

GUJARAT TECHNOLOGICAL UNIVERSITY**BE - SEMESTER-VI (NEW) EXAMINATION – WINTER 2023****Subject Code:2160607****Date:13-12-2023****Subject Name:Elementary Structural Design****Time:02:30 PM TO 05:30 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 Fe415 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) Explain the concept of "Limit State of Collapse" in structural design.	03
	(b) Define the "partial safety factors" in the context of limit state design. Why are they necessary, and how do they affect the design process?	04
	(c) Consider a singly reinforced concrete beam with a rectangular cross-section. The beam is subject to a bending moment of 60 kNm. Given that the characteristic strength of concrete (f_{ck}) is 25 MPa and the characteristic yield strength of the reinforcing steel (f_y) is 400 MPa, determine the moment of resistance (M_u) of the beam. Use a partial safety factor of 1.5 for both material and loading.	07
Q.2	(a) Define a simply supported beam and provide an example of a situation where a simply supported beam is commonly used.	03
	(b) Explain the concept of a "cantilever beam" and provide an example of a real-world application where a cantilever beam is used.	04
	(c) Design a simply supported reinforced concrete beam for a span of 6 meters, supporting a live load of 12 kN/m. The beam should have a width of 250 mm and a depth of 400 mm. Use a partial safety factor of 1.5 for both materials and loading. Calculate the required area of steel reinforcement.	07
	OR	
	(c) Determine area of tension reinforcement for T-beam to resist factored moment of 350 KN.m. use M-20 & Fe -415 steel. Width of flange =1500mm; Width of web = 350mm; Thickness of flange=120mm; Effective depth=700mm	07
Q.3	(a) Define a one-way simply supported slab and explain when it is preferable to use this type of slab in structural design.	03
	(b) Describe a two-way simply supported slab and provide a practical example where a two-way slab is commonly employed.	04
	(c) Design a continuous reinforced concrete slab for a library with a span of 5 meters in both directions. The live load on the slab is 4 kN/m ² . The thickness of the slab is 150 mm. Use a partial safety factor of 1.5 for both materials and loading. Calculate the required area of steel reinforcement.	07

OR

- Q.3** (a) Where do we use combined footing? explain various types of combined footing **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/m^2 . Take grade of concrete M20 and grade of steel Fe 415. **04**
- (c) Design a square footing of uniform thickness for an axially loaded column of 500 mm x 500 mm size. The safe bearing capacity of soil is 180 kN/m^2 . Load on column is 900 kN. **07**
- Q.4** (a) Write short note on “Lug Angle” **03**
- (b) Describe failure modes of steel beam. **04**
- (c) Select a suitable angle section to carry a factored tensile force of 290 kN assuming a single row of M20 bolts and assuming design strength $f_y = 250 \text{ N/mm}^2$. **07**
- OR**
- Q.4** (a) Write down advantages and disadvantages of welding. **03**
- (b) Find bolt value of 20 mm diameter 4.6 grade bolt, connecting 410 grade 10 mm thick plate, in single shear and double shear. Consider area of bolt = 245 mm^2 . **04**
- (c) Calculate the compressive strength of a single angle strut ISA 100x75x10mm with Centre to center length of 1.5 m. angle is loaded through one leg ends are fixed. Consider 1 bolt at each end. Take $f_y = 250 \text{ MPa}$. **07**
- Q.5** (a) Explain “battening” with neat sketch. **03**
- (b) Explain the classification of sections for compression members in steel structures. Discuss the concept of elastic buckling in slender compression members. **04**
- (c) Design a simply supported beam of span 5m carrying working loads of dead load 20 kN/m and imposed load 15 kN/m . assume that the compression flange of the beam is laterally restrained throughout. **07**
- OR**
- Q.5** (a) Explain the concept of "lateral stability" in the design of steel beams and beam-columns. **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 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**
