



GUJARAT TECHNOLOGICAL UNIVERSITY

Bachelor of Engineering

Subject Code: 3150612

SUBJECT NAME: DESIGN OF STRUCTURES

B.E. SEM-V

Type of course: Professional Core course

Prerequisite: Mechanics of Solid, Structural Analysis-I

Rationale: This subject is applications of structural engineering principles to design basic structural elements using of reinforced concrete and steel as materials. The 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		Theory Marks		Practical Marks		
				ESE (E)	PA (M)	ESE (V)	PA (I)	
4	0	2	5	70	30	30	20	150

Note: IS:456(2000), IS:800 (2007), Steel table are permitted in the examination.

Content:

Sr. No.	Content	Total Hrs	% Weightage
1	Unit-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	Unit-2: Philosophy of Limit state design for RC structures 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 Axial, Shear and Torsion, combined flexure & torsion, Bond & Anchorage, Development length, splicing	10	20%
3	Unit-3: Limit state design of RC structural Element Design of Beams: Simply supported, cantilever and continuous beams Design of Slab: One way, two way simply supported and continuous slabs	16	25%



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	Design of Column: Classifications, Assumptions, Design of Short Columns under axial load Design of Foundations: Design of isolated footing under axial load and uni-axial bending, combined footing.		
4	Unit-4: Philosophy of Limit state design for Steel: Limit state of collapse & serviceability, partial safety factor for material and loading, Type & behavior of sections – Plastic, compact, semi-compact, slender. 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.	10	20%
5	Unit-5: Limit state design of Steel components 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, 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) Footing : slab based, gusseted base foundation	16	25%

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
05	20	50	15	05	05

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:



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Reference Books (RC Design)

1. P. C. Vargheese, Limit State Design of Concrete structure,
2. 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 & Ajamani.; 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. IS: 800 – 2007, Code of practice for General Construction in steel
6. IS: 875 - (Part I to V) - Code of practice for structural safety of building loading standards
7. IS: 226 - Structural steel (Standard Quality)
8. SP: 6(1) - Structural steel section
9. SP: 6(6) - Application of plastic theory in design of steel structures

Course Outcome:

Sr. No.	CO statement	Marks % weightage
CO-1	Describe different properties of RC and Structural steel, loads & its combinations, method of analysis used in design of structural elements.	10
CO-2	Explain different design philosophy evolved time to time and its applicability in designing structural elements.	20
CO-3	Apply Indian standard codal provisions of Limit state methods for RC and Steel structural components.	25
CO-4	Apply design principles of Limit state methods in RC and steel structural components.	25
CO-5	Appraise capacity of RC and Steel structural elements in different design methods and designing section with appropriate method.	20

List of Experiments/Tutorials:

1. The students will have to solve at least five examples and related theory from each topic as an assignment/tutorial.
2. Prepare sketches of structural detailing of RC and steel components in sketch book/A3 size sheet.
3. Experiments may be designed and carried out related to the topics of the course such as
 - a. Design, casting and testing of under reinforced, over reinforced and limiting section.
 - b. Design and testing of steel sections as tie, strut, beam etc.
4. Practical examinations shall consist of oral based on term-work and above course.



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Major Equipment/Software:

1. Any professional software of Structural analysis such as STAAD-pro, SAP, ETABS
2. Universal testing machine/Compression Testing Machine/ loading frame & loading jack, Concrete Mixture

List of Open Source Software/learning website:

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