Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–V (NEW) EXAMINATION – WINTER 2022

Subject Code:3150612 Date:11-01-2023

Subject Name:Design of Structures

Time:10:30 AM TO 01:00 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 and Steel Table is permitted**

			Marks
Q.1	**(a)**	Define (1) Partial safety factor (2) Characteristic strength (3) limit state	**03**
	(b)	Derive the limiting values of $X_{u,lim}/d$ for Fe 250 and Fe 415 grade of steel	**04**
	(c)	A singly reinforced beam 230 mm width and 450 mm effective depth reinforced with 4 bars of 20 mm diameter on tension side. Materials used are M20 grade concrete and Fe415 steel. State the type of section and calculate moment of resistance of the section.	**07**
Q.2	**(a)**	Define Under-reinforced section, Balanced section and Over-reinforced section	**03**
	(b)	Calculate the area of tension reinforcement needed with regard to the limit state method for a rectangular RC beam of width, 230 mm and effective depth of 350 mm. The concrete grade is M20 and the grade of reinforcing steel is Fe415. Consider the section to be a balanced section.	**04**
	(c)	Calculate the area of reinforcement in tension and compression zone of rectangular R.C. beam of limited size 250 mm wide and effective depth of 400 mm. The effective cover for compression and tension reinforcement is 40 mm. The beam has to resist factored bending moment 180 kN-m. Use M20 grade of concrete and Fe: 415 grade of steel	**07**
		OR	
	(c)	A simply supported beam 230 mm x 450 mm effective depth is reinforced with 4 no. 20 mm diameter bars of Fe 415 as tension reinforcement. Design the shear reinforcement for a factored shear force of 250 kN. Use M20 concrete and Fe 415 steel.	**07**
Q.3	**(a)**	Differentiate between one-way slab and two-way slab	**03**
	(b)	Find the maximum design moments per unit width for a two-way slab of size 6 m × 4 m without torsion reinforcement. The slab carries a total factored load of 10 kN/m^2 (inclusive of all). Take concrete of grade M 20 and Fe 415 steel.	**04**
	(c)	Design a short R.C. square column for an axial compressive factored load of 1750 kN. Consider percentage of longitudinal reinforcement in the range of 1% to 2%. Also, design lateral ties. Use M20 grade of concrete and Fe 415 grade of steel	**07**
		OR	
Q.3	**(a)**	Describe what you understand by class 4.6 and class 8.8 bolts?	**03**
	(b)	Calculate the development length of 10 mm diameter HYSD bars of grade Fe 415 in tension and compression in concrete of grade M20	**04**

	(c)	Design a simply supported one-way slab for an effective span of 4.0 m to carry total factored load of 10 kN/m^2. Use M20 grade of concrete and Fe 415 grade of steel	**07**
Q.4	**(a)**	State advantages and disadvantages of Steel structures over reinforced structures	**03**
	(b)	Define (i) Gauge (ii) Pitch (iii) slenderness ratio (iv) Beam-column	**04**
	(c)	Select a suitable angle section to resist a factored tensile force of 200 kN assuming single row of 16 mm bolts. Take yield stress fy= 250 N/mm^2 and ultimate stress of 410 N/mm^2.	**07**
		OR	
Q.4	**(a)**	State advantages and disadvantages of welded connections	**03**
	(b)	A tie member of a roof truss consists of single ISA 100×75×8 of Fe410 grade, is welded to a 10 mm thick gusset plate. Design the welded connection to transmit a tensile load of 300 kN. Assume connection are made in the workshop	**04**
	(c)	Determine the design axial load on the column section ISMB 300 having height 3.2 m, hinged at both ends. Take yield stress fy= 250 N/mm^2 and ultimate stress of 410 N/mm^2.	**07**
Q.5	**(a)**	Enlist the various failure modes of axially loaded tensile member along with sketch (line diagram only).	**03**
	(b)	Write the design steps for single lacing system for column	**04**
	(c)	Design a double angle discontinuous strut to carry a factored load of 200 kN. The length of the strut is 3.0 m between intersections. The two angles are connected back to back on the opposite sides of gusset plate and tack bolted. Take yield stress fy= 250 N/mm^2 and ultimate stress of 410 N/mm^2.	**07**
		OR	
Q.5	**(a)**	Draw neat sketch of gusseted based foundation	**03**
	(b)	Two plates of 12 mm and 20 mm thickness have width of 120 mm. These plates are connected by lap joint to resist design tensile load of 75 kN. Find bolt value if 16 mm bolts of grade 4.6 is used for connection.	**04**
	(c)	Design a laterally supported beam of effective span 4 m for the following data. Grade of steel: Fe 410 Factored maximum B.M. = 175 kN-m Factored maximum S. F. = 220 kN Check for deflection is not required	**07**

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