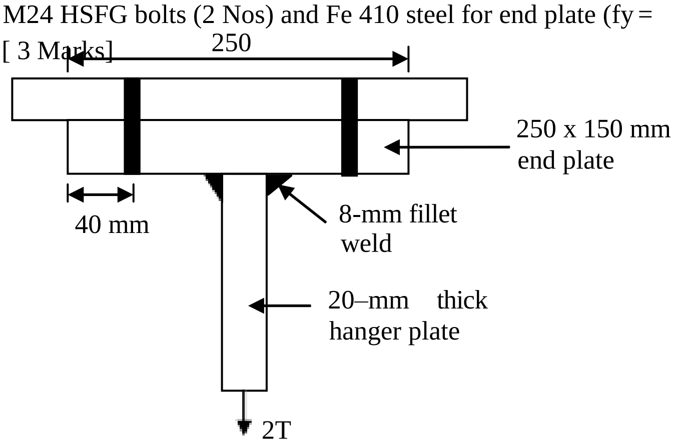
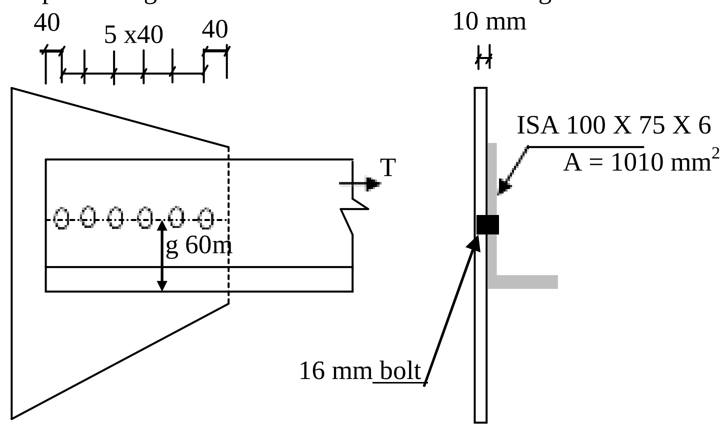
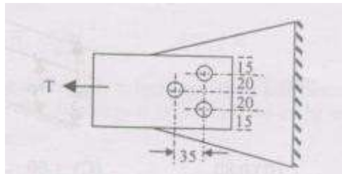
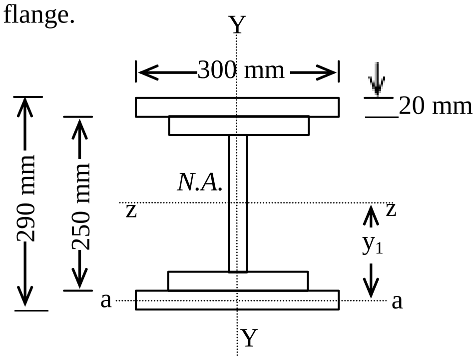
(Long Answer Questions)			
1.	How the local buckling of steel structural shapes does affect the member strength? How is it avoided?	Understand	1
2.	What are the defects that may originate while rolling steel section?	Remember	1
3.	Strength and ductility of steel are equally important for steel structures. How are these improved? If the strength is to be increased while retaining the desired ductility of steel. What is done?	Understand	2
4.	Draw the stress-strain curve of mild steel and explain the salient features. What inferences can be made from stress-strain curve of mild steel?	Apply	2
5.	How ultimate strength, ductility and toughness can be determined from the stress-strain curve of mild steel?	Understand	2
6.	Draw idealised stress-strain curve for mild-steel. Discuss the effect of residual stresses.	Remember	2
7.	What is the importance of local buckling of plate elements of rolled steel sections? How is this accounted for in the design of steel members?	Apply	2
8.	Discuss about the post-buckling strength of plate elements of rolled steel sections? Give an example, if it can be used to make the design economical while retaining the safety.	Apply	2
9.	Write short notes on the following: (a) Lamellar tearing (b) Laminations	Remember	1
10.	Write short notes on the following: (a) Residual Stresses (b) Bauchinger effect	Remember	1
11.	Differentiate between (a) compound section and built-up section (b) ductility and toughness	Understand	1
12.	What are the various design philosophies for designing steel structures?	Remember	1
13.	State the shortcomings of Working stress design philosophy.	Understand	1
(Problem Solving and Critical Thinking Questions)			
1	A specimen was tested in laboratory and the yield strength was found to be 250 N/mm^2. Taking a factor of safety of 2. Find the working stress.	Analyze	1
2	A 100 mm long steel bar and having a square cross section of 20 mm is pulled in tension with a load of 90 kN. It experiences an elongation of 0.10 mm. Assuring that the deformation is entirely elastic, determine the modulus of elasticity of the steel.	Analyze	1

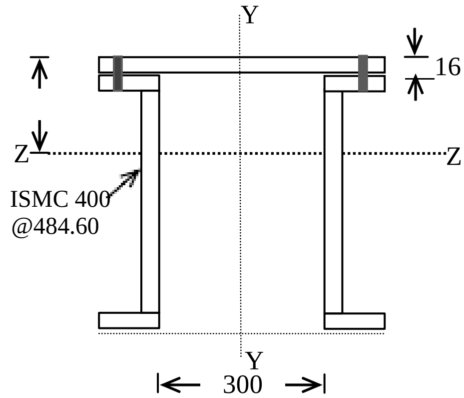
3	For a mild steel specimen, the following data is given. Modulus of elasticity 2×10^5 N/mm^2 stress at which plastic deformation starts is 250 N/mm^2. (a) What is the maximum load that may be applied to a mild steel bar of 20 mm diameter? (b) If the original specimen length is 125 mm, what is the maximum length to which it may be stretched without causing plastic deformation?	Analyze	2
4	A 50 mm x 50 mm tie bar is to carry a load of 80 kN. A specimen of the same quality steel of 250 mm^2 cross-sectional area was tested in a laboratory. The maximum load carried by the specimen was 125 kN. Find the ultimate tensile strength, factor of safety that can be permitted if the yield stress was 280 N/mm^2. Also find the gauge length.	Analyze	2
5	A number of specimens of cross section 100 x 10 mm each were tested in a universal testing machine. Determine the characteristic tensile strength of the steel if the mean tensile strength of the steel and the standard deviation from the test data are 415 N/mm^2 and 2.30 N/mm^2, respectively for 95% reliability.	Analyze	2
6	Hot-rolled steel sections are used to fabricate steel sections. Under no load condition whether the section will have stresses? Comment!	Analyze	2
7	An ISA 65 x 65 x 10 carries a tensile load of 200 kN, applied along its centroidal axis. This angle is to be welded to a gusset plate. Find out the lengths of side fillet welds required at the heel and toe of the angle. [3 marks]	Analyze	3
8	Design a butt joint to connect two plates 175 x 10 mm (Fe 410 grade) using M20 bolts. Arrange the bolts to give maximum efficiency. [3 Marks]	Analyze	3
9	Design a hanger joint as shown in Figure below to carry a facored load of 300 kN. Use an end plate of size 250 mm x 150 mm and appropriate thickness, M24 HSFG bolts (2 Nos) and Fe 410 steel for end plate (fy = 250 Mpa) [3 Marks]  	Analyze	3

<table>
<tr><td>10</td><td>A single unequal angle 100 x 75 x 6 is connected to a 10-mm thick gusset plate at the ends with six 16mm diameter bolts to transfer tension as shown in Figure below. Determine the design tensile strength of the angle assuming that the yield and the ultimate stress of steel used are 250 Mpa and 410 Mpa. If the gusset is coonected to the 100-mm leg.

</td><td>Analyze</td><td>3</td></tr>
<tr><td>11</td><td>Two flats of Fe410 grade steel, each 210 mm x 8 mm, are to be jointed using 20 mm diameter, 4.6 grade bolts, to form a lap joint. The joint has to transfer a factored load of 275 kN. (a) Design the joint and (b) Determine suitable pitch for the bolts.</td><td>Analyze</td><td>3</td></tr>
<tr><td>12</td><td>A 300 ISF 14 mm of grade Fe410 is used as a tension member in a lattice girder. It is connected to a 18 mm thick gusset plate by 18 mm diameter bolts of grade 4.6 Calculate the effective net area of the member, if

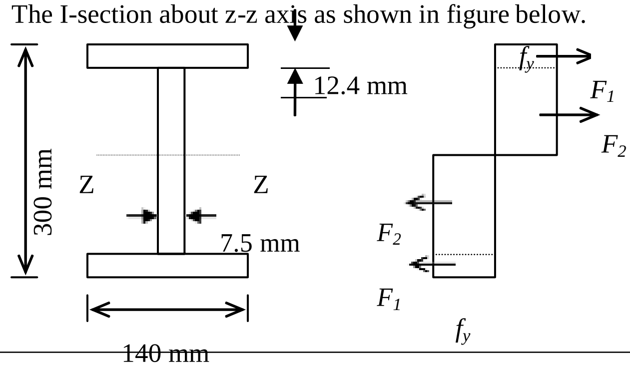
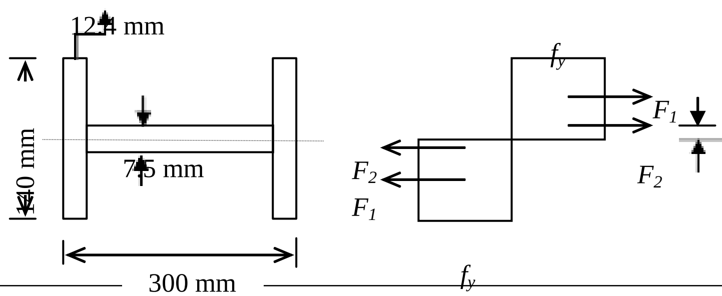
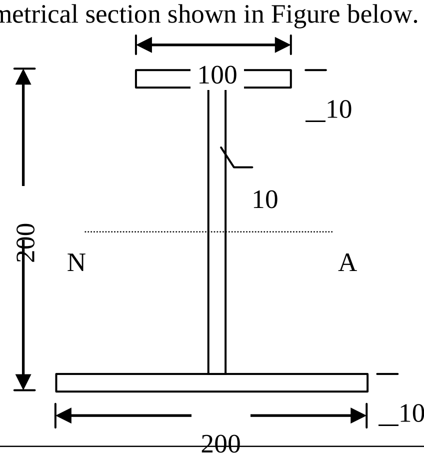
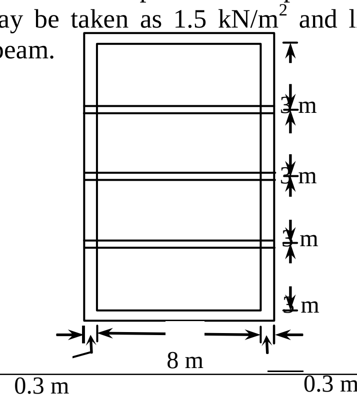
(a) chain bolting is done as shown in Figure 1.
(b) zig-zag bolting is done as shown in Figure 1.</td><td>Analyze</td><td>3</td></tr>
</table>

13	A steel flat of rectangular section of size 70 × 6 mm is connected to a gusset plate by three bolts each having a shear capacity of 15 kN in holes having diameter 11.5 mm. If the allowable tensile stress in the flat is 150 MPa, Find the maximum tension that can be applied to the flat is 	Analyze	3
UNIT - II COMPRESSION MEMBERS			
(Long Answer Questions)			
1.	What is inelastic buckling?	Remember	1
2.	Why a separate provision (formula) for the design of a single angle strut has been proposed by IS: 800 code?	Understand	6
4.	Cite the instances when a column may be regarded as an axially loaded column?	Remember	4
5.	What is the basic difference in behaviour between tension and compression members, while resisting the loads?	Understand	4
4	How can local buckling can be eliminated in the compression member?	Understand	4
5	State the possible failure modes of an axially loaded column.	Remember	4
6	How does the behavior of a compression member differ based on its length?	Understand	4
7	Why is it better to choose plastic or compact sections for columns?	Understand	2
8	Derive the Euler’s formula.	Apply	4
9	What are the basic assumptions that are made while deriving the Euler’s formula?	Remember	4
10	Why is Euler’s formula not adopted for practical designs?	Understand	4
(Problem Solving and Critical Thinking)			

1.	Calculate the value of the least radius of gyration for a compound column consisting of ISHB 250 @ 536.6 N/m with one cover plate 300 mm x 20 mm on each flange.  	Analyze	4
2.	Determine the buckling strength of a W 12 x 50 column. Its length is 20 ft. For major axis buckling, it is pinned at both ends. For minor buckling, is it pinned at one end and fixed at the other end.	Analyze	4
3.	Calculate the design strength of W14 x 74 with length of 20 ft. and pinned ends. A36 steel is used.	Analyze	4
4.	A strut of 3.4 m length in a truss is connected at each of its ends with welding to the gusset plate. The strut is of a section ISA 100 x 100 x 10 mm. Determine its equivalent slenderness ratio.	Analyze	4
5.	Check the buckling of a built-up column as a whole under axial load of 1000 kN for the following data. Section: 2 ISMC 350 face-to face Overall dimension the section: 350 mm (Outer spacing back to back) Service load : 1350 kN Effective length : 6600 mm Grade of steel : Fe 410	Analyze	4
6.	A single angle section ISA 60 x 60 x 8 mm, 3.0 m long, is used as strut. The ends are welded to the gusset plates. Determine the design compressive strength and the service load that can be applied. Assume steel of grade Fe 410 and bolts of grade 4.6 if not specified in the problem. Also assume load factor = 1.5 if not specified. All the dimensions are in mm.	Analyze	4
7.	A strut consists of a double angle sections ISA 70 x 70 x 8 mm and is 3.2 m long. The member is connected to the gusset plate by 3, 20 mm diameter ordinary bolts. Calculate the design compressive strength of the member (a) when the angles are placed on the opposite sides of 12 mm thick gusset plate (b) when the angles are placed on the same side of 12 mm thick gusset plate. Assume steel of grade Fe 410 and bolts of grade 4.6 if not specified in the problem. Also assume load factor = 1.5 if not specified. All the dimensions are in mm.	Analyze	4
8.	A discontinuous strut of 3 m length between the intersections consists of two angles 100 x 75 x 8 mm. The angles are placed back to back on the opposite side of a 10 mm thick gusset plate with long legs connected. Calculate the percentage change in the design compressive strength if the two angles are placed on the same side of the gusset plate with short legs connected. Assume steel of grade Fe 410 and bolts of grade 4.6 if not specified in the problem. Also assume load factor = 1.5 if not specified. All the dimensions are in mm.	Evaluate	4

9.	Calculate the design compressive load which the member shown in Figure below can support, if the member is of 5.5 m effective length. Use of steel grade Fe 410. 	Evaluate	4
10.	Design a column of I-section to support a factored load of 1050 kN. The column has an effective length of 7.0 m with respect to z-axis and 5.0 m with respect to y-axis. Use steel of grade Fe 410.	Apply	4
11.	(a) Design a built up column composed of two channel sections placed back to back, carrying an axial load of 1500 kN. The effective length of column is 7 m (b) Also design a single lacing system.	Apply	4
12.	(a) Design base plate for a column section ISHB 350 carrying an axial load of 1200 kN. and (b) also design welding of base plate to column. Assume Fe 410 grade steel and M25 concrete.	Apply	4
13.	Determine the design axial load on the column section ISMB 400. The height of the column is 6.0 m as shown in Figure 1. It is effectively restrained at mid-height by a bracing member in the y-y direction, but is free to move in the z-z direction and both ends of the columns are pinned. Also assume: f_y = 250 N/mm^2; f_u = 410 N/mm^2; E = 2x10^5 N/mm^2.	Evaluate	4

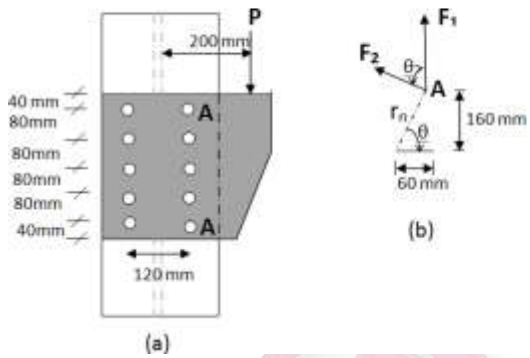
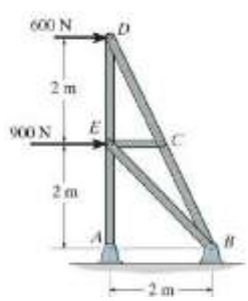
UNIT-III DESIGN OF BEAMS			
(Long Answer Questions)			
1	Application of loads on a beam may be at its top flange or bottom flange or centroid. How does level of application of load affect the beam design?	Understand	4
2	How are the column buckling and the lateral buckling of beam similar?	Understand	4
3	Will a beam buckle when the loading is transverse to its minor axis?	Understand	4
4	How will torsion will be there in beams? What is the difference in St Venant torsion and warping torsion?	Understand	4
5	Mention common situations where shear might become critical?	Remember	4
6	What is meant by web crippling?	Remember	4
7	What are the reasons for specifying deflection limitations?	Analyze	4
8	What is meant by camber and why is it provided?	Remember	4
9	What is meant by shear lag and how it is accounted for in design?	Remember	4
10	Which section performs best in torsion and why?	Understand	4
(Problem Solving and Critical Thinking)			
1	Design by limit state method as per IS: 800 draft code, a hand operated crane, which is provided in a shed, whose details are: Capacity of crane = 50 kN Longitudinal spacing of column = 6m Center to center distance of gantry girder = 12m Wheel spacing = 3m Edge distance = 1m Weight of crane girder = 40 kN Weight of trolley car = 10 kN.	Apply	4
2	Design a beam of 5 m effective span, carrying a uniform load of 20 kN/m if the compression flange is laterally supported (Assume f_y = 250 N/m^2)	Apply	4
3	Design a beam of effective span 6.0 m and subjected to a bending moment of 105.3 x 106 Nmm for the following conditions (i) The compression flange is laterally unsupported throughout, (ii)The beam is encased in concrete Checks for deflection and shear are not required. Assume f_y = 250 MPa.	Apply	4

4	Design the plastic moment capacity and plastic section modulus of (a) The I-section about z-z axis as shown in figure below. 	Evaluate	4
5	Design the plastic moment capacity and plastic section modulus of (a) The I-section about y-y axis as shown in figure below. 	Evaluate	4
6	Determine the plastic moment capacity and plastic modulus of section of the unsymmetrical section shown in Figure below. 	Evaluate	4
7	A roof of a hall measuring 8 m x 12 m consists of 100 mm thick R.C. slab supported on steel I-beams spaced 3 m apart as in Figure below. The finishing load may be taken as 1.5 kN/m^2 and live load as 1.5 kN/m^2. Design the steel beam. 	Evaluate	4

9	Design a simply supported beam of effective span 1.5 m carrying a factored concentrated load of 360 kN at mid span.	Analyze	4
10	Design a simply supported beam of 10 m effective span carrying a total factored load of 60 kN/m. The depth of beam should not exceed 500 mm. The compression flange of the beam is laterally supported by floor construction. Assume stiff end bearing is 75 mm.	Analyze	4
	UNIT-IV **DESIGN OF ECCENTRIC CONNECTIONS**		
(Long Answer Questions)			
1	How are the building connections classified based on their moment-rotation characteristics?	Understand	5
2	Draw the typical sketch to show the following beam column connection: (a) Framed connection	Understand	5
3	Draw the typical sketch to show the following beam column connection: (a) stiffened seated connection (b) unstiffened seated connection	Understand	5

4	Draw the typical sketch to show the following beam column connection: (a) clip-angle connection (b) bracket type moment resistance connection	Understand	5
5	Explain bracing system in roof trusses with neat sketch.	Understand	5
6	Describe connection of purlin to rafter with neat sketch.	Understand	5
7	Explain Anchorages of trusses with concrete column neat sketch.	Apply	5
8	Given: Loads as shown on the truss. Find the forces in each member of the truss.	Understand	5
9	For this truss, determine the number of zero-force members.	Understand	5
10	Determine the basic wind pressure on a pitched roof near Poona. Given: **Structure** : General purpose with probable life of 50 years **Terrain category**: II, Building class A. **Topography** : Height of hill = 350 m **Slope** 1 in 4 **Location of the building**: 300 m from the crest of the hill on downward slope **Eye board height** : 10 m	Understand	5
(Problem Solving and Critical Thinking)			
1	An ISLB 300 carrying UDL of 50 kN/m has effective span of 8 m. This is to be connected to the web of girder ISMB 450. Design the framed connection using 20 mm black bolts.	Apply	5
2.	An ISMB 450 is connected to the flange of a column ISHB 300 @618 N/m. The end reaction transmitted the beam is 120 kN. Design an unstiffened seated connection. Use M20 black bolts.	Apply	5
3.	An ISMB 500 beam transmits an end reaction of 250 kN to the web of a column ISHB300@577 N/m. Design and sketch a stiffened seated connection. Use M24 black bolts.	Apply	5

4.	A beam ISMB 300 transmits an end shear of 120 kN and a moment of 20 kN-m to the flange of a column ISHB 200@ 577 N/m. Using 20 mm dia shop bolts design suitable end connection.	Apply	5
5.	Design a bracket connection to connect a beam ISLB 500 to a column ISHB 400@806 N/m, if vertical shear and moment to be transmitted are 120 kN and 130 kN-m respectively. Use M24 at a pitch of 75 mm. Provide edge distance of 50 mm for all connections.	Evaluate	5

6.	Determine the safe load P that can be carried by the joint shown in Figure below. The bolts used are 20 mm diameter of grade 4.6. The thickness of the Flange of I-section is 9.1 mm and that of bracket plate 10 mm. 	Evaluate	5
7.	Design a bracket connection to transfer an end reaction of 225 kN due to factored loads as in Figure below. The end reaction from the girder acts at an eccentricity of 300 mm from the face of the column flange. Design bolted joint connecting the Tee-flange with the column flange. Steel is of grade Fe 410 and bolts of grade 4.6.	Apply	5
8.	An ISLB 300 @ 369.8 N/m transmits an end reaction of 385 kN, under factored loads, to the web of ISMB 450 @710.2 N/m. Design a bolted framed connection. Steel is of grade Fe410 and bolts are of grade 4.6.	Apply	5
9.	Design a stiffened seat connection for an ISMB 350@ 514 N/m transmitting an end reaction of 320 kN (due to factored loads) to a column section ISHB 300 @ 576.8 N/m. The steel is of grade Fe 410 and bolts of grade 4.6	Apply	5
10.	Given: Loads as shown on the truss. Determine the force in all the truss members (do not forget to mention whether they are in Tension or Compression). 	Evaluate	5

11.	Determine the design loads on the purlins of an industrial building near Vishakapatnam, given: Class of building: General with life of 50 years Terrain: Category 2. Maximum dimension: 40 m Width of building: 15 m Height at eve level: 8m Topography: θ less than 3^o. Permeability: Medium Span of truss: 15m Pitch: 1/5 Sheeting: A.C. sheets Spacing of purlins: 1.35 m Spacing of trusses: 4 m. Design a truss of span 15 m, spacing 4 m to be built near Visakhapatnam	Evaluate	5
12.	Design a channel section purlin for a trussed roof from the following data. Span of roof = 12 m Spacing of purlin along slope = 2 m Spacing of truss = 4 m Slope of roof truss = 1 vertical, 2 horizontal Wind load on roof = 800 N/m^2 Vertical loads from roof sheets = 150 N/m^2	Evaluate	5
13	Design I-section purlin with and without sag bars for a trussed roof from the following data: Span of roof = 10 m Spacing of purlin along slope or truss = 25m Spacing of truss = 4 m Slope of roof truss = 1 vertical, 2 horizontal Wind load on roof = 1100 N/m^2 Vertical loads from roof sheets = 150 N/m^2	Evaluate	5
14	Compute the loads on a steel roof truss to suit the following data, Span of the truss = 12 meters Type of truss = Fan type Roof cover = Galvanised corrugated G.C. sheeting Spacing of roof truss = 4.5 meters Wind pressure = 1.2 kN/m^2	Apply	5
UNIT-V DESIGN OF WELDED PLATE GIRDERS			
1	In what sense the design of plate girders by elastic method and limit state method is different?	Apply	6

2	What is tension field action in plate girders?	Apply	6
3	How does a plate girder derive post- buckling strength?	Apply	6
4	Differentiate between surge load and drag load as applied to gantry girders carrying cranes.	Apply	6
5	Briefly explain the steps involved in the design of plate girders.	Understand	6
6	What are the design concepts of a plate girder?	Understand	6
7	How is the behavior of a plate girder affected by the holes in the web?	Understand	6
8	State the equations for the optimum value of depth and web thickness of a plate girder subjected to moment *M*.	Understand	6
9	What are the main functions of a longitudinal stiffener?	Understand	6
10	Why have bolted and riveted plate girders become obsolete?	Understand	6
(Problem Solving and Critical Thinking)			
1	Design a welded plate girder 24 m in span and laterally restrained throughout. It has to support a uniform load of 100 kN/m throughout the span exclusive of self-weight. Design the girder without intermediate transverse stiffners. The steel for the flange and web plates is of grade Fe 410. Yield stress of steel may be assumed to be 250 MPa irrespective of the thickness of plates used. Design the cross section, the end load bearing stiffner and connections.	Evaluate	6
2	Design a gantry girder to be used in an industrial building carrying a manually operated overhead travelling crane, for the following data: Crane capacity 200 kN Self weight of the crane girder excluding trolley 200 kN Self weight of the trolley, electric motor, hook, etc. 40 kN Approximate minimum approach of the crane hook to the gantry girder 1.20 m Wheel base 3.5 m c/c distance between gantry rails 16 m c/c distance between columns (span of gantry girder) 8 m Self weight of rail section 300 N/m Diameter of crane wheels 150 mm Steel is of grade Fe 410. Design also the field welded connection if required. The support bracket connection need not be designed.	Evaluate	6
3	Design a welded plate girder 24 m in effective span and simply supported at ends. It carries an uniformly distributed load of 100 kN/m. draw section at support and front elevation of plate girder.	Apply	6
4	What are stiffeners and why are they used? How many types of stiffeners are being used in the design of plate girder? Give the conditions (as per IS 800) when stiffeners are required.	Apply	6
5	A plate girder is subjected to a maximum factored moment of 4000 kN-m and factored shear force of 600 kN. Design girder without any stiffeners.	Evaluate	6
6	A plate girder with Fe415 plates is having 12 mm x 150 mm web plate and 56mm x 500mm flange plates. Determine the flexural strength, if the compression flange supported laterally.	Evaluate	6
7	Why / where longitudinal stiffeners provided?	Apply	6
8	What are the different modes of failures of a plate girder?	Remember	6
9	State the advantages of plate girders with corrugated webs.	Understand	6
10	Sketch the different types of cross sections used as plate girders.	Remember	6