

[3hrs]

[80 marks]

- N. B.** (1) Question No. 1 is **compulsory**.
 (2) Solve any **three** questions from remaining questions.
 (3) Assume suitable data wherever required and state them clearly.
 (4) Use of IS 456 not permitted.

1. Attempt any FOUR
 - (a) Compare Ultimate load method and Limit state method. Draw neat stress block diagram for both methods. **5**
 - (b) Why factor of safety is applied to material strength and loads? Draw idealized stress- strain curve for steel and concrete showing the variation after application of factor of safety. **5**
 - (c) Explain the conditions to be satisfied by a beam to design it as a T beam. State the advantages of T beams over the rectangular beams. **5**
 - (d) State the L/D ratios for simply supported, continuous and cantilever case. Why depth of the slab is governed by deflection criteria than the bending moments? **5**
 - (e) What do you understand by $P_u - M_u$ interaction diagram? Explain the procedure to design bi-axial column using interaction diagram. **5**
2. (a) Explain the conditions when the beam shall be designed as a doubly reinforced beam. Draw stress block for doubly reinforced section and derive the formula to find moment of resistance from compressive forces. **4**
- (b) Find MR for a beam 230 x 450 effective, reinforced with 3 bars of 25 mm dia. Also, find a safe load the beam can carry over a span of 5 m. Use M 20 and Fe 415. **6**
- (c) Design shear reinforcement using combination of vertical stirrups and bent-up bars, (bent is at 45 degree) for a beam 230 x 500 effective carrying a factored load of 40 kN/m over a span of 8 m. It is reinforced with 5 bars of 20 mm dia. Use M 20 and Fe 415. **10**

p_t	≤0.15	0.25	0.50	0.75	1.0	1.25	1.50	1.75	2.00
τ_c	0.28	0.36	0.48	0.56	0.62	0.67	0.72	0.75	0.79

- 3 (a) Design reinforcement for a RC beam 230 mm wide to carry a load of 50 kN/m over a simply supported span of 6 m if the effective depth is restricted to 500 mm. Use M 20 and Fe 415. **10**

d' / d	0.05	0.10	0.15	0.20
f_{sc} (N/mm²)	355.1	351.9	342.4	329.2

- (b) A T beam with effective flange width 1200 mm and slab thickness 120 mm is reinforced with 5 bars of 25 mm dia. The width of the beam is 280 mm and effective depth is 550 mm. Calculate MR for the beam if M 20 and Fe 415 is used. **10**

4. (a) Design simply supported slab for a room 4.5 x 4.8 m of a residential building using M 20 and Fe 415. The slab is supported on all sides by a wall of 230 mm thickness. Check the slab for shear using table given in Q.2 c. Sketch the reinforcement details. **14**

L_y/L_x	1.1	1.2	1.3	1.4	1.5	1.75	2.0
α_x	0.074	0.084	0.093	0.099	0.104	0.113	0.118
α_y	0.061	0.059	0.055	0.051	0.046	0.037	0.029

- (b) Design a short column of circular cross section to carry an axial load of 2000 kN. Use M 20 and Fe 415. **6**

- 5 (a) Design isolated rectangular pad footing for a column 230 x 400 mm carrying an axial load of 1000 kN. Take SBC of the soil as 220 kN/sq.m. Use M 20 and Fe 415. Sketch the reinforcement details. **16**

- (b) Explain major and minor axis of the column. Also, explain the reason for providing lateral ties in the column. **4**

- 6 (a) Two columns, A and B, carry the loads of 600 kN and 700 kN respectively, are spaced at 3 m c/c. Design combine footing for the columns if SBC of the soil is 180 kN/sq.m. Use M 20 and Fe 500. **20**
