DESIGN OF REINFORCED CONCRETE STRUCTURES

Course Code: 19CE1115

L	T	P	C
3	0	0	3

Pre-requisites: Strength of Materials, Building Materials and Concrete Technology, Structural Analysis

Course Outcomes:

At the end of the course, the student will be able to:

CO1: Describe the methods of design to reinforced concrete members
CO2: Apply the concept of Limit State design to beams
CO3: Design the members subjected to shear, torsion and bond
CO4: Design one-way and two-way slabs including dog-legged staircase
CO5: Design columns subjected to axial load, uniaxial and bi-axial bending and also design the isolated footings

UNIT-I **(10 Lectures)**

INTRODUCTION TO REINFORCED CONCRETE:

Introduction to Reinforced Concrete- Methods of Design – Structural elements – Loads on structure – Codes of practice – Structural concrete –Reinforcements.
Review of theory of simple bending – Practical requirements of an RCC beam – size of the beam – concrete cover – effective depth – spacing of reinforcement.
Working stress method – Assumptions – permissible stresses in materials –Calculation of constants (Design is not included).
Limit state method – Assumptions – Inelastic behavior of materials –Characteristic and design values – partial safety factors.

Learning outcomes:

1. Compare the concept of various methods of design (L2)
2. Select the sizes of members in reinforced concrete design (L2)
3. Discuss the design approaches to reinforced concrete members (L2)

UNIT-II **(10 Lectures)**

LIMIT STATE METHOD: Design for Flexure

Introduction – Respective IS Code Provisions.
Singly reinforced rectangular beams – Derivation of formulae – General values – Types of problems – Failure of RCC beams in flexure.
Doubly reinforced Beams: Derivation of formulae – Types of problems –Use of design aids.
Flanged Beams: Position of neutral axis – Derivation of formulae –Doubly reinforced flanged beams.
Design of simply supported rectangular beam
Design of cantilever beam
Design of T or L shaped flanged beams

Learning outcomes:

1. Design a singly reinforced beam (L3)
2. Design a doubly reinforced beam (L3)

3. Design of flanged beam sections (L3)

UNIT-III **(10 Lectures)**

LIMIT STATE METHOD: Design for Shear, Torsion and Bond

Introduction – Respective IS Code Provisions.
Design of rectangular and flanged beam sections for shear – Design examples on simply supported and cantilever beams.
Limit state design of beams subjected to uniform Torsion on simply supported beams.
Concept of bond, end anchorage and development length in beams with examples.

Learning outcomes:
1. Apply the shear provisions to various beams (L3)
2. Illustrate the beam design with torsion provisions (L3)
3. Estimate the development length requirement in beams (L2)

UNIT-IV **(10 Lectures)**

DESIGN OF SLABS AND STAIRCASE:

Introduction – Respective IS Code Provisions.
Design of simply supported one way slabs with U.D.L.
Design of cantilever slab with U.D.L. and end concentrated load.
Design of simply supported two way slab using IS code method.
Design of Restrained two-way slabs using IS code method.
Design of a dog-legged stair case – Flight slab supported on opposite beams / walls.

Learning outcomes:
1. Classify different slabs and design one way slab and cantilever slabs (L1)
2. Design of two way slabs for different support conditions (L3)
3. Design of a dog-legged stair case (L3)

UNIT-V **(10 Lectures)**

DESIGN OF COLUMNS AND FOUNDATIONS:

DESIGN OF COLUMNS:

Introduction – Respective IS Code Provisions.
Short and Long columns – Reinforcement requirements – Minimum eccentrically – Assumptions in design – Interaction charts.
Design of short axially loaded tied columns.
Design of short axially loaded spiral columns
Design of short eccentrically loaded columns with Uniaxial Bending
Design of short eccentrically loaded columns with Biaxial bending.
Slender columns – effective length – Design of axially loaded slender columns.

DESIGN OF FOUNDATIONS:

Introduction – Respective IS Code Provisions.
Aspects of soil design – structural design – considerations.
Design of axially loaded square type pad footings.
Design of axially loaded Rectangular type pad footings.
Design of axially loaded square type sloped footings.

Design of axially loaded Rectangular type sloped footings.

Learning outcomes:

1. Design of axially loaded column with uniaxial bending (L3)
2. Design of axially loaded column with biaxial bending (L3)
3. Design of an isolated footing (L3)

NOTE: All the designs to be taught in Limit State Method.

TEXT BOOKS:

1. H.J. Shah, "Reinforced concrete", 11th Edition, Volume 1, Charotor Publishing House Pvt. Ltd., Anand, 2016.
2. Pillai &Devdas Menon, "Reinforced concrete design", 3rd Edition, Tata McGraw Hill, New Delhi, 2009.
3. A.K. Jain, "Reinforced Concrete Design", 5th Edition, Charotor Publications, 2010.

REFERENCES:

1. N.C. Sinha and S.K Roy, "Fundamentals of Reinforced Concrete", 4th Edition, S. Chand Publishers, 2002.
2. N. Krishna Raju and R.N. Pranesh, "Reinforced Concrete Design", 8th Edition, New age International Publishers, New Delhi, 2004.
3. IS 456: 2000 (Reaffirmed 2005): Indian Standard Plain and Reinforced Concrete – Code of Practice (or latest).
4. IS 875 (Part 1)-1987 (Reaffirmed 2003): Code of Practice for Design Loads (other than Earthquake) for Buildings and Structures Part 1. Dead loads – Unit weights of Building Materials and Stored Materials (or latest).
5. IS 875 (Part 2): 1987 (Reaffirmed 2003): Code of Practice for Design loads (other than Earthquake) for Buildings and Structures Part 2. Imposed loads (or latest).
6. Special Publication SP-16, Design Aids for Reinforced Concrete of IS456: 1978.