(CBSGS)

[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. (a) What are partial safety factors for load and material strength? What is their significance in limit state method of design? **5**

   (b) What do you mean by under reinforced, over reinforced and balanced section? **5**

   (c) What are the functions of longitudinal and transverse reinforcement in columns? **5**

   (d) Explain the concept of equivalent flange thickness for analysis and design of T beams **5**

2 (a) A singly reinforced rectangular beam with width 230 mm and effective depth 450 mm is reinforced with 5 bars of 16 mm diameter. Calculate the ultimate moment of resistance of the section using limit state method. Grade of concrete M 20 and steel Fe 500. **6**

   (b) A reinforced concrete beam 230 mm x 600 mm overall depth reinforced with 4 bars of 20 mm diameter is used as a simply supported beam over an effective span of 5 m. Determine the maximum udl the beam can carry safely (including self weight). Adopt M 20 grade of concrete and Fe 415 steel **10**

   (c) Derive values of limiting depth of Neutral axis for grades of steel Fe 415 and Fe 500 **4**

3 (a) A rectangular R.C. beam is 230 mm x 530 mm deep. It is reinforced with 5 bars of 20 mm diameter on tension side and 3 bars of 16 mm diameter on compression side at an effective cover of 50 mm for both the steels. Calculate ultimate moment of resistance of the section if grade of concrete is M20 and grade of steel is Fe 415. **10**

d' / d	**0.05**	**0.1**	**0.15**	**0.2**
f_{sc} (N/mm^2)	**355.1**	**351.9**	**342.4**	**329.2**

Turn Over

(b) A rectangular R.C beam is 300mm x 400 mm deep is subjected to an ultimate torsional moment of 30kNm, ultimate BM of 45kNm and ultimate shear force of 38kN. Adopt grade of concrete M 20 and grade of steel Fe 415. Assume effective cover to tension and compression reinforcement as 40mm.Design the beam. **10**

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

4. (a) Design a slab on a hall of size 3 m x 5 m effective. The slab is simply supported on 230 mm wall on all four sides. Consider LL 4 kN/m^2 and floor finish 1 kN/m^2. Assume M 20 grade of concrete and Fe 415 steel **12**

Ly/Lx	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) Determine the ultimate moment of resistance of a T beam section using Fe 415 grade steel and M20 concrete grade. **8**

Width of flange = 800mm
Depth of slab = 80mm
Width of rib = 300mm
Area of steel = 4- 20 mm ϕ on tension side

5 (a) Draw Whitney's Stress block and hence determine the ultimate moment of resistance of a beam 300 mm wide and 500mm deep considering it as a balanced section. Take σ_{cu} = 20 N/mm^2 and σ_{sy} = 425 N/mm^2. **6**

(b) A R.C. beam 250 mm x 450 mm effective depth is subjected to an ultimate moment of resistance of 225 kN-m. Calculate the steel reinforcement required for the beam. Assume σ_{cu} = 20 N/mm^2 and σ_{sy} = 425 N/mm^2. Use Ultimate Load Method. **10**

(c) State the situations where doubly reinforced beams are necessary? **4**

6 (a) A rectangular column of dimensions 250 mm x 500 mm is subjected to an ultimate axial load of 1200kN. Design an isolated footing for the column assuming safe bearing capacity of soil to be 210 kN/m^2. Adopt grade of concrete M 20 and grade of steel Fe 415. **12**

(b) Design a short square column subjected to a factored load of 2000kN. Adopt grade of concrete M 20 and steel Fe 415. **8**

------X------