correlation and regression to the real-world such as stock price and interest rates.	PO 1	3
AHS010.13	CLO 13	Calculate the regression to the given data.	PO 1	3
AHS010.14	CLO 14	Understand the concept of sampling distribution of statistics and in particular describe the behavior of the sample mean.	PO 1, PO 2	3
AHS010.15	CLO 15	Understand the concept of estimation for classical inference involving confidence interval.	PO 2	2
AHS010.16	CLO 16	Understand the concept of estimation in real-world problems of signal processing.	PO 2	2
AHS010.17	CLO 17	Understand the foundation for hypothesis testing.	PO 1, PO 2	3
AHS010.18	CLO 18	Understand the concept of hypothesis testing in real-world problem to selecting the best means to stop smoking.	PO 1, PO 2	3
AHS010.19	CLO 19	Apply testing of hypothesis to predict the significance difference in the sample means.	PO 1, PO 2	3
AHS010.20	CLO 20	Apply testing of hypothesis to predict the significance difference in the sample proportions.	PO 1, PO 2	3
AHS010.21	CLO 21	Apply Student t-test to predict the difference in sample means.	PO 1	3
AHS010.22	CLO 22	Apply F-test to predict the difference in sample variances.	PO 1	3
AHS010.23	CLO 23	Understand the characteristics between the samples using Chi-square test.	PO 1	3
AHS010.24	CLO 24	Understand the assumptions involved in the use of ANOVA technique.	PO 4	1
AHS010.25	CLO 25	Understand the concept ANOVA to the real-world problems to measure the atmospheric	PO 4	1

		tides.		

3 = High; 2 = Medium; 1 = Low

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

CLOs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CLO 1	3												1		
CLO 2	3												1		
CLO 3	3												1		
CLO 4		2													
CLO 5		2													
CLO 6		2													
CLO 7				2											
CLO 8				1											
CLO 9		3											1		
CLO 10		2											1		
CLO 11	3														
CLO 12	3														
CLO 13	3														
CLO 14	3	2											1		
CLO 15		2													
CLO 16		2													
CLO 17	3	2											1		
CLO 18	3	2											1		
CLO 19	2	2											1		
CLO 20	3	1											1		
CLO 21	3														
CLO 22	3														
CLO 23	2														
CLO 24				2											
CLO 25				1											

CLO 26															

3 = High; 2 = Medium; 1 = Low

XI. ASSESSMENT METHODOLOGIES – DIRECT

CIE Exams	PO 1, PO 2, PO 4	SEE Exams	PO 1, PO 2, PO 4	Assignments	PO 4	Seminars	PO 2
Laboratory Practices	-	Student Viva	-	Mini Project	-	Certification	-
Term Paper	PO 4						

XII. ASSESSMENT METHODOLOGIES - INDIRECT

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

XIII. SYLLABUS

Unit-I	**SINGLE RANDOM VARIABLES AND PROBABILITY DISTRIBUTION**
Random variables: Basic definitions, discrete and continuous random variables; Probability distribution: Probability mass function and probability density functions; Mathematical expectation; Binomial distribution, Poisson distribution and normal distribution.	
Unit-II	**MULTIPLE RANDOM VARIABLES**
Joint probability distributions, joint probability mass, density function, marginal probability mass, density functions; Correlation: Coefficient of correlation, the rank correlation; Regression: Regression coefficient, the lines of regression, multiple correlation and regression.	
Unit-III	**SAMPLING DISTRIBUTION AND TESTING OF HYPOTHESIS**
Sampling: Definitions of population, sampling, statistic, parameter; Types of sampling, expected values of sample mean and variance, sampling distribution, standard error, sampling distribution of means and sampling distribution of variance. Estimation: Point estimation, interval estimations; Testing of hypothesis: Null hypothesis, alternate hypothesis, type I and type II errors, critical region, confidence interval, level of significance. One sided test, two sided test.	
Unit-IV	**LARGE SAMPLE TESTS**
Test of hypothesis for single mean and significance difference between two sample means, Tests of significance difference between sample proportion and population proportion and difference between two sample proportions.	
Unit-V	**SMALL SAMPLE TESTS AND ANOVA**
Small sample tests: Student t-distribution, its properties: Test of significance difference between sample mean and population mean; difference between means of two small samples. Snedecor's F-distribution and its properties; Test of equality of two population variances Chi-square distribution and it's properties; Test of equality of two population variances Chi-square distribution, it's properties, Chi-square test of goodness of fit; ANOVA: Analysis of variance, one way classification, two way classification.	
Text Books:	
1. Erwin Kreyszig, "Advanced Engineering Mathematics", John Wiley & Sons Publishers, 9th Edition, 2014. 2. B. S. Grewal, "Higher Engineering Mathematics", Khanna Publishers, 43rd Edition, 2012.	

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

XIV. COURSE PLAN:

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

Lecture No	Topics to be covered	Course Learning Outcomes (CLOs)	Reference
1	Describe the concept of Random variables and Contrast discrete Random variables and calculate the mean and variance of discrete Random variables	CLO 1	T1:22.5 R1:2.3
2	Recall the continuous probability function	CLO 2	T1:22.5 R1:2.4
3	Identify mathematical mean	CLO 2	T1:22.6 R1:2.6
4-5	Recall characteristics of the Binomial Distribution and find mean , variance	CLO 4	T1:22.7 R1:4.4
6-7	Recognize cases where Poisson Distribution could be appropriate model to find mean and variance	CLO 4	T1:22.7 R1:4.10
8-9	Apply Normal Distributions find the probability over a set of values, mean and variance	CLO 7	T1:22.8 R1:4.15
10	Apply probability distribution	CLO 9	T1:22.9 R1:5.4
11	Apply marginal probability density function	CLO 9	T1:22.9 R1:5.8
12-13	Recognize the limitation of correlation as a summary of bivariate data.	CLO 11	T1:23.10 R1:6.8
14	Interpret the correlation between the bivariate data by allotting ranks.	CLO 11	T1:23.10 R1:6.13
15-16	Define the concept of least squares estimation in linear regression	CLO 13	T1:23.9 R1:7.5
17	Estimate the linear model to a bivariate data	CLO 11	T1:23.10 R1:7.5
18	Recognize the multiple correlation of bivariate data	CLO 9	T1:23.10 R1:8.1
19	Recall the sampling distribution of the sample mean in general situation	CLO 14	T1:23.1 R1:9.2
20	Distinguish between a population and a sample and between parameters & statistics	CLO 14	T1:23.1 R1:9.4
21	Recall the sampling distribution and define standard error	CLO 14	T1:23.1 R1:9.9
22-23	Recall the sampling distribution of the sample mean in general situation	CLO 14	T1:23.1 R1:9.10
24-25	Interpret the confidence interval and confidence level	CLO 14	T2:27.5 R1:10.2
26	Understand the foundation for classical inference involving hypothesis testing and two types of errors possible	CLO 17	T2:27.7 R1:11.3
27	Explain level of significance confidence interval	CLO 17	T2:27.8 R1:11.6
28-30	Identify the confidence interval with single mean	CLO 19	T2:27.12 R1:11.7
31-32	Identify the confidence interval with difference between the mean	CLO 19	T2:27.12 R1:11.8

Lecture No	Topics to be covered	Course Learning Outcomes (CLOs)	Reference
33-34	Identify the confidence interval with difference between the proportions	CLO 20	T2:27.12 R1:11.9
35-36	Identify the confidence interval with difference between the proportions	CLO 20	T2:27.12 R1:11.10
37-38	Recall the definition of a t-statistics in terms of statistics of sample from a normal distribution	CLO 21	T2:27.14 R1:12.3
39	State and apply the definition of F-distribution	CLO 22	T2:27.1 R1:12.7
40-41	State and apply the definition of χ^2 –Distribution	CLO 23	T2:27.17 R1:12.15
42	Apply Chi-square distribution	CLO 23	T2:27.18 R1:12.19
43-44	Apply One way classification	CLO 24	T2:27.19 R2:14.4
45	Apply Two way classification	CLO 24	T2:27.19 R2:14.5

XV. GAPS IN THE SYLLABUS - TO MEET INDUSTRY / PROFESSION REQUIREMENTS:

S No	Description	Proposed Actions	Relevance with Pos	Relevance with Psos
1	To improve standards and analyze the concepts.	Seminars	PO 1	PSO 1
2	Conditional probability, Sampling distribution, correlation, regression analysis and testing of hypothesis	Seminars / NPTEL	PO 4	PSO 1
3	Encourage students to solve real time applications and prepare towards competitive examinations.	NPTEL	PO 2	PSO 1

Prepared By:
Mr. J Suresh Goud, Assistant Professor

HOD, FRESHMAN ENGINEERING

IV SEMESTER

INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)
Dundigal, Hyderabad -500 043

CIVIL ENGINEERING

COURSE DESCRIPTOR

Course Title	**STRENGTH OF MATERIALS – II**				
Course Code	ACE004				
Programme	B. Tech				
Semester	IV	CE			
Course Type	Core				
Regulation	IARE - R16				
Course Structure	**Theory**			**Practical**	
	Lectures	**Tutorials**	**Credits**	**Laboratory**	**Credits**
	3	1	4	-	-
Chief Coordinator	Dr. Venu M, Professor				
Course Faculty	Mr. Suraj Baraik, Assistant Professor				

I. COURSE OVERVIEW:

Civil engineers are required to design structures like building, beams, dams, bridges, etc. The loads coming onto 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 of propped cantilevers, fixed and continuous beams under various load combinations. Through this course content engineers can design the structures for safety and serviceability.

II. COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites	Credits
UG	AME002	II	Engineering Mechanics	4
UG	ACE002	III	Strength of Materials -I	4

III. MARKS DISTRIBUTION:

Subject	SEE Examination	CIA Examination	Total Marks
Strength of Materials – II	70 Marks	30 Marks	100

IV. DELIVERY / INSTRUCTIONAL METHODOLOGIES:

✔	Chalk & Talk	✔	Quiz	✔	Assignments	✘	MOOCs
✔	LCD / PPT	✘	Seminars	✘	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 units and each unit carries equal weightage in terms of marks distribution. The question paper pattern is as follows. Two full questions with "either" or "choice" will be drawn from each unit. Each question carries 14 marks. There could be a maximum of two sub divisions in a question.

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

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

Continuous Internal Assessment (CIA):
CIA is conducted for a total of 30 marks (Table 1), with 25 marks for Continuous Internal Examination (CIE), 05 marks for Quiz/ Alternative Assessment Tool (AAT).

Table 1: Assessment pattern for CIA

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

Continuous Internal Examination (CIE):
Two CIE exams shall be conducted at the end of the 8th and 16th week of the semester respectively. The CIE exam is conducted for 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 / Alternative Assessment Tool (AAT):
Two Quiz exams shall be online examination consisting of 25 multiple choice questions and are be answered by choosing the correct answer from a given set of choices (commonly four). Marks shall be awarded considering the average of two quizzes for every course. The AAT may include seminars, assignments, term paper, open ended experiments, five minutes video and MOOCs.

VI. HOW PROGRAM OUTCOMES ARE ASSESSED:

Program Outcomes (POs)		Strength	Proficiency assessed by
PO1	**Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.	3	Assignments/ Exams
PO2	**Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.	2	Assignments/ Exams
PO3	**Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.	2	Assignments
PO4	**Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.	2	Open ended experiments

3 = High; 2 = Medium; 1 = Low

VII. HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

Program Specific Outcomes (PSOs)		Strength	Proficiency assessed by
PSO1	**Engineering Knowledge**: Graduates shall demonstrate sound knowledge in analysis, design, laboratory investigations and construction aspects of civil engineering infrastructure, along with good foundation in mathematics, basic sciences and technical communication.	2	Lectures, Assignments
PSO2	**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.	-	-
PSO3	**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.	-	-

3 = High; 2 = Medium; 1 = Low

VIII. COURSE OBJECTIVES (COs):

The course should enable the students to:	
I	Apply the concepts of strain energy and virtual work to calculate deflections in beams.
II	Discuss about springs and their various types of combination connections.
III	Outline of columns and struts with different end conditions and awareness about laterally loaded struts.
IV	Understand direct and bending stresses in concrete structures like retaining wall, chimney and dams.

IX. COURSE LEARNING OUTCOMES (CLOs):

CLO Code	CLO's	At the end of the course, the student will have the ability to:	PO's Mapped	Strength of Mapping
ACE004.01	CLO 1	Calculate the slope and deflection for cantilever and simply supported beams under various loads.	PO 1, PO 4	2
ACE004.02	CLO 2	Understand the different methods for deflection of beams with constant and variable moment of inertia.	PO 1	2
ACE004.03	CLO 3	Predict the differential equation for the elastic line of a beam.	PO 1	3
ACE004.04	CLO 4	Apply Mohr's theorems and moment area methods for simple cases including overhanging beams.	PO 2	2
ACE004.05	CLO 5	Understand the concept of conjugate beam method.	PO 1, PO 2	2
ACE004.06	CLO 6	Analyze the strain energy under gradual, sudden, impact and shock loadings simple applications.	PO 2	2
ACE004.07	CLO 7	Apply Strain energy in linear elastic system, expression of strain energy due to axial load, bending moment and shear force.	PO 3	2
ACE004.08	CLO 8	Understand the energy methods like work energy method, principal of virtual work, unit load method and Castigliano's theorem.	PO 1, PO 3	3
ACE004.09	CLO 9	Evaluate the deflections of simple beams and pin jointed trusses and concept extended to frames and indeterminate structures.	PO 3, PO 4	2
ACE004.10	CLO 10	Analyze structures using Maxwell's theorem of reciprocal deflections and betti's Law.	PO 3	2
ACE004.11	CLO 11	Understand the concept of thin seamless cylindrical shells.	PO 1	1
ACE004.12	CLO 12	Derive the formula for longitudinal and circumferential stresses, hoop, longitudinal and volumetrical strains.	PO 1	3
ACE004.13	CLO 13	Analyze Lames theory for thick cylinders.	PO 3, PO 4	1
ACE004.14	CLO 14	Derive the derivation of lames formulae and distribution of hoop and radial stresses across thickness.	PO 2, PO 4	3
ACE004.15	CLO 15	Evaluate thick cylinders and compound cylinders for necessary difference of radii under shrinkage and thick spherical shells.	PO 3	1
ACE004.16	CLO 16	Analyze propped cantilever and fixed beams using different methods.	PO 3, PO 4	2
ACE004.17	CLO 17	Derive the propped cantilever and fixed beams under various conditions.	PO 3, PO 4	2
ACE004.18	CLO 18	Calculate the deflection of propped cantilever and fixed beams.	PO 2, PO 3	2
ACE004.19	CLO 19	Understand the effect of rotation of a support.	PO 2, PO 3	1
ACE004.20	CLO 20	Explain clapeyron's theorem of three moments.	PO 2, PO 3	2
ACE004.21	CLO 21	Analyze continuous beams with constant and variable moments of inertia.	PO 2, PO 3	2

CLO Code	CLO's	At the end of the course, the student will have the ability to:	PO's Mapped	Strength of Mapping
ACE004.22	CLO 22	Analyze the continuous beam with overhangs.	PO 3, PO 4	1
ACE004.23	CLO 23	Calculate the Effects of sinking of supports.	PO 3, PO 4	2

3 = High; 2 = Medium; 1 = Low

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

Course Learning Outcomes (CLOs)	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CLO 1	3			2									1		
CLO 2	2														
CLO 3	3														
CLO 4		2													
CLO 5	3	1													
CLO 6		2													
CLO 7			2												
CLO 8	3		3										2		
CLO 9			2	2									1		
CLO 10			2												
CLO 11	1												2		
CLO 12	3														
CLO 13			2	1											
CLO 14		3		3											
CLO 15			1										2		
CLO 16			1	3											
CLO 17			3	1											
CLO 18		3	2												
CLO 19		2	1										2		
CLO 20		2	3												
CLO 21		3	1										2		

Course Learning Outcomes (CLOs)	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CLO 22			2	1											
CLO 23			3	1									1		

3 = High; 2 = Medium; 1 = Low

XI. ASSESSMENT METHODOLOGIES – DIRECT

CIE Exams	PO1, PO2, PO3, PO4	SEE Exams	PO1, PO2, PO3, PO4	Assignments	PO1, PO2, PO3	Seminars	-
Laboratory Practices	-	Student Viva	-	Mini Project	-	Certification	-
Term Paper	-						

XII. ASSESSMENT METHODOLOGIES - INDIRECT

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

XIII. SYLLABUS

Unit-I	DEFLECTIONS OF BEAMS
Bending into a circular arc, slope, deflection and radius of curvature, differential equation for the elastic line of a beam, double integration and Macaulay's methods, determination of slope and deflection for cantilever and simply supported beams subjected to various loads, Mohr's theorems, moment area method, application to simple cases including overhanging beams; Conjugate beam method, concept of conjugate beam method, difference between a real beam and a conjugate beam, deflections of determinate beams with constant and different moments of inertia.	
Unit-II	**DEFLECTIONS BY ENERGY METHODS**
Strain Energy: Resilience gradual, sudden, impact and shock loadings simple applications; Strain energy in linear elastic system, expression of strain energy due to axial load, bending moment and shear force; Energy Methods: Work energy method, principal of virtual work, unit load method, Castigliano's theorem; Deflections of simple beams and pin jointed trusses; Concept extended to frames and indeterminate structures; Maxwell's theorem of reciprocal deflections; Betti's Law.	
Unit-III	**STRESSES IN CYLINDERS AND SPHERICAL SHELLS**
Thin seamless cylindrical shells, derivation of formula for longitudinal and circumferential stresses, hoop, longitudinal and volumetrical strains, changes in diameter and volume of thin cylinders, thin spherical shells. Lames theory for thick cylinders, derivation of lames formulae, distribution of hoop and radial stresses across thickness, design of thick cylinders, compound cylinders, necessary difference of radii for shrinkage, thick spherical shells.	
Unit-IV	**INDETERMINATE BEAMS: PROPPED CANTILEVER AND FIXED BEAMS**
Analysis of propped cantilever and fixed beams using the method of consistent deformation, including the beams with varying moments of inertia, subjected to uniformly distributed load, central point load, eccentric point load, number of point loads, uniformly varying load, couple and combination of loads, shear force and bending moment diagrams for propped cantilever and fixed beams, deflection of propped cantilever and fixed beams; Effect of rotation of a support.	

Unit-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.	
Text Books:	
1. R. K. Bansal, "A Textbook of Strength of Materials", Laxmi Publications (P) Ltd., New Delhi, 2nd Edition, 2007. 2. F. Beer, E. R. Johnston, J. DeWolf , "Mechanics of Materials", Tata McGraw-Hill Publishing Company Ltd., New Delhi, India, 1st Edition, 2008. 3. S. S. Bhavikatti, "Strength of Materials", Vikas Publishing House Pvt. Ltd., New Delhi, 5th Edition, 2013.	
Reference Books:	
1. B. C. Punmia, Ashok K Jain and Arun K Jain, "Mechanics of Materials", Laxmi Publications Pvt. Ltd., New Delhi, 12th Edition, 2007. 2. R. Subramanian, "Strength of Materials", Oxford University Press, 2nd Edition, 2010. 3. D. S. Prakash Rao, "Strength of Materials A Practical Approach Vol.1", Universities Press (India) Pvt. Ltd., India, 3rd Edition, 2007. 4. J. M. Gere, S.P. Timoshenko, "Mechanics of Materials, SI units edition", CL Engineering, USA, 5th Edition, 2000. 5. E. G. Popov, "Engineering Mechanics of Solids", Pearson Education, India, 21st Edition, 2015.	

XIV. COURSE PLAN:

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

Lecture No	Topics to be covered	Course Learning Outcomes (CLOs)	Reference
1-2	Calculate the slope and deflection for cantilever and simply supported beams under various loads.	CLO 1	T1: 12.1-12.2 R2: 7.2-7.3
3-4	Predict the differential equation for the elastic line of a beam.	CLO 2	T1: 12.3-12.5 R2: 7.4
5-6	Understand the different methods for deflection of beams with constant and variable moment of inertia.	CLO 2	T1: 12.6-12.7 R2:7.5
7-8	Apply Mohr's theorems and moment area methods for simple cases including overhanging beams.	CLO 3	T1: 12.8-12.11 R2:7.8
9-10	Understand the concept of conjugate beam method.	CLO 4	T1:14.1-14.6 R2:7.9
11-12	Understand the different methods for deflection of beams with constant and variable moment of inertia.	CLO 5	T1: 14.6-14.10 R2:7.7, 7.10
13-14	Analyze the strain energy under gradual, sudden, impact and shock loadings simple applications.	CLO 6	T1: 4.1-4.4 R1:12.1, 12.2
15-16	Apply Strain energy in linear elastic system, expression of strain energy due to axial load, bending moment and shear force.	CLO 7	T1: 4.6-4.7 R1:12.3
17-19	Understand the work energy method, principal of virtual work, unit load method and castigliano's theorem.	CLO 8	T2 :7.13-16 R1: 12.3
20-22	Evaluate the deflections of simple beams and pin jointed trusses and concept extended to frames.	CLO 9	T2:7.17-19 R1: 12.6
23-25	Analyze structures using maxwell's theorem of reciprocal deflections and betti's Law.	CLO 10	T2: 7.20 R1: 7.3, 7.4
26	Understand the concept of thin seamless cylindrical shells.	CLO 11	T1:17.1-17.3 R2:12.4
27-30	Derive the formula for longitudinal and circumferential stresses, hoop, longitudinal and volumetric strains.	CLO 12	T1: 17.4-17.7 R2:12.4

Lecture No	Topics to be covered	Course Learning Outcomes (CLOs)	Reference
31-32	Analyze Lames theory for thick cylinders.	CLO 14	T1: 17.8 R2:12.5
33-34	Derive the derivation of lames formulae and distribution of hoop and radial stresses across thickness.	CLO 14	T1: 17.9 R2:12.5.1
35-38	Evaluate thick cylinders and compound cylinders for necessary difference of radii under shrinkage.	CLO 15	T1: 17.10-12 R2:12.5.3
39-44	Analyze propped cantilever and fixed beams using different methods.	CLO 14	T1:14.7, 15.1-3 R2:15.2
45-49	Derive the propped cantilever and fixed beams under various conditions.	CLO 16	T1:15.3-5 R2: 15.3
50-55	Calculate the deflection of propped cantilever and fixed beams. Understand the effect of rotation of a supports.	CLO 17	T1:15.6 –7 R2:15.5, 15.6
56	Explain the clapeyron‘s theorem of three moments.	CLO 19	T1:15.8 R1:8.1
57-58	Analyze continuous beams with constant and variable moments of inertia.	CLO 21	T1:15.8 R1:8.2, 8.3
59-60	Analyze continuous beams with overhangs and calculate the Effects of sinking of supports.	CLO 23	T1:15.8 R1:8.4, 8.5

XV. GAPS IN THE SYLLABUS - TO MEET INDUSTRY / PROFESSION REQUIREMENTS:

S No	Description	Proposed actions	Relevance with POs	Relevance with PSOs
1	The internal behavior of the material with the externally applied loading.	Seminars/Guest Lectures/NPTEL	PO 4	PSO1
2	Analysis of stresses especially for cylindrical shells.	Seminars/Guest Lectures/NPTEL	PO 1	PSO 1
3	Real world applications in sinking of supports under various conditions.	Seminars/ Assignments	PO 4	PSO 1

Prepared by:
Dr. Venu M, Professor

HOD, CIVIL ENGINEERING

INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)
Dundigal, Hyderabad -500 043

CIVIL ENGINEERING

COURSE DESCRIPTOR

Course Title	**FLUID MECHANICS**				
Course Code	ACE005				
Programme	B. Tech				
Semester	IV	CE			
Course Type	Core				
Regulation	IARE - R16				
Course Structure	**Theory**			**Practical**	
	Lectures	**Tutorials**	**Credits**	**Laboratory**	**Credits**
	3	1	4	-	-
Chief Coordinator	Dr. G.V. Ramana, Professor				
Course Faculty	Dr. G.V. Ramana, Professor Mr. CH.V. S. S. Sudheer, Assistant Professor				

I. 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.

II. COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites	Credits
UG	AHS002	I	Linear Algebra And Ordinary Differential Equations	4
UG	AME002	II	Engineering mechanics	4

III. MARKS DISTRIBUTION:

Subject	SEE Examination	CIA Examination	Total Marks
Fluid Mechanics	70 Marks	30 Marks	100

IV. DELIVERY / INSTRUCTIONAL METHODOLOGIES:

✓	Chalk & Talk	✓	Quiz	✓	Assignments	x	MOOCs
✓	LCD / PPT	✓	Seminars	✓	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 units and each unit carries equal weightage in terms of marks distribution. The question paper pattern is as follows. Two full questions with "either" or "choice" will be drawn from each unit. Each question carries 14 marks. There could be a maximum of two sub divisions in a question.

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

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

Continuous Internal Assessment (CIA):
CIA is conducted for a total of 30 marks (Table 1), with 25 marks for Continuous Internal Examination (CIE), 05 marks for Quiz/ Alternative Assessment Tool (AAT).

Table 1: Assessment pattern for CIA

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

Continuous Internal Examination (CIE):
Two CIE exams shall be conducted at the end of the 8th and 16th week of the semester respectively. The CIE exam is conducted for 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 / Alternative Assessment Tool (AAT):
Two Quiz exams shall be online examination consisting of 25 multiple choice questions and are be answered by choosing the correct answer from a given set of choices (commonly four). Marks shall be awarded considering the average of two quizzes for every course.
The AAT may include seminars, assignments, term paper, open ended experiments, five minutes' video and MOOCs.

VI. HOW PROGRAM OUTCOMES ARE ASSESSED:

Program Outcomes (POs)		Strength	Proficiency assessed by
PO 1	**Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.	3	Assignments/ Exams
PO 2	**Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences	2	Assignments/ Exams
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	Assignments
PO 4	**Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.	1	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 receive clear instructions.	2	Assignments
PO 12	**Life-long learning:** Recognize the need for, and have the preparations and ability to engage in independent and life-long learning in the broad cast context of technology change.	1	Seminars

3 = High; 2 = Medium; 1 = Low

VII. HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

Program Specific Outcomes (PSOs)		Strength	Proficiency assessed by
PSO 1	**Engineering Knowledge**: Graduates shall demonstrate sound knowledge in analysis, design, laboratory investigations and construction aspects of civil engineering infrastructure, along with good foundation in mathematics, basic sciences and technical communication.	2	Seminar
PSO 2	**Broadness and Diversity:** Graduates will have a broad understanding of economical, 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.	-	-
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	1	Workshop

Program Specific Outcomes (PSOs)		Strength	Proficiency assessed by
	order to offer engineering services to the society, ethically and responsibly.		

3 = High; 2 = Medium; 1 = Low

VIII. COURSE OBJECTIVES (COs):

The course should enable the students to:	
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.

IX. COURSE LEARNING OUTCOMES (CLOs):

CLO Code	CLO's	At the end of the course, the student will have the ability to:	PO's Mapped	Strength of Mapping
CACE005.01	CLO 1	Define fluid and its properties. Describe surface tension and relations in different conditions.	PO 1	3
CACE005.02	CLO 2	Explain Newton's law of viscosity. Classify fluids based on Newton's law of viscosity and solve problems on Viscosity.	PO 1 PO 2	3
CACE005.03	CLO 3	Employ capillary principle to calculate capillary rise/fall in a given tube.	PO 2	2
CACE005.04	CLO 4	Interpret different forms of pressure measurement.	PO 2	2
CACE005.05	CLO 5	Employ principle of manometry to measure gauge and differential pressure.	PO 2	2
CACE005.06	CLO 6	Employ principle of manometry to measure gauge and differential pressure surface.	PO 2	2
CACE005.07	CLO 7	Examine the possibility of a flow using continuity equation	PO 1 PO 2	3
CACE005.08	CLO 8	Employ Archimedes principle to solve numerical examples on Buoyancy	PO 1 PO 2	3
CACE005.09	CLO 9	Identify and interpret different flows with relevant equations	PO 1 PO 2	3
CACE005.10	CLO 10	Distinguish velocity potential function and stream function and solve for velocity and acceleration of a fluid at a given location in a fluid flow	PO 1 PO 2	3
CACE005.11	CLO 11	Examine stability of a floating body by determining its metacentric height	PO 1 PO 2	3
CACE005.12	CLO 12	Establish Euler's theorem and deduce Bernoulli's equation for a ideal fluid and comment on validation assumption made.	PO 1 PO 2	3
CACE005.13	CLO 13	Examine Bernoulli's equation for ideal and real fluids and evaluate the direction of flow	PO 1 PO 2	3
CACE005.14	CLO 14	Flow and velocity measuring instruments.	PO 1	3
CACE005.15	CLO 15	Employ Darcy-Weischbach and Chezy's equation to calculate friction losses	PO 1	3
CACE005.16	CLO 16	Describe flow through pipes, and Distinguish between major loss and minor loss in pipes.	PO 3	2
CACE005.17	CLO 17	Sketch HGL and TEL for a given pipe setting.	PO 2	2

CLO Code	CLO's	At the end of the course, the student will have the ability to:	PO's Mapped	Strength of Mapping
CACE005.18	CLO 18	Distinguish between Drag force and lift force and Examine drag and lift force for a given set	PO 1	3
CACE005.19	CLO 19	Write the boundary layer concept.	PO 3	2
CACE005.20	CLO 20	Distinguish displacement, momentum, and energy thickness	PO 2	2
CACE005.21	CLO 21	Explain the concept of Prandtl contribution.	PO 3	2
CACE005.22	CLO 22	Evaluate the Vonkarmen momentum integral equation.	PO 3	2
CACE005.23	CLO 23	Analyze the closed conduit flows using Reynolds experiment. Sketch laminar and turbulent	PO 3	2
CACE005.24	CLO 24	Possess the knowledge and skills for employability and to succeed in national and International level competitive examinations.	PO 10	1

3 = High; 2 = Medium; 1 = Low

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

Course Learning Outcomes (CLOs)	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CLO 1	3												3		
CLO 2	3	2	2										2		
CLO 3	3												3		
CLO 4		2											1		
CLO 5		2											2		
CLO 6		2	2										1		
CLO 7			3	1									3		
CLO 8			2	1									1		
CLO 9		2											3		
CLO 10		2	2										3		1
CLO 11	3												2		
CLO 12	3												2		1
CLO 13	3												1		2
CLO 14	3	2	2									1	1		
CLO 15		2	1									1	1		
CLO 16		2		2									3		
CLO 17	3	2											1		

Course Learning Outcomes (CLOs)	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CLO 18	3	2											1		
CLO 19	3	2											1		
CLO 20	3	2											1		
CLO 21	3												1		
CLO 22	3												1		1
CLO 23	3		3										2		
CLO 24										1			1		

3 = High; 2 = Medium; 1 = Low

XI. ASSESSMENT METHODOLOGIES – DIRECT

CIE Exams	PO 1, PO 2, PO 3, PO 4, PO10 & PO 12	SEE Exams	PO 1, PO 2, PO 3, PO 4, PO10&PO 12	Assignments	PO 1, PO 2, PO 3&PO10	Seminars	PO 12
Laboratory Practices	-	Student Viva	PO 1	Mini Project	-	Certification	-
Term Paper	-						

XII. ASSESSMENT METHODOLOGIES - INDIRECT

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

XIII. SYLLABUS

UNIT - I	INTRODUCTION & 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.	
UNIT - II	**FLUID KNIEMATICS**
Description of fluid flow, Stream line, path line and streak lines and stream tube. Classification of flows: Steady and unsteady, uniform and non-uniform, laminar and turbulent, rotational and irrotational flows. Equation of continuity for 1 - D, 2 - D, and 3 - D flows – stream and velocity potential functions, flow net analysis.	
UNIT-III	**FLUID DYNAMICS**
Euler's and Bernoulli's equations for flow along a streamline for 3 - D flow, Navier – Stokes equations (Explanationary), Momentum equation and its applications. Forces on pipe bend. Pitot-tube,	

Venturimeter and Orifice meter, classification of orifices, flow over rectangular, triangular, trapezoidal and stepped notches, Broad crested weirs.	
UNIT-IV	**BOUNDARY LAYER THEORY**
Approximate Solutions of Navier-Stoke's Equations, Boundary layer (BL) – concepts, Prandtl contribution, Characteristics of boundary layer along a thin flat plate, Vonkarmen momentum integral equation, laminar and turbulent boundary layers (no deviation), BL in transition, separation of BL, control of BL, flow around submerged objects, Drag and Lift forces , Magnus effect.	
UNIT-V	**CLOSED CONDUIT FLOW**
Reynolds experiment – Characteristics of Laminar & Turbulent flows. Flow between parallel plates, flow through long pipes, flow through inclined pipes. Laws of Fluid friction – Darcy's equation, minor losses, pipes in series and pipes in parallel. Total energy line and hydraulic gradient line. Pipe network problems, variation of friction factor with Reynolds number – Moody's chart, Water hammer effect..	
Text Books:	
1. Modi and Seth, "Fluid Mechanics‖", Standard book house, 2011. 2. R.K. Rajput, "A text of Fluid mechanics and hydraulic machines", S. Chand & company Pvt. Ltd, Sixth Edition, 2015. 3. S.K. Som & G. Biswas, ―Introduction to Fluid Machines‖, Tata Mc Grawhill publishers Pvt. Ltd, 2010. 4. D. Ramdurgaia, ― Fluid Mechanics and Machinery‖, New Age Publications, 2007.	
Reference Books:	
1. Shiv Kumar, ―Fluid Mechanics Basic Concepts & Principles‖, Ane Books Pvt Ltd., 2010. 2. R.K. Bansal ,‖A text of Fluid mechanics and hydraulic machines‖ - Laxmi Publications (P) ltd., New Delhi 2011.	

XIV. COURSE PLAN:

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

Lecture No	Topics to be covered	Course Learning Outcomes (CLOs)	Reference
1 - 2	Explain of various units	CLO1	T1: 1.1-3 R2:1-1.7
3 - 4	Explain fluid properties	CLO1	T1: 2.4 R2:1-1.7
5 - 6	Understand the concept Newton laws of viscosity	CLO2	T1: 2.6-14 R2:1-1.7
7 - 8	Understand the concept of capillarity and surface tension	CLO3	T1: 2.15-20 R2:1-1.7
9	Distinguish various pressures	CLO4	T1: 3.1-.3 R2:2-2.8
10 - 13	Determine pressure with different instruments	CLO5	T1: 3.5-14 R2:2-2.8
14	Differentiate various flow lines	CLO10	T1: 6.1-5 R2:2-2.8
15 - 16	Classify and describe various flows	CLO8	T1: 9.1-5 R2:2-2.8
17 - 19	Compute rate of flow or Discharge	CLO9	T1: 9.6-7 R2:2-2.8
20 - 22	Explore the continuity equation	CLO8	T1: 9.6-7 R2: 3-3.8
23 - 25	Distinguish the various acceleration	CLO10	T1: 9.6-7 R2: 3-3.8

Lecture No	Topics to be covered	Course Learning Outcomes (CLOs)	Reference
26	Explore velocity potential function and stream function	CLO10	T1:9.6-11 R2: 3-3.8
27 - 28	Define various forces	CLO11	T1: 10.1-5 R2: 4-4.8
29 - 30	Formulate Euler's equation of motion	CLO12	T1: 10.5-7 R2: 4-4.8
31 - 32	Formulate Bernoulli's equation of motion	CLO13	T1: 10.7 R2: 4-4.8
32 - 35	Details Apply momentum equation for a pipe bend	CLO16	T1: 11.1-7 R2: 11-11.10
35 - 38	Define boundary layer	CLO19	T4: 2.1 -2.2 R2: 13-13.7
39 - 41	Distinguish boundary layer of laminar, turbulent and transition	CLO20	T4: 2.3 -2.6 R2: 13-13.7
42 - 45	Explain separation of boundary layer	CLO20	T4: 2.7 - 2.9 R2: 13-13.7
46 - 48	Demonstrate Reynolds experiment	CLO15	T4: 3.8 - 3.10 R2: 19&20
49 - 52	Formulate the Darcy's equation	CLO15	T4: 4.1 - 4.6 R2: 19&20
53 - 55	Discuss the series and parallel connection of pipes	CLO17	T4: 6.1 - 6.3 R2: 19&20
56 - 58	Construct total energy and hydraulic gradient lines	CLO17	T4: 7.1 - 7.6 R2: 19&20
59 - 60	Measure the discharge	CLO14	T4: 8.1 - 8.9 R2: 19&20

XV. GAPS IN THE SYLLABUS - TO MEET INDUSTRY / PROFESSION REQUIREMENTS:

S No	Description	Proposed actions	Relevance with POs	Relevance with PSOs
1	To improve standards and analyze the concepts.	Seminars	PO 1	PSO 1
2	Conditional probability, Sampling distribution, correlation, regression analysis and testing of hypothesis	Seminars / NPTEL	PO 4	PSO 1
3	Encourage students to solve real time applications and prepare towards competitive examinations.	NPTEL	PO 2	PSO 1

Prepared by:

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CIVIL ENGINEERING

COURSE DESCRIPTOR

Course Title	**GEOTECHNICAL ENGINEERING**				
Course Code	ACE006				
Programme	B.Tech				
Semester	IV	CE			
Course Type	Core				
Regulation	IARE - R16				
Course Structure	**Theory**			**Practical**	
	Lectures	**Tutorials**	**Credits**	**Laboratory**	**Credits**
	3	1	4	3	2
Chief Coordinator	Mrs. J. Hymavathi, Assistant Professor				
Course Faculty	Mr. Y. Ravi Kumar, Assistant Professor				

I. COURSE OVERVIEW:

Civil Engineers are required to construct structures on the soil. The loads coming onto these structures, along with the self-weight, have to be safely transmitted to the soil beneath it. A geotechnical engineer must be able to design a footing in such a way that soil below it will not fail there will not be any excessive settlements in the soil. This foundational course in civil engineering is intended to introduce to concepts of types of soils present in nature, properties of soil on which the load carrying capacity of the soil depends For this, the concept of (a) types of soil present in nature and their properties which in turn effect the load carrying capacity of soil, (b) shear strength of the soils, (c) settlement reduction by compaction and consolidation are covered in depth. The important calculations of stresses due to self weight and externally applied loads and the consequent theory of failures for prediction of the strength of the soils are also discussed. Through this course content engineers can design the foundation for safety and serviceability.

II. COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites
UG	AME002	II	Engineering Mechanics

III. MARKS DISTRIBUTION:

Subject	SEE Examination	CIA Examination	Total Marks
Geotechnical Engineering	70 Marks	30 Marks	100

IV. DELIVERY / INSTRUCTIONAL METHODOLOGIES:

✔	Chalk & Talk	✔	Quiz	✔	Assignments	✘	MOOCs
✔	LCD / PPT	✔	Seminars	✔	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 units and each unit carries equal weightage in terms of marks distribution. The question paper pattern is as follows. Two full questions with "either" or "choice" will be drawn from each unit. Each question carries 14 marks. There could be a maximum of two sub divisions in a question.

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

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

Continuous Internal Assessment (CIA):
CIA is conducted for a total of 30 marks (Table 1), with 25 marks for Continuous Internal Examination (CIE), 05 marks for Quiz/ Alternative Assessment Tool (AAT).

Table 1: Assessment pattern for CIA

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

Continuous Internal Examination (CIE):

Two CIE exams shall be conducted at the end of the 8th and 16th week of the semester respectively. The CIE exam is conducted for 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 / Alternative Assessment Tool (AAT):

Two Quiz exams shall be online examination consisting of 25 multiple choice questions and are be answered by choosing the correct answer from a given set of choices (commonly four). Marks shall be awarded considering the average of two quizzes for every course. The AAT may include seminars, assignments, term paper, open ended experiments, five minutes video and MOOCs.

VI. HOW PROGRAM OUTCOMES ARE ASSESSED:

Program Outcomes (POs)		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	Assignments/ Exams
PO 2	**Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences	2	Assignments/ Exams
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	Assignments/ Mini project
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	Open Ended Experiments
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	Mini Project
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	Seminars/Mini Project
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.	1	Seminars/ Workshop

3 = High; 2 = Medium; 1 = Low

VII. HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

Program Specific Outcomes (PSOs)		Strength	Proficiency assessed by
PSO 1	**Engineering Knowledge**: Graduates shall demonstrate sound knowledge in analysis, design, laboratory investigations and construction aspects of civil engineering infrastructure, along with good foundation in mathematics, basic sciences and technical communication.	2	Assignments/ Exams
PSO 2	**Broadness and Diversity:** Graduates will have a broad understanding of economical, 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.	-	-
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	Seminars/ Workshop

3 = High; 2 = Medium; 1 = Low

VIII. COURSE OBJECTIVES (COs):

The course should enable the students to:	
I	Identify the type of soil based on index properties of soils, soil formation & its structure
II	Recognize the importance of permeability for calculating the seepage through soils. Find out the coefficient of permeability using various laboratory & field tests.
III	Analyze the stress at any point below the ground surface due to self weight and externally applied load. Interpret the importance of consolidation and compaction on the settlement of footing.
IV	Recognize the importance of shear strength in load carrying capacity of soil. Calculate the shear strength of soil using various laboratory tests.

IX. COURSE LEARNING OUTCOMES (CLOs):

CLO Code	CLO's	At the end of the course, the student will have the ability to:	PO's Mapped	Strength of Mapping
ACE006.01	CLO 1	Calculate the unit weights in various field conditions using different relationships	PO 1, PO 3, PO4, PO6, PO9	2
ACE006.02	CLO 2	Examine water content, specific gravity, bulk density and dry densities of a soil using various laboratory and field tests.	PO1,PO2, PO4,PO12	1
ACE006.03	CLO 3	Identify the type of soil present in the site by using particle size distribution curve & other index properties of soils as per IS soil classification system	PO3	1
ACE006.04	CLO 4	Find the Atterberg limits of soils which is used in classifying the fine grained soils	PO3	1
ACE006.05	CLO 5	Understand the permeability of soil & find out the range of coefficient of permeability in various soil types.	PO1,PO3 PO9	1
ACE006.06	CLO 6	Explain the importance of permeability in calculation of seepage through earthen dams, amount of water to be pumped when the soil is excavated below ground water table.	PO3,PO4, PO6	1
ACE006.07	CLO 7	Evaluate the coefficient of permeability using falling head tests and constant head tests	PO3,PO4, PO9,PO12	1
ACE006.08	CLO 8	Evaluate the coefficient of permeability using pumping in and pumping out tests	PO4,PO6, PO9	2
ACE006.09	CLO 9	Calculate the stresses beneath the ground level due to self weight of soil	PO1,PO2, PO3,PO12	1
ACE006.10	CLO 10	Analyze the importance of total, neutral and effective stress in load carrying capacity of soil	PO1,PO2, PO4,PO6, PO12	1
ACE006.11	CLO 11	Sketch the total, neutral and effective stress distribution diagram for various field conditions	PO1,PO2, PO4,PO12	1
ACE006.12	CLO 12	Explain quick sand condition, its occurrence and its significance	PO1,PO2, PO3,PO4, PO12	1
ACE006.13	CLO 13	Understand the importance of flow net in calculating seepage loss, uplift pressure, exit hydraulic gradient	PO1,PO2, PO3,PO4	1
ACE006.14	CLO 14	Calculate the stress below the ground due to externally applied load using Boussinesq's theory	PO1,PO2, PO3,PO4	1
ACE006.15	CLO 15	Calculate stress due to load using Westergaard's and approximate method of stress distribution	PO1,PO2, PO4,PO12	1
ACE006.16	CLO 16	Importance of compaction in reducing the immediate settlement, improving the load carrying capacity	PO1,PO2, PO3,PO4, PO12	1
ACE006.17	CLO 17	Determining the maximum dry density and optimum moisture content of soil using standard proctor test soil. List the various field equipments used for compacting	PO1,PO2, PO3,PO4, PO9,PO12	1

		the different types of soils.		
ACE006.18	CLO 18	Recognize the importance of consolidation in settlement calculation & calculate the consolidation settlement especially in clayey soils.	PO1,PO2, PO3,PO4, PO12	1
ACE006.19	CLO 19	Determination of consolidation parameters of a soil using laboratory test such as using square root of time fitting method, logarithmic square method and height of solids method.	PO1,PO2, PO3,PO4, PO12	1
ACE006.20	CLO 20	Understand the shear failure criteria proposed by Mohr-coulomb and shear parameters of soil	PO1,PO2, PO3,PO12	2
ACE006.21	CLO 21	Determination of shear strength of soil using direct shear test and tri-axial test in various drainage conditions.	PO1,PO2, PO3,PO9, PO12	2
ACE006.22	CLO 22	Recognize the behavior of soil in normal, over and under consolidated soil. Understand the concept of dilatancy in sandy soil.	PO1,PO2, PO3,PO4, PO6,PO12	1
ACE006.23	CLO 23	Posses the Knowledge and Skills for employability and to succeed in national and international level competitive examinations.	PO1,PO2, PO3,PO4, PO6,PO12	1

3 = High; 2 = Medium; 1 = Low

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

CLO	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CLO 1	3		2	1		1			1				3		
CLO 2	2	3		1								1	1		
CLO 3			3												1
CLO 4			2										3		
CLO 5	2		1						2				2		
CLO 6			3	1		1							3		
CLO 7			2	1					2			1	3		1
CLO 8				3		1			3				1		
CLO 9	3	3	1									1	3		1
CLO 10	3	2		1		1						1	3		1
CLO 11	2	2		1								1	1		1
CLO 12	2	1	1	1								1	1		
CLO 13	2	2	1	1									2		1
CLO 14	2	3	2	2									1		2
CLO 15	3	3		1								1	3		1
CLO 16	2	2	1	1								2	2		1

CLO 17	2	1	1	2					2			1			1
CLO 18	3	3	1	1								2	3		1
CLO 19	2	2	1	1								1	2		1
CLO 20	1	2	2									1			
CLO 21	3	2	1						2			1	3		
CLO 22	2	1	1	1		1						1	2		
CLO 23	1	1	1	1		1						1			1

3 = High; 2 = Medium; 1 = Low

XI. ASSESSMENT METHODOLOGIES – DIRECT

CIE Exams	PO 1, PO2, PO3, PO4, PO6, PO 9, PO12	SEE Exams	PO1,PO2,PO3, PO4, PO6, PO9, PO12	Assignments	PO 1, PO2, PO3	Seminars	PO 9, PO12
Laboratory Practices	PO 1	Student Viva	PO1,PO2,PO 3, PO4, PO6, PO9, PO12	Mini Project	PO3, PO6,PO9	Certificatior	-
Term Paper	-						

XII. ASSESSMENT METHODOLOGIES - INDIRECT

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

XIII. SYLLABUS

Unit-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.	
Unit-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.	
Unit-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.	
Unit-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.	
Unit-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.	
Text Books:	
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. Manoj dutta and Gulati, "Geotechnical engineering", Tata Mc Grawhill 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.	

XIV. COURSE PLAN:

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

Lecture No	Topics to be covered	Course Learning Outcomes (CLOs)	Reference
1-2	Introduction to geotechnical engineering, properties of soils	CLO 1	T1:1.1, R2:2.2
3	Formation of soil and soil structures	CLO 1	T1:1.4, R2:2.3
4	Clay mineralogy and adsorbed water	CLO 2	T:6.6, R2:2.6
5-6	Mass volume relationship	CLO 2	T1:3.1, R2:2.8
7	Relative density	CLO 4	T3:3.15,R2:2.9
8-9	Index properties of soils: grain sizes analysis	CLO 3	T1:3.3, R2:2.10
10-11	Sieve and hydrometer method of analysis	CLO 3	T1:3.8, R2:2.11
12-13	Consistency limit and indices of soil	CLO 4	T1:3.9, R2:2.12
14	I.S. classification of soils	CLO 3	T1:4.3, R2:2.13
15-16	Permeability - soil water –capillary rise	CLO 5	T1:5.9, R1:3.1
17-18	Flow of water through soil	CLO 5	T1:5.4, R1:3.2
19-20	Darcy's law	CLO 6	T1:5.4.1, R1:3.3
21-22	Permeability and factors effecting, laboratory determination of coefficient of permeability	CLO 7	T1:5.6, R1:3.4
23-24	Permeability of layered systems	CLO 8	T1:5.8, R1:3.4.1
25-26	Seepage through soils –total, neutral and effective stresses quick sand conditions	CLO 12	T1:6.9 to 6.10, R1:3.5
27	Seepage through soils	CLO 11	T1:6.5, R1:3.5.2
28-30	Flow nets, characteristics and uses	CLO 13	T1:6.3 , R1:3.6
31	Stress distribution in soils – Boussinesq's theory for point loads and areas of different shapes	CLO 14	T1:7.22, R2:4.6
32-33	Westergaard's theory for point loads and area of different	CLO 15	T1:7.22,

Lecture No	Topics to be covered	Course Learning Outcomes (CLOs)	Reference
	shapes		R2:4.7
34-35	Newmark's influences chart	CLO 15	T1:12.3.2, R2:4.8
36-37	Compaction- mechanism of compaction	CLO 16	T1:12.6.1, R1: 4.1
38	Factors effecting compaction of soils properties	CLO 16	T1:12.6.2, R1: 4.1.2
39-40	Effect of compaction on soil properties	CLO 17	T1:12.6.2, R1: 4.2
41-42	Field compaction equipment	CLO 17	T1:12.6.2, R1: 4.3
43-44	Compaction control	CLO 17	T1:12.6.3, R1: 4.4
45-46	Consolidation –stress history of clay	CLO 18	T1:7.4, R1: 6.1
47-49	e-p and e- log p curves	CLO 19	T1:10.2.1, R1: 6.4
50-52	Magnitude and rates of 1-d consolidation	CLO 19	T1:10.2.4, R1: 6.6
53-54	Terzaghi's theory	CLO 18	T1:10.7, R1: 6.7
55-57	shear strength of soils –Mohr and Coulomb failure theories	CLO 20	T1:8.4.2, R2: 8.1
58-60	Types of laboratory strength test	CLO 21	T1:8.8, R2: 8.2
61-62	Strength test based on drainage conditions	CLO 21	T1:8.12.2, R2: 8.2.4
63-64	Shear strength of sands	CLO 22	T1:8.11.3, R2: 8.4
65-66	Critical void ratio of clay	CLO 22	T1:8.11.2, R2: 8.5
67-68	Liquefaction and shear strength of clay	CLO 22	T1:8.12, R2: 8.6

XV. GAPS IN THE SYLLABUS - TO MEET INDUSTRY / PROFESSION REQUIREMENTS:

S No	Description	Proposed actions	Relevance with POs	Relevance with PSOs
1	Methods for obtaining flow nets, seepage in anisotropic soils	Seminars/Guest Lectures/NPTEL	PO 3, PO 4	PSO 1
2	Stresses in soil due to externally applied line, strip and trapezoidal loading	Seminars/Guest Lectures/NPTEL	PO 1	PSO 1
3	Fields tests to determine the shear strength of soils	Seminars/NPTEL	PO 4	PSO 1

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HOD, CIVIL ENGINEERING

INSTITUTE OF AERONAUTICAL ENGINEERING

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CIVIL ENGINEERING

COURSE DESCRIPTOR

Course Title	**BUILDING MATERIALS, CONSTRUCTION AND PLANNING**				
Course Code	ACE007				
Programme	B.Tech				
Semester	IV	CE			
Course Type	Foundation				
Regulation	IARE - R16				
Course Structure	**Theory**			**Practical**	
	Lectures	**Tutorials**	**Credits**	**Laboratory**	**Credits**
	3	1	4	-	-
Chief Coordinator	Mr. KAnand Goud, Assistant Professor				
Course Faculty	Mr. KAnand Goud, Assistant Professor Mr. P Vinay Kumar, Assistant Professor				

I. COURSE OVERVIEW:

A 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. Specific topics may include record keeping, job-site management, use of subcontractors and scheduling. Specific computer software may be used for construction project scheduling. Students typically work on sample projects in order to gain real-world experience in planning and scheduling construction projects.

II. COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites
UG	ACE003	III	Engineering Geology

III. MARKSDISTRIBUTION:

Subject	SEE Examination	CIA Examination	Total Marks
Building Materials Construction And Planning	70 Marks	30 Marks	100

IV. DELIVERY / INSTRUCTIONAL METHODOLOGIES:

✔	Chalk & Talk	✔	Quiz	✔	Assignments	✘	MOOCs
✔	LCD / PPT	✔	Seminars	✘	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 units and each unit carries equal weightage in terms of marks distribution. The question paper pattern is as follows. Two full questions with "either" or "choice" will be drawn from each unit. Each question carries 14 marks. There could be a maximum of two sub divisions in a question.

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

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

Continuous Internal Assessment (CIA):
CIA is conducted for a total of 30 marks (Table 1), with 25 marks for Continuous Internal Examination (CIE), 05 marks for Quiz/ Alternative Assessment Tool (AAT).

Table 1: Assessment pattern for CIA

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

Continuous Internal Examination (CIE):
Two CIE exams shall be conducted at the end of the 8th and 16th week of the semester respectively. The CIE exam is conducted for 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 / Alternative Assessment Tool (AAT):
Two Quiz exams shall be online examination consisting of 25 multiple choice questions and are be answered by choosing the correct answer from a given set of choices (commonly four). Marks shall be awarded considering the average of two quizzes for every course. The AAT may include seminars, assignments, term paper, open ended experiments, five minutes video and MOOCs.

VI. HOW PROGRAM OUTCOMES ARE ASSESSED:

Program Outcomes (POs)		Strength	Proficiency assessed by
PO 1	**Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.	3	Presentation on real-world problems
PO 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	Assignments
PO 4	**Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.	2	Open ended experiments

3 = High; 2 = Medium; 1 = Low

VII. HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

Program Specific Outcomes (PSOs)		Strength	Proficiency assessed by
PSO 1	**Engineering knowledge:** Graduates shall demonstrate sound knowledge in analysis, design, laboratory investigations and construction aspects of civil engineering infrastructure, along with good foundation in mathematics, basic sciences and technical communication	3	Guest Lectures
PSO 2	**Broadness and diversity:** Graduates will have a broad understanding of economical, 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.	2	Guest Lectures
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.	-	-

3 = High; 2 = Medium; 1 = Low

VIII. COURSE OBJECTIVES (COs):

The course should enable the students to:	
I	Develop knowledge of material science and behaviour of various building materials used in construction.
II	Identify the construction materials required for the assigned work.
III	Provide procedural knowledge of the simple testing methods of cement, lime and concrete etc.

IX. COURSE LEARNING OUTCOMES (CLOs):

CLO Code	CLO's	At the end of the course, the student will have the ability to:	PO's Mapped	Strength of Mapping
CACE007.01	CLO 1	Predict the properties of building stones and its classifications.	PO 1	3
CACE007.02	CLO 2	Understand the concept of various methods of manufacture of bricks.	PO 1	3
CACE007.03	CLO 3	Identify rock using basic geological classification systems	PO 1	3
CACE007.04	CLO 4	Differentiate the fine aggregates and coarse aggregates under various views.	PO 3	2
CACE007.05	CLO 5	Explain various types of cements and their applications in construction. Various field and laboratory tests on cement.	PO 3	2
CACE007.06	CLO 6	Analyze the importance of mineral and chemical admixtures, requirements of the concrete in construction.	PO 4	2
CACE007.07	CLO 7	Explain different types of lintel, arches and the materials which are commonly used for construction.	PO 4	2
CACE007.08	CLO 8	Explain the suitability of floors in buildings like mosaic flooring, terrazzo flooring, rubber flooring, asphalt flooring.	PO 4	2
CACE007.09	CLO 9	Understand the different types of trusses, RCC roofs, madras terrace/shell roofs.	PO 1	2
CACE007.10	CLO 10	Explain the foundations and uses of different types of foundations.	PO 4	2
CACE007.11	CLO 11	Develop the building walls and foundations how they will help for buildings and details to precise the type of Footings.	PO 1	3
CACE007.12	CLO 12	Explain the classification of various types of woods. State the properties, seasoning of Timber.	PO 4	3
CACE007.13	CLO 13	Understand the Types of properties of wood, aluminium and manufacture of glass.	PO 4	2
CACE007.14	CLO 14	Differentiate the uses of Galvanized iron, fiber-reinforcement plastics, steel and aluminium in construction.	PO 4	3
CACE007.15	CLO 15	Understand masonry, english and flemish bonds. finishing plastering painting and know about building services.	PO 3	2
CACE007.16	CLO 16	Explain Geometrical design of RCC doglegged and open-well stairs. Classification of staircase and technical terms and types of stairs.	PO 3	3
CACE007.17	CLO 17	Principle of building planning and by laws and standards of building material Components and orientation of the building.	PO 1, PO 4	2
CACE007.18	CLO 18	Possess the knowledge and skills for employability and to succeed in national and international level competitive examinations.	PO 1, PO 3	2
CACE007.19	CLO 19	Understand the requirements of good stairs.	PO 1	3
CACE007.20	CLO 20	Design RCC doglegged and open-well stairs.	PO 3	3

3 = High; 2 = Medium; 1 = Low

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

Course Learning Outcomes (CLOs)	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CLO 1	3												3		
CLO 2	3												1		
CLO 3	3													2	
CLO 4			2										1		
CLO 5			2											2	
CLO 6				2										2	
CLO 7				2									2		
CLO 8				3									1		
CLO 9	2												1		
CLO 10				2								2	3		
CLO 11	3												3		
CLO 12				3									2		
CLO 13				2								2		3	
CLO 14				3									1		
CLO 15			2										3		
CLO 16			3										3		
CLO 17	2			2										3	
CLO 18	2		2										3		
CLO 19	3													3	
CLO 20			3										3		

3 = High; 2 = Medium; 1 = Low

XI. ASSESSMENT METHODOLOGIES–DIRECT

CIE Exams	PO 1; PO 3; PO 4	SEE Exams	PO 1; PO 3; PO 4	Assignments	PO 3	Seminars	PO 4
Laboratory Practices	-	Student Viva	-	Mini Project	-	Certification	-
Term Paper	-						

XII. ASSESSMENT METHODOLOGIES-INDIRECT

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

XIII. SYLLABUS

Unit-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.	
Unit-II	**CEMENT AND ADMIXTURES**
Various types of cement and their properties; Various field 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.	
Unit-III	**BUILDING COMPONENTS AND FOUNDATIONS**
Lintels, arches, different types of floors-concrete, mosaic, terrazzo floors, pitched, flat and curved roofs, lean-to-roof, coupled roofs, trussed roofs, king and queen post trusses; RCC roofs, madras terrace/shell roofs; Foundations: Shallow foundations, spread, combined, strap and mat footings..	
Unit-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, fibre-reinforced plastics, steel, aluminium; Types of masonry, English and Flemish bonds, rubble and ashlars masonry, cavity and partition walls.	
Unit-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.	
Text Books:	
1. S. K. Duggal, "Building Materials", New Age International Publishers. 2. Sushil Kumar "Building Materials and construction", Standard Publishers, 20th edition, reprint, 2015. 3. Dr.B. C. Punmia, Ashok kumar Jain, Arun Kumar Jain, "Building Construction", Laxmi Publications (P) ltd., New Delhi. 4. Rangawala S. C. "Engineering Materials‖", Charter Publishing House, Anand, India	
Reference Books:	
1. PC Verghese, "Building Construction", PHI. 2. R. Chuddy, "Construction Technology",Vol 1&2, Longman UK. 3. Subhash Chander, "Basic Civil Engineering", Jain Brothers.	

XIV. COURSE PLAN:

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

Lecture No	Topics to be covered	Course Learning Outcomes (CLOs)	Reference
1-2	Understand stones, bricks and aggregates.	CLO 1	T1:3.1, 2.4,6.1
3-4	Understand Properties of building stones.	CLO 1	T1:3.9
5	Explain Classification of stones	CLO 1	T1:3.3
6	Explain stone quarrying.	CLO 1	T1:3.4
7	Study about precautions in blasting	CLO 1	T1:3.4
8-9	Study of dressing of stone.	CLO 1	T1:3.7
10	Understand the composition of good brick earth.	CLO 2	T1:2.7
11-12	Understand various methods of manufacture of bricks.	CLO 2	T1:2.9
13	Explain Comparison between clamp burning and kiln burning.	CLO 2	T1:2.9
14-15	Explain Fine aggregate: Natural and manufactured Sieve analysis, zoning	CLO 4	T1:6.2, 6.12
16	Explain specify gravity, bulking, moisture content,	CLO 1	T1:6.8
17	Identify deleterious materials	CLO 2	T1:6.4
18-19	Explain Coarse aggregate: Natural and manufactured: Importance of size, shape and texture.	CLO 4	T1:6.9
20	Explain the various types of cement	CLO 5	T1:5.1,5.2
21	Explain properties of cement	CLO 5	T1:5.1,5.2
22-23	Explain the various field and laboratory tests for cement;	CLO 5	T1:5.9
24	Explain various ingredients of cement.	CLO 5	T1:5.3,5.4
25-26	Explain various tests for concrete: Field and lab tests.	CLO 6	T1:10
27-28	Explain admixtures: mineral and chemical admixture.	CLO 6	T1:10.17
29	Explain Building Components Lintels, arches.	CLO 7	T2:9.1
30	Explain different types of floors-concrete, mosaic, terrazzo floors.	CLO 8	T2:12
31-32	Explain the pitched, flat and curved roofs, lean-to-roof, coupled roofs, trussed roofs.	CLO 9	T2:13
33	Explain the king and queen post. Trusses.	CLO 9	T2:13.1
34	Explain RCC roofs, madras terrace/shell roofs.	CLO 9	T2:13
35-36	Introduction to the Foundations: Shallow foundations, spread, combined, strap and mat footings.	CLO 10	T2:9.2
37	Explain classification of various types of woods used in buildings.	CLO12	T1:4.4
38	Explain defects in timber.	CLO 12	T1:4.8
39	Understand Alternative materials for wood, galvanized iron, fibre-reinforced plastics, steel, aluminium.	CLO 14	T1:4.14, 4.17
40	Explain Types of masonry, English and Flemish bonds, rubble and ashlars masonry, cavity and partition walls.	CLO 14	T2:11
41	Explain stairs and building planning; Stairs Definitions, technical terms and types of stairs	CLO 16	T2:8
42-43	Explain the Geometrical design of RCC doglegged and open-well stairs	CLO 14	T2:8
44	Explain Principles of building planning,	CLO 17	T2:9
45	Explain the building by laws.	CLO 17	T2:14

XV. GAPS IN THE SYLLABUS - TO MEET INDUSTRY / PROFESSION REQUIREMENTS:

S no	Description	Proposed actions	Relevance with POs	Relevance with PSOs
1	Knowledge of construction materials, various cement properties and their tests.	Seminars/Guest Lectures/NPTEL	PO 1	PSO 1
2	Analyze the sequence of construction work. Building components and foundation	Seminars/Guest Lectures/NPTEL	PO 3	PSO 1
3	Knowledge of building planning and building By-Laws	Seminars/ Assignments	PO 4	PSO 1

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CIVIL ENGINEERING

COURSE DESCRIPTOR

Course Title	**MATHEMATICAL TRANSFORM TECHNIQUES**				
Course Code	AHS011				
Programme	B.Tech				
Semester	II	EEE			
	III	AE | ECE			
	IV	ME | CE			
Course Type	Foundation				
Regulation	IARE - R16				
Course Structure	**Theory**			**Practical**	
	Lectures	**Tutorials**	**Credits**	**Laboratory**	**Credits**
	3	1	4	-	-
Chief Coordinator	Ms. B Praveena, Assistant Professor				
Course Faculty	Dr. S Jagadha, Associate Professor Ms. V Subba Laxmi, Assistant Professor				

I. COURSE OVERVIEW:

The course focuses on more advanced engineering mathematics topics which provide with the relevant mathematical tools required in the analysis of problems in engineering and scientific professions. The course includes types of matrices, difference calculus methods and differential equations. The mathematical skills derived from this course form a necessary base to analytical and design concepts encountered in the program.

II. COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites
-	-	-	Basic principles of integration

III. MARKS DISTRIBUTION:

Subject	SEE Examination	CIA Examination	Total Marks
Mathematical Transform Techniques	70 Marks	30 Marks	100

IV. DELIVERY / INSTRUCTIONAL METHODOLOGIES:

✔	Chalk & Talk	✔	Quiz	✔	Assignments	✘	MOOCs
✔	LCD / PPT	✔	Seminars	✘	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 units and each unit carries equal weightage in terms of marks distribution. The question paper pattern is as follows. Two full questions with "either" or "choice" will be drawn from each unit. Each question carries 14 marks. There could be a maximum of two sub divisions in a question.

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

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

Continuous Internal Assessment (CIA):
CIA is conducted for a total of 30 marks (Table 1), with 25 marks for Continuous Internal Examination (CIE), 05 marks for Quiz/ Alternative Assessment Tool (AAT).

Table 1: Assessment pattern for CIA

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

Continuous Internal Examination (CIE):
Two CIE exams shall be conducted at the end of the 8th and 16th week of the semester respectively. The CIE exam is conducted for 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 / Alternative Assessment Tool (AAT):
Two Quiz exams shall be online examination consisting of 25 multiple choice questions and are be answered by choosing the correct answer from a given set of choices (commonly four). Marks shall be awarded considering the average of two quizzes for every course. The AAT may include seminars, assignments, term paper, open ended experiments, five minutes video and MOOCs.

VI. HOW PROGRAM OUTCOMES ARE ASSESSED:

Program Outcomes (POs)		Strength	Proficiency assessed by
PO 1	**Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.	3	Presentation on real-world problems
PO 2	**Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences	2	Seminar
PO 4	**Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.	2	Term Paper

3 = High; 2 = Medium; 1 = Low

VII. HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

Program Specific Outcomes (PSOs)		Strength	Proficiency assessed by
PSO 1	**Engineering knowledge:** Graduates shall demonstrate sound knowledge in analysis, design, laboratory investigations and construction aspects of civil engineering infrastructure, along with good foundation in mathematics, basic sciences and technical communication	1	Seminar
PSO 2	**Broadness and diversity:** Graduates will have a broad understanding of economical, 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.	-	-
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	-	-

3 = High; 2 = Medium; 1 = Low

VIII. COURSE OBJECTIVES (COs):

The course should enable the students to:	
I	Epress non periodic function to periodic function using Fourier series and Fourier transforms.
II	Apply Laplace transforms and Z-transforms to solve differential equations.
III	Formulate and solve partial differential equations.

IX. COURSE LEARNING OUTCOMES (CLOs):

CLO Code	CLO's	At the end of the course, the student will have the ability to:	PO's Mapped	Strength of Mapping
AHS011.01	CLO 1	Ability to compute the Fourier series of the function with one variable.	PO 1	3
AHS011.02	CLO 2	Understand the nature of the Fourier series that represent even and odd functions.	PO 1	3
AHS011.03	CLO 3	Determine Half- range Fourier sine and cosine expansions.	PO 1	2
AHS011.04	CLO 4	Understand the concept of Fourier series to the real-world problems of signal processing	PO 2	1
AHS011.05	CLO 5	Understand the nature of the Fourier integral.	PO 2	2
AHS011.06	CLO 6	Ability to compute the Fourier transforms of the function.	PO 2	2
AHS011.07	CLO 7	Evaluate finite and infinite Fourier transforms.	PO 4	1
AHS011.08	CLO 8	Understand the concept of Fourier transforms to the real-world problems of circuit analysis, control system design	PO 2	3
AHS011.09	CLO 9	Solving Laplace transforms using integrals.	PO 2	1
AHS01110	CLO 10	Evaluate inverse of Laplace transforms by the method of convolution.	PO 2	2
AHS011.11	CLO 11	Solving the linear differential equations using Laplace transform.	PO 1	3
AHS011.12	CLO 12	summarize the concept of Laplace transforms to the real-world problems of electrical circuits, harmonic oscillators, optical devices, and mechanical systems	PO 1	3
AHS011.13	CLO 13	Apply Z-transforms for discrete functions.	PO 1	3
AHS011.14	CLO 14	Evaluate inverse of Z-transforms using the methods of partial fractions and convolution method.	PO 1, PO 2	3
AHS011.15	CLO 15	Apply Z-transforms to solve the difference equations.	PO 2	3
AHS011.16	CLO 16	Understand the concept of Z-transforms to the real-world problems of automatic controls in telecommunication.	PO 2	2
AHS011.17	CLO 17	Understand partial differential equation for solving linear equations by Lagrange method.	PO 1, PO 2	3
AHS011.18	CLO 18	Apply the partial differential equation for solving non-linear equations by Charpit's method.	PO 1, PO 2	3
AHS011.19	CLO 19	Solving the heat equation and wave equation in subject to boundary conditions.	PO 1, PO 2	3
AHS011.20	CLO 20	Summarize the concept of partial differential equations to the real-world problems of electromagnetic and fluid dynamics	PO 1, PO 2	3
AHS011.21	CLO 21	Possess the knowledge and skills for employability and to succeed in national and international level competitive examinations.	PO 1	3

3 = High; 2 = Medium; 1 = Low

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

CLOs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CLO 1	3												1		
CLO 2	3												1		
CLO 3	2												1		
CLO 4		1													
CLO 5		2													
CLO 6		2													
CLO 7				1											
CLO 8				3											
CLO 9		1											1		
CLO 10		2											1		
CLO 11	3														
CLO 12	3														
CLO 13	3														
CLO 14	3	2											1		
CLO 15		3													
CLO 16		2													
CLO 17	3	3											1		
CLO 18	3	3											1		
CLO 19	2	3											1		
CLO 20	3	2											1		
CLO 21	3														

3 = High; 2 = Medium; 1 = Low

XI. ASSESSMENT METHODOLOGIES – DIRECT

CIE Exams	PO 1, PO 2, PO 4	SEE Exams	PO 1, PO 2, PO 4	Assignments	PO 1, PO 2, PO 4	Seminars	PO 2
Laboratory Practices	-	Student Viva	-	Mini Project	-	Certification	-

Term Paper	PO 4						

XII. ASSESSMENT METHODOLOGIES - INDIRECT

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

XIII. SYLLABUS

UNIT-I	**FOURIER SERIES**
Definition of periodic function, determination of Fourier coefficients; Fourier expansion of periodic function in a given interval of length 2π; Fourier series of even and odd functions; Fourier series in an arbitrary interval; Half- range Fourier sine and cosine expansions.	
UNIT-II	**FOURIER TRANSFORMS**
Fourier integral theorem, Fourier sine and cosine integrals; Fourier transforms; Fourier sine and cosine transform, properties, inverse transforms, finite Fourier transforms.	
UNIT-III	**LAPLACE TRANSFORMS**
Definition of Laplace transform, linearity property, piecewise continuous function, existence of Laplace transform, function of exponential order, first and second shifting theorems, change of scale property, Laplace transforms of derivatives and integrals, multiplied by t, divided by t, Laplace transform of periodic functions. Inverse Laplace transform: Definition of Inverse Laplace transform, linearity property, first and second shifting theorems, change of scale property, multiplied by s, divided by s; Convolution theorem and applications.	
UNIT-IV	**Z –TRANSFORMS**
Z-transforms: Elementary properties, inverse Z-transform, convolution theorem, formation and solution of difference equations.	
UNIT-V	**PARTIAL DIFFERENTIAL EQUATIONS AND APPLICATIONS**
Formation of partial differential equations by elimination of arbitrary constants and arbitrary functions, solutions of first order linear equation by Lagrange method; Charpit's method; method of separation of variables; One dimensional heat and wave equations under initial and boundary conditions.	
TEXT BOOKS:	
1. Kreyszig, "Advanced Engineering Mathematics", John Wiley & Sons Publishers, 10th Edition, 2010. 2. B. S. Grewal, "Higher Engineering Mathematics", Khanna Publishers, 43rd Edition, 2015.	
REFERENCES:	
1. G. Shanker Rao, "Mathematical Methods", I. K. International Publications, 1st Edition, 2009. 2. G. Shanker Rao, "Engineering Mathematics-1", I. K. International Publications, 1st Edition, 2009.	

XIV. COURSE PLAN:

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

Lecture No	Topics to be covered	Course Learning Outcomes (CLOs)	Reference
1	Define periodic function	CLO 1	T1:22.5 R1:2.3
2	Solve Fourier coefficients	CLO 2	T1:22.5 R1:2.4
3	Apply Fourier series for $(0, 2\pi)$	CLO 2	T1:22.6 R1:2.6
4-5	Determine even and odd function	CLO 4	T1:22.7 R1:4.4
6-7	Determine Fourier series in $(0,2l)$, $(-l,l)$ and also half range series in $(0, l)$	CLO 4	T1:22.7 R1:4.10

Lecture No	Topics to be covered	Course Learning Outcomes (CLOs)	Reference
8-9	Determine half range series in $(0, \pi)$	CLO 7	T1:22.8 R1:4.15
10	Apply Fourier integral theorem to find integrals	CLO 9	T1:22.9 R1:5.4
11	Apply Fourier sine and cosine integrals to find integrals	CLO 9	T1:22.9 R1:5.8
12-13	Define and apply Fourier transforms	CLO 11	T1:23.10 R1:6.8
14	Use properties to solve the given functions	CLO 11	T1:23.10 R1:6.13
15-16	Define and apply Inverse transforms	CLO 13	T1:23.9 R1:7.5
17	Define and apply Finite Fourier transforms	CLO 11	T1:23.10 R1:7.5
18	Define Laplace transform and its property	CLO 9	T1:23.10 R1:8.1
19	Define piecewise continuous function	CLO 14	T1:23.1 R1:9.2
20	Define and apply shifting theorem, change of scale property	CLO 14	T1:23.1 R1:9.4
21	Solve derivatives and integrals, multiplied by t, divided by t	CLO 14	T1:23.1 R1:9.9
22-23	Define periodic functions	CLO 14	T1:23.1 R1:9.10
24-25	Solve Inverse Laplace transform	CLO 14	T2:27.5 R1:10.2
26	Define and apply shifting theorem, change of scale property	CLO 17	T2:27.7 R1:11.3
27	Solve multiplied by s, divided by s	CLO 17	T2:27.8 R1:11.6
28-30	Define and apply Convolution theorem	CLO 19	T2:27.12 R1:11.7
31-32	Define Z-transforms, Elementary properties	CLO 19	T2:27.12 R1:11.8
33-34	Define inverse Z-transform	CLO 20	T2:27.12 R1:11.9
35-36	Define and apply convolution theorem	CLO 20	T2:27.12 R1:11.10
37-38	Formulate partial differential equations	CLO 21	T2:27.14 R1:12.3
39	Solve by lagrange's method	CLO 22	T2:27.1 R1:12.7
40-41	Solve by Charpit's method	CLO 23	T2:27.17 R1:12.15
42	Apply method of separation of variables	CLO 23	T2:18.2 R1:13.1
43-45	Solve heat and wave equations	CLO 23	T2:18.3-18.5 R1:13.2, 13.3

XV. GAPS IN THE SYLLABUS - TO MEET INDUSTRY / PROFESSION REQUIREMENTS:

S no	Description	Proposed Actions	Relevance with Pos	Relevance with Psos
1	Problem deduction, Initial and Boundary value problems	Seminars	PO 1	PSO 1
2	Fourier Integral Transforms, Convolution theorem in Fourier Transforms, Higher order difference equations	Seminars / NPTEL	PO 4	PSO 1
3	Encourage students to identify the type of transform involved in industry	NPTEL	PO 2	PSO 1

Prepared by:
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HOD,CIVIL

V SEMESTER

INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)
Dundigal, Hyderabad -500 043

CIVIL ENGINEERING

COURSE DESCRIPTOR

Course Title	**STRUCTURAL ANALYSIS**				
Course Code	ACE008				
Programme	B. Tech				
Semester	V	CE			
Course Type	Core				
Regulation	IARE - R16				
Course Structure	**Theory**			**Practical**	
	Lectures	**Tutorials**	**Credits**	**Laboratory**	**Credits**
	4	-	4	-	-
Chief Coordinator	Mr. Suraj Baraik, Assistant Professor				
Course Faculty	Mr. Suraj Baraik, Assistant Professor				

I. COURSE OVERVIEW:

Civil Engineers are required to design structures like buildings, dams, bridges, etc. This course is intended to introduce the basic principles to impart adequate knowledge and successfully apply fundamentals of Structural Engineering within their chosen engineering application area. Take advantage of a strong technical education at the undergraduate level to embark on successful professional careers in industry or to continue with a graduate education in their area of specialization. Apply broad multi-disciplinary skills necessary to accomplish professional objectives in a rapidly changing technological world. Understand the ethical issues pertaining to engineering, adopt industry standards of ethical behavior, and apply appropriate communication and collaboration skills essential for professional practice.

II. COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites	Credits
UG	ACE001	IV	STRENGTH OF MATERIAL-II	4

III. MARKS DISTRIBUTION:

Subject	SEE Examination	CIA Examination	Total Marks
Structural Analysis	70 Marks	30 Marks	100

IV. DELIVERY / INSTRUCTIONAL METHODOLOGIES:

✔	Chalk & Talk	✔	Quiz	✔	Assignments	✘	MOOCs
✔	LCD / PPT	✔	Seminars	✘	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 Conducted for 70 marks of 3 hours duration. The syllabus for the theory courses is divided into five units and each unit carries equal weightage in terms of marks distribution. The question paper pattern is as follows: two full questions with 'either' or choice will be drawn from each unit. Each question carries 14marks**.**

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

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

Continuous Internal Assessment (CIA):
CIA is conducted for a total of 30 marks (Table 1), with 25 marks for Continuous Internal Examination (CIE), 05 marks for Quiz/ Alternative Assessment Tool (AAT).

Table 1: Assessment pattern for CIA

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

Continuous Internal Examination (CIE):
Two CIE exams shall be conducted at the end of the 8th and 16th week of the semester respectively. The CIE exam is conducted for 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 / Alternative Assessment Tool (AAT):
Two Quiz exams shall be online examination consisting of 25 multiple choice questions and are be answered by choosing the correct answer from a given set of choices (commonly four). Marks shall be awarded considering the average of two quizzes for every course. The AAT may include seminars, assignments, term paper, open ended experiments, five minutes video and MOOCs.

VI. HOW PROGRAM OUTCOMES ARE ASSESSED:

Program Outcomes (POs)		Strength	Proficiency assessed by
PO1	**Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.	2	Assignments
PO2	**Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.	2	Assignments/ Exams
PO3	**Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.	2	Assignments/ Videos

3 = High; 2 = Medium; 1 = Low

VII. HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

Program Specific Outcomes (PSOs)		Strength	Proficiency assessed by
PSO1	**Engineering Knowledge:** Graduates shall demonstrate sound knowledge in analysis, design, laboratory investigations and construction aspects of civil engineering infrastructure, along with good foundation in mathematics, basic sciences and technical communication.	2	Lectures, Assignments
PSO2	**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.	-	-
PSO3	**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.	-	-

3 = High; 2 = Medium; 1 = Low

VIII. COURSE OBJECTIVES (COs):

The course should enable the students to:	
I	Describe the processes of analysis of various structures such as beams, trusses, arches and frames
II	Analyze statically indeterminate structures using force and displacement methods.
III	Draw the shear force, bending moment and influence line diagrams for various structures.
IV	Examine the various structures to calculate critical stresses and deformations

IX. COURSE LEARNING OUTCOMES (CLOs):

CLO Code	CLO's	At the end of the course, the student will have the ability to:	PO's Mapped	Strength of Mapping
ACE008.01	CLO 1	Differentiate between the perfect, imperfect and redundant pin jointed frames.	PO 1	2
ACE008.02	CLO 2	Identify the pin jointed frames and rigid joint structures.	PO 1	2
ACE008.03	CLO 3	Understand the determinate and indeterminate structures for rigid jointed and pin jointed frames.	PO 1	3
ACE008.04	CLO 4	Analysis of determinate pin jointed frames using method of joint, method of section for vertical load.	PO 2	2
ACE008.05	CLO 5	Evaluate the determinate pin jointed frames by method of joint, method of section for horizontal and inclined load.	PO 2	2
ACE008.06	CLO 6	Analysis of determinate pin jointed frames by tension coefficient method foe vertical, horizontal and inclined loads.	PO 2	2
ACE008.07	CLO 7	Differentiate between three hinged and two hinged arches.	PO 1	2
ACE008.08	CLO 8	Analysis of three hinged circular arches at different levels.	PO 2, PO3	2
ACE008.09	CLO 9	Execute secondary stresses in two hinged arches due to temperature and elastic shortening of rib.	PO 2	2
ACE008.10	CLO 10	Analyze the parabolic arches for the shear forces and bending moments.	PO 2	2
ACE008.11	CLO 11	Evaluate the shear forces and bending moments in two-hinged arches using energy methods.	PO 3	1
ACE008.12	CLO 12	Draw the shear forces and bending moments in three hinged arches using energy methods.	PO 1	2
ACE008.13	CLO 13	Derive the propped cantilever and fixed beams under various conditions	PO 1	2
ACE008.14	CLO 14	Analysis of propped cantilever and fixed beam using the method of consistent deformation for different loading conditions.	PO 1, PO 2	3
ACE008.15	CLO 15	Evaluate of propped cantilever and fixed beam using the method of consistent deformation subjected to varying moment of inertia.	PO 2	2
ACE008.16	CLO 16	Contrast between the concept of force and displacement methods of analysis of 3indeterminate structures	PO 2	2
ACE008.17	CLO 17	Analyze the methods of moment distribution to carry out structural analysis of 2D portal frames with various loads and boundary conditions.	PO 1, PO 2	3
ACE008.18	CLO 18	Apply the methods of slope deflection to carry out structural analysis of 2D portal frames with various loads and boundary conditions.	PO 1, PO 2	3
ACE008.19	CLO 19	Evaluate the shear force and bending moment at a section of a determinate beam under moving load.	PO 1, PO 2	3
ACE008.20	CLO 20	Construct the influence line diagram for shear force and bending movement for the entire beam.	PO 2, PO 3	2

3 = High; 2 = Medium; 1 = Low

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

Course Learning Outcomes (CLOs)	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CLO 1	3												2		
CLO 2	2												2		
CLO 3	3												2		
CLO 4		2											2		
CLO 5		2											2		
CLO 6		2											2		
CLO 7	2												2		
CLO 8		3	2										3		
CLO 9		2											2		
CLO 10		2											2		
CLO 11			1										2		
CLO 12	2												2		
CLO 13		2											2		
CLO 14	2	3											3		
CLO 15		2											2		
CLO 16		2											2		
CLO 17	2	3											3		
CLO 18	2	3											3		
CLO 19	2	3											3		
CLO 20		3	2										2		

3 = High; 2 = Medium; 1 = Low

XI. ASSESSMENT METHODOLOGIES – DIRECT

CIE Exams	PO 1 PO 2 PO 3	SEE Exams	PO 1 PO 2 PO 3	Assignments	PO 1 PO 2 PO 3	Seminars	-
Laboratory Practices	-	Student Viva	-	Mini Project	-	Certification	-
Term Paper	-						

XII. ASSESSMENT METHODOLOGIES - INDIRECT

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

XIII. SYLLABUS

UNIT-I	ANALYSIS OF PIN-JOINTED FRAMES (TRUSSES)
Types of frames, perfect, imperfect and redundant. Pin jointed frames (trusses), analysis of determinate pin jointed frames , analysis of determinate pin jointed frames using method of joints, method of sections and tension coefficient method for vertical loads, horizontal loads and inclined loads.	
UNIT-II	**ARCHES**
Introduction, types of arches, comparison between three hinged and two hinged arches; Normal thrust and radial shear in an arch; Geometrical properties of parabolic and circular arch; Three hinged circular arch at different levels; Absolute maximum bending moment diagram for a three hinged arch; Two hinged arches: Introduction, classification of two hinged arches, analysis of two hinged parabolic arches, secondary stresses in two hinged arches due to temperature and elastic shortening of rib.	
UNIT-III	**FORCE METHOD OF ANALYSIS OF INDETERMINATE BEAMS**
Analysis of propped cantilever and fixed beams using the method of consistent deformation, including the beams with varying moments of inertia, subjected to uniformly distributed load, central point load, eccentric point load, number of point loads, uniformly varying load, couple and combination of loads, shear force and bending moment diagrams for propped cantilever and fixed beams, deflection of propped cantilever and fixed beams; effect of rotation of a support. Continuous beams. Clapeyron's theorem of three moments, analysis of continuous beams with constant and variable moments of inertia with one or both ends fixed, continuous beams with overhang. Effects of sinking of supports.	
UNIT-IV	**DISPLACEMENT METHOD OF ANALYSIS: SLOPE DEFLECTION AND MOMENT DISTRIBUTION**
Derivation of slope, deflection equation, concept of moment distribution method, application of the methods to continuous beams with and without settlement of supports. Shear force and bending moment diagrams, elastic curve, application of the methods to single bay, single storey frames with and without sway.	
UNIT-V	**MOVING LOADS AND INFLUENCE LINES**
Introduction, maximum shear force, and bending moment; At a given section and absolute maximum shear force and bending moment due to various load cases, focal length; Definition of influence line for shear force, influence line for bending moment, load position for maximum SF at a section, load position for maximum BM at a section, for various loads.	
Text Books:	
1. DevadasMenon , "Structural Analysis Vol.1 and Vol. 2",Narosa Publishers, New Delhi, 2010.2. B.S. 2. S. S. Bhavikatti, "Structural Analysis Vol.1 and Vol. 2", Vikas Publishing House, New Delhi, 2010. 3. R. C. Hibbler, "Structural Analysis", Pearson Education, India, 2008.	
Reference Books:	
1. T. S. Thandavamoorthy, "Structural Analysis", Oxford Higher Education, India, 2011. 2. C. S. Reddy , "Basic Structural Analysis", McGraw Hill Education (India), Delhi, 2000 3. C. K. Wang, "Intermediate Structural Analysis", McGraw Hill Education (India), Delhi, 2010.	

XIV. COURSE PLAN:

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

Lecture No	Topics to be covered	Course Learning Outcomes (CLOs)	Reference
1-2	Types of frames- Perfect.	CLO 1	T1:1.1-3,2.1-5
3-4	Imperfect and Redundant pin jointed frames.	CLO 2	T1: 1.1-3,2.1-5
5-6	Problems on determinate pin jointed frames using method of joints for vertical loads,	CLO 2	T1: 2.4
7-8	Problems on determinate pin jointed frames using method of joints for horizontal loads and inclined loads.	CLO 5	T1, T2 : 2.4
9-10	Problems on determinate pin jointed frames using method of sections	CLO 5	T1: 2.6-14
11-12	Problems of determinate pin jointed frames for vertical loads.	CLO 5	T1: 2.6-14
13	Problems of determinate pin jointed frames for inclined loads and horizontal loads.	CLO 5	T1: 2.6-14
14-15	Problems on determinate pin jointed frames using for tension coefficient method using vertical loads, inclined loads and horizontal loads.	CLO 5	T1: 2.15-20
16	Introduction to arches, types of arches, comparison between three hinged and two hinged arches	CLO 7	T1: 3.1-.3
17-18	Introduction to arches, types of arches, comparison between three hinged and two hinged arches	CLO 7	T1: 3.1-.3
19-20	Problems on three hinged and two hinged arches	CLO 8	T1: 3.1-.3
21-22	Normal thrust and radial shear in an arch;	CLO 8	T1: 3.5-14
23	Geometrical properties of parabolic and circular arch;	CLO 8	T1: 3.5-14
24-25	Problems on parabolic and circular arch	CLO 10	T1: 3.5-14
26	Three hinged circular arch	CLO 10	T1: 6.1-5
27-28	Three hinged circular arch at different levels.	CLO 10	T2: 6.1-5
29-30	Absolute maximum bending moment diagram for a three hinged arch.	CLO 12	T1: 6.1-5
31	Introduction to two hinged arches	CLO 11	T1: 9.1-5
32-33	Classification of two hinged arches. Analysis of two hinged parabolic arches. Analysis of two hinged parabolic arches.	CLO 11	T1: 9.1
34	Analysis of two hinged parabolic arches. Problems on secondary stresses in two hinged arches	CLO 11	T1: 9.2-3
35	Problems on secondary stresses in two hinged arches due to temperature and elastic shortening of rib.	CLO 11	T1: 9.2-3
36-37	Problems on secondary stresses in two hinged arches due to temperature and elastic shortening of rib.	CLO 11	T1: 9.4-5
38	Analysis of propped cantilever and fixed beams using the method of consistent deformation, including the beams with varying moments of inertia for different loading conditions.	CLO 11	T1: 9.6-7
39	Problems on fixed beams using the method of consistent deformation. Problems on fixed beam with varying moments of inertia for different loading conditions.	CLO 11	T1: 9.6-7
40	Draw the shear force and bending moment diagrams for propped cantilever and fixed beams. Introduction to cantilever and fixed beam.	CLO 13	T1: 9.6-7
41-42	Deflection of propped cantilever and fixed beams. Deflection of propped cantilever and fixed beams, effect of rotation of a support.	CLO 13	T1: 9.6-7
43-44	Derive the Clapeyron's theorem of three moments for continuous beams. Problems on continuous beam using	CLO 13	T1: 9.6-7

Lecture No	Topics to be covered	Course Learning Outcomes (CLOs)	Reference
	Clapeyron's equation of three moments. Problems on continuous beams with constant and variable moments of inertia		
45-46	Problems on continuous beams with one or both ends fixed. Problems on continuous beams with overhang. Effects of sinking of supports.	CLO 15	T2: 9.6-7
47-48	Derivation of slope deflection equation application of the methods to continuous beams with and without settlement of supports.	CLO 16	T1:9.6-11
49	Derivation of slope deflection equation application of the methods to continuous beams with and without settlement of supports.	CLO 17	T1: 10.1
50-51	Understand the concept of moment distribution method. Problems on application of the methods to continuous beams with and without settlement of supports.	CLO 17	T1: 10.2-3
52-53	Shear force and bending moment diagrams, elastic curve, application of the methods to single bay, single storey frames with and without sway.	CLO 18	T1: 10.4-5
54	Understand the concept of influence line and moving load, **a**t a given section and absolute maximum shear force and bending moment due to various load cases, focal length Understand the concept of influence line and moving load.	CLO 19	T1: 10.5-6
55-56	Definition of influence line for shear force, influence line for bending moment, load position for maximum SF at a section, load position for maximum BM at a section, for various loads.	CLO 19	T1: 10.6-7
57-60	Problems on influence line method.	CLO 20	T2: 10.7

XV. GAPS IN THE SYLLABUS - TO MEET INDUSTRY / PROFESSION REQUIREMENTS:

S No	Description	Proposed actions	Relevance with POs	Relevance with PSOs
1	Analysis of Arches with elastic shortening of rib.	Seminars/ Guest Lectures/ NPTEL	PO 2	PSO 1
2	Application of continuous beam with settlement support.	Seminars/ Guest Lectures/ NPTEL	PO 2, PO3	PSO 1
3	Application of single bay for single frame method.	Seminars/ Assignments	PO 2, PO 3	PSO 1

Prepared by:
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HOD, CIVIL ENGINEERING

INSTITUTE OF AERONAUTICAL ENGINEERING

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CIVILENGINEERING

COURSE DESCRIPTOR

Course Title	**REINFORCED CONCRETE STRUCTURES DESIGN AND DRAWING**				
Course Code	ACE009				
Programme	B. Tech				
Semester	V	CE			
Course Type	Core				
Regulation	IARE - R16				
Course Structure	**Theory**			**Practical**	
	Lectures	**Tutorials**	**Credits**	**Laboratory**	**Credits**
	3	-	3	-	-
Chief Coordinator	Dr. J S R Prasad,Professor				
Course Faculty	Ms. Hymavathi J, Assistant Professor				

I. COURSE OVERVIEW:

Reinforced Concrete Structures Design and Drawingis an introductory design course in civil engineering. This course covers the structural design of reinforced concrete beams like singly reinforced, doubly reinforced, T & L beam sections, columns like short and long columns with biaxial bending, slabs likeone way, two way, continuous and cantilever and footings like isolated, combined, strip, etc. Different methods of design will be briefly described before introducing the limit state of design. The design will be done as per IS 456:2000. In this course, basic elements governed by bending, shear, axial forces or combination of them are identified and are considered for structural analysis of the whole structure.

II. COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites	Credits
UG	AME002	II	Engineering Mechanics	4
UG	ACE002	III	Strength of Materials -I	4
UG	ACE004	IV	Strength of Materials -II	4

III. MARKSDISTRIBUTION:

Subject	SEE Examination	CIA Examination	Total Marks
Reinforced Concrete Structures Design and Drawing	70 Marks	30 Marks	100

IV. DELIVERY / INSTRUCTIONAL METHODOLOGIES:

✔	Chalk & Talk	✔	Quiz	✔	Assignments	✘	MOOCs
✔	LCD / PPT	✘	Seminars	✔	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 units and each unit carries equal weightage in terms of marks distribution. The question paper pattern is as follows. Two full questions with "either" or "choice" will be drawn from each unit. Each question carries 14 marks. There could be a maximum of two sub divisions in a question.

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

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

Continuous Internal Assessment (CIA):
CIA is conducted for a total of 30 marks (Table 1), with 25 marks for Continuous Internal Examination (CIE), 05 marks for Quiz/ Alternative Assessment Tool (AAT).

Table 1: Assessment pattern for CIA

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

Continuous Internal Examination (CIE):
Two CIE exams shall be conducted at the end of the 8th and 16th week of the semester respectively. The CIE exam is conducted for 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 / Alternative Assessment Tool (AAT):
Two Quiz exams shall be online examination consisting of 25 multiple choice questions and are be answered by choosing the correct answer from a given set of choices (commonly four). Marks shall be awarded considering the average of two quizzes for every course. The AAT may include seminars, assignments, term paper, open ended experiments, five minutes video and MOOCs.

VI. HOW PROGRAM OUTCOMES ARE ASSESSED:

Program Outcomes (POs)		Strength	Proficiency assessed by
PO1	**Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.	2	Assignments/ Exams
PO2	**Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.	2	Assignments/ Exams
PO3	**Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.	2	Assignments
PO9	**Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings	2	Mini Project

3 = High; 2 = Medium; 1 = Low

VII. HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

Program Specific Outcomes (PSOs)		Strength	Proficiency assessed by
PSO1	**Engineering Knowledge**: Graduates shall demonstrate sound knowledge in analysis, design, laboratory investigations and construction aspects of civil engineering infrastructure, along with good foundation in mathematics, basic sciences and technical communication.	2	Lectures, Assignments
PSO2	**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.	-	-
PSO3	**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.	-	-

3 = High; 2 = Medium; 1 = Low

VIII. COURSE OBJECTIVES (COs):

The course should enable the students to:	
I	Identify, formulate and solve engineering problems of RC elements.
II	Differentiate between working stress design and limit state design.
III	Understand the importance of limit state design in reinforced concrete structures.
IV	Design of different structural members like beam, slab, column, footing and stair case.

IX. COURSE LEARNING OUTCOMES (CLOs):

CLO Code	CLO's	At the end of the course, the student will have the ability to:	PO's Mapped	Strength of Mapping
ACE009.01	CLO 1	Understand the design load, limit state method	PO 1	3
ACE009.02	CLO 2	Understand the material stress strain curves, safety factors	PO 1	3
ACE009.03	CLO 3	Understand the philosophy of characteristic strength values	PO 1	3
ACE009.04	CLO 4	Derive the stress block parameters for reinforced concrete rectangular section	PO 2	2
ACE009.05	CLO 5	Understand the failure modes of reinforced structures under different load conditions	PO 3	1
ACE009.06	CLO 6	Recognize key features of IS 456: 2000	PO 2	2
ACE009.07	CLO 7	Summarize working stress method, Limit state method in design	PO 2	2
ACE009.08	CLO 8	Design singly reinforced beams	PO 1, PO 3	3
ACE009.09	CLO 9	Design doubly reinforced beams	PO 1, PO 3	3
ACE009.10	CLO 10	Design T beam sections	PO 1, PO 3	2
ACE009.11	CLO 11	Design L beam sections	PO 1, PO 3	2
ACE009.12	CLO 12	Analysis and Design of section for shear and torsion	PO 2	3
ACE009.13	CLO 13	Appreciate concept of bond, anchorage and development length	PO 1	1
ACE009.14	CLO 14	Become familiar with I.S. code provisions	PO 1, PO 3	2
ACE009.15	CLO 15	Understand deflection limits in IS: 456–2000	PO 1	1
ACE009.16	CLO 16	Calculate deflection (theoretically)	PO 3, PO 9	2
ACE009.17	CLO 17	Design different types of slabs	PO 1, PO 3, PO 9	2
ACE009.18	CLO 18	Design of Short columns under axial loads	PO 1	2
ACE009.19	CLO 19	Design of long columns under axial loads	PO 1, PO 3	2
ACE009.20	CLO 20	Design of Short and long columns, under uniaxial and biaxial bending, I S Code provisions	PO 1, PO 2, PO 3	2
ACE009.21	CLO 21	Design of isolated (square, rectangular) footings	PO 1, PO 2	2
ACE009.22	CLO 22	Design of combined footings	PO 1, PO 3	1
ACE004.23	CLO 23	Design of stair case	PO 1, PO 9	2

3 = High; 2 = Medium; 1 = Low

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

Course Learning Outcomes (CLOs)	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CLO 1	3												1		
CLO 2	3														
CLO 3	3														
CLO 4		2													
CLO 5			1												
CLO 6			2												
CLO 7		2													
CLO 8	3		3										2		
CLO 9	2		2										1		
CLO 10	2		2												
CLO 11	2		2										2		
CLO 12		3													
CLO 13	1														
CLO 14	2		2												
CLO 15	1												2		
CLO 16			2						2						
CLO 17	2	2	2												
CLO 18	2														
CLO 19	2		2										2		
CLO 20	2	2	2												
CLO 21	2	2											2		
CLO 22	1		1												
CLO 23	2								3				1		

3 = High; 2 = Medium; 1 = Low

XI. ASSESSMENT METHODOLOGIES–DIRECT

CIE Exams	PO1, PO2, PO3,PO9	SEE Exams	PO1, PO2, PO3, PO9	Assignments	PO1, PO2, PO3	Seminars	-
Laboratory Practices	-	Student Viva	-	Mini Project	PO9	Certification	-
Term Paper	-						

XII. ASSESSMENT METHODOLOGIES-INDIRECT

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

XIII. SYLLABUS

UNIT-I	**DESIGN OF BEAMS**
Concepts of RC Design – Limit state method – Material Stress–Strain curves – Safety factors – Characteristic values – Stress block parameters – IS-456:2000 – Working StressMethod. BEAMS: Limit state analysis and design of singly reinforced, doubly reinforced, T, and L beam sections.	
UNIT-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.	
UNIT-III	**DESIGN OF SLABS**
Design of Two-way Slabs, one-way slabs, Continuous slabs using I.S. coefficients, Cantilever slab/ Canopy slab.	
UNIT-IV	**DESIGN OF COLUMNS**
Short and long columns – Axial loads, uni-axial and bi-axial bending I.S. Code provisions.	
UNIT-V	**DESIGN OF FOOTINGS**
Footings–Isolated (square, rectangle) and Combined Footings. Design of Stair Case.	
Text Books:	
1. Dr. B.C.Punmia,"Limit state design of reinforced concrete",Laxmi Publications, NewDelhi 2. S. UnnikrishnaPillai and DevdasMenon, "Reinforced concrete design",Tata Mc. Graw Hill, NewDelhi. 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, NewDelhi.	
Reference Books:	
1. M. L. Gambhir,"Fundamentalsofreinforcedconcretedesign", PrinticeHallofIndiaPvt.Ltd,NewDelhi. 2. P. Purushotham, "Reinforced concrete structural elements – behaviour, Analysis and design", Tata McGraw Hill, 1994. 3. Chen, "Plasticity in Reinforced Concrete", Cengage Learning Private Limited	

XIV. COURSE PLAN:

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

Lecture No	Topics to be covered	Course Learning Outcomes (CLOs)	Reference
1-2	the design load, limit state method	CLO 1	T1: 2.1 to 2.2 R2: 7.2-7.3
3-4	the material stress strain curves, safety factors	CLO 2	T1: 2.3 to 2.6
5-6	the philosophy of characteristic strength values	CLO 2	T1: 2.7 to 2.9 R2:7.5
7-8	the stress block parameters for reinforced concrete rectangular section	CLO 3	T1: 3.1 to 3.6 R2:7.8
9-10	the failure modes of reinforced structures under different load conditions	CLO 4	T1: 3.8 to 3.10 R2:7.9
11-12	Recognizing key features of IS 456: 2000	CLO 5	T1: 4.1 to 4.6
13-14	Summarize working stress method, Limit state method in design	CLO 6	T1: 6.1 to 6.3 R2:7.7, 7.10
15-16	Design of singly reinforced beams	CLO 7	T1: 6.1 to 6.3 R1: 7.3, 7.4
17-19	Design of doubly reinforced beams	CLO 8	T1: 6.1 to 6.3 R1: 12.6
20-22	Design of T beam sections	CLO 9	T1: 6.1 to 6.3 R1: 12.7
23-25	Design of L beam sections	CLO 10	T1: 6.1 to 6.3
26	Analysis and Design of section for shear and torsion	CLO 11	T1: 7.1 to 7.6
27-30	Appreciate concept of bond, anchorage and development length	CLO 12	T1: 8.1 to 8.9 R1:12.3, 12.4
31-32	Become familiar with I.S. code provisions	CLO 14	T4:9.6-11 R2:12.5.1
33-34	Understand deflection limits in IS: 456–2000	CLO 14	
35-38	Calculate deflection (theoretically)	CLO 15	T4: 10.1 to10.7 R2:12.5.1
39-44	Design different types of slabs	CLO 14	T1: 11.4 to 11.7 R2:12.5.1
45-49	Design of Short columns under axial loads	CLO 16	T1: 16.1 to 16.9
50-55	Design of long columns under axial loads	CLO 17	T1: 17.1 to 17.6
56	Design of Short and long columns, under uniaxial and biaxial bending, I S Code provisions	CLO 19	T1: 18.1 to 18.6
57-58	Design of isolated (square, rectangular) and combined footings	CLO 21	T1: 7.1-3
59-60	Design of staircase	CLO 23	T1: 12.1-3 R2:12.4

XV. GAPS IN THE SYLLABUS - TO MEET INDUSTRY / PROFESSION REQUIREMENTS:

S No	Description	Proposed actions	Relevance with POs	Relevance with PSOs
1	Increase the focus on structural drawings	Seminars/Guest Lectures/NPTEL	PO 9	PSO1

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CIVIL ENGINEERING

COURSE DESCRIPTOR

Course Title	**CONCRETE TECHNOLOGY**				
Course Code	ACE010				
Programme	B.Tech				
Semester	V	CE			
Course Type	Core				
Regulation	IARE - R16				
Course Structure	**Theory**			**Practical**	
	Lectures	**Tutorials**	**Credits**	**Laboratory**	**Credits**
	3	1	4	3	2
Chief Coordinator	Mr. N VenkatRao, Assistant Professor				
Course Faculty	Mr. N VenkatRao, Assistant Professor Mr. Suraj Baraik, Assistant Professor				

I. COURSE OVERVIEW:

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 regulating concrete construction. The properties of concrete and it constituent materials and the role of various admixtures in modifying these properties to suit specific requirements, such as ready mix concrete, reinforcement detailing, disaster-resistant construction, and concrete machinery have been treated exhaustively the and also special concrete in addition to the durability maintenance and quality control of concrete structure.

II. COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites	Credits
UG	ACE007	IV	Building Material Construction and Planning	3

III. MARKSDISTRIBUTION:

Subject	SEE Examination	CIA Examination	Total Marks
Concrete Technology	70 Marks	30 Marks	100

IV. DELIVERY / INSTRUCTIONAL METHODOLOGIES:

✔	Chalk & Talk	✔	Quiz	✔	Assignments	✘	MOOCs
✔	LCD / PPT	✔	Seminars	✔	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 units and each unit carries equal weightage in terms of marks distribution. The question paper pattern is as follows. Two full questions with "either" or "choice" will be drawn from each unit. Each question carries 14 marks. There could be a maximum of two sub divisions in a question.

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

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

Continuous Internal Assessment (CIA):
CIA is conducted for a total of 30 marks (Table 1), with 25 marks for Continuous Internal Examination (CIE), 05 marks for Quiz/ Alternative Assessment Tool (AAT).

Table 1: Assessment pattern for CIA

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

Continuous Internal Examination (CIE):
Two CIE exams shall be conducted at the end of the 8th and 16th week of the semester respectively. The CIE exam is conducted for 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 / Alternative Assessment Tool (AAT):
Two Quiz exams shall be online examination consisting of 25 multiple choice questions and are be answered by choosing the correct answer from a given set of choices (commonly four). Marks shall be awarded considering the average of two quizzes for every course. The AAT may include seminars, assignments, term paper, open ended experiments, five minutes video and MOOCs.

VI. HOW PROGRAM OUTCOMES ARE ASSESSED:

Program Outcomes (POs)		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	Presentation on real-world problems
PO 2	**Problem analysis**: Identify, formulate, review research literature, and analyze complexengineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences	1	Presentation on real-world problems
PO 3	**Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.	2	Seminars
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	Mini Project
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 understandingof the limitations	1	Mini Project

3 = High; 2 = Medium; 1 = Low

VII. HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

Program Specific Outcomes (PSOs)		Strength	Proficiency assessed by
PSO 1	**Engineering knowledge:** Graduates shall demonstrate sound knowledge in analysis, design, laboratory investigations and construction aspects of civil engineering infrastructure, along with good foundation in mathematics, basic sciences and technical communication	2	Assignments
PSO 2	**Broadness and Diversity:** Graduates will have a broad understanding of economical, environmental, societal, health and safety factors involved in infrastructural development, and shalldemonstrate ability to function within multidisciplinary teams with competence in modern tool usage.	1	Seminars
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 offerengineering services to the society, ethically and responsibly.	1	Seminars

3 = High; 2 = Medium; 1 = Low

VIII. COURSE OBJECTIVES (COs):

The course should enable the students to:	
I	Discuss the physical and chemical properties of cement and admixtures
II	Understand the workability of concrete, manufacturing processes of concrete and the behavior of the hardened concrete
III	Identify, formulate and solve problems in concrete mix design
IV	Enrich the practical knowledge on mix design principles, concepts and methods.

IX. COURSE LEARNING OUTCOMES (CLOs):

CLO Code	CLO's	At the end of the course, the student will have the ability to:	PO's Mapped	Strength of Mapping
ACE002.01	CLO 1	Explain the different types of cement, grades of cement and hydration process.	PO1; PO3	2
ACE002.02	CLO 2	Classify different types of admixture and their usage.	PO2;PO5	1
ACE002.03	CLO 3	Understand aggregates and classification of aggregate depending upon shape, size, texture etc.	PO1;PO3	2
ACE002.04	CLO 4	Understand the Alkali Aggregate Reaction.	PO1;PO4	2
ACE002.05	CLO 5	Understand Sieve Analysis and grading of aggregate.	PO2;PO3; PO5	2
ACE002.06	CLO 6	Understand the concept of workability of concrete and factors affecting workability.	PO1;PO2; PO4	2
ACE002.07	CLO 7	Explain the measurement of workability by different test.	PO3	2
ACE002.08	CLO 8	Understand the concept of segregation and bleeding in concrete.	PO1;PO4; PO5	2
ACE002.09	CLO 9	Explain the various steps involved in the manufacturing process of concrete.	PO3	2
ACE002.10	CLO 10	Understand the importance of quality of mixing water.	PO2;PO3	2
ACE002.11	CLO 11	Understand hardened concrete and its properties.	PO2;PO4; PO5	1
ACE002.12	CLO 12	Explain the importance of water cement ratio, maturity concept in hardened concrete	PO1	2
ACE002.13	CLO 13	Understand the various methods of curing of concrete.	PO1;PO2; PO3;PO5	2
ACE002.14	CLO 14	Explain the different tests involved in testing of hardened concrete.	PO2	1
ACE002.15	CLO 15	Understand the concept of creep and how it effects hardened concrete.	PO2;PO3; PO5	1
ACE002.16	CLO 16	Explain shrinkage and its effect on concrete.	PO1;PO4	2
ACE002.17	CLO 17	Understand the importance of Mix proportions.	PO2;PO3	2
ACE002.18	CLO 18	Understand durability and quality control of concrete.	PO2;PO5	1
ACE002.19	CLO 19	Explain Acceptance criteria involved in concrete mix proportioning.	PO2;PO3; PO4	2
ACE002.20	CLO 20	Explain proportioning of concrete method by different methods.	PO1	2
ACE002.21	CLO 21	Design the concrete mix by BIS method.	PO2;PO3; PO4;PO5	2

CLO Code	CLO's	At the end of the course, the student will have the ability to:	PO's Mapped	Strength of Mapping
ACE002.22	CLO 22	Explain the different types of special concrete.	PO1	2
ACE002.23	CLO 23	Explain the effect of fibre in the concrete.	PO1;PO4	2

3 = High; 2 = Medium; 1 = Low

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

CLOs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CLO 1	3		3											2	2
CLO 2		2			2								2		
CLO 3	3		3											1	
CLO 4	1			3										1	
CLO 5		1	3		1								2		
CLO 6	1	1		3										2	
CLO 7			3											1	
CLO 8	3			3	1								1		
CLO 9			2											2	
CLO 10		1	1											2	
CLO 11		2		3	1								2		1
CLO 12	3														1
CLO 13	1	2	2		1										2
CLO 14		1													2
CLO 15		1	1		2								2		
CLO 16	3			3										1	
CLO 17		2	1											2	
CLO 18		2			2									2	
CLO 19		2	1	2									2		
CLO 20	3													1	2
CLO 21		1	2	1	2										1
CLO 22	2													2	
CLO 23	3			2									1		

3 = High; 2 = Medium; 1 = Low

XI. ASSESSMENT METHODOLOGIES–DIRECT

CIE Exams	PO 1; PO2; PO5	SEE Exams	PO 1; PO2; PO5	Assignments	PO 2	Seminars	PO 3
Laboratory Practices	PO 5	Student Viva	-	Mini Project	PO 4; PO5	Certification	-
Term Paper	-						

XII. ASSESSMENT METHODOLOGIES-INDIRECT

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

XIII. SYLLABUS

UNIT-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.	
UNIT-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.	
UNIT-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.	
UNIT-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, BIS method of mix design	
UNIT-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 polymer concrete applications, high performance concrete, self consolidating concrete SIFCON	
Text Books:	
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..	

XIV. COURSE PLAN:

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

Lecture No	Topics to be covered	Course Learning Outcomes (CLOs)	Reference
1	History of port land cement	CLO 1	T1: 1.1-1.2
2	Manufacturing of Portland cement	CLO 2	T1: 1.3-1.5
3	Chemical composition & bogues compounds of Portland cement.	CLO 3	T1: 1.6-1.7
4-5	Hydration, setting of cement, structure of hydrate cement	CLO 2	T1: 2.8-2.11
6-7	Test on physical properties	CLO 6	T1:2.1-.2.6
8-9	Different grades of cement	CLO 7	T1: 2.6-2.10
10	Classification of aggregate, particle shape and texture, bond, strength and other mechanical properties of aggregate	CLO 9	T1: 4.1-4.4
11	Specific gravity, bulk density, porosity, adsorption and moisture content of aggregate, bulking of sand, deleterious substance in aggregate	CLO 10	T1: 4.6-4.7
12-13	Soundness of aggregate, alkali aggregate reaction, thermal properties	CLO 11	T2 :7.13-16
14	Sieve analysis, fineness modulus, grading curves, grading of fine and coarse aggregates, gap graded aggregate, maximum aggregate size	CLO 12	T2:7.17-19
15-16	Introduction, workability, factors affecting workability	CLO 13	T2: 7.20
17	Measurement of workability by different tests, setting times of concrete	CLO 11	T1:17.1-17.3
18	Effect of time and temperature on workability, segregation and bleeding	CLO 10	T1: 17.4-17.5
19	Mixing and vibration of concrete, steps in manufacture of concrete, quality of mixing water	CLO 14	T1: 17.5-17.7
20	Water / cement ratio, Abram's law, gel space ratio and problems	CLO 14	T1: 17.8
21	Nature of strength of concrete, maturity concept, strength in tension and compression	CLO 12	T1: 17.9
22-23	Factors affecting strength, relation between compression and tensile strength, curing	CLO 14	T1: 17.12
24-25	Introduction on hardened concrete	CLO 14	T1: 14.7
26	Compression tests, tension tests	CLO 17	T1:15.1-3
27	Factors affecting strength, flexure tests	CLO 17	T1:15.3-4
28-30	Splitting tests, non-destructive testing methods, codal provisions for NDT.	CLO 19	T1:15.5
31-32	Modulus of elasticity, dynamic modulus of elasticity, Poisson's ratio	CLO 19	T1:15.6
33-34	Creep of concrete, factors influencing creep, relation between creep and time	CLO 20	T1:15.7
35-36	Nature of creep, effects of creep	CLO 20	T1:15.7
37-38	Shrinkage, types of shrinkage.	CLO 21	T1:15.8
39	Problems on modulus of elasticity, shrinkage, creep of concrete	CLO 22	T1:15.8
40-41	Introduction on different mixes of concrete	CLO 23	T1:15.8

Lecture No	Topics to be covered	Course Learning Outcomes (CLOs)	Reference
42	Factors in the choice of mix proportions, durability of concrete	CLO 23	T1:15.9
43	Quality control of concrete, statistical methods	CLO 23	T1:15.9
44	Acceptance criteria, proportioning of concrete mixes by various methods	CLO 23	T1:15.3-4
45	BIS method of mix design	CLO 23	T1:15.5
46	Problems on different mix designs of concrete.	CLO 23	T1:15.6
47-48	Introduction to special concrete	CLO 23	T1:15.7
49	Light weight aggregates, light weight aggregate concrete	CLO 18	T1:15.7
50	Cellular concrete, no-fines concrete, high density concrete	CLO 23	T1:15.8
51	Fibre reinforced concrete, different types of fibres, factors affecting properties of f.r.c	CLO 18	T1:15.8
52	Applications, polymer concrete, types of polymer concrete, properties of polymer concrete	CLO 23	T1: 12.1-12.2
53-54	Applications, high performance concrete, self-consolidatingconcrete, sifcon	CLO 20	T1: 12.3-12.5

XV. GAPS IN THE SYLLABUS - TO MEET INDUSTRY / PROFESSION REQUIREMENTS:

S. No.	Description	Proposed actions	Relevance with POs	Relevance with PSOs
1	Design a concrete mix for lower grade concrete using BIS	Seminars	PO 1	PSO 1
2	Design a concrete mix for higher grade concrete using BIS	Seminars / NPTEL	PO 5	PSO

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CIVIL ENGINEERING

COURSE DESCRIPTOR

Course Title	HYDRAULICS AND HYDRAULIC MACHINERY				
Course Code	ACE011				
Programme	B. Tech				
Semester	V	CE			
Course Type	CORE				
Regulation	IARE - R16				
Course Structure	**Theory**			**Practical**	
	Lectures	**Tutorials**	**Credits**	**Laboratory**	**Credits**
	3	1	4	3	1
Chief Coordinator	Dr. Venkata Ramana Gedela, Professor & HOD.				
Course Faculty	Mr. CH. V. S. S. Sudheer, Assistant Professor				

I. COURSE OVERVIEW:

This course is intended to introduce basic principles of fluid mechanics. It is further extended to cover the application of fluid mechanics by the inclusion of fluid machinery especially water turbine and water pumps. Now days the principles of fluid mechanics find wide applications in many situations directly or indirectly. The use of fluid machinery, turbines pumps in general and in power stations in getting as accelerated fill up. Thus there is a great relevance for this course for mechanical technicians. The Mechanical technicians have to deal with large variety of fluids like water, air, steam, ammonia and even plastics. The major emphasis is given for the study of water. However, the principle dealt with in this course will be applicable to all incompressible fluids.

II. COURSE PRE-REQUISITES:

Level	Course Code	Semester	Pre requisites	Credits
UG	ACE005	IV	Fluid Mechanics	4

III. MARKS DISTRIBUTION:

Subject	SEE Examination	CIA Examination	Total Marks
Hydraulics & Hydraulic Machinery	70 Marks	30 Marks	100

IV. DELIVERY / INSTRUCTIONAL METHODOLOGIES:

✔	Chalk & Talk	✔	Quiz	✔	Assignments	✘	MOOCs
✔	LCD / PPT	✔	Seminars	✘	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 Conducted for 70 marks of 3 hours duration. The syllabus for the theory courses is divided into five units and each unit carries equal weightage in terms of marks distribution. The question paper pattern is as follows: two full questions with „either" or choice will be drawn from each unit. Each question carries 14 marks**.**

Continuous Internal Assessment (CIA):
CIA is conducted for a total of 30 marks (Table 1), with 25 marks for Continuous Internal Examination (CIE), 05 marks for Quiz/ Alternative Assessment Tool (AAT).

Table 1: Assessment pattern for CIA

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

Continuous Internal Examination (CIE):

Two CIE exams shall be conducted at the end of the 8th and 16th week of the semester respectively. The CIE exam is conducted for 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 / Alternative Assessment Tool (AAT):

Two Quiz exams shall be online examination consisting of 25 multiple choice questions and are be answered by choosing the correct answer from a given set of choices (commonly four). Marks shall be awarded considering the average of two quizzes for every course. The AAT may include seminars, assignments, term paper, open ended experiments, five minutes video and MOOCs.

VI. HOW PROGRAM OUTCOMES ARE ASSESSED:

Program Outcomes (POs)		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	Exam/Seminar
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	Exam
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	Assignment

3 = High; 2 = Medium; 1 = Low

VII. HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

Program Specific Outcomes (PSOs)		Strength	Proficiency assessed by
PSO 1	**Engineering Knowledge:** Graduates shall demonstrate sound knowledge in analysis, design, laboratory investigations and construction aspects of civil engineering infrastructure, along with good foundation in mathematics, basic sciences and technical communication.	2	Assignment
PSO 2	**Broadness and Diversity:** Graduates will have a broad understanding of economical, 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.	2	Seminar
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.	-	-

3 = High; 2 = Medium; 1 = Low

VIII. COURSE OBJECTIVES (COs):

The course should enable the students to:	
I	Strengthen the knowledge of theoretical and technological aspects of hydrodynamic forces on jets
II	Correlate the principles with applications in hydraulic turbines
III	Apply the practical applications on Francis and Kaplan turbine
IV	Analysis the similarities between prototype and model types of hydraulic similitude.

IX. COURSE LEARNING OUTCOMES (CLOs):

CLO Code	CLO's	At the end of the course, the student will have the ability to:	PO's Mapped	Strength of Mapping
ACE011.01	CLO 1	Explain the concept for types of flows, type of channels, Non uniform flow - Dynamic equation for G.V.F., Mild, Critical, and Steep channels	PO 1, PO 4	3
ACE011.02	CLO 2	Understand concept of velocity distribution, energy and momentum correction factors for different flows	PO 1, PO 4	3
ACE011.03	CLO 3	Understand Chezy's, Manning's and Basin formulae for uniform flow.	PO 4	3
ACE011.04	CLO 4	Explain the concepts based on Specific energy, critical depth, critical, sub-critical and super critical flows	PO 1, PO 4	2
ACE011.05	CLO 5	Understand and designing for the computation of economical sections based on flow parameters and channel characteristics.	PO 1, PO 2, PO 4	2
ACE011.06	CLO 6	Understand the Dimensional quantities and analysis for various parameters.	PO 1, PO 2, PO 4	2
ACE011.07	CLO 7	Derive the problems based on Rayleigh's method and Buckingham's pi theorem with applications.	PO 2	1
ACE011.08	CLO 8	Explain the concept of similitude with examples and different types of similitude concepts.	PO 1	1
ACE011.09	CLO 9	Remember the concepts of dimensionless numbers to solve numerical problems	PO 1	2
ACE011.10	CLO 10	Explain the practical problems associated with model and prototypes based on concept of similitude	PO 2, PO 4	2
ACE011.11	CLO 11	Explain the different types of jets used in construction of turbines and machinery and their importance.	PO 1, PO 4	3
ACE011.12	CLO 12	Demonstrate the formulation of velocity triangles at inlet and out let of vanes with different combinations of jet.	PO 1, PO 2, PO 4	3
ACE011.13	CLO 13	Derive the expressions based on Angular momentum principle, work done and efficiency for various types of vanes.	PO 2	3

CLO Code	CLO's	At the end of the course, the student will have the ability to:	PO's Mapped	Strength of Mapping
ACE011.14	CLO 14	Explaining the concepts of hydro power plant with various components and their functioning.	PO 2, PO 4	3
ACE011.15	CLO 15	Deriving numerical problems based on power developed in Hydro power plant, efficiency of jet, stationary and moving vanes.	PO 1, PO 2, PO 4	2
ACE011.16	CLO 16	Demonstrating different types of turbines with their principles and practical applications	PO 1, PO 4	2
AHS010.17	CLO 17	Remember the concept of work done, efficiency for different vanes and application to the concept of turbines.	PO 1	3
ACE011.18	CLO 18	Deriving the expressions for most economical design of turbines to withstand for the designed discharge.	PO 1, PO 4	3
ACE011.19	CLO 19	Understand the working principles for various and working of different components of Kaplan, Francis and Pelton turbines.	PO 1	3
ACE011.20	CLO 20	Understand the working mechanism of different types of pumps, importance and functioning of various components.	PO 1, PO 2	3
ACE011.21	CLO 21	Explain characteristic curves for pumps with their practical applications	PO 1, PO 4	3
ACE011.22	CLO 22	Understand the concept of NPSH, performance of pumps and working efficiency.	PO 1	3
ACE011.23	CLO 23	Explain the designing of reciprocating pump and centrifugal pump.	PO 1, PO 2	3
ACE011.24	CLO 24	Understand the practical problems associated during the installation of pumps and	PO 1, PO 2, PO 4	1
ACE011.25	CLO 25	Understand the concept ANOVA to the real-world problems to measure the atmospheric tides.	PO 1, PO 2, PO 4	1

3 = High; 2 = Medium; 1 = Low

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

Course Learning Outcomes (CLOs)	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CLO 1	3			2									3		
CLO 2	2			3									2	3	
CLO 3				3										2	
CLO 4	3			3									3	2	
CLO 5	2	3		3									2	1	
CLO 6	2	2		2									3		
CLO 7		3													
CLO 8	2												2		
CLO 9	3												3		
CLO 10		2		2										2	
CLO 11	3			3									3		
CLO 12	2	3		2									2	2	
CLO 13		3													
CLO 14		3		2										2	
CLO 15	2	2		2									2	2	
CLO 16	2			2									2		
CLO 17	3														
CLO 18	1			2									2		
CLO 19	3												3		
CLO 20	3	1											3		
CLO 21	2			2									2		
CLO 22	3														
CLO 23	3	3													
CLO 24	2	3		2									2		
CLO 25	3	3		2									3		

3 = High; 2 = Medium; 1 = Low

XI. ASSESSMENT METHODOLOGIES – DIRECT

CIE Exams	PO 1, PO2, PO4	SEE Exams	PO 1, PO2, PO4	Assignments	PO4	Seminars	PO 1
Laboratory Practices	PO 1	Student Viva	PO 1	Mini Project	-	Certification	-
Term Paper	-						

XII. ASSESSMENT METHODOLOGIES - INDIRECT

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

XIII. SYLLABUS

UNIT – I	**OPEN CHANNEL FLOW**
Types of flows, types of channels, channel characteristics, velocity distribution, energy and momentum correction factors, Chezy's, Manning's, Basin's formulae for uniform flow, economical sections, critical flow, critical depth, specific energy, channel transitions	
UNIT – II	**DIMENSIONAL ANALYSIS AND SIMILITUDE**
Dimensional analysis, Rayleigh's method, Buckingham's pi theorem, hydraulic models, similarity laws, geometric, kinematic and dynamic similarities, dimensionless numbers, model and prototype relations.	
UNIT – III	**HYDRODYNAMIC FORCE ON JETS**
Hydrodynamic force of jets on stationary and moving flat inclined and curved vanes, jet striking centrally and at tip. Velocity triangles at inlet and outlet, work done, efficiency, angular momentum principle, layout of hydropower plant, heads and efficiencies.	
UNIT – IV	**HYDRAULICS TURBINS**
Classification of hydraulic machine, Euler's equation of turbo machines, selection of hydraulic machines, design of Pelton turbines, design of Francis turbine, design of Kaplan/ axial flow turbine, draft tube, theory and function efficiency	
UNIT – V	**CENTRAIFUGAL PUMPS**
Pump installations, classification of pumps, work done, Manometric head, minimum starting speed, losses and efficiency, specific speed, multistage pump, pumps in parallel, performance of pumps, design of centrifugal pumps, design of reciprocating pumps, NPSH, cavitation.	
Text Books:	
1. Subramanya K, "Open Channel Flow", Tata McGraw Hill Publications, New Delhi, 2008. 2. Modi, Seth, "Fluid Mechanics. Hydraulic and Hydraulic Machines", Standard Book House, 2011. 3. Madan Mohan Das, Mimi Das Saikia, Bhargab Mohan Das, "Hydraulics and Hydraulic Machines Textbook", PHI Learning, 1st edition, 2013.	
Reference Books:	
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. Rajput R.K., "A text book of Fluid Mechanics", S. Chand Publications, 1998.
4. Franck N. White, "Fluid Mechanics", Tata Mc Grawhill Publications, 8 th Edition, 2015.
5. Dr .R.K Bansal A text book of Fluid mechanics & Hydraulics machines in SI units Laxmi publications 2015.

XIV. COURSE PLAN:

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

Lecture No	Topics to be covered	Course Learning Outcomes (CLOs)	Reference
1 – 2	To understand the Basics of Open Channel Flow.	CLO 1	T1:22.5 R1:2.3
3 – 4	To know the types of flows, Type of channels, Velocity distribution	CLO 2	T1:22.5 R1:2.4
5 – 6	To derive the derivation of Energy and momentum correction factors, Chezy's, Manning's and Bazin's formulae for uniform flow.	CLO 3	T1:22.6 R1:2.6
7 – 8	Ability to solve the problems on Energy and momentum correction factors, Chezy's, Manning's and Bazin's formulae for uniform flow.	CLO 4	T1:22.7 R1:4.4
9 – 11	Ability to know the Most Economical sections.	CLO 5	T1:22.7 R1:4.10
12 – 13	To understand the Basics of Critical Flow	CLO 6	T1:22.8 R1:4.15
14 – 15	To know the Specific energy, critical depth, computation of critical depth	CLO 7	T1:22.9 R1:5.4
16 – 18	To know the critical sub-critical and super critical flows	CLO 8	T1:22.9 R1:5.8
19 – 20	Ability to solve the problems on Specific energy, critical depth, computation of critical depth	CLO 9	T1:23.10 R1:6.8
21 – 23	Ability to understand Non uniform flow-Dynamic equation for G.V.F., Mild, Critical, Steep	CLO 10	T1:23.10 R1:6.13
24 – 26	Ability to understand Non uniform flow-Dynamic equation for horizontal and adverse slopes, surface profiles, direct step method	CLO 11	T1:23.9 R1:7.5
27 – 28	Ability to understand Rapidly varied flow, hydraulic jump, energy dissipation	CLO 12	T1:23.10 R1:7.5
29 – 30	Ability to solve the problems on Non uniform flow-Dynamic equation for G.V.F., Mild, Critical, Steep.	CLO 13	T1:23.10 R1:8.1
31 – 32	Ability to solve the problems on Rapidly varied flow, hydraulic jump, energy dissipation	CLO 14	T1:23.1 R1:9.2
33 – 34	To understand the Dimensional analysis, Rayleigh's method and Buckingham's pi theorem	CLO 15	T1:23.1 R1:9.4
35 – 38	To study of Hydraulic models, Geometric, kinematic and dynamic similarities. To know dimensionless numbers, model and prototype relations, Ability to solve the problems Rayleigh's method and Buckingham's pi theorem	CLO 16	T1:23.1 R1:9.9
39 – 41	Ability to solve the problems on kinematic and dynamic similarities. Ability to solve dimension less numbers, model and prototype relations.	CLO 17	T1:23.1 R1:9.10
41 – 43	To understand the Basics of Basics of Turbo Machinery, To know the Hydrodynamic force of jets on stationary and moving flat inclined and curved vanes.	CLO 18	T2:27.5 R1:10.2

Lecture No	Topics to be covered	Course Learning Outcomes (CLOs)	Reference
44 – 46	Ability to solve the problems on Hydrodynamic force of jets on stationary and moving flat inclined and curved vanes, to know the jet striking centrally and at tip, velocity triangles at inlet and outlet.	CLO 19	T2:27.7 R1:11.3
47 – 50	Ability to solve the problems jet striking centrally and at tip, velocity triangles at inlet and outlet, To know the concept of the Angular momentum principle, applications to radial flow turbines.	CLO 20	T2:27.8 R1:11.6
51 – 53	Ability to solve the problems on Angular momentum principle, To know Layout of a typical Hydropower installation, Heads and efficiencies, To know about the Hydraulic Turbines, To know classification of turbines- Pelton wheel, Francis turbine and Kaplan turbine working, working Proportions, ability to solve the problems on Pelton wheel, Francis turbine and Kaplan turbine.	CLO 21	T2:27.12 R1:11.7
54 – 55	To know velocity diagram, hydraulic design, draft tube, theory and function efficiency, Ability to know Governing of turbines, surge tanks, unit and specific turbines, unit speed, unit quantity, unit power and specific speed, performance characteristics, geometric similarity, cavitations.	CLO 22	T2:27.12 R1:11.8
56 – 57	To know the centrifugal pumps, To study the Pump installation details, classification, Manometric head, minimum starting speed.	CLO 23	T2:27.12 R1:11.9
57 – 58	Ability to solve problems on specific speed , multi stage pumps, speed.	CLO 24	T2:27.12 R1:11.10
59 – 60	Ability to solve problems on multi stage pumps, pumps in pumps in parallel. Ability to solve the problems on performance of pumps characteristic curves –NSPH cavitation and classification of hydro power plants – definition of terms: load factor, utilization factor, capacity factor, estimation of hydro power potential.	CLO 25	T2:27.14 R1:12.3

XV. GAPS IN THE SYLLABUS - TO MEET INDUSTRY / PROFESSION REQUIREMENTS:

S. No	Description	Proposed actions	Relevance with POs	Relevance with PSOs
1	To improve standards and analyze the concepts.	Seminars	PO 1	PSO 1
2	Conditional probability, Sampling distribution, correlation, regression analysis and testing of hypothesis	Seminars / NPTEL	PO 4	PSO 1
3	Encourage students to solve real time applications and prepare towards competitive examinations.	NPTEL	PO 2	PSO 1

Prepared by:

Dr. G. Venkata Ramana, Professor & HOD

HOD, CE

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Dundigal, Hyderabad -500 043

CIVIL ENGINEERING

COURSE DESCRIPTOR

Course Title	**BUSINESS ECONOMICS AND FINANCIAL ANALYSIS**				
Course Code	AHS015				
Programme	B.Tech				
Semester	V	ECE | IT | CSE | MECH |CIVIL | EEE			
Course Type	Skill				
Regulation	IARE - R16				
Course Structure	**Theory**			**Practical**	
	Lectures	**Tutorials**	**Credits**	**Laboratory**	**Credits**
	2	1	3	-	-
Chief Coordinator	Ms E. Sunitha, Assistant Professor, MBA				
Course Faculty	Ms E.Sunitha, Assistant Professor, MBA Ms S.Lakshmi , Assistant Professor, MBA Ms G.Joseph Mary, Assistant Professor, MBA Mr. P.Nagesh Assistant Professor, MBA				

I. 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.

II. COURSE PRE-REQUISITES:

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

III. MARKS DISTRIBUTION:

Subject	SEE Examination	CIA Examination	Total Marks
Business Economics and Financial Analysis	70 Marks	30 Marks	100

IV. DELIVERY / INSTRUCTIONAL METHODOLOGIES:

✔	Chalk & Talk	✔	Quiz	✔	Assignments	✘	MOOCs
✔	LCD / PPT	✔	Seminars	✘	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 units and each unit carries equal weight age in terms of marks distribution. The question paper pattern is as follows. Two full questions with "either" or "choice" will be drawn from each unit. Each question carries 14 marks. There could be a maximum of two sub divisions in a question.

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

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

Continuous Internal Assessment (CIA):
CIA is conducted for a total of 30 marks (Table 1), with 25 marks for Continuous Internal Examination (CIE), 05 marks for Quiz/ Alternative Assessment Tool (AAT).

Table 1: Assessment pattern for CIA

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

Continuous Internal Examination (CIE):
Two CIE exams shall be conducted at the end of the 8th and 16th week of the semester respectively. The CIE exam is conducted for 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 / Alternative Assessment Tool (AAT):
Two Quiz exams shall be online examination consisting of 25 multiple choice questions and are be answered by choosing the correct answer from a given set of choices (commonly four). Marks shall be awarded considering the average of two quizzes for every course. The AAT may include seminars, assignments, term paper, open ended experiments, five minutes video and MOOCs.

VI. HOW PROGRAM OUTCOMES ARE ASSESSED:

Program Outcomes (POs)		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.	1	Assignments.
PO 8	**Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice**.**	1	Assignments.
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	Seminars.
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	Seminars

3 = High; 2 = Medium; 1 = Low

VII. HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

Program Specific Outcomes (PSOs)		Strength	Proficiency assessed by
PSO 1	**Engineering knowledge:** Graduates shall demonstrate sound knowledge in analysis, design, laboratory investigations and construction aspects of civil engineering infrastructure, along with good foundation in mathematics, basic sciences and technical communication.	---	----
PSO 2	**Broadness and diversity:** Graduates will have a broad understanding of economical, 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	Seminar
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.	----	----

3 = High; 2 = Medium; 1 = Low

VIII. COURSE OBJECTIVES (COs):

The course should enable the students to:	
I	Understand the concepts of managerial economics and financial analysis for optimal decision making in business environment.
II	Analyze the market dynamics namely demand, elasticity of demand and pricing in different market structures
III	Gain the knowledge on the production theories and cost analysis while dealing with the production and factors of production.
IV	Study the various pricing methods which are adopted in attracting the potential customers for the different commodities.

IX. COURSE LEARNING OUTCOMES (CLOs):

CLO Code	CLO's	At the end of the course, the student will have the ability to:	PO's Mapped	Strength of Mapping
AHS015.01	CLO 1	Describe the economic activities performed by the businessmen in the business for profit earning.	PO 11	3
AHS015.02	CLO 2	Understand the significance of demand, its analysis, measurement of demand and its forecasting .	PO 2	1
AHS015.03	CLO 3	Write the production function through the Cobb Douglas Production Function.	PO 8	1
AHS015.04	CLO 4	Design and implement different structures of market covering how price is determined under different market structures	PO 8, PO 9	2
AHS015.05	CLO 5	Analyze different forms of business organizations existing in the modern business.	PO 2	3
AHS015.06	CLO 6	Describe the allocation of capital which plays a vital role in a business organization.	PO 11	3
AHS015.07	CLO 7	Demonstrate the concept of capital budgeting and allocations of the resources through capital budgeting methods	PO 9, PO11	3
AHS015.08	CLO 8	Apply the Principle of double entry to give an exposure to the maintenance of books of records and allocation of profits in an enterprise.	PO 2, PO8	1
AHS015.09	CLO 9	Explain the significance and objectives of trial balance and final accounts for knowing arithmetical accuracy of books of accounts	PO 2	1
AHS015.10	CLO 10	Understand the Ratio analysis to give an idea about financial forecasting	PO 11	3

3 = High; 2 = Medium; 1 = Low

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

(CLOs)	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CLO1											3				
CLO2		1												1	
CLO3								1							
CLO4								1	3						
CLO5									3						
CLO6											3				
CLO7									3		3				
CLO8		1						1						1	
CLO9		1												1	
CLO10											3				

3 = High; 2 = Medium; 1 = Low

XI. ASSESSMENT METHODOLOGIES – DIRECT

CIE Exams	PO 2, PO8, PO 9, PO11	SEE Exams	PO 2, PO8, PO 9, PO11	Assignments	PO 2	Seminars	PO9,PO11
Laboratory Practices	-	Student Viva	-	Mini Project	-	Certification	-
Term Paper	-						

XII. ASSESSMENT METHODOLOGIES - INDIRECT

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

XIII. SYLLABUS

UNIT-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	
UNIT-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, Opportunity cost, Fixed vs. Variable costs, Explicit costs vs. Implicit costs, out of pocket costs vs. Imputed costs, Break-even analysis, Determination of Break – Even point (Simple Problems) , Managerial Significance of BEA.	
UNIT-III	**MARKETS& NEW ECONOMIC ENVIRONMENT**
Market 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.	
UNIT-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).	
UNIT-V	**INTRODUCTION TO FINANCIAL ACCOUNTING AND FINANCIAL ANALYSIS**
Accounting Concepts and Conventions, Introduction to IFRS– Double – Entry Book keeping, Journal, Ledger, Trial balance, Final accounts (Trading Account, Profit and Loss Account and Balance Sheet with simple adjustments.) Financial Analysis through Ratios: Significance, limitations of Ratio Analysis and Ratios Computation, Analysis and Interpretation of Liquidity Ratios (Current Ratio and quick ratio). Activity Ratios (Inventory turnover ratio and Debtor Turnover ratio), Capital structure Ratios (Debt-Equity ratio, Interest Coverage ratio) and profitability ratios (Gross profit Ratio, Net profit ratio, Operating Ratio, P/E Ratio and EPS), Du Pont Chart.	
Text Books:	
1. Aryasri, "Managerial Economics and Financial Analysis", TMH publications, 4 th Edition, 2012. 2. M. Kasi Reddy, Saraswathi, "Managerial Economics and Financial Analysis", PHI Publications, New Delhi, 2 nd Edition, 2012. 3. Varshney, Maheswari, "Managerial Economics", Sultan Chand Publications, 11th Edition, 2009.	

Reference Books:
1. D.N. Dwivedi, "Managerial Economics", Vikas Publication House Pvt.Ltd, 2nd Edition, 2012. 2. S.N. Maheshwari & S.K.Maheshwari, "Financial Accounting", Vikas Publication House Pvt.Ltd, 4th Edition, 2012. 3. R.Narayana Swamy, "Financial Accounting- A managerial Perspective", Pearson publications, 1st Indian Reprint Edition, 2012. 4. J.V.Prabhakar Rao & P.V.Rao, "Managerial Economics & Financial Analysis", Maruthi Publishers, 1st Revised Edition, 2011. 5. .Kasi Reddy & Saraswathi, "Managerial Economics and Financial Analysis", PHI Publications, New Delhi, 10th Revised Edition, 2012. 6. Varshney & Maheswari, "Managerial Economics", Sulthan Chand Publishers, 1st Revised Edition, 2009.

XIV. COURSE PLAN:

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

Lecture No	Topics to be covered	Course Learning Outcomes (CLOs)	Reference
1-2	Explain about managerial economics according to the business	CLO 1	T1- 1.3-1.8
3-4	Describe about demand analysis, the Law of Demand and Demand Function.	CLO 2	T1-2.2-2.11
5-6	Understand elasticity of the demand of the product, different types, Measurement of Elasticity of Demand and Factors influencing on Elasticity of Demand.	CLO 2	T1-3.3-3.20
6-7	State different methods of Demand Forecasting and the factors governing Demand Forecasting.	CLO 4	T1-4.6-4.19
8-9	Demonstrate the Production function, features of Iso-Quants and Iso-Costs,	CLO 4	T1- 5.3-5.18
10-12	Different types of Internal Economies, External Economies and Law of Returns with appropriate examples	CLO 4	T1- 5.3-5.18
13-14	Illustrate different types of costs	CLO 5	T1- 5.29-6.8
15-16	Explain the Significance and Limitations of Break-Even Analysis	CLO 5	T1- 7.13-7.14
17-18	Calculate Break-Even Point (Simple Problems)	CLO 6	T1- 7.1-7.12
19-20	Illustrate the features, price-output determination under Perfect Competition, Monopoly and Monopolistic competition Markets.	CLO 6	T1- 8.4-8.16
22-23	Demonstrate the Objectives, Policies and Methods of Pricing Strategies and Price Methods.	CLO 7	T1- 8.21-8.25
24-25	Describe Features of business, Definitions of Various forms of Business Units.	CLO 7	T1-9.3-9.15
26-27	State the Merits & Demerits of Different types of Public	CLO 8	T1- 9.2-10.23
28-29	Enterprises Changing Business Environment to Post Liberalization Scenario.	CLO 8	T1- 9.2-10.23
30-31	Explain the significance and classification of capital, Methods	CLO 9	T1- 11.3-11.5
32-33	Demonstrate the concept of capital budgeting and allocations of the resources through capital budgeting methods and compute simple problems.	CLO 9	T1-12.1-12.26
34-35	Illustrate the Significance of Financial Accounting, Double Entry, Accounts.	CLO 8	T1-13.4-13.15
36-37	Accounting Concepts and Conventions	CLO 8	T1-13.4-13.15
38-39	Explain the meaning, advantages and Limitations of the Journal, Ledger and Trial Balance	CLO 10	T1-13.5-13.68
40-41	Final Accounts and Solve simple Problems.	CLO 8	T1-13.4-13.15
42-43	Describe Meaning, Definitions and Limitations of Ratio Analysis	CLO 10	T1-14.1-14.8
44-45	Compute different types of Financial Ratios (Problems)	CLO 10	T1-14.4-14.18

XV. GAPS IN THE SYLLABUS - TO MEET INDUSTRY / PROFESSION REQUIREMENTS:

S. No	Description	Proposed actions	Relevance with PO's	Relevance with PSO's
1	To improve standards and analyze the concepts.	Seminars	PO 1	PSO 1
2	Conditional probability, Sampling distribution, correlation, regression analysis and testing of hypothesis	Seminars	PO 4	PSO 1
3	Encourage students to solve real time applications and prepare towards competitive examinations.	Guest lectures	PO 2	PSO 1

Prepared by:
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INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)
Dundigal, Hyderabad -500 043

CIVIL ENGINEERING

COURSE DESCRIPTOR

Course Title	ELEMENTS OF MECHANICAL ENGINEERING				
Course Code	AME551				
Programme	B.Tech				
Semester	V	CE			
Course Type	Foundation				
Regulation	IARE - R16				
Course Structure	**Theory**			**Practical**	
	Lectures	**Tutorials**	**Credits**	**Laboratory**	**Credits**
	3	-	3	-	-
Chief Coordinator	Mr. P Sadanandam, Assistant Professor				
Course Faculty	Mr. P Sadanandam, Assistant Professor Mr. A. Anudeep Kumar, Assistant Professor				

I. COURSE OVERVIEW:

Understand about the working, functions and applications of equipment's used in daily life.Identify the broad context of Mechanical engineering problems, including describing the problem conditions and identifying possible contributing factors. Understand the fundamental elements of Mechanical engineering systems, system components and processes, with a good understanding of associated safety, quality, scheduleand cost considerations.Employ mathematics, science, and computing techniques in a systematic, comprehensive,and Rigorous manner to support the study and solution of Mechanical engineeringproblems

II. COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites
-	-	-	-

III. MARKSDISTRIBUTION:

Subject	SEE Examination	CIA Examination	Total Marks
Elements of Mechanical Engineering	70 Marks	30 Marks	100

IV. DELIVERY / INSTRUCTIONAL METHODOLOGIES:

✔	Chalk & Talk	✔	Quiz	✔	Assignments	✘	MOOCs
✔	LCD / PPT	✔	Seminars	✘	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 units and each unit carries equal weightage in terms of marks distribution. The question paper pattern is as follows. Two full questions with "either" or "choice" will be drawn from each unit. Each question carries 14 marks. There could be a maximum of two sub divisions in a question.

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

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

Continuous Internal Assessment (CIA):
CIA is conducted for a total of 30 marks (Table 1), with 25 marks for Continuous Internal Examination (CIE), 05 marks for Quiz/ Alternative Assessment Tool (AAT).

Table 1: Assessment pattern for CIA

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

Continuous Internal Examination (CIE):
Two CIE exams shall be conducted at the end of the 8th and 16th week of the semester respectively. The CIE exam is conducted for 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 / Alternative Assessment Tool (AAT):
Two Quiz exams shall be online examination consisting of 25 multiple choice questions and are be answered by choosing the correct answer from a given set of choices (commonly four). Marks shall be awarded considering the average of two quizzes for every course. The AAT may include seminars, assignments, term paper, open ended experiments, five minutes video and MOOCs.

VI. HOW PROGRAM OUTCOMES ARE ASSESSED:

Program Outcomes (POs)		Strength	Proficiency assessed by
PO 1	**Engineering Knowledge**: Capability to apply the knowledge of mathematics, science and engineering in the field of mechanical engineering.	3	Presentation on real-world problems
PO 5	**Modern tool usage:** An ability to formulate solve complex engineering problem using modern engineering and information Technology tools.	2	5 minute video
PO 9	**Individual and team work:** To function as an effective individual and as a member or leader in multi-disciplinary environment and adopt in diverse teams.	1	Seminar

3 = High; 2 = Medium; 1 = Low

VII. HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

Program Specific Outcomes (PSOs)		Strength	Proficiency assessed by
PSO 1	**Engineering Knowledge:** Graduates shall demonstrate sound knowledge in analysis, design, laboratory investigations and construction aspects of civil engineering infrastructure, along with good foundation in mathematics, basic sciences and technical communication.	1	Assignment
PSO 2	**Broadness and Diversity:** Graduates will have a broad understanding of economical, 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	Seminar
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	Seminar

3 = High; 2 = Medium; 1 = Low

VIII. COURSE OBJECTIVES (COs):

The course should enable the students to:	
I	Familiarize with fundamental of mechanical systems.
II	Understand and appreciate the significance of mechanical engineering in different fields of engineering.
III	Understanding the application and usage of various engineering materials

IX. COURSE LEARNING OUTCOMES (CLOs):

CLO Code	CLO's	At the end of the course, the student will have the ability to:	PO's Mapped	Strength of Mapping
CAME551.01	CLO 1	Understand prime movers and concept of force, pressure, energy, work, power, system, heat, temperature, specific heat capacity.	PO 1	3
CAME551.02	CLO 2	Explain change of state, path, process, cycle, internal energy, enthalpy, statement of zeroth law and first law.	PO 1	3

CLO Code	CLO's	At the end of the course, the student will have the ability to:	PO's Mapped	Strength of Mapping
CAME551.03	CLO 3	Understand the application, different types of energy sources.	PO 1	3
CAME551.04	CLO 4	Knowledge of Gas laws, Boyle's law, Charle's law, gas constant, relation between Cp and Cv, various non-flow processes like constant volume processes, constant pressure process, isothermal process, adiabatic process, poly-tropic process.	PO 5	2
CAME551.05	CLO 5	Demonstrate knowledge of formation of steam and use of steam table for identifying the various parameters at given conditions.	PO 5	2
CAME551.06	CLO 6	Derive the efficiency of various heat engines and problem solving.	PO 5	2
CAME551.07	CLO 7	Knowledge of different types of steam boilers and its mountings.	PO 9	1
CAME551.08	CLO 8	Explain the working principle of Internal combustion engines classification.	PO 9	1
CAME551.09	CLO 9	Demonstrate the working of pumps and air compressors.	PO 9	1
CAME551.10	CLO 10	Explain the refrigeration and air conditioning and their types.	PO 5	2
CAME551.11	CLO 11	Knowledge of various machining process of lathe, drilling and milling Machine tools	PO 1	3
CAME551.12	CLO 12	Explain the fundamentals of robotic and automation based on the coordinate systems.	PO 1	3
CAME551.13	CLO 13	Understanding the concepts about flexible automation, NC/CNC machines.	PO 1	3
CAME551.14	CLO 14	Knowledge of Engineering materials and joining processes.	PO 5	2
CAME551.15	CLO 15	Understand the applications of ferrous metals, non-ferrous metals, alloys,	PO 5	2
CAME551.16	CLO 16	Knowledge of Composites and their applications in the aircraft and automobiles.	PO 5	2

3 = High; 2 = Medium; 1 = Low

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

(CLOs)	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CLO 1	3												1		
CLO 2	3												1		
CLO 3	3												1		
CLO 4					2									1	
CLO 5					2										1
CLO 6					2										1
CLO 7									1						

(CLOs)	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CLO 8									1						
CLO 9									1				1		
CLO 10					2								1		
CLO 11	3														
CLO 12	3														
CLO 13	3													1	
CLO 14					2								1		
CLO 15					2									1	
CLO 16					2										

3 = High; 2 = Medium; 1 = Low

XI. ASSESSMENT METHODOLOGIES–DIRECT

CIE Exams	PO 1, PO5, PO 9	SEE Exams	PO 1, PO5, PO 9	Assignments	PO 5	Seminars	PO 5
Laboratory Practices	-	Student Viva	-	Mini Project	-	Certification	-
Term Paper	PO 9						

XII. ASSESSMENT METHODOLOGIES-INDIRECT

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

XIII. SYLLABUS

Unit-I	INTRODUCTION TO ENERGY SYSTEMS
Introduction: Prime movers and its types, concept of force, pressure, energy, work, power, system, heat, temperature, specific heat capacity, change of state, path, process, cycle, internal energy, enthalpy, statement of zeroth law and first law; Energy: Introduction and application, of energy sources like fossil fuels, nuclear fuels, hydels, solar, wind, and bio-fuels, environment issues like global warming and ozone depletion; Properties of gases: Gas laws, Boyle's law, Charle's law, gas constant, relation between Cp and Cv, various non-flow processes like constant volume processes, constant pressure process, isothermal process, adiabatic process, poly-tropic process.	
Unit-II	**STEAM TURBINES, HYDRAULIC MACHINES**
Properties of steam: Steam formation, types of steam enthalpy, specific volume, internal volume, internal energy and dryness fraction of steam, use of steam tables, calorimeters; Heat engine: Heat engine cycle and heat engine, working substances, classification of heat engines, description and thermal efficiency of Carnot, Rankin, Otto cycle, diesel cycles; Steam boilers: Introduction, Cochran, Lancashire, Babcock, and Wilcox boiler, functioning of different mountings and	

accessories.	
Unit-III	**INTERNAL COMBUSTION ENGINES, REFRIGERATION AND AIR-CONDITIONING**
Internal combustion engines: Introduction, classification, engine details, four stroke, two stroke cycle, petrol engine, diesel engine, indicated power, brake power, efficiencies; Pumps: Types, operation of reciprocating. rotary, centrifugal pumps, priming. Air compressors: Types, operation of reciprocating, rotary air compressors, significance of multi-staging; Refrigeration and air-conditioning: Refrigerant, vapor compression refrigeration system, vapor absorption refrigeration system, domestic refrigerator, window and split air conditioners.	
Unit-IV	**MACHINE TOOLS AND AUTOMATION**
Machine tools and automation machine tools operation: Turning, facing , knurling, thread cutting, taper turning by swiveling the compound rest, drilling, boring, reaming, tapping, counter sinking, counter boring, plane milling, end milling, slot milling; Robotic and automation: Introduction, classification based on robot configuration, polar, cylindrical, cartesian, coordinate and spherical, application, advantages and advantages; Automation: Definition, types, fixed, programmable and flexible automation, NC/CNC machines, basic elements with simple block diagrams, advantages and disadvantages.	
Unit-V	**ENGINEERING MATERIALS, JOINING PROCESS**
Engineering materials and joining processes: Types, applications of ferrous metals, non-ferrous metals, alloys; Composites: Introduction, definition, classification and application (Automobile and Air Craft).	
Text Books:	
1. V. K. Manglik, "Elements of Mechanical Engineering", Prentice Hall, 1st Edition, 2013. 2. Mikell P. Groover, "Automation, Production Systems and CIM", Prentice Hall, 4th Edition, 2015.	
Reference Books:	
1. S. Trymbaka Murthy, "A Text Book of Elements of Mechanical Engineering", University Press, 4th Edition, 2006. 2. K. P. Roy, S. K. HajraChoudary, Nirjhar Roy, "Element of Mechanical Engineering", Media Promoters & Publishers, 7th Edition, 2012. 3. Pravin Kumar, "Basic Mechanical Engineering", Pearson, 1st Edition, 2013.	

XIV. COURSE PLAN:

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

Lecture No	Topic/s to be covered	Course Learning Outcomes (CLOs)	Reference
1-3	concept of force, pressure, energy, work, power, system, heat, temperature, specific heat capacity, change of state, path, process, cycle, internal energy, enthalpy, statement of zeroth law and first law	CLO 1	T1-1.1
4-6	Introduction and application, of energy sources like fossil fuels, nuclear fuels, hydels, solar, wind, and bio-fuels, environment issues like global warming and ozone depletion.	CLO 2	T1-1.2, R2-1.3
7-9	Gas laws, Boyle's law, Charle's law, gas constant, relation between Cv variousnon-flow processes like constant volume processes, constant pressure process, isothermal process, adiabatic process, poly-tropic process.	CLO 3	T1-1.4
10-12	Steam formation, types of steam enthalpy, specific volume, internal volume, internal energy and dryness fraction of steam, use of steam tables, calorimeters.	CLO 4	T1-2.1, R1-2.2

Lecture No	Topic/s to be covered	Course Learning Outcomes (CLOs)	Reference
13-15	Heat engine cycle and heat engine, working substances, classification of heat engines, description and thermal efficiency of Carnot, Rankine, Otto cycle, diesel cycles	CLO 5	T1-2.3, R1-2.4
16-18	Introduction, Cochran, Lancashire, Babcock, and Wilcox boiler, functioning of different mountings and accessories.	CLO 6 CLO 7	T1-2.5
19-21	Introduction, classification, engine details, four stroke, two stroke cycle, petrol engine, diesel engine, indicated power, brake power, efficiencies; Pumps: Types, operation of reciprocating. rotary, centrifugal pumps, priming.	CLO 8	T1-3.1, R1-3.2
22-24	Types, operation of reciprocating, rotary air compressors, significance of multi-staging	CLO 9	T1-3.3
25-27	Refrigerant, vapor compression refrigeration system, vapor absorption refrigeration system, domestic refrigerator, window and split air conditioners.	CLO 10	T1-3.4, T2-3.4
28-30	Turning, facing, knurling, thread cutting, taper turning by swiveling the compound rest, drilling,	CLO 11	T2-4.1
31-33	boring, reaming, tapping, counter sinking, counter boring, plane milling, end milling, slot milling	CLO 12	T1-4.2, T2-4.3
34-36	Introduction, classification based on robot configuration, polar, cylindrical, Cartesian, coordinate and spherical, application, advantages; Automation: Definition, types, fixed, programmable and flexible automation, NC/CNC machines, basic elements with simple block diagrams, advantages and disadvantages	CLO 13	T1-4.4
37-39	Types, applications of ferrous metals, non-ferrous metals, alloys	CLO 14	T1-5.1
40-42	Types of joining process, types of welding	CLO 15	T1-5.2, R2-5.3
43-45	Introduction, definition, classification of Automobile	CLO 15	T1-5.2, T2-5.3
46-48	Introduction, definition, classification of Air Craft).	CLO16	T1-5.4, T2-5.5
49-51	Application of Automobile and Air Craft	CLO 16	T1-5.4, R2-5.5

XV. GAPS IN THE SYLLABUS - TO MEET INDUSTRY / PROFESSION REQUIREMENTS:

S No	Description	Proposed actions	Relevance with POS	Relevance with PSOs
1	To improve standards and analyze the concepts of materials..	Guest lectures	PO 1	PSO 1
2	Improves the practical solve problems related to Refrigeration and Air-Conditioning	Seminars / NPTEL	PO 5	PSO 1
3	Encourage students to solve real time applications and prepare towards competitive examinations.	NPTEL	PO 9	PSO 1

Prepared by:
Mr. P.Sadanandam, Assistant Professor
Mr. A. Anudeep Kumar, Assistant Professor

HOD, CE

VI SEMESTER

INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)
Dundigal, Hyderabad -500 043

CIVILENGINEERING

COURSE DESCRIPTOR

Course Title	**DESIGN OF STEEL STRUCTURES AND DRAWING**				
Course Code	ACE012				
Programme	B.Tech				
Semester	VI	CE			
Course Type	Core				
Regulation	IARE - R16				
Course Structure	**Theory**			**Practical**	
	Lectures	**Tutorials**	**Credits**	**Laboratory**	**Credits**
	3	1	4	-	-
Chief Coordinator	Mr. B.Suresh , Assistant Professor				
Course Faculty	Mr.CH.Venugopalreddy, Assistant Professor Mr. B.Suresh , Assistant Professor				

I. COURSE OVERVIEW:

This course addresses mechanical properties of steel, concepts of elasticity and plasticity, concept of limit state design-Limit Sates like serviceability, and stability check. It also creates awareness and share knowledge on the design provisions as per current codes (IS 800-2007) leading to wider use in the future. This course provides a broader understanding of the behaviour of steel structures as systems, in opposition to individual elements only. This course also focuses on the design of ductile steel structures. Although emphasis is placed on design concepts and strategies pertinent to steel structures, the methods presented can be applied to other materials with certain modifications. This course will help in up-gradation of knowledge / information / skills of academicians, researchers and design engineers to create environment for efficient / economic design of steel structures.

II. COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites	credits
UG	ACE004	IV	Strength of Materials - II	4
UG	ACE008	V	Structural Analysis	4

III. MARKSDISTRIBUTION:

Subject	SEE Examination	CIA Examination	Total Marks
Design of steel structures and drawing	70 Marks	30 Marks	100

IV. DELIVERY / INSTRUCTIONAL METHODOLOGIES:

✔	Chalk & Talk	✔	Quiz	✔	Assignments	✘	MOOCs
✔	LCD / PPT	✔	Seminars	✘	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 fiveunits and each unit carries equal weightage in terms of marks distribution. The question paper pattern is as follows. Two full questions with "either" or "choice" will be drawn from each unit. Each question carries 14 marks. There could be a maximum of two sub divisions in a question.

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

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

Continuous Internal Assessment (CIA):
CIA is conducted for a total of 30 marks (Table 1), with 25 marks for Continuous Internal Examination (CIE), 05 marks for Quiz/ Alternative Assessment Tool (AAT).

Table 1: Assessment pattern for CIA

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

Continuous Internal Examination (CIE):
Two CIE exams shall be conducted at the end of the 8th and 16th week of the semester respectively. The CIE exam is conducted for 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 / Alternative Assessment Tool (AAT):
Two Quiz exams shall be online examination consisting of 25 multiple choice questions and are be answered by choosing the correct answer from a given set of choices (commonly four). Marks shall be awarded considering the average of two quizzes for every course. The AAT may include seminars, assignments, term paper, open ended experiments, five minutes video and MOOCs.

VI. HOW PROGRAM OUTCOMES ARE ASSESSED:

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

3 = High; 2 = Medium; 1 = Low

VII. HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

Program Specific Outcomes (PSOs)		Strength	Proficiency assessed by
PSO 1	**Engineering knowledge:** Graduates shall demonstrate sound knowledge in analysis, design, laboratory investigations and construction aspects of civil engineering infrastructure, along with good foundation in mathematics, basic sciences and technical communication.	3	Assignments/ Exams
PSO 2	**Broadness and Diversity:** Graduates will have a broad understanding of economical, environmental, societal, health and safety factors involved in infrastructural development, and shalldemonstrate ability to function within multidisciplinary teams with competence in modern tool usage.	2	Assignments/ Exams
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 offerengineering services to the society, ethically and responsibly.	1	Seminars

3 = High; 2 = Medium; 1 = Low

VIII. COURSE OBJECTIVES (COs):

The course should enable the students to:	
I	Discuss the concepts of structural steel design conforming to the IS 800 design code.
II	Identify various types of structural steel and its properties also define concepts of Limit State Design.
III	Analyze structures using plastic method of analysis and evaluate collapse load and plastic moment capacity.
IV	Design compression members, beams, connections and girders.

IX. COURSE LEARNING OUTCOMES (CLOs):

CLO Code	CLO's	At the end of the course, the student will have the ability to:	PO's Mapped	Strength of Mapping
ACE012.01	CLO 1	Know the materials, making of iron and steel.	PO1,PO2	2
ACE012.02	CLO 2	Know the types of structural steel, mechanical properties of steel.	PO1, PO4	2
ACE012.03	CLO 3	Know the concepts of plasticity yield strength	PO3	3
ACE012.04	CLO 4	Understand loads and combinations loading wind loads on roof trusses.	PO1,PO3	3
ACE012.05	CLO 5	Understand behavior of steel, local buckling	PO1,PO2	2
ACE012.06	CLO 6	Concept of limit state design – different limit states as per IS 800:2007.	PO1.PO2	2
ACE012.07	CLO 7	Concept of design strengths deflection limits, serviceability	PO1,PO2, PO3	3
ACE012.08	CLO 8	Evaluate the bolted connections	PO3	3
ACE012.09	CLO 9	Evaluate welded connections, efficiency of joint	PO3	3
ACE012.10	CLO 10	Analyze the prying action types of welded joints.	PO1	2
ACE012.11	CLO 11	Understand the design of tension members and design strength of members.	PO3	3
ACE012.12	CLO 12	Understand the design of compression members, buckling class, slenderness ratio.	PO3	3
ACE012.13	CLO 13	Understand the strength design, laced battened columns	PO3	3
ACE012.14	CLO 14	Understand the design of column splice, column base, and slab base.	PO3	3
ACE012.15	CLO 15	Understand the design of beams, plastic moment	PO3	3
ACE002.16	CLO 16	Analyze the bending and shear strength laterally supported beams.	PO2	2
ACE012.17	CLO 17	Understand the design, built up sections, large plates web buckling	PO3	3
ACE012.18	CLO 18	Analyze the crippling and deflection of beams, design of purlin.	PO2 ,PO3	3
ACE012.19	CLO 19	Understand the design of eccentric connections with brackets.	PO3	3

CLO Code	CLO's	At the end of the course, the student will have the ability to:	PO's Mapped	Strength of Mapping
ACE012.20	CLO 20	Analyze the beam end connections, web angle, unstiffened and stiffened seated connections, and design of truss joints	PO2, PO3	3
ACE012.21	CLO 21	Understand the design of welded plate girders, optimum depth, and design of main section.	PO3	3
ACE012.22	CLO 22	Understand the design of end bearing stiffness and intermediate stiffness	PO1	2
ACE012.23	CLO 23	Analyze the Connection between web and flange and design of flange splice and web splices	PO2	2

3 = High; 2 = Medium; 1 = Low

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

CLOs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CLO 1	3	2											3	2	
CLO 2	3			2									2	2	
CLO 3			2										2	2	
CLO 4	2		2										2		
CLO 5	2	2											3		
CLO 6	2	2											2		
CLO 7	2	2	2										3	1	
CLO 8			2										2		
CLO 9			2										2		
CLO 10	2												2		
CLO 11			3										3	1	
CLO 12			3										3	1	1
CLO 13			3										3	2	1
CLO 14			3										3	1	1
CLO 15			3										3	1	1
CLO 16		2											3	1	1
CLO 17			3										3	2	1
CLO 18		2	2										3	2	1

CLOs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CLO 19			3										3	2	1
CLO 20		2	2										3	2	1
CLO 21			3										3	2	1
CLO 22			3										3	2	1
CLO 23		2											3	2	1

3 = High; 2 = Medium; 1 = Low

XI. ASSESSMENT METHODOLOGIES–DIRECT

CIE Exams	PO 1; PO2; PO3,PO4	SEE Exams	PO 1; PO2; PO3;PO4	Assignments	PO 2	Seminars	-
Laboratory Practices	-	Student Viva	-	Mini Project	-	Certification	-
Term Paper	-						

XII. ASSESSMENT METHODOLOGIES-INDIRECT

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

XIII. SYLLABUS

Unit-I	INTRODUCTION ON MECHANICAL BEHAVIOUR OF STEEL
Materials, making of iron and steel, types of structural steel, mechanical properties of steel, concepts of plasticity yield strength, loads and combinations loading wind loads on roof trusses, behaviour of steel, local buckling. Concept of limit state design – different limit states as per IS 800:2007. Design strengths deflection limits, serviceability, bolted connections, welded connections, efficiency of joint, prying action types of welded joints, design of tension members, design strength of members..	
Unit-II	**COMPRESSION MEMBERS**
Design of compression members, buckling class, slenderness ratio, strength design, laced battened columns, column splice, column base, slab base..	
Unit-III	**BEAMS**
Design of beams, plastic moment, and bending and shear strength laterally supported beams. Design, built up sections, large plates web buckling, crippling and deflection of beams, design of purlin..	
Unit-IV	**ECCENTRIC CONNECTIONS**
Design of eccentric connections with brackets, beam end connections, web angle, unstiffened and stiffened seated connections (bolted and welded types), design of truss joints.	
Unit-V	**WELDED PLATE GIRDERS**
Design of welded plate girders, optimum depth, design of main section, design of end bearing stiffness and intermediate stiffness. Connection between web and flange and design of flange splice and web splices.	
Text Books:	
1. N. Subramanian, “Design of steel structures”, Oxford University Press, 2016. 2. S. K. Duggal, “Limit state design of steel structures”, Tata McGraw-Hill, 2010.	

Reference Books:
1. Ramachandra, “Design of steel structures Volumes 1 and 2”, Standard Publications, 2009. 2. S.S. Bhavikatti, “Design of steel structures”, IK International Publication House, New Delhi, 2010.

XIV. COURSE PLAN:

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

Lecture No	Topics to be covered	Course Learning Outcomes (CLOs)	Reference
1-3	Making iron and steel, types of structural steel, mechanical properties of steel, concepts of plasticity, yield strength	CLO1, CLO2,	T2:1.1 - 1.8
4-5	Limit state, design strength, deflection limits, serviceability and stability check.	CLO6	T2:2.1-2.10
6-7	General Design Requirements, Limit State Design	CLO6	R4:3.1-3.10
8-9	Design Considerations for Bolted connections	CLO8	T2:10.2
10-12	Design Considerations for Riveted connections As per IS -800-2007	CLO8	T2:10.1
13-15	Concepts related to Design strength and problems related to design strength	CLO8	T2: 10.4-10.5
16-18	Types of welded joints, specifications and design requirements	CLO9	T2: 11.1-11.8
19-20	Design of eccentric connection, framed, stiffened and seat connection	CLO7	T2: 11.10 - 11.11
21-22	Introduction, Design considerations		
23-24	Design strength, Design procedure, splice lug- angle.	CLO11	T2: 3.10-3.12
25-27	Problem related to tension members		T2 : 3.10
28	Introduction , possible failure Modes , Behaviour of compression member	CLO12	T2: 5.1-5.3
29-31	Design Considerations buckling class, slenderness ratio, strength design, laced, battened columns,	CLO13	T2: 5.4-5.9
32-33	Problems on slenderness ratio , Design of compression members	CLO12	T2: 5.11-5.13
34	Types of Beams, lateral stability of beams, effective length, buckling of beams.	CLO14	T2: 6.1-6.4
35	General Design considerations, Design Strength of Laterally supported beams, Design of beams.	CLO15	T1: 6.5-6.12
36-38	Problems related to design of beams	CLO15	T1: 6.12
39-41	Design of end bearings, Problems related to it.	CLO16	T2: 12.6
42-43	Design of Joints for trusses	CLO18	T2: 11.3-11.4
44-46	Introduction to plate girders, economical depth, design of main section.	CLO21	T2: 7.1-7.3
47-49	Connections between web flange, design of stiffness bearing, intermediate stiffeners, design of web splice and flange splice.	CLO21	T2: 7.4-7.8
50-51	Design of Plate girder using IS 800:2007 Problems related.	CLO21	T2: 7.6.
52-54	Analysis of trusses, design of members, design of joints, End bearings	CLO19	R3: 12.11-12.15
55-56	Design of Roof trusses	CLO20	R3:Ex 12.4

Lecture No	Topics to be covered	Course Learning Outcomes (CLOs)	Reference
57-59	Introduction to Purlin, Design considerations	CLO18	T2: 6.11
60	Problems on design of Purlin	CLO18	T2: 6.11.1

XV. GAPS IN THE SYLLABUS - TO MEET INDUSTRY / PROFESSION REQUIREMENTS:

S No	Description	Proposed actions	Relevance with POs	Relevance with PSOs
1	The internal behaviour of the material with the externally applied loading including thermal loads.	Seminars/Guest Lectures/NPTEL	PO 1, PO 4	PSO 1, PSO 2
2	Analysis of steel structure especially for building moments and shear force and decision making of analysis.	Seminars/Guest Lectures/NPTEL	PO 2	PSO 1, PSO 2
3	Torsional effects in the structure and failure criteria of the compression members.	Seminars/ Assignments	PO 2, PO 3	PSO 1, PSO 2

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CIVIL ENGINEERING

COURSE DESCRIPTOR

Course Title	**TRANSPORTATION ENGINEERING**				
Course Code	ACE013				
Programme	B.Tech				
Semester	VI	CE			
Course Type	Core				
Regulation	IARE - R16				
Course Structure	**Theory**			**Practical**	
	Lectures	**Tutorials**	**Credits**	**Laboratory**	**Credits**
	3	1	4	3	2
Chief Coordinator	Ms. K. Anusha Hadassa, Assistant Professor.				
Course Faculty	Ms. K. Anusha Hadassa ,Assistant Professor Ms. K. Shruthi, Assistant Professor.				

I. COURSE OVERVIEW:

The course gives an overview about the Transportation engineering with respect to, planning, design, construction and maintenance of highways as per IRC standards, specifications and methods. To impart knowledge of Traffic engineering, traffic regulation, management and traffic safety with integrated approach in traffic planning as well.

II. COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites	Credits
UG	ACE002	III	Surveying	4

III. MARKSDISTRIBUTION:

Subject	SEE Examination	CIA Examination	Total Marks
Transportation Engineering	70Marks	30Marks	100

IV. DELIVERY / INSTRUCTIONAL METHODOLOGIES:

✔	Chalk & Talk	✔	Quiz	✔	Assignments	✘	MOOCs
✔	LCD / PPT	✔	Seminars	✔	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 units and each unit carries equal weightage in terms of marks distribution. The question paper pattern is as follows. Two full questions with "either" or "choice" will be drawn from each unit. Each question carries 14 marks. There could be a maximum of two sub divisions in a question.

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

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

Continuous Internal Assessment (CIA):

CIA is conducted for a total of 30 marks (Table 1), with 25 marks for Continuous Internal Examination (CIE), 05 marks for Quiz/ Alternative Assessment Tool (AAT).

Table 1: Assessment pattern for CIA

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

Continuous Internal Examination (CIE):

Two CIE exams shall be conducted at the end of the 8th and 16th week of the semester respectively. The CIE exam is conducted for 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 / Alternative Assessment Tool (AAT):

Two Quiz exams shall be online examination consisting of 25 multiple choice questions and are be answered by choosing the correct answer from a given set of choices (commonly four). Marks shall be awarded considering the average of two quizzes for every course. The AAT may include seminars, assignments, term paper, open ended experiments, five minutes video and MOOCs.

VI. HOW PROGRAM OUTCOMES ARE ASSESSED:

Program Outcomes (POs)		Strength	Proficiency assessed by
PO 1	**Engineering knowledge**: Apply the knowledge of mathematics, science, engineeringfundamentals, and an engineering specialization to the solution of complex engineering problems.	3	Assignments/ Seminars
PO 2	**Problem analysis**: Identify, formulate, review research literature, and analyze complexengineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences	2	Seminars
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	Assignments
PO 4	**Conduct investigations of complex problems**: Use research-based knowledge and researchmethods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.	2	Mini Projects

3 = High; 2 = Medium; 1 = Low

VII. HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

Program Specific Outcomes (PSOs)		Strength	Proficiency assessed by
PSO 1	**Engineering Knowledge**: Graduates shall demonstrate sound knowledge in analysis, design, laboratory investigations and construction aspects of civil engineering infrastructure, along with good foundation in mathematics, basic sciences and technical communication.	2	Mini Projects
PSO 2	**Broadness and Diversity:** Graduates will have a broad understanding of economical, 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.	-	-
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.	-	-

3 = High; 2 = Medium; 1 = Low

VIII. COURSE OBJECTIVES (COs):

The course should enable the students to:	
I	To Understand the importance of highway development of India and classification ofroads and road patterns.
II	To design various geometric elements like curves, gradients, super elevation etc.
III	To Capableof performing various traffic surveys.
IV	To Analyse traffic signals intersections and road markings and their designs.

IX. COURSE LEARNING OUTCOMES (CLOs):

CLO Code	CLO's	At the end of the course, the student will have the ability to:	PO's Mapped	Strength of Mapping
ACE013.01	CLO 1	Understand necessity for highway planning, different road development plans.	PO1,PO2	2
ACE013.02	CLO 2	Study Classification of roads, road network patterns, highway alignment,	PO1	3
ACE013.03	CLO 3	Capable of performing various traffic surveys	PO1,PO4	2
ACE013.04	CLO 4	Study factors affecting alignment, engineering surveys, drawing and reports, highway project.	PO1	3
ACE013.05	CLO 5	Understand Importance of geometric design.	PO3	3
ACE013.06	CLO 6	Analyze factors affecting highway geometric design. Design controls and criteria.	P03	2
ACE013.07	CLO 7	Understand highway cross section elements including shoulder, kerb, carriageway.	PO2,PO3	2
ACE013.08	CLO 8	Analyze sight distance elements, stopping sight distance, overtaking sight distance and intermediate sight distance.	PO4	2
ACE013.09	CLO 9	Analyze design of horizontal alignment, design of super elevation and extra widening.	PO3	2
ACE013.10	CLO 10	Analyze design of transition curves, design of vertical alignment, gradients, vertical curves.	PO3	2
ACE013.11	CLO 11	Study basics of traffic engineering and regulations.	PO11	1
ACE013.12	CLO 12	Predict basic parameters of traffic, volume, speed and density, traffic volume studies,	PO4	2
ACE013.13	CLO 13	Analyze Parking studies, on street and off street parking , road accidents , causes and preventive measures, accident	PO2	1
ACE013.14	CLO 14	Study road markings, need for road markings, types of road markings, design of traffic signals, Webster method.	PO2,PO3	2
ACE013.15	CLO 15	Understand types of Intersections, conflicts at intersections, requirements of at, grade intersection.	PO1,PO3	3
ACE013.16	CLO 16	Understand types of at grade intersections, canalization traffic islands, types of grade separated intersections, rotary intersection,	PO1	3
ACE013.17	CLO 17	Study concept of rotary, design factors of rotary, advantages and limitations of rotary intersections.	PO3	3
ACE013.18	CLO 18	Understand Highway material characterization; sub-grade soil, stone aggregate.	PO1	3
ACE013.19	CLO 19	Explain construction of water bound macadam roads, construction of bituminous pavements:	PO4	3
ACE013.20	CLO 20	Study Surface dressing, bitumen bound macadam, bituminous concrete,	PO1	3
ACE013.21	CLO 21	Study various types of bitumen materials, construction of gravel roads.	PO1	3
ACE013.22	CLO 22	Understand construction of cement concrete pavements, construction of joints in cement concrete pavements joint filter.	PO2	2
ACE013.23	CLO 23	Analyze seal pavement failures, maintenance of highways.	PO1	1

3 = High; 2 = Medium; 1 = Low

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

CLO	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CLO 1	3	1											3		
CLO 2	3												3		
CLO 3	3			2											
CLO 4	3												3		
CLO 5			3												
CLO 6			2												
CLO 7		2	2										2		
CLO 8				2											
CLO 9			2												
CLO 10		2	2												
CLO 11													2		
CLO 12				2											
CLO 13		2													
CLO 14		2	2												
CLO 15	3		2										3		
CLO 16	3												2		
CLO 17			3												
CLO 18	3												2		
CLO 19				3											
CLO 20	3														
CLO 21	3												3		
CLO 22		2											2		
CLO 23	1												2		

3 = High; 2 = Medium; 1 = Low

XI. ASSESSMENT METHODOLOGIES–DIRECT

CIE Exams	PO1,PO2, P03,PO4	SEE Exams	PO1,PO2, P03,PO4	Assignments	PO1, PO3	Seminars	PO2, PO4
Laboratory Practices	PO1	Student Viva	PO1	Mini Project	PO2, P03	Certificatior	-
Term Paper	-						

XII. ASSESSMENT METHODOLOGIES-INDIRECT

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

XIII. SYLLABUS

UNIT -I	**HIGHWAY DEVELOPMENT AND PLANNING:**
Highway development in India, necessity for highway planning, different road development plans; Classification of roads, road network patterns, highway alignment, factors affecting alignment, engineering surveys, drawing and reports, highway project.	
UNIT - II	**HIGHWAY GEOMETRIC DESIGN:**
Importance of geometric design, factors affecting highway geometric design. Design controls and criteria, highway cross section elements, sight distance elements, stopping sight distance, overtaking sight distance and intermediate sight distance, design of horizontal alignment, design of super elevation and extra widening, design of transition curves, design of vertical alignment, gradients, vertical curves	
UNIT - III	**TRAFFIC ENGINEERING AND REGULATIONS:**
Basic parameters of traffic, volume, speed and density, traffic volume studies, data collection and presentation, speed studies, data collection and presentation, origin and destinations studies. Parking studies, onstreet and offstreet parking , road accidents , causes and preventive measures, accident data recording, condition diagram and collision diagrams, traffic signs, types and specifications, road markings, need for road markings, types of road markings, design of traffic signals, webster method	
UNIT - IV	**INTERSECTION DESIGN:**
Types of Intersections, conflicts at intersections, requirements of at, grade intersection, types of at grade intersections, canalization ,traffic islands, types of grade separated intersections, rotary intersection, concept of rotary, design factors of rotary, advantages and limitations of rotary intersections	
UNIT-V	**HIGHWAY MATERIAL, CONSTRUCTION ANDMAINTENANCE:**
Highway material characterization; subgrade soil, stone aggregate, bitumen materials, construction of gravel roads, construction of water bound macadam roads, construction of bituminous pavements: Surface dressing, bitumen bound macadam, bituminous concrete, construction of cement concrete pavements, construction of joints in cement concrete pavements joint filter and seal pavement failures, maintenance of highways, highway drainage..	
Text Books:	
1. Highway Engineering – S.K.Khanna& C.E.G. Justo, Nemchand& Bros., 7th edition (2000). 2. Traffic Engineering & Transportation Planning – Dr.L.R.Kadyali, Khanna	
Reference Books:	
1. Principles of Traffic and Highway Engineering – Garber &Hoel,CengageLearning. 2. Principles of Practices of Highway Engineering–Dr.L.R.Kadyali, and Dr.N.BLal-Khannapublications 3. Highway Engineering – S.P.Bindra, DhanpatRai& Sons. – 4th Edition(1981)	

XIV. COURSE PLAN:

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

Lecture No	Topics to be covered	Course Learning Outcomes (CLOs)	Reference
1	To Know the highway development in India	CLO1	T1:24.6
2	To know the necessity of highway	CLO2	T1:12.14
3-5	To know the types of road plans.	CLO3	T1:3.10
6-7	To Know the classification of roads and its patterns.	CLO4	T4:3.11
8-9	To know the concept of highway alignment.	CLO5	T1:16.2
10	To understand the geometric design of roads	CLO6	T1:16.5
11	Able to know the highway elements	CLO7	T1:16.6.2
12	Able to know the measurement of cross sectional elements.	CLO8	T1:16.6.2
13	Able to know the measurement of Sight distances	CLO9	T2:26.9
14	Able to know the measurement of Sight distances	CLO10	T2:26.11
15-16	Able to know the measurement of Sight distances	CLO11	T1:16.7
17-18	Able to know the design Horizontal curve	CLO12	T2:26
19-21	Able to know the design Super elevation and extra widening	CLO13	T2:20.4
23-24	Able to know the design Transition curves	CLO14	T2:23.4
25-26	Able to know the design Horizontal curve	CLO15	T2:20.9
27-28	To know about gradient	CLO16	T4:5.13
29	To able to design vertical curves.	CLO17	T2:21.1-21.2
30-31	To know about traffic volume.	CLO18	T2:21.3-
32	To understand the parameters of speed Speed and density	CLO18	T2:21.5-21.6
33-36	Able to understand the traffic volume studies,	CLO19	T2:7.1-7.3
37-38	Able to understand the speed studies,	CLO20	T2:27.2
32	To understand the parameters of speed Speed and density	CLO21	T2:21.5-21.6
33-36	Able to understand the traffic volume studies,	CLO22	T2:7.1-7.3
37-38	Able to understand the speed studies,	CLO23	T2:27.2
39	To know about the concept of solving the problems on speed studies	CLO21	T2:27.9
40-42	To know about the parking studies	CLO22	T2:27.9
43-44	To understand the concept of accident studies	CLO23	T3:27.10
45-46	To know about the specifications of traffic markings and specification	CLO20	T2:27.11
47-48	To know about the road markings	CLO21	T2:27.12
49-50	To design traffic signal	CLO22	T2:10.7
50-51	To understand about the intersection	CLO23	T2:10.8
52-54	To know about the types of intersections	CLO21	T3:10.10
55	To get the knowledge of Traffic islands	CLO22	T3:13.8
56-58	understand the concept of rotary intersection	CLO23	T4:13.9

XV. GAPS IN THE SYLLABUS - TO MEET INDUSTRY / PROFESSION REQUIREMENTS:

S No	Description	Proposed actions	Relevance with POs	Relevance with PSOs
1	Knowledge of construction materials, various cement properties and their tests.	Seminars/Guest Lectures/NPTEL	PO1, PO4	PSO 1, PSO 2
2	Analyze the sequence of construction work. Building components and foundation	Seminars/Guest Lectures/NPTEL	PO 1, PO5	PSO 1, PSO 2
3	Knowledge of building planning and building By-Laws	Seminars/ Assignments	PO1, PO4	PSO 3

Prepared by:
Ms. K. Anusha Hadassa, Assistant Professor.

HOD, CIVIL ENGINEERING

INSTITUTE OF AERONAUTICAL ENGINEERING

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CIVIL ENGINEERING

COURSE DESCRIPTOR

Course Title	**WATER RESOURCES ENGINEERING**				
Course Code	ACE014				
Programme	B.Tech				
Semester	VI	CE			
Course Type	Core				
Regulation	IARE - R16				
Course Structure	**Theory**			**Practical**	
	Lectures	**Tutorials**	**Credits**	**Laboratory**	**Credits**
	3	1	4	-	-
Chief Coordinator	Dr. Papolu Ram Mohan Rao, Professor				
Course Faculty	Dr. Papolu Ram Mohan Rao Professor Mr. Srinivas Angadi, Assistant Professor				

I. COURSE OVERVIEW:

This course addresses the concept of present science of the practice of irrigation engineering which comprising partially all the modern developments which occurs in irrigation purpose. In this mainly the units are taken as metric unit which covers the total area which need for irrigation. In this we can know about water requirement of crops by hydrology, ground water, reservoir water and rain water storing. By this water recourses engineering we can know about design of irrigation structures and planning of reservoir as for flood control.

II. COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites	Credits
UG	ACE005	IV	Fluid Mechanics	4

III. MARKS DISTRIBUTION:

Subject	SEE Examination	CIA Examination	Total Marks
Water Resources Engineering	70 Marks	30 Marks	100

IV. DELIVERY / INSTRUCTIONAL METHODOLOGIES:

✔	Chalk & Talk	✔	Quiz	✔	Assignments	✘	MOOCs
✔	LCD / PPT	✔	Seminars	✔	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 units and each unit carries equal weightage in terms of marks distribution. The question paper pattern is as follows. Two full questions with "either" or "choice" will be drawn from each unit. Each question carries 14 marks. There could be a maximum of two sub divisions in a question.

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

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

Continuous Internal Assessment (CIA):
CIA is conducted for a total of 30 marks (Table 1), with 25 marks for Continuous Internal Examination (CIE), 05 marks for Quiz/ Alternative Assessment Tool (AAT).

Table 1: Assessment pattern for CIA

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

Continuous Internal Examination (CIE):

Two CIE exams shall be conducted at the end of the 8th and 16th week of the semester respectively. The CIE exam is conducted for 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 / Alternative Assessment Tool (AAT):

Two Quiz exams shall be online examination consisting of 25 multiple choice questions and are be answered by choosing the correct answer from a given set of choices (commonly four). Marks shall be awarded considering the average of two quizzes for every course. The AAT may include seminars, assignments, term paper, open ended experiments, five minutes video and MOOCs.

VI. HOW PROGRAM OUTCOMES ARE ASSESSED:

Program Outcomes (POs)		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	Assignments/ Exams
PO 2	**Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences	2	Assignments/ Exams
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	Assignments/ Seminars
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	Open Ended Experiments
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	Mini Project
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	Seminars/Mini Project

3 = High; 2 = Medium; 1 = Low

VII. HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

Program Specific Outcomes (PSOs)		Strength	Proficiency assessed by
PSO 1	**Engineering Knowledge**: Graduates shall demonstrate sound knowledge in analysis, design, laboratory investigations and construction aspects of civil engineering infrastructure, along with good foundation in mathematics, basic sciences and technical communication.	2	Assignments/ Exams
PSO 2	**Broadness and Diversity:** Graduates will have a broad understanding of economical, 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.	-	-
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	Seminars/ Workshop

3 = High; 2 = Medium; 1 = Low

VIII. COURSE OBJECTIVES (COs):

The course should enable the students to:	
I	Enrich the knowledge of hydrology that deals with the occurrence, distribution and movement of water on the earth.
II	Design unlined and lined irrigation canals; mitigate sediment problems associated with canal.
III	Identifying, formulating and management of water resource related issues.
IV	Discuss the limitations and applications of hydrograph flood analysis

IX. COURSE LEARNING OUTCOMES (CLOs):

CLO Code	CLO's	At the end of the course, the student will have the ability to:	PO's Mapped	Strength of Mapping
ACE014.01	CLO 1	Understand the basic concepts of Hydrology and its applications. And also understand different forms and types of precipitation.	PO 1, PO 3, PO4, PO7, PO9	2
ACE014.02	CLO 2	Understand the Rainfall measurement methods and different types of Rain gauges	PO1,PO2, PO4	1
ACE014.03	CLO 3	Compute the average rainfall over a basin, processing of rainfall data, and adjustment of rainfall record and usage of double mass curve.	PO3	1
ACE014.04	CLO 4	Understand the concepts of runoff, factors affecting runoff, runoff over a catchment, empirical and rational formulae.	PO3	1
ACE014.05	CLO 5	Understand the abstraction from rainfall, evaporation, factors affecting evaporation, measurement of evaporation, evapo-transpiration, penman and Blaney & Criddle methods.	PO1,PO3 PO9	1
ACE014.06	CLO 6	Explain the importance of infiltration, factors affecting infiltration, measurement of infiltration, infiltration	PO3,PO4, PO7	1
ACE014.07	CLO 7	Understand the concept of Hydrograph, effective rainfall, and base flow separation.	PO3,PO4, PO9	1
ACE014.08	CLO 8	Analyze the importance of direct runoff hydrograph, unit hydrograph, definition, and limitations applications of unit hydrograph.	PO4,PO7, PO9	2
ACE014.09	CLO 9	Understand the derivation of unit hydrograph from direct runoff hydrograph and runoff hydrograph to unit hydrograph	PO1,PO2, PO3	1
ACE014.10	CLO 10	Understand the concept of synthetic unit hydrograph and its applications.	PO1,PO2, PO4,PO7	1
ACE014.11	CLO 11	Understand the Ground water Occurrence and types of aquifers	PO1,PO2, PO4	1
ACE014.12	CLO 12	Define and understand the different terminology of water resource engineering like aquifer parameters, porosity, specific yield, permeability, and Transmissivity.	PO1,PO2, PO3,PO4,	1
ACE014.13	CLO 13	Determine the radial flow to wells in confined and unconfined aquifers and understand concept of Darcy's law	PO1,PO2, PO3,PO4	1
ACE014.14	CLO 14	Understand the Types of wells, well construction, and well development.	PO1,PO2, PO3,PO4	1
ACE014.15	CLO 15	Understand the work necessity and importance of irrigation, advantages and ill effects of irrigation, types of irrigation	PO1,PO2, PO4	1
ACE014.16	CLO 16	Explain the methods of application of irrigation water and understand the India agricultural soils, methods of improving soil fertility, crop rotation, and preparation of land for irrigation	PO1,PO2, PO3,PO4	1
ACE014.17	CLO 17	Understand the standards of quality for irrigation water, soil, water, plant relationship, vertical distribution of soil moisture, soil moisture constants.	PO1,PO2, PO3,PO4, PO9	1
ACE014.18	CLO 18	Calculate the soil moisture tension, consumptive use, duty and delta and understand the factors affecting duty.	PO1,PO2, PO3,PO4	1
ACE014.19	CLO 19	Determination of design discharge for a water course. Depth and frequency of irrigation, irrigation efficiencies, water logging	PO1,PO2, PO3,PO4	1
ACE014.20	CLO 20	Understand the mechanical classification of canals,	PO1,PO2,	2

		design of irrigation canals by Kennedy‘s and Lacey‘s theories, balancing depth of cutting	PO3	
ACE014.21	CLO 21	Calculate by using IS standards for a canal design canal lining. Design discharge over a catchment, computation of design discharge, rational formula.	PO1,PO2, PO3,PO9	2
ACE014.22	CLO 22	Understand the SCS curve number method and flood frequency analysis of stream flow	PO1,PO2, PO3,PO4, PO7	1
ACE014.23	CLO 23	Posses the Knowledge and Skills for employability and to succeed in national and international level competitive examinations.	PO1,PO2, PO3,PO4, PO7	1

3 = High; 2 = Medium; 1 = Low

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

CLO	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CLO 1	3		2	1			1		1				3		
CLO 2	2	3		1									1		
CLO 3			3												1
CLO 4			2										3		
CLO 5	2		1						2				2		
CLO 6			3	1			1						3		
CLO 7			2	1					2				3		1
CLO 8				3			1		3				1		
CLO 9	3	3	1										3		1
CLO 10	3	2		1			1						3		1
CLO 11	2	2		1									1		1
CLO 12	2	1	1	1									1		
CLO 13	2	2	1	1									2		1
CLO 14	2	3	2	2									1		2
CLO 15	3	3		1									3		1
CLO 16	2	2	1	1									2		1
CLO 17	2	1	1	2					2						1
CLO 18	3	3	1	1									3		1
CLO 19	2	2	1	1									2		1

CLO 20	1	2	2												
CLO 21	3	2	1						2				3		
CLO 22	2	1	1	1			1						2		
CLO 23	1	1	1	1			1								1

3 = High; 2 = Medium; 1 = Low

XI. ASSESSMENT METHODOLOGIES – DIRECT

CIE Exams	PO 1, PO2, PO3, PO4, PO7, PO 9	SEE Exams	PO 1, PO2, PO3, PO4, PO7, PO 9	Assignments	PO 1, PO2, PO3	Seminars	PO 9
Laboratory Practices	PO 4	Student Viva	PO 1, PO2, PO3, PO4, PO7, PO 9	Mini Project	PO3, PO7, PO9	Certification	-
Term Paper	-						

XII. ASSESSMENT METHODOLOGIES - INDIRECT

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

XIII. SYLLABUS

UNIT-I	INTRODUCTION TO ENGINEERING HYDROLOGY AND ITS APPLICATIONS
Introduction to engineering hydrology and its applications, hydrologic cycle, types and forms of participation, rainfall measurement, types of rain gauges, computation of average rainfall over a basin, processing of rainfall data, adjustment of record, rainfall double mass curve runoff, factors affecting runoff, runoff over a catchment, empirical and rational formulae. Abstraction from rainfall, evaporation, factors affecting evaporation, measurement of evaporation, evapo-transpiration, penman and Blaney & Criddle methods, infiltration, factors affecting infiltration, measurement of infiltration, infiltration indices.	
UNIT-II	**DISTRIBUTION OF RUNOFF**
Hydrograph analysis flood hydrograph, effective rainfall, base flow separation, direct runoff hydrograph, unit hydrograph, definition, and limitations applications of unit hydrograph, derivation of unit hydrograph from direct runoff hydrograph and vice versa, hydrograph, synthetic unit hydrograph.	
UNIT-III	**GROUND WATER OCCURRENCE**
Ground water Occurrence, types of aquifers, aquifer parameters, porosity, specific yield, permeability, transmissivity and storage coefficient. Darcy‘s law, radial flow to wells in confined and unconfined aquifers. Types of wells, well construction, well development.	
UNIT-IV	**NECESSITY AND IMPORTANCE OF IRRIGATION**
Work necessity and importance of irrigation, advantages and ill effects of irrigation, types of irrigation, and methods of application of irrigation water, India agricultural soils, methods of improving soil fertility, crop rotation, and preparation of land for irrigation, standards of quality for irrigation water, soil, water, plant relationship, vertical distribution of soil moisture, soil moisture constants, soil moisture tension, consumptive use, duty and delta, factors affecting duty, design	

discharge for a water course. Depth and frequency of irrigation, irrigation efficiencies, water logging.	
UNIT-V	**CLASSIFICATION OF CANALS**
Mechanical classification of canals, design of irrigation canals by Kennedy‘s and Lacey‘s theories, balancing depth of cutting, IS standards for a canal design canal lining. Design discharge over a catchment, computation of design discharge, rational formula, SCS curve number method, flood frequency analysis of stream flow.	
Text Books:	
1. Jayarami Reddy, “Engineering hydrology”, Laxmi publications Pvt. New Delhi, 2005. 2. Punmia & Lal, “Irrigation and Water Power Engineering”, Laxmi publications Pvt. Ltd, New Delhi, 1992. 3. V.P.Singh, “Elementary hydrology”, PHI publications, 1992. 4. Dr.G.Venkata Ramana, “Water Resources Engineering-I”, Academic Publishing Company. 5. D.K.Majundar, “Irrigation Water Management”, Prentice Hall of India, 2002.	
Reference Books:	
1. Elementary hydrology by V.P.Singh, PHI publications 2. Irrigation and water Resources & Water power by P.N.Modi,Standard Book House 3. Irrigation and water Management by Dr.Majumdar,Printice Hall of India 4. Irrigation and Hydraulic Structures by S.K. Garg 5. Applied hydrology by Ven Te Chow, David R.Mays Tata Mc Graw Hill. 6. Introduction to hydrology by Warren Viessvann,Jr ,Garyl.Lewis,PHI.	

XIV. COURSE PLAN:

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

Lecture No	Topics to be covered	Course Learning Outcomes (CLOs)	Reference
1-2	Introduction to engineering hydrology and its applications, Hydrologic cycle.	CLO 1	T2:24.6-8 R2: 2.4
3-4	Types and forms of Derive the kinds and forms of precipitation.	CLO 1	T1:12.14
5-6	Rainfall measurement, types of rain gauges, Computation of average rainfall over a basin	CLO 2	T4:3.10 R2: 2.8
7-8	Processing of rainfall data. Abstraction from rainfall. Adjustment of record	CLO 2	T4:3.11,12
9-10	Rainfall double mass curve	CLO 4	T1:16.2
11-12	Runoff – factors affecting runoff.	CLO 3	T16:5
13-14	Runoff over catchment empirical formulae.	CLO 3	T16:6.2
15-16	Rational formulae.	CLO 4	T2:26.9
17-18	Evaporation – factors affecting evaporation	CLO 3	T2:26.11
19-20	Measurement of evaporation and evapotranspiration.- penman method	CLO 5	T1:6:7 R2:3.1
21-22	Evapotranspiration.- criddle method	CLO 5	T2:26
23-24	Infiltration – factors affecting infiltration, measurement of infiltration, infiltration indices.	CLO 6	T2:20.4 R2: 4.1
25-26	Distribution of runoff- Hydrograph analysis flood hydrograph.	CLO 7	T2:23.4
27	Effective rainfall base Flow separation direct method	CLO 8	T2:20.9 T2:20.10
28-30	Derivation of Unit Hydrograph, S hydrograph, Synethic unit hydrograph	CLO 12	T2:21.1 - 21.2
31	Derivation of Unit Hydrograph, S hydrograph, Synethic unit hydrograph.	CLO 11	T2:21.1 - 21.2
32-33	Ground water - Occurrence, types of aquifers.	CLO 13	T2:23-24
34-35	Aquifer parameters, porosity, specific yield, permeability, Transmissivity and storage coefficient, types of wells.	CLO 14	T2:21.5 - 26

Lecture No	Topics to be covered	Course Learning Outcomes (CLOs)	Reference
36-37	Darcy's law, radial flow to wells in confined and unconfined aquifers	CLO 15	T4:7.1 - 7.3
38	Types of wells, well construction and development	CLO 15	T3:27.2
39-40	Necessity and Importance of Irrigation, advantages and ill effects of Irrigation.	CLO 16	T3:27.9 R2: 5.4
41-42	Types of Irrigation, methods of application of Irrigation water	CLO 16	T3:27.9
43-44	Indian agricultural soils, methods of improving soil fertility	CLO 17	T3:27.10
45-46	Soil-water plant relationship	CLO 17	T3:27.11
47-48	Vertical distribution of soil moisture, Soil moisture constants.	CLO 17	T3:27.12
49-50	Soil moisture tension, consumptive use	CLO 18	T4:10.7
51-52	Duty and delta, Factors affecting duty.	CLO 19	T4:10.8 T4:10.9
53-54	Factors affecting duty, Irrigation efficiencies. Water logging	CLO 19	T4:10.10
55	Classification of canals, Design of irrigation by Kennedy's and lacey's theories	CLO 18	T5:13.8 R2:7.1
56	Balancing depth of cutting ,IS Standard for canal design canal lining	CLO 20	T5:13.9 R2:7.3
57	Design discharge over a catchment, Computation of design discharge - rational formula.	CLO 21	T4:9.8 T4:9.9
58-59	SCS Curve number method, flood frequency analysis – introductory part only	CLO 21	T4:9.10 R2:8.2
60	Stream gauging measurement and estimation of stream flow	CLO 22	T3:27.12

XV. GAPS IN THE SYLLABUS - TO MEET INDUSTRY / PROFESSION REQUIREMENTS:

S No	Description	Proposed actions	Relevance with POs	Relevance with PSOs
1	Concepts for Planning Water Resources Development	Seminars/Guest Lectures/NPTEL	PO 3, PO 4	PSO 1
2	National Policy For Water Resources Development	Seminars/Guest Lectures/NPTEL	PO 1	PSO 1
3	India's Irrigation Needs and Strategies for Development	Seminars/NPTEL	PO 4	PSO 1

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