GUJARAT TECHNOLOGICAL UNIVERSITY

Bachelor of Civil & Infrastructure Engineering

Subject Code: 3164011
Semester – VI
Subject Name: Design of Concrete and Masonry Structures

Type of course: Professional Core Subject

Prerequisite: Mechanics of solid, Fundamentals of Structural Analysis, Concrete Technology.

Rationale: Design of Concrete Structures subject provides conceptual understanding and applications of design of concrete structures. With the help of this knowledge students may be able:

1. To understand the general mechanical behavior of reinforced concrete as composite material.
2. To analyze and design reinforced concrete structural members subjected to bending/flexural, compression, shear and torsional stress.
3. To design reinforced concrete slabs, beams, columns, stairs, footings and retaining walls.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks				Total Marks
				Theory Marks		Practical Marks		
L	T	P	C	ESE (E)	PA (M)	ESE (V)	PA (I)	
4	0	2	5	70	30	30	20	150

Content:

Sr. No.	Content	Total Hrs
1	**Introduction to Concrete Design** Design requirements: strength, stiffness, stability, serviceability Design process: analysis, design and detailing Design philosophy: working stress method, Limit state method, Ultimate stress method.	**05**
2	**Basics of Concrete Structure Design:** Stress-strain relation of concrete, Assumptions -- Role of reinforcement – Bond between steel and concrete – Development of micro-crack and formation of isolated cracks. Limit state of collapse & serviceability, partial safety factors for material & loading. Limit State of Flexure: Stress-strain characteristics of concrete & reinforcing steel, Type of section-under reinforced, over reinforced & balance section, Neutral Axis depth, Moment of Resistance for singly reinforced, doubly reinforced and flanged sections. Limit State of Shear and Torsion, combined flexure & torsion, Bond & Anchorage, Development length, splicing.	**10**

3	**Limit State Design of RC Elements:** Design of beams: Simply supported, cantilever and continuous beams Design of columns: Classifications, Assumptions, Design of Short Columns under axial loading, uniaxial and biaxial bending Design of slabs: One way & Two way slab and continuous slabs Design of staircases. Design of Foundations: Design of isolated footing under axial load and uni-axial bending, combined footing Design of retaining walls	**25**
4	**Design of Masonry Structures:** Introduction to Earthquake Resistant Features of unreinforced & reinforced masonry Structure (IS 4326), Basic structural behavior; Good construction practice, design of unreinforced masonry elements, Structural Use of Unreinforced Masonry (IS 1905), Design of two storeyed masonry buildings.	**08**

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	**U Level**	**A Level**	**N Level**	**E Level**	**C Level**
05	**15**	**30**	**20**	**10**	**20**

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

Reference Books:

[1] S. U. Pillai and D. Menon, Reinforced Concrete Design, Tata McGraw-Hill 3rd edition, 2009.
[2] P. C. Varghese, Limit State Design of Reinforced Concrete, Prentice Hall India, 2008.
[3] S. N. Sinha, Reinforced Concrete Design, Tata McGraw-Hill, 2nd Edition, 2002.
[4] Nilson A H and Winter G, Design of Concrete Structures, Tata McGraw-Hill
[5] Ferguson P M, Bren J E and Jirsa J O, Reinforced Concrete Fundamentals, John Wiley and Sons, NewYork.
[6] M. L. Gambhir, Fundamentals of Reinforced Concrete Design, Prentice Hall India, 2006.
[7] A. K. Jain, Reinforced concrete: Limit state design, Nem Chand and Bros. 1999.
[8] J. Macgregor and J. K. Wight, Reinforced Concrete: Mechanics and Design, Prentice Hall, 5th edition, 2008.
[9] R. Park and T. Paulay, Reinforced Concrete Structures, John Wiley and Sons, 1975.
[10] Shah & Karve; Limit State Theory & Design of Reinforced Concrete; Structure Pub.,Pune.
[11] Dr. H.J. Shah; Reinforced concrete Vol-I; Charotar Pub. Anand.
[12] IS: 456 - Code of practice for plain and reinforced concrete.
[13] IS: 875 (Part I to V) - Code of practice for structural safety of Buildings Loading standards.
[14] Building Code Requirements for Masonry Structures (TMS 502-08/ACI 530-08/ASCE 5-08).

[15] Specifications for Masonry Structures (ACI 530.1-08/ASCE 6-08/TMS 602-08) and Commentary.
[16] K S Jagadish, Structural Masonry, I K International Publishing House, New Delhi.

Course Outcomes:

At the end of the program students will be able to

Sr. No.	CO statement	Marks % weightage
CO-1	Understand various design philosophy and processes to be used in the reinforced concrete structures	10 %
CO-2	Justify reinforced concrete element requirements satisfying limit state of collapse and serviceability	20 %
CO-3	Design of various reinforced concrete elements such as beam, slab, column, stairs, foundation and retaining wall as per IS codal provisions and guidelines.	55 %
CO-4	Design of masonry buildings as per IS codal provisions and guidelines.	15 %

List of Software Based Practical

- Introduction and Overview of Structural Analysis and Design software
- Introduction to GUI of Software
- Creating New Project and Importing files and Generation of Models in Software
- Support, Load, Section and Member property specifications in Software
- Analysis and Design of Beams
- Analysis and Design of Slabs
- Analysis and Design of Columns
- Analysis and Design of Foundations
- Analysis and Design of Multistorey Framed structure

- Planning of Masonry House in Drafting Software and Design of Structure

Term-Work:

The student will have to carry out analysis and design a RCC or Masonry Building, which should include various types of structural components. Using the techniques, skills, and modern engineering software tools such as industry software STAAD Pro, ETAB etc. selected structure should be analysis and designed as per IS codes and report should be prepared. The students have to draw detailing of full design problems in A2 size drawing sheet and sketches of various structural components with proper detailing in sketch book/A3 size sheet from remaining topics of the syllabus.

Design based problem/ Open ended problem may also considered as a part of Term-work
A group of students has to undertake one open ended problem/design problem. Few examples of the same are given below:

1. Development of spread sheets for design of various structural elements like beam, column, slab, foundation etc.
2. Design of any one RCC or masonry structure from the course using any open-source / professional software and/or self-developed spread sheet/programs.
3. Site visit related to construction stages and report preparation

Practical examinations shall consist of oral based on term work and above course.

List of Open Source Software/learning website:
1. http://nptel.ac.in
2. www.elearning.vtu.ac.in
3. www.gsdma.org
4. www.nicee.org