Q. P. Code : 21359

(3 Hours) (Total Marks : 80)

N. B. 1. Question **No.1** is compulsory

2. Answer **any three** questions out of remaining

3. Assume any data, if required and state them clearly.

4. Attempt sub questions in order.

5. Illustrate answer with neat sketches wherever required.

6. Figure to the right indicates full marks.

1. Attempt Any Four.
   a. What do you mean by balanced rectangular beam? Establish the equations for determining the moment of resistance and percentage of tension steel in a balanced rectangular beam. **05**
   b. Write a short note on "modes of failure in case of columns". **05**
   c. Explain the structural benefits of flanged beam and doubly reinforced beam. **05**
   d. When do we go for doubly-reinforced beams? Establish the equation for determining areas of steel for the doubly reinforced rectangular beams. **05**
   e. State span to depth ratios of two-way slabs for different support conditions to be considered for the control of deflection. **05**

2.
   a. A doubly reinforced beam is 400mm wide and 600mm deep to the centre of tensile reinforcement. The compression reinforcement consists of 4 bars of 16mm diameter, and is placed with its centre at a depth of 40mm from the top. The tensile reinforcement consists of 4 bars of 20mm diameter. The section is subjected to a bending moment of 100kN-m. Determine the stresses in concrete and steel. Take m=11. **10**

   b. Design a cycle stand shade consists of a R.C. slab which cantilevers 3m on each side of central R.C. beam and is monolithic with it. The R.C. beam is simply supported on columns 400mm wide, at the ends, over a clear span of 6m. Design the shade for superimposed load of 2000N/m^2. Use M20 concrete and Fe415 steel. **10**

3.
   a. Design and detail a slab over a room 6.5m X 8m. The slab is supported on a wall all around with adequate restraint and the corners are held down. The live load on the slab is 3000N/m^2. This slab has a bearing of 125 mm on the supporting walls. Use M25 concrete and Fe415 steel. **08**

L_y/l_x	1	1.1	1.2	1.3	1.4	1.5	1.75	2	2.5	3
α_x	0.062	0.074	0.084	0.093	0.099	0.104	0.113	0.118	0.122	0.124
α_y	0.062	0.061	0.059	0.055	0.051	0.046	0.037	0.029	0.020	0.014

   b. An isolated T- beam, simply supported over a span of 6m has following dimensions : width of flange 750mm, thickness of flange 125mm, overall depth of beam 400mm, width of web 260mm, effective cover of tensile reinforcement 40mm. The beam is reinforced with 4 bars of 20mm dia. Determine the moment of resistance of the beam if
      i. Mild steel bars are used
      ii. Fe 415steel bars are used
      m=19in each case. **12**

4.
   a. A rectangular column 600mm X 400mm carries a load of 800kN. Design a rectangular footing to support the column. The safe bearing capacity of the soil is 200kN/m^2. Use M20 concrete and Fe 415 steel.
   b. A post tension concrete beam of 30m span is subjected to a transfer prestress force of 2500kN at 28 days strength. The profile of the cable is parabolic with maximum eccentricity of 200mm at mid span. Determine the loss of prestress and the jacking force required if jacking is done from both ends of the

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beam. The beam has a cross section of 500mmX 800mm, and is prestressed with 9 cables, each cable consisting 12 wires of 5mm diameter. Take E=2.1X10^{5}N/mm^2 and Ec=3.5X10^4 N/mm^2.

5.

a. A simply supported prestressed concrete beam of rectangular cross section 400mmX 600mm, is loaded with a total uniformly distributed load of 256 kN over a span of 6m. Sketch the distribution of stresses at mid-span and end section if the prestressing force is 1920 kN and the tendon is..
   i. Concentric
   ii. Eccentric located at 200mm above the bottom fibre. **10**

b. Differentiate pre-tensioning and post-tensioning prestressing systems. **05**

c. What are the three different ways to provide shear reinforcement? Explain the method of design of each of them. **05**

6.

a. The section of a singly reinforced concrete beam is subjected to a sagging bending moment of 2000 N-m. If the stresses in the concrete and steel are not to exceed 7N/mm^2 and 230 N/mm^2 respectively, find the dimensions of the beam. The width of the beam may be made 2/3 the effective depth. Take m=13.33 find also area of steel. **10**

b. Design a circular column to carry an axial load of 500kN. The diameter of column is limited to 500mm. Use spiral reinforcement. Use M20 concrete and Fe415 Steel. **10**
