Year / Semester: III B.Tech VI Semester   **Regulation: R23**

Subject and Code: DESIGN OF STEEL STRUCTURES & 23CIV361T

SYLLABUS

III B. Tech– II Semester					
Course Code	**DESIGN OF STEEL STRUCTURES**	**L**	**T**	**P**	**C**
23CIV361T		3	0	0	3

Course Objectives:
The objectives of this course are to make the student to:

1. **Understand the properties, types, and applications of structural steel in construction.**

2. **Analyze the behavior and design of bolted and welded connections for steel structures.**

3. **Design tension and compression members, including built-up members and column bases.**

4. **Develop steel structural elements such as beams, plate girders, roof trusses, and gantry girders.**

5. **Apply plastic analysis concepts to the design of continuous beams and portal frames.**

UNIT– I

INTRODUCTION TO STRUCTURAL STEEL and DESIGN OF CONNECTIONS
General -Types of Steel -Properties of Structural Steel - I.S. Rolled Sections - Concept of Limit State Design - Design of Simple and Eccentric Bolted and Welded Connections - Types of Failure and Efficiency of Joint –- Introduction to HSFG bolts-Prying Action

UNIT– II

DESIGN OF TENSION AND COMPRESSION MEMBERS
Behaviour and Design of Simple and Built-Up Members Subjected to Tension - Shear Lag Effect Design of Lug Angles - Tension Splice - Behaviour of Short and Long Columns - Euler's Column Theory Design of Simple and Built-Up Compression Members with Lacings and Battens - Design of Column Bases - Slab Base and Gusseted Base.

UNIT– III

DESIGN OF BEAMS
Design of Laterally Supported and Unsupported Beams - Design of Built-Up Beams - Design of Girders.

UNIT– IV

INDUSTRIAL STRUCTURES
Design of Roof Trusses – Loads On Trusses – Purlin Design Using Angle and Channel Sections – Truss Design, Design of Joints and End Bearings–Design of Gantry Girder - Introduction to Pre-Engineered Buildings.

UNIT– V

PLASTICANALYSIS AND DESIGN
Introduction to Plastic Analysis - Theory of Plastic Analysis - Design of Continuous Beams and Portal Frames Using Plastic Design Approach

Prepared by Mrs. K.Sumalatha assistant professor, CE department

Year / Semester: III B.Tech VI Semester   **Regulation: R23**

Subject and Code: DESIGN OF STEEL STRUCTURES & 23CIV361T

COURSE OUTCOMES:

Upon successful completion of this course, students will be able to:	POs related to COs
CO1	**Apply estimation techniques to prepare detailed estimates for various construction projects.**	**PO1, PO2, PO3**
CO2	**Develop abstract estimates and rate analysis for different civil engineering works.**	**PO1, PO2, PO3**
CO3	**Analyze the preparation of measurement books and bill preparation as per AP State Government procedures.**	**PO1, PO2,PO3,PO4**
CO4	**Create detailed specifications and tender documents for construction projects.**	**PO1,PO2**
CO5	**Assess building valuation, cost escalation, and value analysis techniques.**	**PO1, PO2,PO3,PO4**

TEXT BOOKS:

1. **Duggal S.K., Design of Steel Structures, Tata McGraw Hill, Publishing Co. Ltd., New Delhi, 2010**

2. **Bhavikatti S.S, Design of Steel Structures, Ik International Publishing House, New Delhi, 2017.**

REFRENCEBOOKS:

1. **Gambhir M L, Fundamentals of Structural Steel Design, McGraw Hill Education India Pvt Limited, 2013**

2. **Jack C. Mc Cormac& Stephen F. Csernak - Structural Steel Design, Pearson, 7th Edition, 2023.**

3. **William T. Segu i& Farid Soleimani - Steel Design, Cengage, 7th Edition, 2023.**

4.   **Sarwar AlamRaz, Structural Design in Steel, New Age International Publishers, 2014**

5. **Subramanian N, Design of Steel Structures, Oxford University Press, New Delhi, 2016**

Online Learning Resources: https://nptel.ac.in/courses/105105162
CO-MAPPING

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO-1	3	2	2	2	1	1	1	-	1	-	2	2	2	2
CO-2	3	2	2	2	1	1	1	-	1	-	2	2	1	1
CO-3	3	2	2	2	1	-	-	-	1	-	2	2	2	1
CO-4	3	2	2	2	1	-	-	-	1	-	2	2	1	1
CO-5	3	2	2	2	1	-	-	-	1	-	2	2	2	2

Prepared by Mrs. K.Sumalatha assistant professor, CE department

Year / Semester: **III** B.Tech **VI** Semester   Regulation: **R23**

Subject and Code: **DESIGN OF STEEL STRUCTURES &** 23CIV361T

Max Marks: 10

S.No.	CO	Questions	BT
		Unit I: (INTRODUCTION TO STRUCTURAL STEEL & DESIGN OF CONNECTIONS)	
1	1	**What are the advantages and disadvantages of welding?**	**L4**
2	1	**Explain what are types of welding?**	**L3**
3	1	**Two plates Fe410 grade steel, each 210mmX8mm are to be joined using 20mmdiameter, 4.6 grade bolts to form a lap joint. The joint is supposed to transfer a factored load of 400KN.Design the joint and determine suitable pitch for the bolts?**	**L4**
4	1	**What are different types of welding joints?**	**L3**
5	1	**Explain about the advantages and disadvantages of welding**	**L5**
6	1	**Two plates of 12mm and 18mm thick are joined by a U-butt weld determine the strength of the welded joint .the effective length of the member is 220mm check the strength in case of incomplete and complete penetration?**	**L4**
7	1	**Two plates of 12mm and 18mm thick are joined by a U-butt weld determine the strength of the welded joint .the effective length of the member is 220mm check the strength in case of incomplete and complete penetration ?**	**L3**
8	1	**Determine the strength of the fillet weld carried a welded joint which is shown in figure .take allowable stress in the weld is 110n/mm². size of fillet weld is 60mm?**	**L5**
9	1	**Two flats Fe410 grade steel, each 210mmX8mm are to be joined using 20mm diameter, 4.6 grade bolts to form a lap joint. The joint is supposed to transfer a factored load of 400KN.Design the joint and determine suitable pitch for the bolts?**	**L4**
10	1	**The plates of a 6mm thick tank are used by a single bolted lap joint with 20mm diameter bolts at 60mm pitch. Calculate the efficiency of the joint. Take Fu of plate as 410Mpa and assume 4.6 grade bolts?**	**L3**
11	1	**The plates of a 6mm thick tank are used by a single bolted lap joint with 20mm diameter bolts at 60mm pitch. Calculate the efficiency of the joint. Take Fu of plate as 410Mpa and assume 4.6 grade bolts?**	**L3**

Year / Semester: III B.Tech VI Semester   **Regulation: R23**

Subject and Code: DESIGN OF STEEL STRUCTURES & 23CIV361T

S.No.	CO	Questions	BT
Unit II: (**DESIGN OF TENSION AND COMPRESSION MEMBERS**)			
1	2	A single unequal angle 100 x 65 x 10 mm is connected to a 10 mm thick gusset plate with 8 no's bolts with 18mm diameter to transfer the tension. The ultimate stress Fu=415 N/mm²and yield stress Fy=250 N/mm².Determine the design tensile strength of the angle?	L4
2	2	A single unequal angle 100 x 75 x 10 mm is connected to a 10 mm thick gusset plate with 8 no's bolts with 18mm diameter to transfer the tension. The ultimate stress Fu=415 N/mm²and yield stress Fy=250 N/mm² .Determine the design tensile strength of the angle?	L3
3	2	A single unequal angle 100 x 65 x 8mm is connected to a 8 mm thick gusset plate with 8 no's bolts with 18mm diameter to transfer the tension. The ultimate stress Fu=415 N/mm²and yield stress Fy=250 N/mm² .Determine the design tensile strength of the angle?	L4
4	2	A single unequal angle 90x 60 x 6mm is connected to a 10 mm thick gusset plate with 5 no's bolts with 16mm diameter to transfer the tension. The ultimate stress Fu=415 N/mm²and yield stress Fy=250 N/mm² .Determine the design tensile strength of the angle section When the gusset connected to 60mm leg?	L3
5	2	A single unequal angle 90x 60 x 6mm is connected to a 10 mm thick gusset plate with 6 no's bolts with 18mm diameter to transfer the tension. The ultimate stress Fu=415 N/mm²and yield stress Fy=250 N/mm² .Determine the design tensile strength ofthe angle section When the gusset connected to 60mm leg?	L5
6	2	Design the compression member of a rolled steel beam section ISHB 350 @ 0.674 kN/m is used as a stanchion. If the unsupported length of the stanchion is 4 m, evaluate safe load carrying capacity o f the section?	L4
7	2	Design the compression member of a rolled steel beam section ISHB 350 @ 0.674 kN/m is used as a stanchion. If the unsupported length of the stanchion is 5 m, evaluate safe load carrying capacity o f the section?	L3
8	2	Design the compression member of a rolled steel beam section ISHB 300 @ 577 N/m is used as a stanchion. If the unsupported length of the stanchion is 3 m, evaluate safe load carrying capacity o f the section.?	L5
9	2	Design the compression member of a rolled steel beam section ISHB 300 @ 577 N/m is used as a stanchion. If the unsupported length of the stanchion is 4 m, evaluate safe load carrying capacity o f the section.?	L4

10	2	Design axial load on the column section ISMB 350 given that the height of the column is 3M and that it is pinned on both the sides. Also assume Fu=415 N/mm², Fy=250N/mm² &E=2x10⁵N/mm² ?	L3
11	2	Design axial load on the column section ISMB 350 given that the height of the column is 4M and that it is pinned on both the sides. Also assume Fu=415 N/mm², Fy=250N/mm² &E=2x10⁵N/mm² ?	L4

S.No.	CO	Questions	BT
		Unit III: (DESIGN OF BEAMS)	
1	3	Design a simply supported beam to carry a U.D.L of 44 KN/m. The effective span of the beam is 8M .The effective length of the compression flange is also 8M.The beam the is laterally supported. The ends of the beam are not free to rotate at bearings? Assume Fy=250N/mm²&E=2x10⁵N/mm²	L4
2	3	Design a simply supported beam to carry a U.D.L of 40 KN/m. The effective span of the beam is 8M .The effective length of the compression flange is also 8M.The beam the is laterally supported. The ends of the beam are not free to rotate at bearings? Assume Fy=250N/mm²&E=2x10⁵N/mm²	L3
3	3	Design a simply supported beam to carry a U.D.L of 35KN/m. The effective span of the beam is 8M .The effective length of the compression flange is also 8M.The beam the is laterally supported. The ends of the beam are not free to rotate at bearings? Assume Fy=250N/mm²&E=2x10⁵N/mm²	L4
4	3	Design a simply supported beam to carry a U.D.L of 50 KN/m. The effective span of the beam is 8M .The effective length of the compression flange is also 8M.The beam the is laterally supported. The ends of the beam are not free to rotate at bearings? Assume Fy=250N/mm²&E=2x10⁵N/mm²	L3
5	3	Design a simply supported beam to carry a U.D.L of 45 KN/m. The effective span of the beam is 8M .The effective length of the compression flange is also 8M.The beam the is laterally supported. The ends of the beam are not free to rotate at bearings? Assume Fy=250N/mm²&E=2x10⁵N/mm²	L5
6	3	Calculate the moment carrying capacity of a laterally unrestrained ISMB 400member length is 3M?	L4
7	3	Calculate the moment carrying capacity of a laterally unrestrained ISMB 550 member length is 6M?	L3
8	3	Calculate the moment carrying capacity of a laterally unrestrained ISMB 600 member length is 8M?	L5
9	3	Calculate the moment carrying capacity of a laterally unrestrained ISMB 550 member length is 4M?	L4

Year / Semester: III B.Tech VI Semester   **Regulation: R23**

Subject and Code: DESIGN OF STEEL STRUCTURES & 23CIV361T

10	3	**Design a simply supported beam to carry a U.D.L of 45 KN/m. The effective span of the beam is 8M .The effective length of the compression flange is also 8M.The beam the is laterally unsupported. The ends of the beam are free to rotate at bearings? Assume Fy=250N/mm²&E=2x10⁵N/mm²**	**L3**
11	3	Design a simply supported beam to carry a U.D.L of 50 KN/m. The effective span of the beam is 6M .The effective length of the compression flange is also 8M.The beam the is laterally unsupported. The ends of the beam are free to rotate at bearings? Assume Fy=250N/mm²&E=2x10⁵N/mm²	**L3**

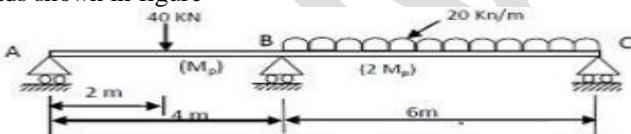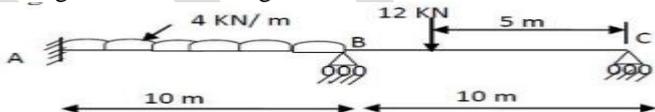| S.No.	CO	Questions	BT
		Unit IV: (INDUSTRIAL STRUCTURES)	
1	4	What is a roof truss? What are the different parts of a roof truss?	**L4**
2	4	What are the different types of roof truss? Draw sketches.	**L3**
3	4	What are the Loads On Trusses?	**L4**
4	4	**a. What are purlins?** b. **Give basic considerations for designs of purlins.**	**L3**
5	4	**Describe factors which are taken for design of truss.**	**L5**
6	4	Design a double angle discontinuous strut to carry a factored load of 135 kN. The length of strut is 3 m between intersections. The two angles are placed back to back (with long legs are connected) and are tack bolted. Use steel grade Fe410. a) Angles are placed on opposite side of 12 mm gusset plate. b) Angles are placed on same side of 12 mm gusset plate.	**L4**
7	4	Design I section purlin for a trussed roof for the following data : Span of roof = 10 m, Spacing of pulins along slope or truss = 2.5 m, Spacing of truss = 4 m, Slope of roof truss = 1 vertical to 2 horizontal, Wind load on roof surface normal to roof = 1100 N/m², Vertical load from roof sheet = 150 N/m². Sketch the details of the roof.	**L3**
8	4	Describe design of joints and end bearings in trusses.	**L5**
9	4	Describe design of joints and end bearings in trusses.	**L4**
10	4	Design a double angle discontinuous strut to carry a factored load of 135 kN. The length of strut is 3 m between intersections. The two angles are placed back to back (with long legs are connected) and are tack bolted. Use steel grade Fe410. a) Angles are placed on opposite side of 12 mm gusset plate. b) Angles are placed on same side of 12 mm gusset plate.	**L3**

Prepared by Mrs. K.Sumalatha assistant professor, CE department

Year / Semester: III B.Tech VI Semester   **Regulation: R23**

Subject and Code: DESIGN OF STEEL STRUCTURES & 23CIV361T

| 11 | 4 | Design I section purlin for a trussed roof for the following data : Span of roof = 10 m, Spacing of pulins along slope or truss = 2.5 m, Spacing of truss = 4 m, Slope of roof truss = 1 vertical to 2 horizontal, Wind load on roof surface normal to roof = 1100 N/m², Vertical load from roof sheet = 150 N/m². Sketch the details of the roof. | L3 |

S.No.	CO	Questions	BT
		Unit V: (PLASTIC ANALYSIS AND DESIGN)	
1	5	**a.** Introduction to Plastic Analysis **b. Theory of Plastic Analysis**	L4
2	5	Derive the shape factor for Triangular section	L3
3	5	(a) Define plastic moment. (b) Calculate the plastic moment capacity required for the continuous beam with working loads shown in figure 	L4
4	5	Derive the moment curvature relationship in plastic analysis.	L3
5	5	(b) Calculate the plastic moment capacity required for the continuous beam with working loads shown in figure. 	L5
6	5	Derive the shape factor for circular section	L4
7	5	a) Define plastic hinge and plastic moment capacity. b) Define the collapse load and load factor	L3
8	5	Find the fully plastic moment required for the frame shown in figure, if all the members have same value of MP.	L5

9	**5**	Determine the shape factor for the rectangular?	**L4**
10	**5**	A T-section consists of a flange 150x10mm and a web of 150x10mm. The section modulus of the T-section is 54600mm3. This section is used as a fixed beam of 7m span and carries a UDL of 180kN/m on the whole span. Determine the shape factor of the beam and also calculate the collapse load for the beam. Assume yield stress as 300 MPa	**L3**
11	**5**	A T-section consists of a flange 150x10mm and a web of 140x10mm. The section modulus of the T-section is 54600mm3. This section is used as a fixed beam of 7m span and carries a UDL of 180kN/m on the whole span. Determine the shape factor of the beam and also calculate the collapse load for the beam. Assume yield stress as 255 MPa	**L3**

Note: L1-Remembering, L2-Understanding, L3-Applying, L4-Analyzing, L5-Evaluating, and L6-Creating

Instruction to Faculty Members:

The Six Levels of Bloom's Taxonomy:

1. **Remembering:** Retrieving, recognizing, and recalling relevant knowledge from long-term memory (e.g., list, define, name, locate).

2. **Understanding:** Constructing meaning, explaining ideas, or concepts (e.g., summarize, interpret, classify, compare).

3. **Applying:** Using information in new situations or implementing procedures to solve problems (e.g., solve, use, demonstrate, implement).

4. **Analyzing:** Breaking material into constituent parts, determining how the parts relate to one another and to an overall structure (e.g., contrast, categorize, distinguish, diagram).

5. **Evaluating:** Making judgments based on criteria and standards through checking and critiquing (e.g., judge, critique, justify, defend, argue).

6. **Creating:** Putting elements together to form a coherent or functional whole; reorganizing elements into a new pattern or structure (e.g., design, construct, develop, formulate).