Enrollment No./Seat No.:

GUJARAT TECHNOLOGICAL UNIVERSITY

Bachelor of Engineering - SEMESTER - V EXAMINATION - SUMMER 2025

Subject Code: 3150612 **Date: 17-05-2025**

Subject Name: Design of Structures

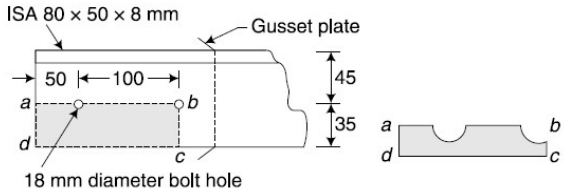
Time:02:30 PM TO 05:00 PM **Total Marks: 70**

Instructions

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**
4. **Simple and non-programmable scientific calculators are allowed.**
5. **Use of IS : 456-2000, IS : 800-2007, IS 875 and Steel Table or SP-6 (1) is permitted**

			Marks
Q.1	**(a)**	Compare the limit state method for deign of reinforced concrete and steel structures with respect to serviceability criteria.	**03**
	(b)	Define (1) Design Shear (2) Characteristic strength (3) Two-way Shear (4) Effective cover	**04**
	(c)	Two plates of thickness 10 mm and 12 mm are connected using HSFG 8.8 grade bolts of 22 mm diameter. Calculate the proof load. Calculate the design shear force for the bolt if slip resistance is designed at ultimate load and assume fasteners in clearance holes. (Take coefficient of friction = 0.5, number of effective interfaces offering frictional resistance to slip = 1)	**07**
Q.2	**(a)**	What does 6 and 8 imply for bolts of grade 6.8?	**03**
	(b)	Explain the different types of failures observed in bolted connection with neat sketches.	**04**
	(c)	Calculate the design shear strength of ordinary bolt of nominal diameter 20 mm and grade 4.6 under double shearing condition; one shearing plane intercepts at shank portion and another at threaded portion. The sizes of two connecting plates are 12 mm and 14 mm.	**07**
		OR	
	(c)	The singly reinforced concrete beam section of width 300 mm and effective depth 450 mm, is made of M25 grade concrete and Fe 500 grade reinforcing steel. The total cross-sectional area of the tension steel is 942 mm^2. As per Limit State Design of IS 456, Calculate the design moment capacity of the beam section?	**07**
Q.3	**(a)**	Differentiate the lap and butt joint with neat sketches.	**03**
	(b)	Draw neat sketch of Slab based foundation.	**04**

(c) Determine the block shear strength of the tension member shown in Fig. 1. The steel is of grade Fe 410. **07**



OR

(a) Define (i) Gauge (ii) Pitch (iii) slenderness ratio **03**

(b) Explain the stress-strain curve of concrete and steel with stress block parameters with neat sketch adopted by Bureau of Indian Standards for Concrete and Steel Structures. **04**

(c) Design an interior slab panel of effective dimensions 4.2 m × 6.25 m subjected to a factored load of 15 kN/m^2 inclusive of self-weight and floor finish load. The slab is provided with main reinforcement bar diameter as 10 mm, and has overall thickness of 150mm. Clear cover is 20 mm, grade of concrete is M20, grade of steel Fe415. **07**

Q.4 **(a)** State advantages and disadvantages of welded connections. **03**

(b) Determine the development for 16 mm diameter bar, Fe 415 grade steel in compression and M 25 grade of concrete. **04**

(c) The rectangular beam of width, 300 mm is having overall depth of 600 mm. The concrete grade is M20 and the grade of reinforcing steel is Fe415. The tensile reinforcement is provided by 5-20 mm dia. bars. The clear cover is 25 mm. The design shear force is 500 kN. For M20 grade of concrete, the maximum shear stress permitted is 2.80 MPa. Find the effective depth and check whether it is sufficient or not. **07**

OR

(a) Why are the end returns provided in fillet welds? **03**

(b) A perfectly axially loaded concrete column of gross dimension 400 mm × 400 mm is reinforced with 4 bars of 20 mm diameter. Determine the design axial load carrying capacity of the column. Consider M25 grade concrete and Fe 415 grade steel. **04**

(c) The rectangular beam of width, 300 mm is having overall depth of 400 mm. The concrete grade is M20 and the grade of reinforcing steel is Fe 415. The tensile reinforcement is provided by 4-20 mm bars. In the compression side, the reinforcement is provided by 2-16 mm bars. The clear cover is 25 mm. The salient points of design stress-strain curve of Fe 415 is given by (strain, stress, N/mm^2) (0.00144, 288), (0.00163, 306), (0.00192, 324), (0.00241, 342), (0.00276, 351), (0.00380, 360).
Evaluate the (i) additional moment that the section can take. (ii) The stress in steel at compression level (iii) The moment of resistance of the whole section, and
(iv) Check the nature of the section (Under reinforced/Over reinforced) **07**

Q.5 **(a)** Explain the necessity of four different buckling curves prescribed to evaluate column strength? **03**

(b) Enlist the various failure modes of axially loaded tensile member along with sketch (line diagram only). **04**

(c) Design a laterally supported beam of effective span 5 m for the following data. Grade of Steel: Fe 410; Factored Maximum Bending Moment 180 kN-m and maximum Shear Force 220 kN. Only provide safety check for buckling. **07**

OR

(a) If a short column having overall dimension of 300 mm X 500 mm and 16 mm diameter of longitudinal bars, Estimate the maximum spacing between two lateral ties. **03**

(b) The main reinforcement of RC slab consists of 10 mm bars at 10 cm spacing. If it is desired to replace 10 mm bars by 12 mm bars, then estimate the revised spacing of 12 mm bars. **04**

(c) For a factored load of 15 KN/m^2, inclusive of self-weight, on an interior panel of 4.2 m × 6.25 m (effective dimensions). **07**

Consider the following statements-

(1) The negative moment at the continuous edge for longer span, rounded to two decimal places will be 18.75 KN-m; (2) The positive moment at the mid-span for longer span, rounded to two decimal places will be 14.06 KN-m; (3) The negative moment at the continuous edge for shorter span, rounded to two decimal places will be 13.97 KN-m; (4) The positive moment at the mid-span for shorter span, rounded to two decimal places will be 10.78 KN-m

Which of the above statements are incorrect? Justify your answers with proper calculations.

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