B.TECH/CE/6TH SEM/CIVL 3203 (BACKLOG)/2022

PRESTRESSED CONCRETE
(CIVL 3203)

Time Allotted : 3 hrs **Full Marks : 70**

Figures out of the right margin indicate full marks.

Candidates are required to answer Group A and any 5 (five) from Group B to E, taking at least one from each group.

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

Group – A
(Multiple Choice Type Questions)

1. Choose the correct alternative for the following: **10 × 1 = 10**

(i) Composite construction using PSC and cast-in-situ concrete is adopted in
(a) water tanks (b) pipes (c) bridges (d) chimneys.

(ii) Magnel's graphical method is helpful in designing minimum prestressing force and corresponding
(a) minimum eccentricity (b) maximum eccentricity
(c) feasible eccentricity (d) both (a) and (b).

(iii) Anchorage zone in post-tensioned prestressed extends over a length of
(a) half the depth of beam (b) twice the depth of beam
(c) depth of beam (d) width of beam.

(iv) 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) minimum deflection.

(v) The loss of stress which is absent in pre-tensioned members is
(a) shrinkage of concrete (b) friction and anchorage slip
(c) creep of concrete (d) elastic deformation of concrete.

(vi) Short term deflection of a prestressed beam can be computed using
(a) Elastic theory (b) Mohr's theorm
(c) Shear force diagram (d) Bending moment diagram.

(vii) In pre-stressed concrete beam the applied loads are resisted by
(a) an increase in stress in tendons
(b) a shift in pressure line from cable line depending upon the moment
(c) an increase in tensile stress in concrete
(d) pressure line coinciding with cable line.

(viii) In post-tensioning system,
(a) wires are first tensioned followed by concreting
(b) tensioning of wires and concreting is simultaneously done
(c) the wires are tensioned against hardened concrete
(d) the wires are tensioned in workshop and transfer it to the site.

(ix) Loss of stress due to creep of concrete is influenced by
(a) friction (b) creep co-efficient
(c) creep strain (d) anchorage slip.

(x) Loss of stress due to elastic deformation of concrete depends upon
(a) area of concrete section (b) relaxation of steel
(c) friction and anchorage slip (d) modular ratio.

Group- B

2. (a) A prestressed concrete beam of section 120 mm wide and 300 mm deep is used over an effective span of 6m to support an uniformly distributed load of 4kN/m, which includes self-weight of the beam. The beam is prestressed by a force of 200 kN and located at an eccentricity of 50 mm. Determine the location of the thrust line in the beam and plot its position at quarter and central span section.
[(CO6)(Evaluate/HOCQ)]

(b) A prestressed concrete beam spanning over 8m is of rectangular section, 150 mm wide and 300 mm deep. The beam is prestressed by a parabolic cable having an eccentricity of 75 mm below the centroidal axis at centre of span and an eccentricity of 25 mm above the centroidal axis at support section. The initial force in the cable is 350kN. The beam supports an udl of 8kN/m in addition to its self weight. E_c = 35 kN/mm^2
(i) Neglecting loss of prestress, estimate the short-term deflection due to prestress and self weight
(ii) Assuming 20% loss in prestress, estimate the long term deflection under prestress, self weight and live load assuming creep co-efficient 1.8.
[(CO3)(Evaluate/HOCQ)]
5 + 7 = 12

3. (a) Discuss various type of losses in pre-tensioned and post-tensioned prestressed concrete members. [(CO1)(Understand/LOCQ)]

(b) A post-tensioned cable of a beam is 10m long is initially tensioned to a stress of 1000 N/mm^2 at one end. If the tendons are curved so that the slope is 1/15 at each end with a cross-sectional area of 600mm^2, calculate the loss of prestress due to friction, the following data are given:
Co-efficient of friction between duct and cable = 0.55
Friction co-efficient for wave effect = 0.0015/m
During anchoring, if there is a slip of 3mm at the jacking end, calculate the final force in cable and % loss due to friction and anchorage slip.
[(CO3)(Evaluate/HOCQ)]
3 + 9 = 12

Group - C

4. The cross-section of a prestressed concrete beam is an unsymmetrical T-section with an overall depth of 1300 mm. Thickness of web = 150 mm. Distances of top and bottom fibres from the centroid are 545 mm and 755 mm respectively.
At a particular section, the beam is subjected to an ultimate moment
M = 2130 kN-m and shear force V = 237 kN
Effective depth d = 1100 mm
Cube strength of concrete = 45N/mm^2
Effective prestress at the extreme tensile face of the beam
f_{ep} = 19.3 N/mm^2
Second moment of area I = 665×10^8 mm^4
Area of steel in the section A_p = 2310 mm^2
Tensile strength of tendons f_p = 1500 N/mm^2
Effective stress in tendons after all losses f_{pe} = 890 N/mm^2
Estimate the flexure-shear resistance of the section using Indian code regulations.
[(CO2)(Evaluate/HOCQ)]
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5. (a) A pre-tensioned T-section has a flange which is 300 mm wide and 200 mm thick. The web is 150 mm wide by 400 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 T-section using IS code regulations.
[(CO3)(Evaluate/LOCQ)]

(b) A post-tensioned prestressed beam of rectangular section of 250 mm wide is to be designed for an imposed load of 12 kN/m, uniformly distributed load on a span of 12 m. The stress in the concrete must not exceed 17 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 percent, calculate
(i) minimum possible depth of the beam
(ii) for the section provided the minimum prestressing force and corresponding eccentricity. [(CO2)(Evaluate/HOCQ)]
4 + 8 = 12

Group - D

6. (a) Explain the terms:
(i) Anchorage zone (ii) End block (iii) Bursting tension with reference to post-tensioned prestressed members. [(CO3)(Remember/LOCQ)]

(b) The end block of a prestressed concrete girder is 200 mm wide by 300 mm deep. The beam is post-tensioned by two Freyssinet anchorages each of 100 mm diameter with their centres located at 75 mm top and bottom of the beam. The force transmitted by each anchorage being 2000 kN. Compute the bursting tension and design suitable reinforcements according to IS: 1343.
[(CO3)(Evaluate/HOCQ)]
3 + 9 = 12

7. A continuous prestressed concrete beam ABC (AB = BC = 10 m) has a uniform rectangular cross-section with a width of 150 mm and depth 300 mm. The cable carrying an effective prestressing force of 300 kN is parallel to the axis of the beam and located at 100 mm from the soffit.
   (i) Determine the secondary and resultant moment at central support B.
   (ii) If the beam supports an imposed load of 2 kN/m, calculate the resultant stresses at top and bottom of the beam at B. Assume unit weight of concrete as 25 kN/m^3.
   (iii) Locate the resultant line of thrust through beam AB. [(CO4)(Analyze/IOCQ)]

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Group - E

8. (a) Explain the advantages of using composite construction with prestressed and in-situ concrete in structural members. [(CO5)(Understand/LOCQ)]
   (b) A precast pretensioned beam of rectangular section has a 200 mm × 400 mm. The beam with an effective span of 8 m is prestressed by tendons with their centroids coincide with the bottom kern. The initial force in tendons is 250 kN. The loss of prestress may be assumed as 25%. The beam is incorporated in a composite T-beam by casting a top flange of width 400 mm and thickness of 40 mm. If the composite beam supports a live load of 10kN/m^2, calculate the resultant stress developed in the pre-cast and in-situ cast concrete assuming the pre-tensioned beam as (i) un-propped and (ii) propped during the casting of the slab. Assume the same modulus of elasticity for concrete in pre-cast beam and in-situ slab. [(CO5)(Evaluate/HOCQ)]

2 + 10 = 12

9. Design an electric pole of 12 m high to support cables at its top which apply a reversible horizontal force of 3000 N. The tendons are initially stressed to 1200 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 $\varphi = 30^\circ$. Soil weight = 18 kN/m^3. [(CO6)(Create/HOCQ)]

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Cognition Level	LOCQ	IOCQ	HOCQ
Percentage distribution	12.5	12.5	75

Course Outcome (CO):

After the completion of the course students will be able to

1. Learn the introduction of prestressed concrete member and its deflection properties
2. Develop the design criteria of prestressed concrete section for flexure and shear properties
3. Analyze the anchorage zone stress for post-tensioned members
4. Impart knowledge regarding the methods of Analysis of Statically Indeterminate Structures.
5. Impart knowledge regarding the composite construction of Prestress and In-situ concrete.

6. Impart knowledge regarding Design of Prestressed concrete poles and sleepers and introduction of partial prestressing.

*LOCQ: Lower Order Cognitive Question; IOCQ: Intermediate Order Cognitive Question; HOCQ: Higher Order Cognitive Question