Name : ....

Roll No. : ....

Invigilator's Signature : ....

CS/B.TECH(CE)/SEM-8/CE-802/4/2012

2012

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 : $10 \times 1 = 10$

i) Prestress is economical for members of

a) long span b) medium span

c) short span d) any span.

ii) The minimum grade of concrete used for post-tension member is

a) M30 b) M35

c) M40 d) M45.

iii) Looping of high tensile tendons around the concrete is used in

a) B.B.R.V. system b) Magnel-Blaton system

c) Lee-McCall system d) none of these.

iv) 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.

v) The deflection of a cracked prestressed concrete beam can be computed by

a) stress-strain diagram

b) bending moment diagram

c) bilinear moment-curvature relationships

d) none of these.

vi) Large magnitudes of torsion are better resisted by selecting beams of

a) rectangular section

b) hollow base girder section

c) I-section

d) none of these.

vii) The anchorage zone in a post-tensioned P.S.C. beam extends over a length of

a) half the depth of beam

b) twice the depth of beam

c) depth of beam

d) none of these.

viii) Prestressing steel has an ultimate tensile strength nearly

a) twice that of HYSD bars

b) thrice that of mild steel reinforcement

c) four times that of HYSD.

ix) Shrinkage of concrete in structural member is due to
  a) dead load on the member
  b) live load
  c) loss of moisture and drying of concrete.

x) Composite construction using P.S.C. and cast in situ concrete is adopted in
  a) water tank b) piles
  c) bridge d) none of these.

xi) Stressing concordant cables in continuous structures result in
  a) primary reaction
  b) zero redundant reactions
  c) axial thrust
  d) none of these.

xii) Which of the following losses are not present in Pre-tensioning member ?
  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.

GROUP – B
(Short Answer Type Questions)

Answer any *three* of the following. $3 \times 5 = 15$

2. Why are high strength concrete and high tensile steel wires necessary for pre-stress concrete ?

3. A pre-stressed concrete rectangular beam 300 mm × 600 mm is prestressed with a force of 1565 kN applied at 180 mm from the bottom, the force finally reducing to 1361 kN. The span of the beam is 12 m and carries two equal live loads 45 kN each at a distance of 4 m from each support. Find the extreme fibre stresses at mid-span under the following conditions :
  i) Initial prestress and no live load
  ii) Final condition.

  Assume specific weight of concrete is 25 kN/m^2. 3 + 2

4. A rectangular concrete beam of cross-section 30 cm deep and 20 cm wide is pre-stressed by means of 15 wires of 5 mm diameter located 6·5 cm from the bottom of the beam and 3 wires of diameter 5 mm, 2·5 cm from the top. Assuming the prestress in the steel as 840 N/mm^2, calculate the stresses at the extreme fibres of the mid-span section when the beam is supported its own weight over span of 6 m. If a uniformly distributed live load of 6 kN is imposed, evaluate the maximum working stress in concrete. The density of concrete is 24 kN/m^3.

5. A pretensioned prestressed concrete beam having a rectangular cross-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 the area of prestressing steel $A_p = 461\,mm^2$, calculate the ultimate flexural strength of the section using IS:1343 code provision.

6. The end block of a post-tensioned prestressed concrete beam, 300 mm wide and 300 mm deep, is subjected to a concentric anchorage force 832800 N by a Freyssinet anchorage of area 11720 mm^2. Design and detail anchorage reinforcement for the end block.

GROUP – C

(Long Answer Type Questions)

Answer any *three* of the following. $3 \times 15 = 45$

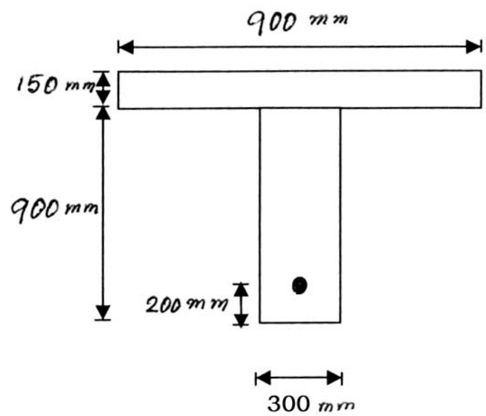
7. a) Discuss the various types of losses of prestress in pre-tensioned and post-tensioned members.

b) In a prestressed concrete beam of cross-section 200 mm × 300 mm and span 6 m, an initial prestressing force of 400 kN is applied at an eccentricity of 70 mm, by tendons of area 400 mm². Assuming $E_s = 2 \times 10^5$ N/mm² and $E_c = 0 \cdot 333 \times 10^5$ N/mm², anchor slip is 1·5 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

8. A post-tensioned pre-stressed concrete beam (bonded) of rectangular section width of 300 mm and overall depth of 600 mm is pre-stressed by an effective force of 175 kN acting at an eccentricity e = 180 mm. At service conditions, the section is subjected to B.M. = 200 kN-m, T = 75 kN-m and transverse shear force of 80 kN. If $f_{ck} = 40$ N/mm², $f_y = 250$ N/mm² and $f_p = 1600$ N/mm², design only longitudinal reinforcement in the section using IS : 1343 code. Assume area of pre-stressed steel = 575 mm².

9. The cross-section of a composite beam which consists of a 300 mm × 900 mm precast stem and cast in situ flange 900 mm × 150 mm. The stem is a post-tensioned unit with an initial prestressing force of 2500 kN. The effective prestress available after making deduction for losses, is 2200 kN. The dead load moment at mid span due to the weight of the precast section is 250 kN-m. The dead load moment due to the weight of the flange is 125 kN-m.

After the hardening of the flange concrete, the composite section has to carry a live load which produces a bending moment of 700 kN-m. Determine the stress distribution in concrete at the various stages of the loading.



10. A two-span continuous concrete beam ($AB = BC = 12$ m) has a rectangular cross-section of 300 mm wide and 800 mm deep. The beam is pre-stressed by a cable carrying an effective force of 700 kN. The cable has a linear profile in the span AB and parabolic profile in span BC. The eccentricities of the cable are + 50 mm at A, –100 mm at a distance of 7 m from A, and + 200 mm at support B and – 200 mm at mid-span of BC (– below & + above centroidal axis).

    a) Evaluate the resultant moment developed at B due to the pre-stressing force.

    b) Sketch the line of thrust in the beam if it supports a uniformly distributed load of 5 kN/m which includes the self-weight of the beam.

    c) Find the resultant stress distribution at the mid-support section for condition (b). 6 + 6 + 3

11. Design an electric pole 12 m high to support wires at its top which can exert a reversible horizontal force of 3000 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 Ø = 30. Soil weighs 18000 N/m^3.

12. What is anchorage slip ? How do you compute the loss of stress due to anchorage slip ?

    A pretensioned beam, 200 mm wide and 300 mm deep, is prestressed by 10 wires of 7 mm diameter initially stressed to 1200 N/mm^2, with their centroids located 100 mm from the soffit. Find the maximum stress in concrete immediately after transfer, allowing only elastic shortening of concrete.

    If the concrete undergoes a further shortening due to creep and shrinkage while there is a relaxation of 5% of steel stress, estimate the final percentage loss of stress in the wires using Indian Standard Code (IS:1343-1980) regulation and the following data :

    $E_s = 210\,\text{kN/mm}^2$

    $E_c = 5700\sqrt{f_{cu}}$

    $f_{cu} = 42\,\text{N/mm}^2$

    Creep coefficient $\phi = 1 \cdot 6$

    Total residual shrinkage = 3×10^4 .

=============