Reg. No. : | | | | | | | | | |

Question Paper Code: 31173

B.E. / B.Tech. DEGREE EXAMINATION, NOV 2016

Seventh Semester

Civil Engineering

01UCE703 - PRESTRESSED CONCRETE STRUCTURES

(Regulation 2013)

Duration: Three hours | Maximum: 100 Marks

Answer ALL Questions

[IS1343-2012 and IS 3370 (part III and part IV) are permitted]

PART A - (10 x 2 = 20 Marks)

1. What is the basic principle of prestressing?
2. State the losses in post-tensioning method of prestressing.
3. Draw the permissible stress diagram for concrete as per IS 1343.
4. What is meant by Type 2 structure?
5. What are the factors influencing deflection?
6. What is meant by end zone?
7. What are the advantages of composite beam?
8. What is a concordant cable profile?
9. State the critical load conditions for the design of prestressed concrete poles.
10. What is meant by partial prestressing?

PART - B (5 x 16 = 80 Marks)

11. (a) An unsymmetrical I-section beam is used to support an imposed load of 2 *kN/m* over a span of 8 *m*. The sectional details are top flange, 300 *mm* wide and 60 *mm* thick; bottom flange 100 *mm* wide and 60 *mm* thick; thickness of web = 80 *mm*; overall depth of beam = 400 *mm*. At the centre of span, the effective prestressing force of 100 *kN* is located at 50 *mm* from the soffit of beam. Estimate the stresses at the centre of span section of the beam for the following load conditions (a) Prestress + self-weight (b) Prestress + self-weight + live load. (16)

Or

(b) A prestressed concrete beam 200 *mm* wide and 300 *mm* deep is prestressed with wires (area = 320 mm^2) located at a constant eccentricity of 50 *mm* and carrying an initial stress of 1000 N/mm^2. The span of the beam is 10 *m*. Calculate the percentage loss of stress in wires if (a) the beam is pretensioned and (b) the beam is post-tensioned using the following data:

E_s = 210 kN/mm^2 and E_c = 35 kN/mm^2

Relaxation of steel stress = 5 percent of the initial stress

Shrinkage of concrete = 300 x 10^{-6} for pretensioning and 200 x 10^{-6} for post-tensioning

Creep coefficient = 1.6

Slip at anchorage = 1 *mm*

Frictional coefficient for wave effect = 0.0015/*m*. (16)

12. (a) A prestressed concrete beam is to be designed to resist a bending moment of 500 *kNm* at service load conditions. The depth of the beam is restricted to 900 *mm*. High tensile steel of strength 2000 N/mm^2 is available and it can be pre-tensioned upto 0.6 *fp* during initial prestressing. Concrete quality with f_{ck} = 45 N/mm^2 is proposed to be used with a permissible compressive stress of 14 N/mm^2 at service load conditions. The prestressing is proposed to be transferred only after the concrete attains the full strength of 45 N/mm^2. The dead load bending moment may be assumed to be 100 *kN/m*. No tension is permitted in concrete at any stage (Type 1 structure). Design the cross section and details regarding prestressing. (16)

Or

(b) A pretensioned prestressed concrete beam having a rectangular section 150 *mm* wide and 350 *mm* deep has an effective cover of 50 *mm*. If f_{ck} = 40 N/mm^2, f_p = 1600 N/mm^2 and area of prestressing streel A_p = 461 mm^2, calculate the flexural strength of the section using IS1343 code. (16)

13. (a) A prestressed concrete beam having a cross-sectional area of 5 x 10^4 mm^2 is simply supported over a span of 10 *m*. It supports a uniformly distributed imposed load of 3 *kN/m*, half of which is non-permanent. The tendon follows a trapezoidal profile with an eccentricity of 100 *mm* within the middle-third of the span and varies linearly from the third-span points to zero at the supports. The area of tendons is 350 mm^2 which have an effective prestress of 1290 N/mm^2 immediately after transfer. Using the following data, calculate 1. Short-term deflection 2. Long-term deflection.

Assume I_g = 4.5 x 10^8 mm^4; E_c = 34 kN/mm^2; E_s = 200 kN/mm^2; Density of concrete = 23.6 kN/m^3; Creep coefficient = 2; Concrete shrinkage, ε_{cs} = 450 x 10^{-6}; Relaxation of steel stress = 10%. (16)

Or

(b) The end block of prestressed concrete beam is rectangular section 100 *mm* wide and 200 *mm* deep. The prestressing force of 100 *kN* is transmitted to concrete by a distribution plate 100 *mm* wide and 50 *mm* deep concentrically located at the ends. Estimate the position and magnitude of maximum tensile stress and bursting tension on the horizontal section through the centre and edge of anchor plate. (16)

14. (a) A precast pre-tensioned beam of rectangular section has a breadth of 100 *mm* and a depth of 200 *mm*. The beam with an effective span of 5 *m*, is prestressed by tendons with their centroids coinciding with the bottom kern. The initial force in the tendons is 150 *kN*. The loss of prestress may be assumed to be 15%. The beam is incorporated in a composite *T* beam by casting a top flange of breadth 400 *mm* and thickness 40 *mm*. If the composite beam supports a live load of 8 kN/m^2, calculate the resultant stresses developed in the precast and in-situ concrete assuming the pre-tensioned beam as:

(i) unpropped

(ii) propped during the casting of slab. Assume the same modulus of elasticity for concrete in precast beam and in situ cast slab. (16)

Or

(b) A continuous prestressed concrete beam *ABC (AB* = *BC* = 10 *m)* having a rectangular section with a width of 200 *mm* and depth of 400 *mm* is prestressed by a parabolic cable carrying an effective force of 100 *kN*. The cable is concentric at supports *A*, *B* and *C* and has an eccentricity of 100 *mm* towards the soffit of the beam at the centre of span sections. Calculate the secondary and resultant moments developed in the beam due to prestressing at *B*. (16)

15. (a) Design a non-cylindrical prestressed concrete pipe of 600 *mm* internal diameter to withstand a working hydrostatic pressure of 1.05 N/mm^2 using a 2.5 *mm* high tensile wire stressed to 1000 N/mm^2 at transfer. Permissible maximum and minimum stresses in concrete at transfer and service loads are 14 and 0.7 N/mm^2. The loss ratio is 0.8. Calculate the test pressure required to produce a tensile stress of 0.7 N/mm^2 in concrete when applied immediately after tensioning and also the winding stress in steel if $E_s = 210\ kN/mm^2$ and $E_c = 35\ kN/mm^2$. (16)

Or

(b) A cylindrical prestressed concrete water tank of internal diameter 30 *m* is required to store water over a depth of 7.5 *m*. The permissible compressive stress in concrete at transfer is 13 N/mm^2 and minimum compressive stress under working pressure is 1 N/mm^2. The loss ratio is 0.75. Wires of 5mm diameter with an 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. (16)