GUJARAT TECHNOLOGICAL UNIVERSITY

CIVIL & INFRASTRUCTURE ENGINEERING
DESIGN OF CONCRETE STRUCTURES
SUBJECT CODE:2164001
B.E. 6th Semester

Type of Course: Core Subject in Civil and Infrastructure engineering

Prerequisite: NIL

Rationale:

Design of Concrete Structures is providing 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.
2. To analyze and design reinforced concrete members subjected to bending/flexural, compression, shear and torsional stress
3. To design reinforced concrete slabs, beams, columns, footings and retaining walls

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks						Total Marks
				Theory Marks			Practical Marks			
L	T	P	C	ESE	PA(M)		ESE (V)		PA (I)	
					PA	ALA	ESE	OEP		
3	2	0	5	70	20	10	30	0	20	150

Contents:

Sr. No.	Topics	Hrs.	% Weightage
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, plastic method	06	18
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	08	22

	singly reinforced, doubly reinforced and flanged sections. Limit State of Shear and Torsion, combined flexure & torsion, Bond & Anchorage, Development length, splicing		
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	**22**	**60**

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**	**25**	**05**	**20**

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above

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:

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

Course Outcome

After learning the course the students should be able to:

1. Understand various design philosophy to be used in the design of structural elements.
2. Design basic structural elements like slab, beams, columns and foundation etc. using steel

and concrete as materials

3. Design basic structural elements slab, beams, columns and foundation etc. using limit state approach.
4. Design & detail RC structures like Retaining Walls and Water Tanks.
5. Identify and apply the applicable design codes relevant to the design of reinforced concrete members.

Term-Work

The students will have to solve at least full design of Retaining wall/water tank and at least five examples from remaining topics of the syllabus. The students have to draw detailing of full design problems 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.
Practical examinations shall consist of oral based on term work and above course.
Design based problem/ Open ended problem may also considered as a part of Term-work

Design based Problems (DP)/Open Ended Problem:

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 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

List of Tutorials

1. Design, casting and testing of under reinforced and over reinforced beam.
2. Prepare model showing reinforcement detail of singly reinforced, doubly reinforced simply supported and continuous beams.
3. Prepare model showing reinforcement detail of one way and two way slabs with various end conditions.
4. Prepare model for detailing of beam column junction and column-footing junction

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

Active learning Assignments (AL) : Preparation of power-point slides, which include videos, animations, pictures, graphics for better understanding theory and practical work – The faculty will allocate chapters/ parts of chapters to groups of students so that the entire syllabus to be covered. The Power-point slides should be put up on the web-site of the College/ Institute, along with the names of the students of the group, the name of the faculty, Department and College on the first slide. The best three works should submit to GTU.