INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)
Dundigal, Hyderabad -500 043

CIVIL ENGINEERING

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	Mr. Gude Ramakrishna, Associate Professor				
Course Faculty	Mr. Gude Ramakrishna, Associate Professor Mr. P. Vinay kumar, Assistant Professor				

I. COURSE OVERVIEW:

Reinforced Concrete Structures Design and Drawings an introductory design course in civil engineering. This course covers the structural design of reinforced concrete beams like singly reinforced, doubly reinforced, T & L beam sections, columns like short and long columns with biaxial bending, slabs like one 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

III. MARKS DISTRIBUTION:

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 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.

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 problem
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
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	Guest Lectures
PO9	**Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings	2	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.	3	Assignments
PSO 2	**Broadness and Diversity**: Graduates will have a broad understanding of economic, environmental, societal, health and safety factors involved in infrastructural development, and shall demonstrate ability to function within multidisciplinary teams with competence in modern tool usage.	-	-
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 :

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 OUTCOMES (COs):

COs	Course Outcome	CLOs	Course Learning Outcome
CO 1	Describe the Concepts of RC design, material Stress–Strain curves, factors, characteristic values, Stress block parameters, Working Stress Method, Limit state analysis, design of singly, doubly reinforced T, and L beam sections.	CLO 1	Describe the basic concepts of RC design.
		CLO 2	Understand the concept material Stress–Strain curves, Safety factors.
		CLO 3	Understand the concept Stress block parameters.
		CLO 4	Use the design concept of Working Stress Method.
		CLO 5	Design of singly reinforced, doubly reinforced sections.
		CLO 6	Design of T and L beam sections.
CO 2	Understand Limit state analysis and design of section for shear and torsion, concept of bond,	CLO 7	Understand Limit state analysis and design of section for shear.
		CLO 8	Understand Limit state analysis and design of section for torsion.
		CLO 9	Concept of bond, anchorage.

COs	Course Outcome	CLOs	Course Learning Outcome
	anchorage and development length, I.S. code provisions.	CLO 10	Concept of development length.
		CLO 11	Illustrate the deflection limits as per IS: 456–2000
CO 3	Explore the design concept of two-way Slabs, one-way slabs, continuous slabs using I.S. coefficients, Cantilever slab/ Canopy slab.	CLO 12	Understand the design concept of one-way slabs.
		CLO 13	Understand the design concept of two-way Slabs.
		CLO 14	Understand the design concept of continuous slabs.
		CLO 15	Calculate the I.S. coefficients for Cantilever slab.
		CLO 16	Calculate the I.S. coefficients for Canopy slab.
CO 4	Design of short and long column, Axial loads, uni-axial and bi-axial bending I.S. Code provisions.	CLO 17	Discuss the concept of short and long column
		CLO 18	Understand the concept of Axial loading.
		CLO 19	Understand the concept of uni-axial and bi-axial bending.
		CLO 20	Apply I.S. Code provisions.
CO 5	Design footings–Isolated (square, rectangle) and Combined Footings. Design of Stair Case.	CLO 21	Design concept for isolated footing.
		CLO 22	Design concept for Combined footing.
		CLO 23	Understand the Design procedure for Stair Case.
		CLO 24	Types of stair Case.

X. 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	Describe the basic concepts of RC design.	PO 1	2
ACE009.02	CLO 2	Understand the concept material Stress–Strain curves, Safety factors.	PO 2	1
ACE009.03	CLO 3	Understand the concept Stress block parameters.	PO 2	2
ACE009.04	CLO 4	Use the design concept of Working Stress Method.	PO 2, PO 3	2
ACE009.05	CLO 5	Design of singly reinforced, doubly reinforced sections.	PO 1, PO 3	2
ACE009.06	CLO 6	Design of, T, and L beam sections.	PO 1, PO 3	2
ACE009.07	CLO 7	Understand Limit state analysis and design of section for shear.	PO 2	2
ACE009.08	CLO 8	Understand Limit state analysis and design of section for torsion.	PO 2, PO 3	3
ACE009.09	CLO 9	Concept of bond, anchorage.	PO 1, PO 3	2
ACE009.10	CLO 10	Concept of development length.	PO 1	1
ACE009.11	CLO 11	Illustrate the deflection limits as per IS: 456–2000	PO 3, PO 9	3
ACE009.12	CLO 12	Understand the design concept of one-way slabs.	PO 1, PO 3, PO 9	3
ACE009.13	CLO 13	Understand the design concept of two-way Slabs.	PO 1, PO 3, PO 9	2
ACE009.14	CLO 14	Understand the design concept of continuous slabs.	PO 1, PO 3, PO 9	2
ACE009.15	CLO 15	Calculate the I.S. coefficients for Cantilever slab.	PO 3	2
ACE009.16	CLO 16	Calculate the I.S. coefficients for Canopy slab.	PO 3	2
ACE009.17	CLO 17	Discuss the concept of short and long column	PO 2, PO 3	2
ACE009.18	CLO 18	Understand the concept of Axial loading.	PO 2, PO 3	1

CLO Code	CLO's	At the end of the course, the student will have the ability to:	PO's Mapped	Strength of Mapping
ACE009.19	CLO 19	Understand the concept of uni-axial and bi-axial bending.	PO 2, PO 3	1
ACE009.20	CLO 20	Apply I.S. Code provisions.	PO 3	2
ACE009.21	CLO 21	Design concept for isolated footing.	PO 2, PO 3	3
ACE009.22	CLO 22	Design concept for Combined footing.	PO 1, PO 2, PO 3	2
ACE009.23	CLO 23	Understand the Design procedure for Stair Case.	PO 1, PO 2, PO 3	1
ACE009.24	CLO 24	Types of stair Case.	PO 1, PO 3	2

3= High; 2 = Medium; 1 = Low

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

Course Outcomes (COs)		Program Outcomes (POs)			
	PO 1	PO 2	PO 3	PO 9	PSO1
CO 1	2	1	2		3
CO 2	1	2	2		1
CO 3	2		2	2	3
CO 4		1	1		
CO 5	2	2	3		2

XII. 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	2												3		
CLO 2		1											3		
CLO 3		2											1		
CLO 4		2	2										3		
CLO 5	2		2										3		
CLO 6	2		2										3		
CLO 7		2											2		
CLO 8		3	3										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 9	2		2												
CLO 10	1														
CLO 11			3						3				1		
CLO 12	3		3						3				3		
CLO 13	2		2						2				3		
CLO 14	2		2						2						
CLO 15			2										3		
CLO 16			2										2		
CLO 17		2	3												
CLO 18		1	1												
CLO 19		1	1												
CLO 20			2												
CLO 21		3	3										3		
CLO 22	1	2	3										2		
CLO 23	1	1	3										2		
CLO 24	2		2												

3 = High; 2 = Medium; 1 = Low

XIII. ASSESSMENT METHODOLOGIES – DIRECT

CIE Exams	PO1, PO 2, PO3, PO 9 PSO 1	SEE Exams	PO1, PO 2, PO3, PO 9 PSO 1	Assignments	PO2	Seminars	-
Laboratory Practices	-	Student Viva	-	Mini Project	PO9	Certification	-
Term Paper	-						

XIV. ASSESSMENT METHODOLOGIES - INDIRECT

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

XV. 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 Stress Method. 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. Design of continuous slabs using I.S. coefficients, Cantilever slab/ Canopy slab.	
UNIT -IV	**DESIGN OF COLUMNS**
SHORT AND LONG COLUMN – 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, New Delhi.+10 2. S. Unnikrishna Pillai and Devdas Menon, "Reinforced concrete design", Tata Mc. Graw Hill, New Delhi. 3. N. Krishna Raju and R. N. Pranesh, "Reinforced Concrete Design", New Age International Publishers, New Delhi. 4. P. C. Varghese, "Limit state design of reinforced concrete", Prentice Hall of India, New Delhi.	
Reference Books:	
1. M. L. Gambhir, "Fundamentals of reinforced concrete design", Printice Hall of India Pvt. Ltd, New Delhi. 2. P. Purushotham, "Reinforced concrete structural elements – behaviour, Analysis and design", Tata McGraw Hill, 1994.	

XVI. 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	Explanation about loading, working stress method, limit state method	CLO 1	T1: 2.1 R1:3.9
3-4	Material stress strain curves, safety factors	CLO 2	T1: 2.3
5	Philosophy of characteristic strength values	CLO 2	T1: 2.7
6-7	Stress block parameters for reinforced concrete rectangular section	CLO 3	T1: 3.1
8	The failure modes of reinforced structures under different load conditions	CLO 3	T1: 3.8 R2:7.9
9	Recognizing key features of IS 456: 2000	CLO 4	T1: 4.1
10	Summarize working stress method, Limit state method in design	CLO 4	T1: 6.1
11-12	Design of singly reinforced beams	CLO 5	T1: 6.1

Lecture No	Topics to be covered	Course Learning Outcomes (CLOs)	Reference
13-14	Design of doubly reinforced beams	CLO 5	T1: 6.1 R1: 12.6
15-16	Design of T beam sections and L beam sections	CLO 6	T1: 6.3 R1: 12.7
17-18	Analysis and Design of section for shear	CLO 7	T1: 7.1
19	Analysis and Design of section for torsion	CLO 8	T1: 7.2
20-22	Problems on shear and torsion	CLO 7, CLO 8	T1: 7.3
23-24	Concept of bond, anchorage and development length	CLO 9, CLO 10	T1: 8.1 to 8.9
25-27	Problems on development length	CLO 10, CLO 11	T4:9.6-11 R2:12.5.1
28	Understand deflection limits in IS: 456–2000	CLO 11	T4:9.6-11 R2:12.5.1
29-30	Calculate deflection (theoretically)	CLO 11	T4: 10.1 R2:12.5.1
31-32	Design and concept of one-way slabs.	CLO 12	T1:11.1
33-35	Problems on one-way slabs.	CLO 12	T1:11.3
36	Design and concept of two-way slabs.	CLO 13	T1:12.1to 12.6
37-38	Problems on Two-way slabs.	CLO 13	T1:12.1to 12.6
39	Design concept of continuous slabs.	CLO 14	T1:11.5
40-41	Calculate the I.S. coefficients for Cantilever slab	CLO 15	T1: 11.4
42	Calculate the I.S. coefficients for Canopy slab.	CLO 16	T1: 11.4
43-44	Problems on Cantilever and Canopy slab.	CLO 16	T1: 11.4 R2:12.5.1
45-46	Design of Short columns	CLO 17	T1: 16.4
47-48	Design of Long column	CLO 17	T1: 16.5
49	Design of Short columns under axial loads	CLO 18	T1: 16.6
50-52	Design of long column s under axial loads	CLO 18	T1: 17.1
53-54	Design of Short and long columns, under uniaxial and biaxial bending, I S Code provisions	CLO 19, CLO 20	T1: 18.1
55-58	Design of isolated (square, rectangular) and combined footings	CLO 21, CLO 22	T1: 7.1-7.3
59-60	Design of combined footings	CLO 23	T1: 12.1-3 R2:12.4
61-63	Design and types of staircase	CLO 23	T1: 12.1-3

XVII. 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	Increase the focus on structural drawings	Guest Lecture	PO 9	PSO 1

Prepared by:

Mr. Gude Ramakrishna, Associate Professor **HOD, CE**