GUJARAT TECHNOLOGICAL UNIVERSITY

CIVIL ENGINEERING (06)
ELEMENTARY STRUCTURAL DESIGN
SUBJECT CODE: 2160607
B.E. 6th SEMESTER

Type of course: Applied Mechanics

Prerequisite: Mechanics of Solids, Structural Analysis-I,II

Rationale: This subject is applications of structural engineering principles to design basic structural elements using of reinforced concrete and steel concrete as materials. This subject is specifically aim to develop understanding of various design philosophy, Indian codal provisions, design basis used in design of basic elements of framed structures and its detailing requirement.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks						Total Marks
L	T	P	C	Theory Marks			Practical Marks			
				ESE (E)	PA (M)		ESE (V)		PA (I)	
					PA	ALA	ESE	OEP		
4	1	0	5	70	20	10	30	0	20	150

Content:

Sr. No.	Topics	Teaching Hrs.	Weightage %
1	**Introduction:** Objectives, Properties of Reinforced Concrete and Structural Steel, Loads & load combinations, Methods of Analysis, Codes & specifications, Design Philosophies **-** Working stress Method, Ultimate Load Method, Limit State Method, Plastic Method.	04	10
2	**Limit state design of RC elements:**	26	40
	(A) Philosophy of Limit state design: 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	06	
	(B) Design of Beams: Simply supported, cantilever and continuous beams	04	
	(C) Design of Slab: One way, two way simply supported and continuous slabs	06	
	(D) Design of Column: Classifications, Assumptions, Design of Short Columns under axial load.	04	
	(E) Design of Foundations: Design of isolated footing under axial load and uni-axial bending, combined footing	06	
3	**Limit State design of Steel elements:**	26	40

(A) Philosophy of Limit state design: Limit state of collapse & serviceability, partial safety factor for material and loading, Type & behavior of sections – Plastic, compact, semi-compact, slender.	02	
(B) Connections: Bolted connections – bearing type, behavior of bolted joints, Design strength of ordinary & HSFG bolts. Welded connections- Fillet and Butt weld, design of simple connections such as lap and butt joints, truss joint connections.	06	
(C) Axial force design: Tension member: types of tension member, behavior, modes of failure, Design of tension member, splices, lug angle. Compression member: Behaviour, classification of sections, possible modes of failure, elastic buckling of slender member, design of compression member having single & built-up section, lacing & battening,	08	
(D) Design for Beams and Beam-Columns: Type of sections, classification, Lateral stability, Design strength of laterally restrained and unrestrained beams, shear strength, deflection, web buckling & crippling, Design of simply supported beam. Combined axial and flexural design of member (Beam-Column)	06	
(E) Footing : slab based, gusseted base foundation	04	

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 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:

Reference Books (RC Design)
1. Shah & Karve; Limit State Theory & Design of Reinforced Concrete; Structure Pub., Pune
2. Dr. H.J. Shah; Reinforced concrete Vol-I; Charotar Pub. Anand
3. A.K.Jain; Design of Concrete Structures, Nemchand Publication
3. IS: 456 - Code of practice for plain and reinforced concrete
4. IS: 875 (Part I to V) - Code of practice for structural safety of Buildings Loading standards
5. IS: 1893 - Criteria for earthquake resistant design of structures
6. IS: 13920 -Code of Practice for ductile detailing of RC structure subjected to seismic force

Reference Books (Steel Design)
1. N.Subramanian; Steel Structures, Oxford Publication
2. Arya A.S. & Ajamani J.L.; Design of Steel Structures; Nemchand & Bros., Roorkee
3. Dayaratnam P.; Design of Steel Structures; Wheelor pub. co., Delhi
4. Ramamrutham S. & Narayanan R.; Design of Steel Structures; Dhanpatrai & Sons, Delhi

5. K. S. Sai Ram; Design of Steel Structures, Pearson
6. IS: 800 – 2007, Code of practice for General Construction in steel
7. IS: 875 - (Part I to V) - Code of practice for structural safety of building loading standards
8. IS: 226 - Structural steel (Standard Quality)
9. SP: 6(1) - Structural steel section
10. SP: 6(6) - Application of plastic theory in design of steel structures

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.

Term-Work:
The students will have to solve at least five examples and related theory from each topic as an assignment/tutorial (minimum 30 problems). Practical examinations shall consist of oral based on term work and above course. The students have to draw at least five structural components (RCC and Steel) with proper details in sketch book/A3 size sheet.

List of Tutorials:
1. Design, casting and testing of under reinforced and over reinforced beam.
2. Design and testing of steel beam section.
3. Prepare model of various connections/elements in steel structures.
4. Prepare model showing reinforcement detail of singly reinforced, doubly reinforced simply supported and continuous beams.
5. Prepare model showing reinforcement detail of one way and two way slabs with various end conditions.
6. Prepare model for detailing of beam column junction and column-footing junction.

List of Open Source Software/learning website:

www.nptel.iitm.ac.in/courses/

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.