

# GUJARAT TECHNOLOGICAL UNIVERSITY

**BRANCH NAME: Civil Engineering**  
**SUBJECT NAME: Design of Reinforced Concrete Structures**  
**SUBJECT CODE: 2170607**  
**B.E. 7<sup>th</sup> SEMESTER**

**Type of course:** Applied Mechanics

**Prerequisite:** Mechanics of Solids, Structural analysis I & II, Concrete technology, Elementary Structural Design

**Rationale:** Majority of civil engineering structures are normally made up of Reinforced Cement Concrete. Knowledge of designing and detailing of reinforced concrete structures is very important for civil engineers in order to make structures safe and serviceable during its life span. Limit State design philosophy is currently used worldwide for design of RC structures. Proper detailing of reinforcement in structural drawing is necessary in order to get the correct behavior of structures and leads to smooth construction of RC structures. This course will provide detailed knowledge of design and reinforcement detailing as per related Indian standards.

## Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks						Total Marks
L	T	P		Theory Marks			Practical Marks			
			ESE (E)	PA (M)		ESE (V)		PA (I)		
				PA	ALA	ESE	OEP			
04	02	00	06	70	30	00	30	00	20	150

ESE-End Semester Exam, PA-Progressive Assessment, E-External, M-Mid semester, V-Viva (External) , I-Internal, ALA-Active Learning Assignment, OEP-Open Ended Problem

**Note: IS:456(2000), SP(16), IS:1893, IS:875, IS 3370, IS1343, IS:13920 are permitted in the examination.**

## Content:

Sr. No.	Content	Total Hrs.	% Weightage
1	<b>Building Layout and Design:</b> Loads as per I.S., distribution & flow of loads, lateral load due to wind and seismic as per latest IS standards, load combinations, guide lines for preparation of structural layout for building. Analysis, design & detailing of G + 3 RC framed building for residential /commercial purpose including ductile detailing.	16	30
2	<b>Design of Retaining wall:</b> Types, behavior and application of retaining wall, stability criteria, design & detailing of cantilever & counterfort type retaining wall for various ground conditions.	10	20
3	<b>Design of Water Tank:</b> Classification of water tank and method of analysis, permissible stresses, codal provisions, Design of circular and rectangular under-ground water tanks using IS code method, Design of elevated water tank with Intze type of container, frame and shaft type of staging and foundation considering effect of earthquake and wind forces.	12	25

<b>4</b>	<b>Design of Flat Slab:</b> Direct design method – Distribution of moments in column strips and middle strip-moment and shear transfer from slabs to columns – Shear in Flat slabs- Check for one way and two way shears, Limitations of Direct design method, Introduction to Equivalent frame method.	<b>08</b>	10
<b>5</b>	<b>Earthquake Resistant Design of building:</b> Earthquake resistant design philosophy, capacity design concept, four virtues of Earthquake Resistant design: strength, stiffness, ductility and configuration, Irregularities in structures, Lateral load distribution – Torsionally coupled & uncoupled system, Seismic coefficient Method, Ductile detailing as per IS:13920.	<b>10</b>	15

### Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
<b>05</b>	<b>10</b>	<b>30</b>	<b>30</b>	<b>20</b>	<b>5</b>

**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. R. Karve and V. L. Shah, Illustrated Design of Reinforced Concrete Buildings, Structures Publishers.
2. N. Krishna Raju, Advanced Reinforced Concrete Design, CBS Publishers.
3. S. Unnikrishna Pillai and Devdas Menon, Reinforced Concrete Design, Tata McGraw Hill.
4. H. J. Shah, Reinforced Concrete, Vol. I and II, Charotar Publishing.
5. Punmia B.C “Advanced RCC Design” Laxmi Publications Pvt. Ltd”. 2006.
6. Varghese A. V., Advanced Reinforced Concrete, Varghese, Prentice Hall of India.
7. Sinha S. N., Reinforced Concrete Design, Tata Mc-Graw Hill, Delhi.
8. IS Codes (latest) : IS:456, IS:875 (all parts), IS:1893(P-1,2), IS:4326, IS:13920, IS: 3370 (P-1 to 4), SP:16, SP:34.

### Course Outcome:

After learning the course, the students should be able to:

1. Assess loads, prepare layout, analyse, design and detail of various structural elements for RC framed structure up to G+3.
2. Identify the typical failure modes of RC building, retaining walls, water tanks, flat slabs & prestressed concrete sections.
3. Apply the principles, procedures and current Indian code requirements to the analysis and design.
4. Design & detail RC structures like Retaining Wall, Water Tank and Flat slab.
5. Apply the concept of earthquake resistant design in the building.

**Term-Work:**

The students will have to solve at least full design of (1) design of G+3 building (design manually & check with software) (2) 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.

**List of Experiments: - NIL –**

**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
4. Failure study : during and/or after construction, due to earthquake etc.

**Major Equipment: - NIL -**

**List of Open Source Software/learning website:**

1. <http://nptel.ac.in>
2. [elearning.vtu.ac.in](http://elearning.vtu.ac.in)
3. [www.gsdma.org](http://www.gsdma.org)
4. [www.nicee.org](http://www.nicee.org)

**ACTIVE LEARNING ASSIGNMENTS:** 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.