Name : .....

Roll No. : .....

Invigilator's Signature : .....

CS/B.Tech(CE)/SEM-8/CE-802/4/2013

2013

PRESTRESSED CONCRETE

Time Allotted : 3 Hours *Full Marks :* 70

The figures in the margin indicate full marks.

Candidates are required to give their answers in their own words as far as practicable.

GROUP – A

(Multiple Choice Type Questions)

1. Choose the correct alternatives for any *ten* of the following : 10 × 1 = 10

i) The loss that does not occur in pre-tensioned member is

a) Friction and shrinkage of concrete

b) Friction and Anchorage slip

c) Elastic deformation of concrete and Relaxation of stress in steel

d) Relaxation of stress in steel.

ii) In a pre-stressed concrete beam, the applied loads are resisted by

a) Stress in the tendons

b) A shift in the pressure line from cable line depending upon the moments

c) An increase in the tensile stress in the concrete

d) None of these.

iii) Loss of stress due to relaxation of steel is influenced by

a) Shrinkage of concrete

b) Friction between steel and concrete

c) Initial stress in steel

d) None of these.

iv) In post-tensioning system

a) wires are first tensioned followed by concreting

b) the wires are tensioned against hardened concrete

c) tensioning of wires and concreting is done simultaneously

d) none of these.

v) End block is

a) stronger than remaining part of beam

b) weaker than remaining part of beam

c) both (a) & (b)

d) none of these.

vi) The minimum section modulus of a prestressed concrete section is influenced by

a) the range of stress at top fibre

b) the compressive stress at top fibre

c) range of stress at bottom fibre

d) none of these.

vii) In the anchorage zone of a post-tensioned beam splitting cracks due to bursting tension develops in the direction of

a) depth of beam

b) inclined at 45 degrees to the axis of the beam

c) horizontal axis of the beam

d) none of these.

viii) Magnel's graphical solution is helpful in designing minimum pre-stressing force and the corresponding

a) minimum eccentricity

b) maximum eccentricity

c) feasible eccentricity

d) none of these.

ix) Uniformly distributed load on pre-stressed concrete beam can be effectively counterbalanced by

a) concentric straight cable

b) eccentric cable

c) parabolic cable

d) none of these.

x) In a load balance pre-stressed concrete beam under self load the cross-section is subjected to

a) axial stress

b) bending stress

c) axial and shear stress

d) axial and bending stress.

xi) In a typical Box girder type of prestressing used is

a) post-tensioning

b) pre-tensioning

c) both (a) & (b)

d) none of these.

xii) Prestress concrete electric poles are generally prestressed with

a) Eccentric prestress

b) Axial prestress

c) transverse prestress

d) all of these

e) none of these.

GROUP – B

(Short Answer Type Questions)

Answer any *three* of the following. 3 × 5 = 15

2. A pre-tensioned, T-section has a flange which is 350 mm wide, 200 mm thick. The rib is 200 mm wide by 350 mm deep. The effective depth of the cross-section is 500 mm. Given A_p = 200 mm ^{2}, f_{ck} = 50 N/mm ^{2} and f_p = 1600 N/mm ^{2}. Estimate the ultimate moment capacity of the *T*-section using the Indian Standard Code.
3. A pre-stressed concrete pile, 400 mm × 400 mm cross-section, contains 60 pre-tensioned wires each of 2 mm diameter. The wires are initially tensioned on the pre-stressing bed with a total force of 800 kN. Calculate the final stress in concrete and the percentage loss of stress in steel after all losses, given that :
   E_s = 210 kN/mm ^{2} , E_c = 32 kN/mm ^{2} .
   Shortening due to creep = 30 × 10 $^{-6}$.
   Relaxation of steel = 2% of initial stress.
   Total shrinkage = 200 × 10 $^{-6}$ per unit length.
4. Explain the following terms with reference to post-tensioned pre-stressed members :
   a) End block
   b) Bursting tension.
5. Prestress cantilever 8 m long caries a dead load of 8 kN/m and a live load of 20 kN/m. The beam is 750 mm deep. Design a cable profile by load balancing method by balancing full dead load and half live load.
6. A prestressed concrete beam of rectangular section 150 mm × 300 mm supports a uniformly distributed load of 4 kN/m over the entire effective span of 6 m. The beam is concentrically pre-stressed by a straight cable carrying a force of 200 kN. Compute the resultant stresses at the mid-span section. The self-weight of the beam may be neglected.

GROUP – C

(Long Answer Type Questions)

Answer any *three* of the following. 3 × 15 = 45

7. A composite pre-stressed concrete beam comprising 500 mm × 50 mm cast-in-situ flange and 150 mm × 250 mm precast stem pre-stressed with an initial prestressing force of 250 kN applied through tendons placed 80 mm above soffit. Loss in pre-stress may be assumed to be 15%. The beam is to support an imposed load of 4 kN/m in addition to its self-weight over a span of 6 m. Determine the resultant stresses in the beam for various stages of loading if the beam is (i) Propped (ii) un-propped.

8. Design an electric pole 12 m high to support wires at its top which can exert a reversible horizontal force of 2000 N. The tendons are initially stressed to 1000 N/mm^2 and the loss of stress due to shrinkage and creep is 15%. Maximum compressive stress in concrete shall be limited to 12 N/mm^2. Take $m = 6$ and $\phi = 30^\circ$. Soil weight = 18000 N/m^3.

9. a) Discuss the various types of losses of prestress in pre-tensioned and post-tensioned members.

   b) In a pre-stressed concrete beam of cross-section 200 mm × 300 mm and span 6 m, an initial prestressing force of 600 kN is applied at an eccentricity of 70 mm, by tendons of area 600 mm^2. Assuming $E_s = 2 \times 10^5$ N/mm^2 and $E_c = 0.333 \times 10^5$ N/mm^2 anchor slip is 0.5 mm : creep coefficient in concrete $\varphi = 1$, shrinkage of concrete = 0.0002 and creep loss in steel = 3%, find the total percentage loss of stress in the tendons. 7 + 8

10. A post-tensioned pre-stressed beam of rectangular section 250 mm wide is to be designed for an imposed load of 15 kN/m, uniformly distributed on a span of 12 m. The stress in the concrete must not exceed 16 N/mm^2 in compression or 1.4 N/mm^2 in tension at any time and the loss of prestress may be assumed to be 15%. Calculate

    a) the minimum possible depth of the beam.

    b) for the section provided the minimum prestressing force and the corresponding eccentricity. 8 + 7

11. A two-span continuous prestressed concrete beam has a rectangular cross-cection of width 200 mm and depth 300 mm. Each span of the beam is 10 m. The beam is prestressed with an effective force of 400 kN provided through cable parallel to the axis of the beam and located at 100 mm from soffit.

    a) Determine the secondary and resultant moment at the central support.

    b) Calculate the resultant stresses at top and bottom of the beam section at the central support, if the beam is subjected to an imposed load of 1.5 kN/m.

    c) Locate the resultant line of thrust.