Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–VII (NEW) EXAMINATION – SUMMER 2024

Subject Code: 3170618 Date:22-05-2024

Subject Name: Design of Steel Structures

Time:02:30 PM TO 05:00 PM Total Marks:70

Instructions:

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Draw appropriate figures, wherever necessary to support design calculations.**
4. **Simple and non-programmable scientific calculators are allowed.**
5. **Use of IS: 800 (2007), SP 6 (1), IS: 1893 - 1 (2016) and IS: 875 (Part 3) are permitted.**
6. **Consider f_y = 250 N/mm^2 and f_u = 410 N/mm^2, E = 2 x 10^5 N/mm^2 if not mentioned.**

Q.1	**(a)**	Explain advantages and disadvantages of steel structures compared to RCC structures.	**03**
	(b)	Enlist various types of loads to be considered in design of steel structure. Briefly explain steps for calculation of wind load on steel structure.	**04**
	(c)	Design a bolted unstiffened seat angle to connect a beam ISMB 250 @ 365.9 N/m, which transmits factored end reaction 80 kN to the flange of column ISHB 250 @ 500.3 N/m, using diameter 16 mm. Take (clearance + tolerance) = 10 mm. Check selected seat angle for moment and shear capacity.	**07**
Q.2	**(a)**	Define (i) Collapse load, (ii) Plastic hinge, (iii) Load factor	**03**
	(b)	Differentiate between flexible and rigid connections with sketch.	**04**
	(c)	A beam ISMB 250 @ 365.9 N/m is connected to the flange of a column ISHB 250 @ 500.3 N/, using two ISA 90 x 60 x 8 mm and 180 mm long on each side of web of beam with fillet shop weld, transmits factored end reaction of 120 kN. Design weld for a double angle framed connection. Longer leg of both angles are connected to the flange of column with fillet filed weld. Take (clearance + tolerance) = 10 mm.	**07**
		OR	
	(c)	Design suitable section for welded plate girder of span 24 m and without intermediate stiffeners, carrying U.D.L. of 30 kN/m (including self weight), over the entire span and two point loads 100 kN at 6 m from each support. Check for (i) Moment capacity of girder and (ii) Shear capacity of web plate. Design of connections and stiffeners need not required.	**07**
Q.3	**(a)**	Explain various types of stiffeners used in plate girder with their purpose.	**03**
	(b)	Describe various criteria recommended by IS: 800 – 2007 for minimum web thickness requirements of plate girder based on serviceability.	**04**
	(c)	A welded plate girder consisting web plate of size 1500 mm deep x 8 mm thick, is provided with intermediate transverse stiffeners at spacing of 2000 mm on both side of web plate. Considering shear force in web plate is 900 kN and assuming size of steel flat stiffeners 120 mm wide and 10 mm thick, check for buckling of typical stiffener using simple post critical method. Stiffeners are not subjected to any external load. Take poisson's ratio μ = 0.3	**07**
		OR	
Q.3	**(a)**	Enlist common type of trusses with sketch, used as a truss girder in foot over bridge.	**03**
	(b)	Explain simple post critical method to evaluate shear strength of web of plate girder as per IS 800 – 2007.	**04**

(c) Design a cross beam of a steel foot over bridge for the following data and check for the moment and shear capacity of cross girder: **07**
(i) Type of truss: N-type as shown in fig. 1, (ii) Span: 18 m with 6 equal panels (iii) Width of walk way: 3 m (iv) Truss height = 3 m (v) Flooring: RCC slab 110 mm thick (vi) Live Load: 4.0 kN/m^2 (vii) Floor Finish: 0.8 kN/m^2 (viii) Self weight of cross beam = 0.5 kN/m.

Q.4 **(a)** Enlist various forces to be considered in design of foot over bridge. **03**

(b) Describe tension field method used for computing shear buckling strength of web plate. **04**

(c) Design most heavily loaded top chord member of a through type steel foot over bridge truss for the same data given in Q.3 (c) OR above and fig. 1. Take self weight of truss = 0.75 kN/m. **07**

OR

Q.4 **(a)** Write advantages and disadvantages of plate girder compared to truss girder. **03**

(b) Sketch typical cross section of a bolted plate girder indicating various components. **04**

(c) Determine plastic moment capacity for a portal frame loaded as shown in fig. 2. **07**

Q.5 **(a)** Enlist various components of foot over bridge. **03**

(b) Determine collapse load for simply supported beam carrying concentrated load Wc at mid span in terms of plastic moment Mp and span L. **04**

(c) Determine the plastic moment capacity about horizontal centroidal axis of ISMB 250 provided with 125 mm x 20 mm plates each at top and bottom of flange. **07**

OR

Q.5 A laterally unsupported gantry girder of span 8 m, supports an EOT crane of capacity 100 kN. The span of the crane girder between the rails is 16 m. Weight of crane girder excluding crab is 180 kN, weight of crab is 30 kN and self weight of gantry girder including rail section is 1.4 kN/m. Take maximum hook approach = 1.2 m and wheel base = 2.4 m.

(a) Determine maximum bending moment and maximum shear force in gantry girder for the respective maximum design load positions. Also draw BM diagram at design load position for maximum bending moment. **07**

(b) For the above data select appropriate section, built up from I - section and channel section. Check the built up section for moment capacity and shear capacity. **07**

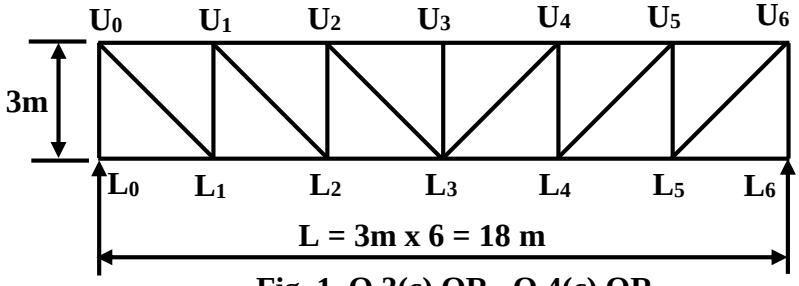

Fig. 1, Q.3(c) OR , Q.4(c) OR

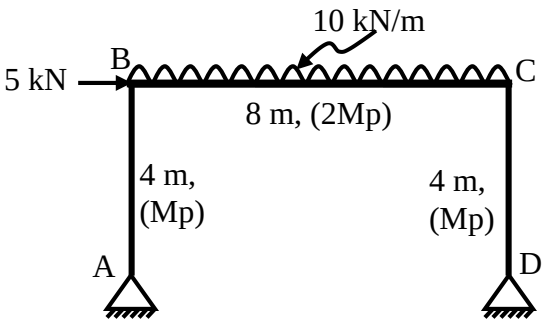

Fig. 2, Q.4(c) OR

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