Seat No.: _____   Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY
BE - SEMESTER– VI EXAMINATION – SUMMER 2020

Subject Code: 2160607   **Date:02/11/2020**

Subject Name: ELEMENTARY STRUCTURAL DESIGN

Time: 10:30 AM TO 01:30 PM   **Total Marks: 70**

Instructions:
1. Attempt all questions.
2. Make suitable assumptions wherever necessary.
3. Figures to the right indicate full marks.
4. Use of IS:456, IS:800 and steel table is permitted.
5. Assume M20 grade concrete and Fe415 steel for RCC element and f_y of 250 MPa and f_u of 410 MPa for the structural steel if not given.

Q.1	**(a)**	Sketch reinforcement detail for a simply supported two-way square slab showing all required details including torsion reinforcement.	**03**
	(b)	Sketch the typical lap joint and bolted connection using lug angle.	**04**
	(c)	A simply supported rectangular beam of size 250 mm wide and 450 mm effective depth is subjected to a factored load of 150 kN/m. Span of beam is 4 m. Find the reinforcement for flexure. Effective cover for compression reinforcement is 50 mm.	**07**
Q.2	**(a)**	Define (i) Limit State (ii) Characteristic strength (iii) Partial Safety Factor	**03**
	(b)	A singly reinforced rectangular beam of width 230 mm and 450 mm effective depth is reinforced with 3 no. 20 mm diameter bars. Find out the factored moment of resistance of the section. Take grade of concrete M20 and grade of steel Fe 415.	**04**
	(c)	A tee-beam with 1500mm wide flange and 100 mm deep slab. The overall depth of beam is 650 mm and width of web is 300 mm. A beam is reinforced with 6 nos. of 28 mm dia. bar and 2 nos. of 22 mm dia. bar. Find the factored moment of T-Beam. Take grade of concrete M20 and grade of steel Fe 415. Assume effective cover is 50 mm.	**07**

OR

	(c)	Design a square footing for isolated column 500 mm x 500 mm size carrying an axial load of 1600 kn. Safe bearing capacity of soil is 200 kN/m². Use M-20 grade of concrete and Fe – 415 grade of steel. Draw neat sketch.	**07**
Q.3	**(a)**	Write advantages and disadvantages of Steel and R.C.C. Structures.	**03**
	(b)	Calculate mid span moments of simply supported two way slab with effective span 3.11 m and 4.11 m in x and y direction respectively. Slab is subjected to total factored load (Including self weight) of 10.76 kN/ m². Take grade of concrete M20 and grade of steel Fe 415.	**04**
	(c)	Design a simply supported one-way slab for clear room dimension 3 m x 10 m. Slab is supported on masonry walls of 300 mm thickness. Live load acting on slab is 3.0 kN/m² and floor finish is equal to 0.75 kN/m². Use M-20 grade of concrete and Fe – 415 grade of steel.	**07**

OR

Q.3	**(a)**	Draw and details of edge strip and middle strip of two way slab aper IS 456: 2000.	**03**
	(b)	Calculate size and longitudinal reinforcement of RCC square column section to carry ultimate axial load 2000 kN. Assume 2% of cross section as longitudinal reinforcement.	**04**

(c) Design and detail shear reinforcement for RC beam subjected to ultimate shear force of 120 kN. Cross section of beam is 250 x 400 mm effective and reinforced with 4 nos. of 16 mm diameter bars. Use M-20 grade of concrete and Fe – 415 grade of steel. **07**

Q.4 (a) Sketch the details of slab base footing. **03**

(b) Design suitable fillet weld to connect a tie plate 60 x 8 mm to a 12 mm thick gusset plate. The plate is suitable to load equal to full strength of the member. Assume shop welding and Fe 410. **04**

(c) Design a double angle discontinuous strut to carry a factored load of 200 kN. The length of strut is 3.0 m between intersections. The two angles are connected back to back on same side of gusset plate and tack bolted. Assume grade Fe 410 steel with f_y = 250 MPa. **07**

OR

Q.4 (a) Write down advantages and disadvantages of welding. **03**

(b) Find shear capacity of a bolt for 20 mm diameter 4.6 grade bolt, connecting 410 grade 10 mm thick plate, in single shear and double shear. Consider area of bolt is 245 mm^2. **04**

(c) Design a steel column to carry factored load of 1200 kN. The length of column is 6 m with both end effectively held in passion and restrain against rotation. Select two channels butting and welded toe to toe. Assume f_y = 250 MPa. **07**

Q.5 (a) Explain single lacing system and double lacing system with neat sketches. **03**

(b) Two plates of 12 mm and 20 mm thickness have width of 100 mm. These plates are connected by lap joint to resist design tensile load of 70 kN. Find bolt value if 16 mm bolts of grade 4.6 is used for connection. **04**

(c) Design a tie member of roof truss subjected to working dead load and live load 90 kN and 110 kN respectively. Use double angle section connected back to back on either side of 8 mm thick gusset plate. Use bolted connection. f_y = 250 MPa and f_u = 410 MPa. **07**

OR

Q.5 (a) Explain slenderness ratio, lug angle and shear leg effect. **03**

(b) Explain term (i) Lateral – torsional buckling (ii) Web crippling **04**

(c) Design the slab base foundation for an ISHB 350 column to carry a factored load of 1200 kN. Take Fe 410 grade steel and M25 grade concrete. Assume SBC of soil is   200 kN/m^2. **07**

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