DESIGN OF STEEL STRUCTURES
ENCE 303

Year/Part: III/I

Teaching Schedule				Examination Scheme						Total
				Theory			Practical			
L	T	P	Total	Assessment Marks	Final		Assessment Marks	Final		
					Duration (Hrs)	Marks		Duration (Hrs)	Marks	
3	1	0	4	40	3	60	0	0	0	100

Depth Codes

E-Explanation	M-Modal	D-Definition	DM-Demonstration
DV-Derivation	DW-Drawing	P-Proof	I-Illustration
NUM-Numerical	MT-Mid Term Test	S-State	ACT-Activity-based Learning
MP- Mini Project	EXP-Experiment	REV-Review / Recap	PS- Problem Solving
QA- Question Answer	Q- Quiz	ST- Surprise Test	

Unit	Topic/ Sub topic	Depth Code	Description of Depth	Actual plan			Week
				L	T	P	
1	**Introduction**			**4**			**1**
	1.1. Steel Structure: Scope; advantages and disadvantages; types of steel structures	D, E, I	Definition of Steel Structure, comparison with RCC and other structures with examples of steel structure like Buildings, towers, stadiums, etc	0.5			
	1.2. Structural Steel and Classification of Steel Structures	D, E	Types and grades of Structural Steel (Table-1 of IS-800), explain the stress-strain relation of steel, properties and classification of structural steel sections	1			
	1.3. Design Process and Basis for design	E	Steps in steel structure design, Considerations, analysis and design of steel structure, concept of FEM	0.5			
	1.4 Method of Analysis and Design	D, E	Explain the types of Design philosophy	1.5			
	1.4.1 Working stress method	D, E	Explain the WSM, its assumptions and application (IS-800 codal provisions), Limitations				
	1.4.2 Limit state design method: Different limit states for steel design; Design strength of materials and design loads.	D, E	Explain LSM, its assumptions, types of Limit states and their differences. Describe the design strength and design load as per IS-800, Classification of Section as per local buckling.				
	1.4.3 Ultimate Load Method	E	Explain the Method				
	1.5 Prevailing codes and standards	E	Different codes used in design and introduce NBC for wind and Steel (once officially published)	0.5			
	Evaluation	QA, Q					

Unit	Topic/ Sub topic	Depth Code	Description of Depth	Actual plan			Week
				L	T	P	
2	**Connections in Steel Structures**			**13**	**4**		**1**
	2.1. Connection in steel structure: Importance and its type.	D, E	Introduction to steel connections, Purpose and classification of connections	0.5			
	2.2. Welded connections: Welds and welding; Design of simple and eccentric welding connections.	D, E, DV, P, NUM, DW	Describe Weld and Welded connection, terms used in weld, advantages and disadvantages of welded connection, Types of weld connection, Fillet weld and Butt weld (groove weld), failure mechanism of welded connections and welded connection under eccentric loading with numerical and real problems	6	2		
	2.3 Bolted connections: Bolts and bolting; Design of simple and eccentric bolting connections.	D, E, DV, P, NUM, DW	Explain bolts and bolted connections, advantages and disadvantages of bolted connection, terms used and specifications in bolted connection, failures in bolted connection, bearing type bolt and HSFG bolts and their design with numerical and bolt under eccentric load and numerical related.	6	2		
	2.4 Riveted connections: Brief introduction		Introduction to Rivet and riveted connections.	0.5			
	Evaluation	QA, Q					

Unit	Topic/ Subtopic	Depth Code	Description of Depth	Actual plan			Week
				L	T	P	
3	**Tension Members**			**4**	**2**		**1**
	3.1. Tension members: Definition and type of tension members.	D, E	Tension members and their types based on section & failure modes, Yielding, rupture and block shear failure	0.5			
	3.2. Section area of tension members.	D, E, NUM	Calculation of Gross and Net area and illustrate with examples	0.5	0.5		
	3.3 Design of tension members of simple and built-up section.	D, E, DV, NUM, DW	Design of simple and built-up Tension members and	2	1		
	3.4 Design of Lug angle and tension splices.	D, E, NUM, DW	Define Lug angle, importance, its type and design specification with an example, explain tension splice	1	0.5		
	Evaluation	QA, Q					

Unit	Topic/ Subtopic	Depth Code	Description of Depth	Actual plan			Week
				L	T	P	
4	**Flexure members**			**10**	**4**		**1**
	4.1. Steel beams and its type.	D, E	Steel beams: types and behavior, local buckling behavior	1			
	4.2. Design of simple beam and built-up beams.	D, E, P, NUM, DW	Design of simple and built-up beam consider low and high shear, laterally unsupported beam, floor beam system	3	3		
	4.3 Design of continuous beams.	E	Concept of Continuous Beam, calculation of B.M and SF (Theory Only)	1			

Unit	Topic/ Subtopic	Depth Code	Description of Depth	Actual plan			Week
				L	T	P	
	4.4 Design of plate girders.	D, E, P, NUM, DW	Define Plate Girder, Types, economical depth and thickness, components	1			
	4.4.1 Necessity and requirements of plate girders.	E	Explain the importance of Plate girder and its requirement as per IS-800.	0.5			
	4.4.2 Design for bending, shear, deflection and lateral stability.	D, E, DW	Explain the basics of design in BM, shear, deflection, web buckling and web crippling	1			
	4.4.3 Curtailment of plates.	D, E, DW	Explain the details of curtailment as per IS-800	0.5			
	4.4.4 Design of web and flanged splices.	D, E, P, NUM, DW	Design basics of Web and flange splices and relevant numerical (Connection Design not required and size of flange and web plate known along with SF and BM)	2	1		
	Evaluation	QA, Q, MP					

Unit	Topic/ Subtopic	Depth Code	Description of Depth	Actual plan			Week
				L	T	P	
5	**Compression members**			**10**	**4**		**1**
	5.1. Types of compression members.	D, E	Definition of Compression Member; Its type	0.5			
	5.2. Buckling behavior of columns.	D, E	Column behavior and buckling, Euler theory, slenderness ratio and effective length	0.5			
	5.3 Design of column of simple and built-up sections.	D, E, P, DW, NUM	Design strength of Struts, design of simple and built-up column	1	0.5		
	5.4 Design of lateral bracing of compression members.	D, E, P, NUM, DW	Explain different types of Bracings, design of single and double lacing system, batten system, tie plates and their connection design	3	1.5		
	5.5 Design of eccentrically loaded columns.	D, E, DW	Concept of eccentrically loaded column and related codal provisions	1			
	5.6 Design of column bases.	D, E, P, NUM, DW	Concept of Column Bases, Its type and design consideration	0.5			
	5.6.1 Axially loaded column bases.	D, E, P, NUM, DW	Design of Axially loaded Slab base, derivation of thickness of slab base	1	0.5		
	5.6.2 Eccentrically loaded column bases.	D, E, P, NUM, DW	Concept and Design of eccentrically loaded column bases, concept and numerical on anchor bolt.	2	1		
	5.7 Design of column splices.	D, E, P, NUM, DW	Concept and Design of column splices (Numerical on same size columns and concept on different size column splices)	0.5	0.5		
	Evaluation	QA, Q, MP					

Unit	Topic/ Subtopic	Depth Code	Description of Depth	Actual plan			Week
				L	T	P	
6	**Design of Roof Trusses**			**4**	**1**		**1**

Unit	Topic/ Subtopic	Depth Code	Description of Depth	Actual plan			Week
				L	T	P	
	6.1. Types and components of roof trusses.	D, E	Types and components of trusses, terms related to roof truss, Concept of Connection between roof truss and masonry wall.	0.5			
	6.2. Loads on roof trusses.	D, E,	Different types of load on roof, DL, LL and WL	0.5			
	6.3 Wind load calculations.	D, E, NUM	Calculation of Wind load as per IS-875 (part-3) and NBC 104.	1	0.5		
	6.4 Design of roof components.	D, E, NUM, DW	Design of I, C and angle section Purlin in pitched roof	2	0.5		
	Evaluation	QA, Q					

References: (Primarily based on the syllabus, and relevant chapters may be consulted as needed)

1. Duggal, S. K. (2010). Limit state design of steel structures. Tata McGraw-Hill Education.
2. Ram, S. (2010). Design of steel structures. Pearson Education India.
3. Ramamrutham, S. (1986). Design of Steel Structures (6th ed.). Dhanpat Rai Pub Company.
4. Subramanian, N. (2011). Steel structures: Design and Practice. Oxford University Press, USA.
5. Bhavikatti, S. (2009). Design of steel structures (By limit State method as per IS: 800 2007). I. K. International Pvt Ltd.
6. Suwal, R. (2015). Design of Steel Structure (By Limit State Method) (Reprint 2017). Mark Line Publication, Kathmandu

Model Question

Subject: - DESIGN OF STEEL STRUCTURES Code: - ENCE 303

QN	Question	Marks	CH
1. a)	An ISLC 300@ 324.7 N/m (Fe 410 grade of steel) is to carry a factored tensile force of 900 kN. The channel section is to be welded at the site to a gusset plate 12 mm thick. Design a fillet weld, if the overlap is limited to 350 mm.	6	2
b)	Design a connection of bracket using M20 bolts of product grade C and property class 4.6, if 12 mm thick bracket is connected by angle 100 100x10 mm. The factored load of 200 kN acted at a eccentricity of 300 mm from the flange of column. Design bolts lying in plane perpendicular to Load. Refer fig 1 .	9	2
2. a)	A column ISHB 350 @ 661.N/m carries an axial compressive factored load of 1000 kN. Design a suitable Column base. The base rests on M20 grade concrete pedestal.	5	4
b)	Design a built-up column 10 m long to carry a factored axial compressive load of 1080 kN. The column is restrained in position but not in direction at both ends. Design the column with connecting system as single lacing with bolted connection. Use two channel back to back Assume steel of grade Fe 410, E250 C and bolts grade 4.6	10	4
3. a)	Write down the steps followed in calculation of wind load as per IS-875 (part-3)	4	6
b)	What are the advantages of Steel Structure	1	1
c)	A simply supported beam of span 6 m supports a reinforced concrete slab. The compressive flange of the beam is restrained due to its connection with the slab. The beam is subjected to a dead load of 35kN/m and imposed load of 30 kN/m. Design the beam. Assume the beam is sufficiently stiff against bearing.	10	5
4. a)	A diagonal member of a roof truss carries a maximum pull of 300 kN, design the section and its connection with 16 mm thick gusset plate. The steel is grade Fe 410 and bolts of grade 4.6 are to be used.	6	3
b)	Explain about load carrying capacity of a single angle in compression. Derive the relation for most economical section of Plate girder	(2+3)	4
c)	How the steel sections are classified according to their moment resistance capacity.	2	1&5
d)	Explain with figures about web-Buckling and web-Crippling	2	5

Note: *Number of questions and distribution of marks are indicative only.*

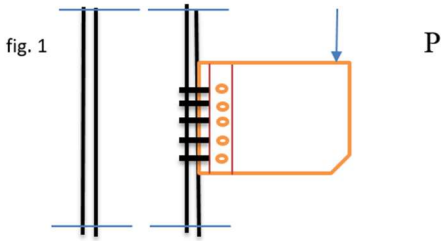

fig. 1