

Design of Steel Structures

01CI0716

Objective of the Course:

- Develop the capability to analyze and design connections by Indian Standard code provisions, ensuring structural integrity and safety in various construction projects.
- Acquire the skills necessary to design the components of industrial structures following Indian Standard code provisions, considering factors such as loading conditions, material properties, and structural stability.
- Gain proficiency in the design of diverse steel structures, including plate girders and foot-over bridges, adhering to Indian Standard code provisions.
- Apply the principles of plastic design effectively in the analysis and design of steel beams and portal frames, integrating considerations such as load redistribution and ductility enhancement for robust structural performance.

Credit Earned: 03

Prerequisite: Structural Analysis, Elementary Design of Structures.

Student's learning outcomes:

After successful completion of the course, it is expected that students will be able to,

1. Prepare the structural layout of various types of steel structures.
2. Apply the principles of plastic design for steel structural members.
3. Evaluate the stability and structural integrity of steel structures considering factors such as loading conditions and material properties.
4. Design the components of industrial structures according to Indian Standard codes.

Teaching and Examination Scheme

Teaching Scheme (Hours)			Credits	Theory Marks			Tutorial/ Practical Marks		Total Marks
Theory	Tutorial	Practical		ESE (E)	IA (M)	CSE (I)	Viva (V)	Term Work (TW)	
03	00	00	03	50	30	20	25	25	150

Detailed Syllabus

Sr. No	Topic name	Hours
1	Connections	08
	1.1 Design and Detailing of Various Connection, Simple Connection, Lap and Butt Joints, Truss Joint Connection, Clip and Seat angle connections, Web angle connections, Unstiffened and Stiffened Connections.	05
	1.2 Beam to Beam Connection, Beam to Column Connection, Semi Rigid Connection, Simple Welded Joints, Shear and Moment Resisting Connections.	03
2	Design of Industrial Building	12
	2.1 Structural layout of an industrial building, Various types of trusses, roofing, and their selection, assessment of loads, the effect of wind and earthquake loads, analysis and design of Roof Trusses.	04
	2.2 Components: Roofing system, Trusses, Purlins, Girts, column, lateral load resisting system, Bracing Systems, gantry girder, footing	04
	2.3 Gantry girder: Loading Characteristics, static and moving loads, selection of gantry girder, design of gantry girder.	04
3	Plate Girder	08
	3.1 Modes of failure: Elastic buckling, bending in the plane of the web, Local buckling, buckling in the plane of the web, Vertical buckling of the compression flange, Shear buckling	04
	3.2 Design of bolted, welded plate girder by Tension field Method & Simple Post Critical Method including design of vertical & horizontal stiffeners, Splices, Curtailment, and Design of various elements of plate girder.	04
4	Design of Foot-Over Bridges	06
	4.1 Structural system of through & deck type bridges, design of foot-over bridge & its Supporting system.	06
5	Plastic Design	08
	5.1 Introduction, Plastic theory, Plastic hinge concept, Plastic collapse load, conditions of plastic analysis, Theorem of Plastic collapse.	02
	5.2 Methods of Plastic analysis, Plastic Analysis of Beams and Frames, Plastic Design of beam.	06
	TOTAL	42

Suggested Theory Distribution

The suggested theory distribution as per Bloom's taxonomy is as per follows. This distribution serves as guidelines for teachers and students to achieve an effective teaching-learning process

Distribution of Theory for course delivery and evaluation					
Remember	Understand	Apply	Analyze	Evaluate	Create
5%	10%	25%	30%	20%	10%

Instructional Method and Pedagogy:

- 1 At the start of the course, the course delivery pattern and prerequisite of the subject will be discussed.
- 2 Lectures will be taken in the classroom with the use of multi-media presentations, whiteboard– a mix of both.
- 3 Attendance is compulsory in lectures which carries a 5% component of the overall evaluation.
- 4 About 10 to 15% of the topics/ sub-topics, which are relatively simple, are to be given to the students for self-learning and collaborative learning methods. The assessment of Cos for the particular topics will be through classroom presentations.
- 5 Guide Students to undertake a micro-project/ physical model of the various elements.
- 6 Minimum two internal exams will be conducted and an average of two will be considered as a part of continuous evaluation
- 7 Assignments based on course content will be given to the students at the end of each unit/topic and will be evaluated at regular intervals. It carries a weightage of 5%.
- 8 Surprise tests/Quizzes will be conducted, which carry a 5% component of the overall evaluation.

Recommended Study Material

1. N. Subramanian, Design of Steel Structures: Theory and Practice, Oxford University.
2. V. L. Shah and Veena Gore, Limit State Design of Steel Structures IS: 800-2007, Structures.
3. S. S. Bhavikatti, Design of Steel Structures by Limit State Methods as Per IS 800-2007, I & K. International.
4. M. R. Shiyekar, Limit State Design in Structural Steel, PHI Learning.
5. S. K. Duggal, Limit State Design of Steel Structures, Tata McGraw Hill.
6. M. L. Gambhir, Fundamentals of Structural Steel Design, McGraw Hill Education.
7. IS Codes: IS: 800, IS: 801, IS: 811 IS: 875, SP: 6 and Steel Table.
8. Ramchandra, Design of Steel Structures - Vol. II, Standard Book House, Delhi.
9. Arya A. S., Ajmani J. L., Nemchand and Bros., Design of Steel Structures, Roorkee.
10. Neal B. G., Plastic Methods of Structural Analysis, Chapman and Hall London.

Web Links

1. <https://nptel.ac.in/courses/105105162>
2. https://onlinecourses.nptel.ac.in/noc23_ce76/preview
3. <https://archive.nptel.ac.in/courses/105/106/105106113/>