 (3 Hours) **[Total Marks : 80**

Instructions: 1. Question No. 1 is **COMPULSORY.** 2. Answer any **THREE** from the remaining. 3. Each full question carries **EQUAL** marks. 4. **ASSUME** any suitable data, if needed.

Q. 1. A) A 250 mm X 250 mm RCC member has to support an axial compressive load of 400 kN. If the stress in concrete is not to exceed 4 MPa, calculate the required steel area. Take m = 13.33. **(04 M)**

B) Differentiate between One-Way & Two-Way Slabs. **(04 M)**

C) State the assumptions for designing the Prestressed Concrete Members. **(04 M)**

D) Design a Singly Reinforced Beam section subjected to maximum BM of 56 kNm. Assume beam width = (2/3) X Effective Depth of the beam. Use M20 concrete & Fe415 steel. **(04 M)**

E) Write a note on the Doubly Reinforced Beam. **(04 M)**

Q. 2. A) A beam is 300 mm wide & 450 mm deep to the centre of tensile steel. It is reinforced with 4 bars of 16 mm diameter as compressive steel & 4 bars of 25 mm diameter as tensile steel. Find the Moment of Resistance of the section. Cover to the centre of compression steel = 50 mm. Use M20 concrete & Fe415 steel. **(10 M)**

B) A Singly Reinforced beam was originally planned to be designed as a balanced section. Later it was decided to increase the Moment of Resistance of the section by doubling the amount of steel, thereby making it Over-Reinforced. By what percentage the Moment of Resistance can be enhanced by doing so? Use M20 concrete & Fe415 steel. **(10 M)**

Q. 3. A) Write a brief note on the loss of Prestress due to the creep of concrete. **(05 M)**

B) What are the IS Recommendations for Development Length? **(05 M)**

C) A RCC beam of span 6.50 m is 300 mm wide & 750 mm deep to the centre of tensile reinforcement, which consists of 6 bars of 20 mm diameter. The beam carries a load of 45 kN/m including the self weight. Design the shear reinforcement if 50% of the tensile steel is curtailed near the support. Use M20 concrete & Fe415 steel. For M20 concrete, τ_{cmax} = 1.80 MPa. Refer Table 1. **(10 M)**

Table 1: Permissible Nominal Shear Stresses in Concrete Beams, τ_c (IS 456: 2000)

100 A_{st}/bd	τ_c (MPa) for M20 concrete
0.25	0.22
0.50	0.30

Q. 4. A) A RCC T-beam has a flange width of 1500 mm, a flange thickness of 110 mm, an effective depth of 450 mm & a rib width of 300 mm. It is provided with tensile steel area of 2455 mm². The beam section is subjected to a BM of 200 kNm. Determine the maximum compressive stress in concrete & the tensile stress in steel. Use M20 concrete & Fe415 steel. **(10 M)**

B) A Prestressed concrete beam 400 mm X 600 mm in section has a span of 6 m & is subjected to a UDL of 16 kN/m, including the self weight. The prestressing tendons are located at the lower third point & provide an effective prestressing fore of 960 kN. Determine the extreme fibre stresses in concrete at the mid-span section. (10 M)

Q. 5. A) The roof of a Cycle Stand consists of of a RCC slab which cantilevers 3.50 m on each side of a central RCC beam, supported on columns. Allowing a LL of 1750 N/m^2, design the cantilevering slab. Finishing material load is 500 N/m^2. Use M20 concrete & Fe415 steel. (07 M)

B) Design a slab over a room 5 m X 7 m as per IS code guidelines. The edges of the slab are simply supported & the corners are not held down. The Live Load on the slab is 3200 N/m^2. The slab has a bearing of 150 mm on the supporting walls. Use M20 concrete & Fe415 steel. Refer Table 2. (07 M)

Table 2: BM coefficients for slabs spanning in 2 directions at right angles- S/S on 4 sides.

$l_y/l_x = r$	α_x	α_y	$l_y/l_x = r$	α_x	α_y
1.0	0.062	0.062	1.3	0.093	0.055
1.1	0.074	0.061	1.4	0.099	0.051
1.2	0.084	0.059	1.5	0.104	0.046

C) A Prestressed concrete cantilever 8 m long carries a Dead Load of 8 kN/m & a Live Load of 25 kN/m. The beam is 750 mm deep. Design a cable profile by Load Balancing Method by balancing full Dead Load & half the Live Load. (06M)

Q. 6. A) A short column of square section is to be designed to carry an axial load of 1025 kN. Design the column. Permissible stresses in concrete & steel are 5 MPa & 130 MPa respectively. (06 M)

B) A square column 450 mm X 450 mm supports an all inclusive axial load of 1650 kN. Design a square footing for the column. The safe bearing capacity of soil is 250 kN/m^2. Use M25 concrete & Fe415 steel. Checks for one way shear & two way shear are **not required**. (06 M)

C) A Prestressed concrete pile is 300 mm X 300 mm in section & is provided with 40 wires of 3 mm diameter distributed uniformly over the section. Initially the wires are tensioned in the prestressing beds with a total pull of 450 kN. Determine the final stress in concrete & the percentage loss of stress in the wires. Take $E_s = 2.08 \times 10^5$ MPa, $E_c = 3.20 \times 10^4$ MPa. Creep shortening = 32×10^{-6} mm/mm per N/mm^2 of stress, Total shrinkage strain = 200×10^{-6}. Relaxation loss of stress in steel = 4.50% of the initial stress. (06 M)

D) Draw the stress & strain diagrams for the Working Stress Method of RCC Design. What are the basic assumptions in the analysis of the members? (02 M)

END OF PAPER