

GUJARAT TECHNOLOGICAL UNIVERSITY, AHMEDABAD, GUJARAT

**COURSE CURRICULUM
COURSE TITLE: DESIGN OF STEEL STRUCTURE
(COURSE CODE: 3350601)**

Diploma Programme in which this course is offered	Semester in which offered
Civil Engineering	5 th Semester

1. RATIONALE

Civil Engineering structures are normally made up of either Steel Sections or of Reinforced Cement Concrete. Normally, industrial structures are constructed using steel sections.

In industry, to cover wider area without any obstruction at floor level due to columns etc., normally steel roof truss is provided and hence Load calculation using IS 875 is required for such trusses.

Using our previous semester study of Structural Analysis and design provisions as per IS-800-2007, in this subject, students will analyse and design different components of steel structure.

In Steel Structure, Rolled Steel Sections are used and its connections at different stages on site is highly important for the safety of Structure and hence, study of Connection through Welding or Bolting is important. This course is therefore an important course for civil engineering students.

2. LIST OF COMPETENCY

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

- **Design of Tension & Compression members of Steel Structure along with Foundation, Steel Beam and Welded and Bolt Connection as per IS 800-2007**
- **Structure Detailing of Steel Roof Truss and Different Steel Structure Component**

3. COURSE OUTCOMES

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

- i. Calculate Dead Load , Live Load and Wind Load on panel points of a Roof Truss as per IS-875-1984
- ii. Design Bolt Connection of Angle Section to Gusset Plate & Welded Connection of Angle Section to Gusset Plate , Lacing System (Single or Double) for Built up Column , Batten System for Built up Column , laterally Restrained Simply Supported beam, Purlin made up Angle Section , Slab Base Foundation under Axially Loaded Column made up of Single H Section
- iii. Analyze and Design Axially Loaded Tension Member made up of Angle Section , Strut made up of Angle Section , Axially Loaded Column

4. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (InHours)			Total Credits (L+T+P)	Examination Scheme				Total Marks
L	T	P		Theory Marks		Practical Marks		
			C	ESE	PA	ESE	PA	200
03	00	04	07	70	30	40	60	

Legends:L- Lecture;T- Tutorial/TeacherGuidedStudentActivity;P - Practical; C -Credit; ESE- End Semester Examination; PA-Progressive Assessment.

5. COURSE CONTENT DETAILS

Unit	Major Learning Outcomes (in Cognitive Domain)	Topics and Sub-topics
Unit – I Calculation of Load on Roof Truss	1a. Calculate Dead Load , Live Load and Wind Load on panel points of a Roof Truss 1b. List types of Truss	1.1 Rolled Steel Section – ISA, I & H Section, Channel Section and its application in Steel Structure 1.2 Types of Truss, Pitch of Truss, Rise, Spacing of Truss, Purlin, Principal Rafter, Main Tie, Sag Tie, Members of Truss , Roofing material- GI and AC Sheets 1.3 Dead Load of Truss per panel point- Self Weight , Weight of Purlin , Wind Bracing , Weight of Roofing Material 1.4 Live Load per panel point in Truss as per IS – 875 – Part II -1984 when access is not provided 1.5 Wind Load per panel point in Truss using IS – 875 – Part III -1984

Unit	Major Learning Outcomes (in Cognitive Domain)	Topics and Sub-topics
Unit – II Bolt and Welded Connection	2a. D Design Bolt Connection of Angle Section to Gusset Plate 2b. D Design Welded Connection of Angle Section to Gusset Plate 2c. C Solve Numerical on Bolted Connection of Angle Section to Gusset Plate and for Efficiency of Joint having Chain Bolting 2d. C Solve Numerical on Welded Connection of Angle Section to	2.1 Rigid Connection, Pinned Connection, Semi Rigid Connection, Black Bolts, Turned Bolts, HSFG Bolts, Grade of Bolts 2.2 Lap and Butt Joint, Minimum and Maximum Pitch, Tack Bolting, Edge Distance, Gauge Distance, Bolt Hole 2.3 Shear Capacity of Bolt – V_{dsb} , Bearing Capacity of Bolt – V_{dpb} as per IS-800-2007, Bolt Value, Efficiency of Joint 2.4 Numerical on Bolted Connection of Angle Section to Gusset Plate and for Efficiency of Joint having Chain Bolting 2.5 Types of Weld, Fillet Weld and
Unit – III Tension Member	3a Analyze and Design Axially Loaded Tension Member made up of Angle Section 3b Solve Numerical for Analysis & Design type based on 1.2 for Single and Double Angle Sections on same side and either side of Gusset Plate	3.1 Examples of Tension Members in Civil Engineering Structures 3.2 Design Strength of Tension Member, Design Strength due to Yielding of Gross Section, Design Strength due to Rupture of Critical Section for Angle Section, Design Strength due to Block Shear in Angle Section as per IS – 800-2007 3.3 Slenderness ratio of Tension Member as per IS – 800 – 2007 3.4 Numerical for Analysis & Design type based on 1.2 for Single and Double Angle Sections on same side and either side of Gusset Plate

Unit	Major Learning Outcomes (in Cognitive Domain)	Topics and Sub-topics
Unit – IV Compression Member Strut & Column	<p>4a Analyze and Design Strut made up of Angle Section</p> <p>4b Analyze and Design Axially Loaded Column</p> <p>4c Solve Numerical on Column made up of ISHB , ISHB with Flange Plate , Double Channels Back to Back and Toe to Toe</p> <p>4d Solve Numerical on Strut made up of Single Angle, Double Angle same and either side of G.P as per 1.2 & 1.3 Built up Column , Effective Length of Column as per Table 11, IS-800-2007</p>	<p>4.1 Strut , Maximum Slenderness Ratio, Classification of Cross – Sections and Buckling Class as per IS-800-2007</p> <p>4.2 Angle Strut as per Cl. 7.5 , IS-800-2007</p> <p>4.3 Design Compressive Stress – fcd according to Tables of IS-800-2007</p> <p>4.4 Numerical on Strut made up of Single Angle , Double Angle same and either side of G.P as per 1.2 & 1.3 Built up Column , Effective Length of Column as per Table 11 , IS-800-2007</p> <p>4.5 Design Compressive Stress – fcd according to Tables of IS-800-2007</p> <p>4.6 Numerical on Column made up of ISHB, ISHB with Flange Plate, Double Channels Back to Back and Toe to Toe</p>
Unit – V Lacing & Battens	<p>5a Design Lacing System (Single or Double) for Built up Column</p> <p>5b Describe Objective of Lacing , Single Lacing , Double Lacing , Batten</p> <p>5c Design Batten System for Built up Column</p>	<p>5.1 Objective of Lacing , Single Lacing ,</p> <p>5.2 Double Lacing</p> <p>5.3 IS – 800-2007 requirements for Lacing System as per Cl. 7.6</p> <p>5.4 Numerical on Single and Double Lacing as per 1.2</p> <p>5.5 Objective of Batten , Batten</p> <p>5.6 IS – 800-2007 requirements for Batten System as per Cl. 7.7</p> <p>5.7 Numerical on batten as per 2.2</p>
Unit – VI Lateral Restrained Beam & Purlin	<p>6a Design of laterally Restrained Simply Supported beam</p> <p>6b Design of Purlin made up Angle Section</p>	<p>6.1 Main Beam , Secondary Beam , Standard I Sections , Laterally restrained and unrestrained beam</p> <p>6.2 Plastic Section Modulus – Annexure –H , IS-800-2007 , Section classification as per Table 2 – IS-800-2007 , Shear buckling , Shear Strength and Bending Strength of Section as per Cl. 8.4.1 and Cl. 8.2.1.2 of IS-800-2007 , Deflection as per Table-6 of IS-800-2007 , Shear Leg Effect , Web Crippling</p>

Unit	Major Learning Outcomes (in Cognitive Domain)	Topics and Sub-topics
Unit-VII Slab Base Foundation	7a Design of Slab Base Foundation under Axially Loaded Column made up of Single H Section 7b Solve Numerical on Slab Base Foundation under Column made up of Single H	7.1 Slab Base , Gusseted Base , Base plate and its Thickness as per IS-800-2007 , Concrete Block , SBC of Soil , Anchor Bolt , Cleat and Dummy Angle 7.2 Numerical on Slab Base Foundation under Column made up of Single H Section

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

Unit	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	Calculation of Load on Roof Truss	08	02	00	09	11
II	Bolted and Welded Connection	06	01	02	04	07
III	Tension Member	06	00	02	05	07
IV	Compression Member Strut & Column	06	02	02	06	10
V	Lacing & Batten	04	01	02	04	07
VI	Laterally Restrained Beam & Purlin	08	02	04	08	14
VII	Slab Base Foundation	04	02	00	05	07
	Sketches As Mentioned In Drawing Work	00	03	04	00	07
Total		42	13	16	41	70

Legends: R = Remember, U = Understand, A= Apply and above Level (Bloom's revised taxonomy)

Note: This specification table shall be treated as 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/PRACTICAL

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/Exercise (outcomes in psychomotor domain)	Approx. Hrs. Required
1	I	Find Forces in given Truss Members using Graphical Method due to D.L , L.L and W.L and Design Forces in the Members – Drawing Sheet – No: 01 ,A1 Size	08
2	II , III , IV	Draw Plan & c/s Elevation of Eaves Level Joint , Ridge Joint and Two Other Joints of a Truss Selected in Sheet No:01 with all design details like Size of Angle Section , G.P , Connection Details , Purlin , Roofing Material – Drawing Sheet – No: 02 , A1 Size	10
3	IV , VII	Draw Plan and c/s Elevation of Built up column made up of Double Channel provided back to back with Single or Double Lacing Draw Plan and c/s Elevation of Slab Base Foundation under column made up of H section Sheet No:03 – A1 Size	08
4	----	Prepare following Neat sketches in Sketch Book Different Types of Truss Truss Details – Spacing of Truss , Principal Rafter, Main Tie, Members, Ridge, span, Roof Covering, Purlin etc... Eaves Level Joint of Truss Ridge Level Joint of Truss Beam to Beam Connection at Same Level Beam to Beam Connection at Different Level Column to Beam Seated Connection (Weld & Bolt Connection) Column to Beam framed Connection (Weld & Bolt Connection) Gusseted Slab Base Foundation	14
5	I , II , III , IV , V, VII	Prepare a Report File related to Calculation work of Drawing Sheet No: 1 , 2 & 3	10
6		Site Visit of Industry Truss , Steel Structure Railway Platform – Report , Photographs	06
Total Hours			56

8. SUGGESTED LIST OF STUDENT ACTIVITIES

- i. Collect the Photographs of nearby Typical Roof Trusses and from Internet
- ii. Collect the Photographs of Elevated Steel Structure Water Tank
- iii. Collect the Photographs of Steel Columns with Lacing and / or Batten

9. SPECIAL INSTRUCTIONAL STRATEGIES (If Any)

- i. Site Visit must be arranged for Industrial Truss to explain Truss terminology and Connection Details
- ii. Show video of Fabrication work using Bolt and Weld

10. SUGGESTED LEARNING RESOURCES

A. List of Books:

*** Students are permitted to appear in theory & practical examination with these books (highlighted and under lined)

S. No.	Title of Books	Author	Publication
1.	<u>***IS-800 – 2007</u>	-----	Bureau of Indian Standard
2.	<u>***Handbook on Steel – SP-6</u>	-----	Bureau of Indian Standard
3.	<u>***IS – 875 – 1984 , Part - III</u>	-----	Bureau of Indian Standard
4.	Design of Steel Structures (By Limit State Method As Per Is: 800—2007)	S S Bhavikatti	I. K. International Pvt Ltd
5.	Design of Steel Structures	K. S. Sai Ram	Pearson Education India
6.	Design of Steel Structures: Theory And Practice	N. Subramanian	Oxford University Press (2010)
7.	Limit State Design of Steel Structures	S . K Duggal	Tata Mcgraw Hill Education Private Limited

B. List of Major Equipment/Materials

- i. Drawing Hall having Drawing Facilities
- ii. Models of Truss , Built up column , Beam and Column Connection

C List of Software/Learning Websites

- i. <http://nptel.iitm.ac.in> - Lecture series from IIT , Guwahati
- ii. elearning.vtu.ac.in

11. COURSE CURRICULUM DEVELOPMENT COMMITTEE

Faculty Members from Polytechnics

- Prof. B.G. Rajgor, H.O.D, App. Mech. , BBIT, V V Nagar
- Prof. B. G. Bhankhar , H.O.D , App. Mech., GP , Ahmedabad
- Prof. K. K. Patel, H.O.D , App. Mech. , GP , Rajkot
- Prof. C. H. Bhatt, LAM, DR. S & S. S. Gandhi Engg. College , Surat
- Prof. Bhruguli H Gandhi , LAM , GGP , Ahmedabad

Coordinator and Faculty Members from NITTTR Bhopal

- Dr. K. K. Pathak, Professor Department of Civil and Environmental Engineering
- Dr. M. C. Paliwal, Associated Professor, Department of Civil and Environmental Engineering