PRESTRESSED CONCRETE STRUCTURES
(CIVL 4141)

Time Allotted : 2½ hrs **Full Marks : 60**

Figures out of the right margin indicate full marks.

Candidates are required to answer Group A and any 4 (four) from Group B to E, taking one from each group.

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

Group – A

1. Answer any twelve: **12 × 1 = 12**

Choose the correct alternative for the following

(i) The minimum grade of concrete used for post-tensioned member is
(a) M30 (b) M35 (c) M40 (d) M50

(ii) 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

(iii) 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

(iv) Prestressed concrete beam fails suddenly without warning due to
(a) Failure of concrete in compression zone
(b) Failure of concrete in tension zone
(c) Failure of steel in tension
(d) None of these

(v) The partial safety factor for dead and live loads at the limit state of collapse is
(a) 1.2 (b) 1.15 (c) 1.5 (d) 1.75

(vi) The anchorage zone in a post-tensioned P.S.C beam extends over a length of
(a) Half the depth of the beam (b) Twice the depth of the beam
(c) Depth of the beam (d) None of these

(vii) Composite construction using PSC and cast-in situ concrete is adopted in
(a) Water tanks (b) Pipes
(c) Bridges (d) Chimneys

(viii) Prestressing a continuous concrete beam results in
(a) Primary moments (b) Secondary moments
(c) Tertiary moments (d) None of these

(ix) Prestress concrete electric poles are generally prestressed with:
(a) Eccentric prestress (b) Axial prestress
(c) Transverse prestress (d) All of the above

(x) Continuity in prestressed concrete structures results in
(a) An increase in the size of the members
(b) Reduction in the size of the members
(c) Neither increase nor decrease in the size of the members
(d) None of these

Fill in the blanks with the correct word

(xi) Loss of stress due to elastic deformation of concrete depends upon ______________

(xii) Shrinkage of concrete in structural member is due to _______________.

(xiii) Maximum permissible final deflection of a beam should not exceed _________________.

(xiv) A parabolic cable profile with maximum eccentricity at mid-span and concentric at supports when stressed result in _____________ deflection.

(xv) The clear cover to cables in a PSC post-tensioned girder should not be less than ____________.

Group - B

2. (a) Distinguish between concentric and eccentric tendons, indicating their practical applications. *[(CO1)(Remember/LOCQ)]*
(b) A rectangular concrete beam, 100mm wide by 250mm deep, spanning over 8m is prestressed by a straight cable carrying an effective prestressing force of 250kN located at an eccentricity of 40mm. The beam supports a live load of 1.2kN/m.
(i) Calculate the resultant stress distribution for the central cross section of the beam. The density of the concrete is $24 kN/m^3$
(ii) Find the magnitude of the prestressing force with an eccentricity of 40mm which can balance the stresses due to dead and live load at the bottom fibre of the central section of the beam. *[(CO2)(Apply/IOCQ)]*

3 + 9 = 12

3. (a) Explain the various factors influencing the deflections of prestressed concrete members. *[(CO1)(Remember/LOCQ)]*
(b) A prestressed concrete beam spanning over 8m is of rectangular section, 150mm wide and 300mm deep. The beam is prestressed by a parabolic cable having an eccentricity of 75mm below the centroidal axis at the centre of span and an eccentricity of 25mm above the centroidal axis at the support sections. The initial force in the cable is 350kN. The beam supports three concentrated loads of 10kN each at intervals of 2m. $E_c = 38 kN/mm^2$.

(i) Neglecting losses of prestress, estimate the short term deflection due to (prestress + self-weight); and
(ii) Allowing for 20 percent loss in prestress, estimate the long term deflection under (prestress + self-weight + live load), assuming creep co-efficient as 1.80.

[(CO2)(Apply/IOCQ)]

3 + 9 = 12

Group - C

4. (a) Define Strain-Compatibility Method. Outline the various steps followed in computing the flexural strength of prestressed concrete sections. *[(CO3)(Remember/LOCQ)]*

(b) A pretensioned T-section has a flange 1200mm wide and 150mm thick. The width and depth of the web are 300mm and 1500mm respectively. The high tensile steel has an area of 4700mm^2 and is located at an effective depth of 1600mm. If the characteristic cube strength of the concrete and tensile strength of steel are 40N/mm^2 and 1600N/mm^2 respectively. Calculate the flexural strength of the T-section. *[(CO3)(Evaluate/HOCQ)]*

6 + 6 = 12

5. (a) Define Shear stress and Principal stress with sketch. Mention different ways of improving the shear resistance of structural concrete members by prestressing techniques. *[(CO6)(Remember/LOCQ)]*

(b) A concrete beam having a rectangular section, 150mm wide and 300mm deep, is prestressed by a parabolic cable having an eccentricity of 100mm at the centre of span, reducing to zero at the supports. The span of the beam is 8m. The beam supports a live load of 2kN/m. Determine the effective force in the cable to balance the dead and live loads on the beam. Estimate the principal stresses at the support section. *[(CO6)(Apply/IOCQ)]*

6 + 6 = 12

Group - D

6. (a) Sketch a typical tensile stress distribution in an end block of a post-tensioned beam with a single anchorage. *[(CO2)(Remember/LOCQ)]*

(b) The end block of a prestressed concrete girder is 200mm wide by 300mm deep. The beam is post-tensioned by two Freyssinet anchorages each of 100mm diameter with their centres located at 75mm from the top and bottom of the beam. The force transmitted by each anchorage being 2000kN. Compute the bursting force and design the suitable reinforcements according to IS:1343 code provisions. *[(CO4)(Evaluate/HOCQ)]*

6 + 6 = 12

7. (a) Explain the terms:
(i) Primary moment, (ii) Secondary moment, (iii) Resultant moment with respect to continuous prestressed concrete beam. *[(CO4)(Remember/LOCQ)]*

(b) A two-span continuous prestressed concrete beam ABC (AB=BC=15m) has an uniform cross-section with a width of 250mm and depth of 600mm. A cable carrying an effective prestressing force 500kN is parallel to the axis of the beam and located at an eccentricity of 200mm. Determine the secondary and resultant moment developed at the mis-support section B. *[(CO2)(Evaluate/HOCQ)]*

6 + 6 = 12

Group - E

8. (a) Distinguish between propped and unpropped construction methods in composite construction using stress diagrams at various stages of construction. *[(CO5)(Remember/LOCQ)]*

(b) A propped precast pretensioned beam of rectangular section has a width of 100mm and depth of 200mm. The beam with an effective span of 5m is prestressed by tendons with their centroids coinciding with the bottom kern. The initial force in the tendon is 150kN. The loss of prestress may be assumed to be 15 percent. The beam is incorporated in a composite beam supports a live load of 8kN/m^2, calculate the resultant stresses developed in the precast and in-situ cast concrete. *[(CO5)(Evaluate/HOCQ)]*

3 + 9 = 12

9. Design an electric pole 10m high to support wires at its top which can exert a reversible horizontal force of 2500N. The tendons are initially stressed at 1000N/mm^2 and the loss of shrinkage and creep is 15%. Maximum compressive stress in concrete shall be limited to 10N/mm^2. Take m=6 and $\varphi = 30°$, self weight=18kN/m^3. *[(CO6)(Evaluate/HOCQ)]*

12

Cognition Level	LOCQ	IOCQ	HOCQ
Percentage distribution	34	19	47