Name : .....

Roll No. : .....

Invigilator's Signature : .....

CS/B.Tech (CE-NEW)/SEM-8/CE-802/4/2011

2011

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) For testing of sleepers under dynamic loads the Indian railways tentatively stipulated a load range of

   a) 5 – 20 ton b) 20 – 32 ton

   c) 2 – 4 ton d) 14 – 22 ton.

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

   a) BBRY system b) Magnel-Blaton system

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

iii) The locus of the centroid of the prestressing force along the structure is called

a) Thrust line b) Neutral axis

c) Line of prestress d) Transformation profile.

iv) The spacing of stirrups in a prestressed beam should

a) not exceed the overall depth

b) not be greater than effective depth

c) not exceed 0·75 times the effective depth

d) none of these.

v) 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.

vi) A parabolic cable profile with maximum eccentricity at mid-span and concentric at supports when stressed results in

a) zero deflection b) downward deflection

c) upward deflection d) none of these.

vii) The Indian P.S.C. sleeper for broad gauge is designed for a moment capacity exceeding

a) 5 kN-m b) 10 kN-m

c) 8 kN-m d) 12 kN-m.

viii) The amount of creep in steel varies from

a) 2% – 6% b) 4% – 8%

c) 9% – 12% d) none of these.

ix) Short term deflation of a prestressed beam can be computed using

a) elastic theory b) Mohr's theorem

c) shear force diagram d) none of these.

x) A posttensioned prestressed concrete member is subjected to an initial prestressing force of 400 kN. The cross-sectional area of the wires in the cable is 350 mm^2, $E_s = 210\ kN/mm^2$. Age of concrete at transfer is 9 days. The loss of prestress due to total residual shrinkage as per IS 1343 is

a) 6·3 % b) 4·2 %

c) 6·1 % d) none of these.

xi) Minimum period of mixing of concrete in prestressed concrete construction should be

a) 20 minutes

b) 10 minutes

c) 5 minutes

d) 2 minutes.

xii) Grouting of the ducts in post-tensioned, prestressed concrete causes

a) Reduction in pre-stress

b) Increase in pre-stress

c) Increase in corrosion

d) Reduction in corrosion.

xiii) Transfer length in pre-tensioned prestressed concrete is approximately equal to

a) 20 D b) 48 D

c) 100 D d) 200 D.

GROUP – B

(Short Answer Type Questions)

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

2. Explain the following terms :

   a) End block

   b) Anchorage zone

   c) Bursting tension

   d) Splitting crack

   with reference to post-tensioned pre-stressed members.

3. A post-tensioned cable of a 12 m long beam is initially stressed to 100 N/mm^2 at one end. The tendons 600 mm^2 in cross-sectional area are sloped at 1 in 24 at end and co-efficient of friction between duct and cable = 0·3 and friction coefficient for wave effect = 0·0015 N/m. Find the loss of pre-stress.

4. The stress-strain diagram of concrete in compression is idealized as parabolic with the following limits :

   Crushing strain in concrete = 0·0035.

   Effective pre-strain in steel = $\in_{se} = 0 \cdot 004$, yield strain in steel = $\in_{y} = 0 \cdot 002 + \frac{0 \cdot 87 f_y}{E_s}$. The section is triangular with its apex in compression and width at steel is b.

   $k_p f_{ck} = 0 \cdot 67 f_{ck}$.

   Compute the moment capacity of the triangular section.

5. What is partial pre-stressing ? What are the advantages of partial pre-stressing ? What is the use of non-prestress-reinforcement in partial pre-stressing ?

6. Discuss Zielinski and Rowe's method to compute the transverse tensile stress and bursting tension in end blocks.

GROUP – C

(Long Answer Type Questions)

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

Note : (Assume, reasonable value of data if additionally required)

7. A 20 m long simply supported pre-tensioned pre-stressed concrete beam is of a box section. The top and bottom flanges are 100 cm × 20 cm and 100 cm × 15 cm respectively. The thickness of the vertical web is 10 cm each. The overall depth of the section is 80 cm and it is uniform. The beam is pre-stressed with a set of cables having a total force of 4000 kN at transfer. The stress in the steel at transfer is 105 kW/cm^2 . The net sag of the cables at mid-span is 30 cm. Determine the loss of prestress in the beam. $E_s = 200\,GPa$, $E_c = 30\ GPa$.

8. a) What are the different ways of improving the shear resistance of structural concrete members by pre-stressing technique ? What are the various types of shear cracks ?

b) Estimate the position and magnitude of the maximum transverse tensile stress and bursting tension for the end block with a concentric anchor force of 200 kN. The end block is 200 mm wide × 300 mm deep and the distribution plate is 100 mm × 50 mm deep.

9. A three span continuous beam of equal span is subjected to a uniformly distributed load. Determine a cable profile which will not cause any secondary moments.

10. A simply supported beam of span 8 m is subjected to a line load of 20 kN/m. Design a rectangular section post-tensioned type – 1 beam with the following data by the limit states design :

$f_{ck} = 35$ MPa, $f_p = 1500$ MPa

$\sigma_{aci} = 14$ MPa

$\delta_{ace} = 12$ MPa

$V_a = \frac{L}{350}$

$\tau_0 = 0 \cdot 4$ MPa .

11. Design an electric pole 13 m high to support wires at its top which can exert a reversible horizontal force of 3500 N. The tendons are initially stressed to 1000 N/mm^2 and the loss of stress due to shrinkage and creep is 16% maximum. Compressive stress in concrete shall be limited to 12 W/mm^2. Take m = 6 and Φ = 30°, soil weighs 19000 W/m^3.

12. A simply supported beam of span 4 m is subjected to a *udl* of 6000 N/m. Determine the pre-stressing force and eccentricity of a cable after assuming an approximate section M-42 concrete is used in the beam and $f_p = 1600$ MPa.

    You may use the following data :

    $\sigma_{aci} = 0 \cdot 5 f_{ck}$, $\sigma_{ati} = 0 \cdot 1 \times \sigma_{aci} = 210$ select 140

    $\sigma_{ace} = 0 \cdot 4 \times 4200 = 1680$; $\sigma_{ate} = 140$. All these data are for permissible stress $\left(\text{N}/\text{cm}^2\right)$. Assume that the beam is in pre-tensioned condition.