

|                       |                                                      |
|-----------------------|------------------------------------------------------|
| <b>Branch Name:</b>   | Civil Engineering                                    |
| <b>Semester/Year:</b> | Semester VII/ Forth Year                             |
| <b>Subject Title:</b> | Structural Design - I                                |
| <b>Subject Code:</b>  | 1ET1060701                                           |
| <b>Pre-requisite:</b> | Mechanics of Solids, Structural Analysis-I,II, & III |

**Course Objective:**

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 Scheme<br>(Hours per week) |                 |                  |        | Evaluation Scheme (Marks) |                          |                          |                          |                  |
|-------------------------------------|-----------------|------------------|--------|---------------------------|--------------------------|--------------------------|--------------------------|------------------|
| Lecture<br>(L)                      | Tutorial<br>(T) | Practical<br>(P) | Credit | Theory (Marks)            |                          | Practical (Marks)        |                          | Total<br>(Marks) |
|                                     |                 |                  |        | University<br>Assessment  | Continuous<br>Assessment | University<br>Assessment | Continuous<br>Assessment |                  |
| 04                                  | 00              | 02               | 05     | 70                        | 30                       | 30                       | 20                       | 150              |

| Subject Contents |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                |                   |  |
|------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|-------------------|--|
| Sr.<br>No        | Topic                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | Total<br>Hours | Weighta<br>ge (%) |  |
| 1                | <b>Introduction:</b><br>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                | <b>Limit state design of RC elements:</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | 26             | 45                |  |
|                  | <b>(A) Philosophy of Limit state design:</b><br>Limit state of collapse & serviceability, partial safety factors for material & loading.<br>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 | 04             |                   |  |
|                  | <b>(B) Design of Beams:</b><br>Simply supported, cantilever and continuous beams                                                                                                                                                                                                                                                                                                                                                                                                                                             | 06             |                   |  |
|                  | <b>(C) Design of Slab:</b><br>One way, two way simply supported and continuous slabs                                                                                                                                                                                                                                                                                                                                                                                                                                         | 06             |                   |  |
|                  | <b>(D) Design of Column:</b><br>Classifications, Assumptions, Design of Short Columns under axial load.                                                                                                                                                                                                                                                                                                                                                                                                                      | 04             |                   |  |

|   |                                                                                                                                                                                                                                                                                                                                                                      |           |           |
|---|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------|-----------|
|   | <b>(E) Design of Foundations:</b><br>Design of isolated footing under axial load and uni-axial bending, combined footing                                                                                                                                                                                                                                             | <b>06</b> |           |
| 3 | <b>Limit State design of Steel elements:</b>                                                                                                                                                                                                                                                                                                                         | <b>26</b> | <b>45</b> |
|   | <b>(A) Philosophy of Limit state design:</b><br>Limit state of collapse & serviceability, partial safety factor for material and loading, Type & behavior of sections – Plastic, compact, semicompact, slender.                                                                                                                                                      | <b>02</b> |           |
|   | <b>(B) Connections:</b><br>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.                                                                                                      | <b>06</b> |           |
|   | <b>(C) Axial force design:</b><br>Tension member: types of tension member, behavior, modes of failure, Design of tension member, splices, lug angle.<br>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, | <b>08</b> |           |
|   | <b>(D) Design for Beams and Beam-Columns:</b><br>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)                                              | <b>06</b> |           |
|   | <b>(E) Footing:</b><br>slab based, gusseted base foundation                                                                                                                                                                                                                                                                                                          | <b>04</b> |           |

#### 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.

#### 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 materials
3. Design basic structural elements slab, beams, columns and foundation etc. using limit state approach.

#### 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
4. IS: 456 - Code of practice for plain and reinforced concrete
5. IS: 875 (Part I to V) - Code of practice for structural safety of Buildings Loading standards
6. IS: 1893 - Criteria for earthquake resistant design of structures
7. 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

**E-Resources (If any):**

[www.nptel.iitm.ac.in/courses/](http://www.nptel.iitm.ac.in/courses/)