

Enrolment No./Seat No_____

GUJARAT TECHNOLOGICAL UNIVERSITY

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

Subject Code:2160607

Date:24-05-2024

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. Simple and non-programmable scientific calculators are allowed.
5. Use of IS: 456, IS 800 and steel table is permitted.
6. Assume M20 grade concrete and Fe-415 steel for RCC element and f_y of 250 MPa and f_u of 410 MPa for the structural steel if it is not given.

		MARKS
Q.1	(a) Discuss the suitability of steel as reinforcement material.	03
	(b) Described Advantages and Disadvantages of Steel and Reinforced Concrete	04
	(c) A simply supported rectangular beam of size 300 mm wide and 500 mm effective depth is subjected to a factored load of 150 kN/m. The Span of beam is 4.5 m. Find the reinforcement for flexure. Effective cover for compression reinforcement is 50 mm. Take Fe 415, M20 grade of concrete.	07
Q.2	(a) What is the purpose of distributing steel in a slab?	03
	(b) Draw detailed stress and strain diagrams for singly under-reinforced section & Over reinforced section.	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/m ² and floor finish is equal to 0.75 kN/m ² . Use M-20 grade of concrete and Fe – 415 grade of steel.	07
	OR	
	(c) Find area of tensile & compressive steel required for a rectangular beam 250mm x 500 mm for the factored moment of 180 KN.m, the effective cover for tensile and compressive steel are 50 mm & 40 mm respectively.	07
Q.3	(a) Define the classifications of columns based on their design parameters. Discuss the assumptions made during the design of columns. Provide a detailed for short columns under axial load.	03
	(b) A square reinforced concrete column with dimensions 400 mm x 400 mm is subjected to an axial load of 1200 kN. Design a suitable reinforcement for the column assuming M20 grade concrete and Fe 415 grade steel. Consider the appropriate safety factors and detailing requirements.	04
	(c) Design a circular reinforced concrete column with a diameter of 600 mm to carry an axial load of 2000 kN. Use M20 grade concrete and Fe 415 grade steel. Determine the necessary area of longitudinal reinforcement and provide the reinforcement detailing, ensuring compliance with relevant design codes and safety factors.	07

OR

- Q.3** (a) Where do we use combined footing? explain various types of combined footing **03**
- (b) Consider a simply supported two-way reinforced concrete slab with an effective span of 3.5 m in the x-direction and 4.5 m in the y-direction. The slab is subjected to a total factored load, including self-weight, of 12 kN/m². Design the slab using M25 grade concrete and Fe 500 grade steel **04**
- (c) Design a square isolated footing for a 350 mm x 350 mm RCC column subjected to an axial load of 800 kN. The soil has a bearing capacity of 250 kN/m². Utilize M20 concrete mix and mild steel for the design. Provide all necessary check for cracking, one way and two ways shear. **07**
- Q.4** (a) Analyze the behavior of plastic, compact, semi-compact, and slender sections under various loading conditions, **03**
- (b) Compare the advantages and disadvantages of welded connections over bolted connections in structural applications. **04**
- (c) Design a double angle discontinuous strut to carry a factored load of 200 kN. The length of strut is 3.8 m between intersections. The two angles are connected back to back on opposite sides of gusset plate and tack bolted. Assume grade Fe 410 steel with $f_y = 250$ Mpa. **07**

OR

- Q.4** (a) Draw neat sketch of gusseted base foundation **03**
- (b) Find bolt value of 16 mm diameter 4.6 grade bolt, connecting 410 grade 12 mm thick plate, in single shear and double shear. Consider area of bolt = 245 mm². **04**
- (c) Determine bolt value of 20 mm diameter, 8.8 grade HSFG bolts connecting two plates 16 mm thick and 220 mm wide. Grade of plate is 410 Mpa. Also design the lap joint, is subjected to design tension load of 240 kN. **07**
- Q.5** (a) Explain single lacing system and double lacing system with neat sketches **03**
- (b) Explain term (i) Lateral – torsional buckling (ii) Web crippling **04**
- (c) Design a simply supported beam of span 5m carrying working loads of dead load 20KN/m and imposed load 15 KN/m. assume that the compression flange of the beam is laterally restrained throughout **07**

OR

- Q.5** (a) Describe design steps of lacing column. **03**
- (b) Two plates with thicknesses of 15 mm and 20 mm are to be joined by a groove or butt weld. The joint is subjected to a factored tensile force of 400 kN. Assuming an effective length of 200 mm, check the safety of the joint for a single groove weld joint and a double V groove weld joint. Assume Fe410 grade steel plates and the welds are shop welded. **04**
- (c) Design a simply supported beam of span 5m carrying working loads of dead load 20KN/m and imposed load 15 KN/m. assume that the compression flange of the beam is laterally restrained throughout. **07**
