

GUJARAT TECHNOLOGICAL UNIVERSITY, AHMEDABAD, GUJARAT**COURSE CURRICULUM****COURSE TITLE: STRUCTURAL DESIGN AND DRAFTING****(Code: 3341304)**

| Diploma Programmes in which this course is offered | Semester in which offered |
|---|----------------------------------|
| Environmental Engineering | 4 th Semester |

1. RATIONALE

Knowledge and understanding of Structural design and Drafting is very important for engineers in order to make Civil Engineering Structures safe and serviceable. The Structural Mechanics – I course is taught in third semester to develop the concept of analysis of determinate structures under various types of transverse &/or direct loading. Analysis of Industrial Trusses is also incorporated to give an idea of typical structure to the students. In this course, Design of steel and RCC structures is incorporated to give an idea of Structure Design under different loading to the students is to be studied. At diploma level students are expected to study about these aspects of analysis and design of various concrete and steel structures so as to develop their understanding in order to apply their knowledge in construction particularly in Industrial structures.

2. COMPETENCY

The course content should be taught and curriculum should be implemented with the aim to develop required skills in the students so that they are able to acquire following competency:

- **Design and Draft the RCC structures like Beams, Slabs, columns and Footings using relevant IS codes**

3. COURSE OUTCOMES (COs)

The theory should be taught and practical should be carried out in such a manner that students are able to acquire required learning outcomes in cognitive, psychomotor and affective domain to demonstrate following course outcomes.

- Calculate various types of loads coming on the structures
- Use various IS codes IS 456 -2000, IS 800-2007, IS 875 part 1,2,3
- Design the RCC structures like Beams, Slabs, columns and Footings
- Design various members of the Steel structures
- Prepare the Drawings of RCC details and Steel Structure Connections

4. TEACHING SCHEME OF STUDIES AND EXAMINATIONS

| Teaching Scheme (In Hours) | | | Total Credits (L+T+P) | Examination Scheme | | | | Total Marks |
|-------------------------------|---|---|-----------------------------|--------------------|----|--------------------|----|----------------|
| | | | | Theory Marks | | Practical Marks | | |
| L | T | P | C | ESE | PA | ESE | PA | 150 |
| 3 | 0 | 2 | 5 | 70 | 30 | 20 | 30 | |

Legends: L-Lecture; T – Tutorial/Teacher Guided Theory Practice; P - Practical; C – Credit ESE - End Semester Examination; PA - Progressive Assessment.

5. DETAILED COURSE CONTENT

| Unit | Major Learning Outcomes (Outcomes in Cognitive Domain) | Topics and Sub-topics |
|--|--|--|
| Unit – I Introduction (R.C.C.) | 1a. Apply basic concept of Limit State Method (LSM) of Design of RCC Structure 1b. Use various properties of concrete and steel in analysis and design. 1c. Distinguish various terms Used in Limit State Method of design | 1.1 Scope 1.2 Importance of use of reinforcement 1.3 Limit state method of design. 1.4 Limit state of collapse and serviceability and state of shear 1.4.1 State the assumptions made in theory of limit state of collapse . I.S. 456-2000. 1.4.2 Limit State of Serviceability. 1.5 Define characteristic strength of concrete and steel 1.6 Define characteristic load 1.7 Partial safety factor for load and Strength of materials 1.8 Define 1.8.1 Partial safety factor for material: γ_m 1.8.2 Partial safety factor for load: γ_f 1.8.3 Grades of concrete and steel 1.8.4 Flexural members beam, slab, & footing. |
| Unit – II I.S. Provisions for Design Considerations (Is:456:2000) | 2a. Use IS 456- 2000 and its various clauses regarding the Requirements | 2.1 Effective depth 2.2 Effective span. 2.3 Control of deflection. 2.4 Cover to reinforcement. 2.5 Spacing of reinforcement. 2.6 Requirements of reinforcement for beam |

| Unit | Major Learning Outcomes (Outcomes in Cognitive Domain) | Topics and Sub-topics |
|--|--|---|
| | | 2.7 Requirements of reinforcement for slab 2.8 Requirements of reinforcement for column 2.9 Minimum eccentricity in column. 2.10 Development length of bars. 2.11 Shear reinforcement |
| Unit-III Designs and Detailing of Beams | 3a. Design a Singly Reinforced Cement Concrete(R.C.C.) Beam 3b. Design Shear reinforcement in a R.C.C. Beam | 3.1 Flexural members. 3.2 Classification of beam: 3.2.1 Singly reinforced beam. 3.3 Methods of design of beam. 3.3.1 Design of singly reinforced rectangular beam using I.S.456-2000. 3.3.2 Design of singly reinforced rectangular beam using SP: 16 Handbooks 3.4 Design of shear reinforcement using I.S.456-2000. 3.5 Check for development length and deflection using I.S.456-2000 and S16 Handbook. |
| Unit-IV Design and Detailing of Slab | 4a. Design a One-way RCC slab 4b. Draw reinforcement details of a one way RCC slab | 4.1 One-way slab 4.2 Load on slab as per I.S. 875-1987. 4.3 Design of one way simply supported slab using I.S. 456-2000 and SP:16 Hand book. 4.4 Reinforcement Details of One-way slab |
| Unit-V Design and Detailing of Axially Loaded Columns | 5a. Design a Square RCC columns Under Axial Loads | 5.1 Compression member. 5.1.1 State the assumptions in designing a compression member by limit state method. 5.1.2 Define: short and long column. 5.1.3 State the types of failures that may be observed in columns with sketches. 5.2 Effective length of column as per I.S. 456-2000 5.3 Design of A Square column as per I.S 456-2000 5.4 Check for minimum eccentricity. |

| Unit | Major Learning Outcomes (Outcomes in Cognitive Domain) | Topics and Sub-topics |
|--|--|--|
| Unit-VI Design and Detailing of Isolated Column Footings | 6a. Design a Square Pad footing for a Square RCC column | 6.1 Bearing capacity of soil. 6.2 Type of footing. 6.3 Design of square pad footing. 6.4 Check the footing for one-way shear, two-way shear.. 6.5 Check for the development length of the base. 6.6 Check for spacing |
| Unit-VII Sketches of Reinforce- ment Details | 7a. Draw Reinforcement Details of various R.C. C. structures | 7.1 Reinforcement Details of various R.C structures like Beam, slab, column, footings, Retaining Wall, Water Tank, Chhajja, Lintels |
| Unit-VII Loads on Roof Truss | 8a. Calculate various types of Loads coming on Structures As per IS 875 | 8.1 Dead Loads as per IS- 875 part-1 8.2 Live Load as per IS- 875 part -2 8.3 Wind Loads as per IS- 875 part-3 8.4 Numerical related to 8.1 and 8.2 |
| Unit-IX Introduction (Steel Structures): -Advantages of Steel Structures. | 9a. Draw components of various types of Roof Trusses 9b. Design roof connection using bolts and welds | 9.1 Various types of Roof Truss 9.2 Shape, size and properties of different Indian Standard steel sections from steel hand book 9.3 Provisions for bolted joints in IS- 800:2007 9.4 Types of Bolts and welds 9.5 Design of bolted and welded joints., permissible stress, Edge distance, Pitch, Dia. Of bolts, size of weld |
| Unit-X Sketches of Steel Roof Truss | 10a. Draw reinforcement details of various types of joints of a roof truss with bolted as well as welded connections | 10.1 Various types of roof truss 10.2 Detail of joint at support 10.2.1 Detail of joint at crown 10.3 Detail of connection between purlin and roofing with principal Rafter 10.4 Different Types of welded connections |

6. SUGGESTED SPECIFICATION TABLE WITH HOURS & MARKS (THEORY)

| Unit No. | Unit Title | Teaching Hours | Distribution of Theory Marks | | | |
|----------|---|----------------|------------------------------|-----------|-----------|-------------|
| | | | R Level | U Level | A Level | Total Marks |
| I. | Introduction (R.C.C.) | 04 | 03 | 03 | 01 | 07 |
| II. | I.S. Provisions For Design Considerations: | 04 | 03 | 03 | 01 | 07 |
| III. | Designs And Detailing Of Beams | 08 | 01 | 03 | 03 | 07 |
| IV. | Design And Detailing Of Slab | 04 | 01 | 03 | 03 | 07 |
| V. | Design And Detailing Of Axially Loaded Columns: | 04 | 01 | 03 | 03 | 07 |
| VI. | Design And Detailing Of Isolated Column Footings: | 04 | 01 | 03 | 03 | 07 |
| VII. | Sketches Of Reinforcement Details | 03 | 01 | 03 | 03 | 07 |
| VIII. | Loads On Roof Truss | 04 | 01 | 03 | 03 | 07 |
| IX. | Introduction To Steel Structures | 04 | 01 | 03 | 03 | 07 |
| X. | Sketches Of Steel Roof Truss | 03 | 01 | 03 | 03 | 07 |
| | Total Hrs | 42 | 14 | 30 | 26 | 70 |

Legends: R = Remembrance; U = Understanding; A = Application and above levels (Bloom's Revised 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.

7. SUGGESTED LIST OF EXERCISES/PRACTICALS

The practical/exercises should be properly designed and implemented with an attempt to develop different types of skills (**outcomes in psychomotor and affective domain**) so that students are able to acquire the competencies/programme outcomes. Following is the list of practical exercises for guidance.

*Note: Here only outcomes in psychomotor domain are listed as practical/exercises. However, if these practical/exercises are completed appropriately, they would also lead to development of certain outcomes in affective domain which would in turn lead to development of **Course Outcomes** related to affective domain. Thus over all development of **Programme Outcomes** (as given in a common list at the beginning of curriculum document for this programme) would be assured.*

Faculty should refer to that common list and should ensure that students also acquire outcomes in affective domain which are required for overall achievement of Programme Outcomes/Course Outcomes.

| S. No. | Unit No. | Practical Exercises (Outcomes' in Psychomotor Domain) | Approx Hrs. |
|--------|----------|---|-------------|
| 1 | III | Design a singly R.C. beam and Draft a sheet showing R.C.C. details | 4 |
| 2 | IV | Design a One way S.S. slab and Draft a sheet showing R.C..C. details | 4 |
| 3 | V | Design a R.C. Square column and Draft a sheet showing R.C..C. details | 4 |

| | | | |
|--------------|------|---|-----------|
| 4 | VI | Design a Square isolated pad footing showing R.C.C. details | 4 |
| 5 | VII | Prepare sketches of R.C.C. Structure in A4 size sheets | 4 |
| 6 | VIII | Prepare sketches of roof truss in A4 size sheets | 2 |
| 7 | IX | Prepare sketches of Steel Structure in A4 size sheets | 4 |
| 8 | X | Prepare sketches of Steel roof truss in A4 size sheets | 2 |
| Total | | | 28 |

Note: If students are not able to complete the work in allotted time in the class then they have to complete it at home after college hours or at weekends or on holidays.

8. SUGGESTED LIST OF STUDENT ACTIVITIES

- i. Site Visit to understand RCC structure
- ii. Site Visit to understand Steel structure

9. SPECIAL INSTRUCTIONAL STRATEGIES (If Any)

- i. Demonstration of Models & Charts of RCC Structures and Steel Structures

10. SUGGESTED LEARNING RESOURCES

A. List of Books

| S. No. | Title of Book | Author | Publication |
|--------|--|-------------------------------|----------------------|
| 1. | Limit State Theory & Design of Reinforce concrete | Dr.S.R.Karve & Dr. D.L. SHAH | Charotar Publication |
| 2. | Illustrated Reinforced concrete design | Dr. S.R. Karve & Dr. D.L.Shah | Charotar Publication |
| 3. | Hand Book of Reinforced concrete design | Dr.S.R.Karve& Dr. D.L.Shah | Charotar Publication |
| 4. | Reinforced Concrete | A.K. Jain. | S.Chand & Co. |
| 5. | Reinforced Concrete Design | S.N. Sinha. | S.Chand & Co. |
| 6. | Design for Reinforced concrete structure | P. Dayaratnam. | S.Chand & Co. |
| 7. | Design of Reinforced Concrete | S. Ramamrutham. | Dhanpat Rai & Sons |
| 8. | Design aids for Reinforced concrete to IS:456-2000 | B.I.S. | B.I.S.New Delhi |
| 9. | Design aid SP: 16 Handbook B.I.S. | B.I.S. | B.I.S.New Delhi |
| 10 | Design of R.C.C. Structure vol. 1 and 2 | H.J.SHAH | Charotar publication |
| 11 | Design of Steel Structure | Dayaratnam. | Tata Mc grow Hill |
| 12 | Design of Steel Structure | L.S. Negi | |
| 13 | Design of R.C.C. Structure | Ramamrutham. | Dhanpat Rai & Sons |

B. List of Major Equipment/ Instrument with Broad Specifications

Models of the different civil structures

C. List of Software/Learning Websites

nptel.iitm.ac.in/courses

11. COURSE CURRICULUM DEVELOPMENT COMMITTEE**Faculty Members from Polytechnics**

- **Prof. K. K. Patel** , Head Applied Mechanics Department, GP Rajkot
- **Prof. C. H. Bhatt**, Lecturer Applied Mechanics, Dr S & S Ghandhy College, Surat

Coordinator and Faculty Members from NITTTR Bhopal

- **Prof. M. C. Paliwal**, Associate Professor, Civil & Environmental Engineering Department.