M.E.Civil Engg. Structural Engg Subject (Sem. I)(Choice Base)Advanced Prestressed Concrete Structures.

(4 Hours) **Max.marks-80**

Note-
1. Question No. 1 is **compulsory**. Attempt **any three** out of remaining five questions.
2. Figures to the right indicate full marks.
3. Assume additional data if needed but justify the same.
4. Use of relevant IS codes **is permitted.**

Q.1 A box girder of a prestressed concrete bridge is of span 50 m has overall dimensions of width 1500 mm & depth 2000 mm, the uniform thickness of wall being 25 mm. it is subjected to maximum live load moment of 2200 KNm. Design the box girder as class 1 type structure and find the number of cables required at mid span section with their position from centroidal axis. Cable consisting of 12 high tensile wire of 8 mm diameter are initially prestressed to 1000 N/mm^2. 32
Assume the compressive strength of concrete at transfer as 16 N/mm^2 & loss ratio as 0.8.

OR

Design a post tensioned prestressed concrete slab bridge deck for a national highway crossing to suit the following data- 32

i) Live load = IRC class AA tracked vehicle
ii) Clear span = 10 m
iii) Width of bearing =400 mm
iv) Clear width of roadway = 7.5 m
v) Footpath 1 m on either side
vi) Kerbs = 600 mm wide
vii) Thickness of wearing coat = 80 mm
viii) Type of structure = class 1 type.

Materials M -40 grade concrete and 7mm diameter high tensile wires with an ultimate tensile strength of 1500 N/mm^2 housed in cables with 12 wires and anchored by Freyssinet anchorages of 150 mm diameter.
For supplementary reinforcement, adopt Fe 415 grade HYSD bars.
Compressive stress at transfer, f_{ci} =35 N/mm^2. Loss ratio =0.8.
The permissible compressive stresses in concrete at transfer and working loads are f_{ct} = 15 N/mm^2, f_{cw} = 12 N/mm^2, $f_{tt} = f_{tw} = 0$

Q.2 (a) What are advantages of continuous members in prestressed concrete structures? 4

(b) A 2-span continuous prestressed concrete beam ABC (AB=BC= 15 m) has a uniform rectangular cross section 250 mm x 600 mm. A cable carrying an effective prestressing force of 500 KN is parallel to the axis of the beam and located at an eccentricity 200 mm. 12

i) Determine the secondary and resultant moment developed at the mid support section B.

ii) Calculate the resultant stresses developed at the top & bottom of the beam at B if the beam supports an imposed load of 2.4 KN/m.

iii) Also locate the resultant line of thrust through beam ABC.

Q.3 (a) A cylindrical prestressed concrete water tank of internal diameter 30 m is required to store water over a depth of 7.5 m. the average wall thickness of tank is 150 mm. The permissible compressive working stress in concrete at transfer is 13 N/mm^2 and the minimum compressive stress under working pressure is 1N/mm^2. The loss ratio is 0.75. Wires of 5mm diameter of initial stress of 1000 N/mm^2 are available for circumferential winding and Freyssinet cables made up of 12 wires of 8 mm diameter stressed to 1200 N/mm^2 are to be used for vertical prestressing. Design the tank walls assuming the base as fixed. The cube strength of concrete is 40 N/mm^2 10

(b) A simply supported concrete beam of span 7.5 m with rectangular cross section of size 150 mm x 350 mm, is prestressed by a parabolic cable having 125 mm eccentricity at mid span and zero at support sections. The bean supports an imposed load of 2.5 KN/m. Find the effective force in the cable to balance the dead load & imposed load on the beam. Also calculate the principal tension at support section. 6

Q.4 (a) A concrete cylindrical shell roof covering an area of 10 m x 30 m is to designed with prestressed edge beams using following data - Radius of the shell = 7.5 m, semi-central angle =40^0, chord width = 10 m, span of shell = 30 m, thickness of shell = 75 mm, width of edge beam = 150 mm, depth of edge beam = 1.5 m. 12

(b) Explain the slab action & plate action with reference to folded plates subjected to transverse loading. Give neat sketches. 4

Q.5 (a) A precast pre-tensioned beam of effective span 5m has rectangular c/s of size 100 mm X 200 mm. the beam is prestressed by tendons with their centroids coinciding with the bottom kern. The initial force in the tendon is 150 KN. The loss in prestress may be assumed as 15 %. The beam is incorporated in a composite T-beam by casting a top flange of breadth 400 mm and thickness 40 mm. calculate the resultant stresses developed in the precast & cast in situ concrete if the beam is (i) unpropped, and (ii) propped during the casting of slab. Assume E_C values for prestressed & cat in situ concrete as 35 KN/m^2 and 28 KN/m^2 respectively. 8

(b) A dam trapezoidal in section with vertical water faced is 1.5 m wide at the top 3.5 m wide at the base and 12 m in height. It is subjected to water pressure for its full height on the vertical face Determine the magnitude and the line of action of the prestressing force required given that- i) the loss in stress = 15% and ii) permissible stress in concrete = 5 /mm^2. Assume specific gravity of masonry = 2.3 There should be no tension in the dam both stages i.e. When it is full or empty. Check the stresses at toe and heel for tank empty and tank full conditions. 8

Q,6 (a) Design an electric pole of height 10 m to support wire at its top which can exert a reversible horizontal force of 2800 N. The tendons are initially stressed to 1000 N/ mm^2 and the loss of stress due to shrinkage & creep is 16 %. Assume width of pole as 300 mm. 12
Maximum compressive stress in concrete is limited to 12 N/mm^2.
Adopt modular ratio m = 6 and $\phi = 30^0$. Soil weighs 18000 N/m^2

(b) Write a short note on maintenance of prestressed concrete structures. 4