(b) The end block of a prestressed concrete girder is 200 x 400mm. The beam is post-tensioned by two Freyssinet anchorages each of 80mm diameter with their centre located at 100mm from the top and bottom of the beam. The force transmitted by each anchorages being 2000kN. Compute the bursting force and design reinforcement as per IS code regulations.

3 + 9 = 12

7\. (a) Explain the method of "Theorem of three moments" for the analysis of secondary moments.

(b) A continuous prestressed concrete beam ABC (AB=BC=10m) has a uniform rectangular cross-section with a width of 100mm and depth of 300mm. The cable is carrying an effective pre-stressing force of 360kN is parallel to the axis of the beam and located at 100mm from the soffit.
(i) Determine the secondary and resultant moment at central support B.
(ii) If the beam supports a live load of 1.5kN/m, calculate the resultant stresses at the top and bottom of the beam at B. Assume the density of concrete as $24kN/m^3$.

2 + 10 = 12

Group – E

8\. (a) Explain the advantages of using composite construction with prestressed and in-situ concrete in structural members.

(b) A precast pretensioned beam of rectangular section has a 200mm × 400mm. The beam with an effective span of 8m is prestressed by tendons with their centroids coincide with the bottom kern. The initial force in tendons is 250kN. 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 400mm and thickness of 40mm. 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.

2 + 10 = 12

9\. Design an electric pole 12 m high to support wires at its top which can exert a reversible horizontal force of 2500N. The tendons are initially stressed to $1000N/mm^2$ and the loss of stress due to shrinkage and creep is 15%. Maximum compressive stress in concrete shall be limited to $12N/mm^2$. Take $m = 6$ and $\varphi = 30^\circ$. Soil weight = $18kN/m^3$.

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B.TECH/CE/6^{TH} SEM/CIVL 3203/2017

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) 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.

(ii) 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.

(iii) Shrinkage of concrete in a structural member is due to
(a) dead load on the member (b) live load
(c) loss of moisture (d) hardening of concrete.

(iv) Resultant stress in the cross-section of a prestressed beam comprises of
(a) prestress + dead load stress + live load stress
(b) prestress + dead load stress
(c) prestress + live load stress
(d) only direct stress + bending stress

(v) Uniformly distributed load on a concrete beam can be effectively counterbalanced by selecting
(a) concentric cable (b) eccentric cable
(c) parabolic cable (d) straight cable.

(vi) The magnitude of deflection of a prestressed beam is directly proportional to
(a) modulus elasticity of concrete
(b) prestressing force in cable
(c) second moment of area of cross-section
(d) modulus of elasticity of steel.

(vii) Web-shear cracks are likely to develop in prestressed beams with
(a) rectangular section (b) T-section
(c) I-section with thin webs (d) circular section.

(viii) The limiting zone for prestressing force in a prestressed concrete beam has a maximum range at
(a) centre of span (b) support section
(c) quarter span section (d) at one-fourth of span.

(ix) The anchorage zone in a post-tensioned beam 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.

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

Group – B

2. (a) A rectangular concrete beam 150mm wide by 300mm deep is spanning over 8m is prestressed by a straight cable carrying an effective prestressing force of 300kN located at an eccentricity of 40mm. The beam supports a live load of 2kN/m. Calculate the resultant stress distribution for the centre of span of the beam assuming density of concrete as 24kN/m^3.

(b) A prestressed concrete beam of rectangular section 200mm wide x300mm deep spans over 8m. The beam is prestressed by a straight cable carrying an effective force of 250kN at an eccentricity of 50mm. The modulus of elasticity is 38kN/m^2.
(i) Compute the deflection at centre of the span under (prestress+self-weight)
(ii) Find the magnitude of uniformly distributed live load which will nullify the deflection due to prestress and self-weight.

5 + 7 = 12

3. A post-tensioned beam of 250 X 400 mm deep is prestressed by 12 wires of 5mm diameter initially stressed with 1000N/mm^2. The cable profile is parabolic with zero eccentricity at supports and 120mm at the centre. The span of the beam is 10m. Estimate the loss of prestress due to various factors and percentage loss for the following data.
Grade of concrete: M40
E_s =210kN/mm^2
Residual shrinkage strain: 3 x10^{-4}
Relaxation of stress in steel=4%
Creep co-efficient=1.6

Co-efficient of friction between cable and duct is 0.55
Wave effect=0.0015/m
Anchorage slip=3mm.
Take E_c =$5000\sqrt{f_{ck}}$.

(5 + 7) = 12

Group – C

4. A prestressed unsymmetrical T section having overall depth 1400mm and thickness of web 175mm. The distance of the top fibre from centroid is 595mm and distance of the bottom fibre from the centroid is 805mm.
At particular section, the beam is subjected to an ultimate moment 2200kN-m S.F = 250kN
Effective depth d = 1150mm
Cube strength of concrete f_{ck} = 45N/mm^2
Effective prestress at the extreme tension face of the beam (f_{cp}) = 20N/mm^2
I = 690 × 10^8 mm^4
Area of steel A_p = 2400mm^2
Tensile strength of the tendons f_p = 1500N/mm^2
Effective stress in tendons after all losses f_{pe} = 895N/mm^2
Estimate the flexure-shear resistance of the section as per IS-1343.

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5. (a) A pre-tensioned T-section has a flange which is 300mm wide and 200mm thick. The web is 150mm wide by 400mm deep. The effective depth of the cross-section is 500mm. Given A_p = 200mm^2, f_{ck} = 50N/mm^2 and f_p = 1600N/mm^2. Estimate the ultimate moment capacity of T-section using IS code regulations.

(b) A post-tensioned prestressed beam of rectangular section of 250mm wide is to be designed for an imposed load of 12kN/m, uniformly distributed load on a span of 12m. The stress in the concrete must not exceed 17N/mm^2 in compression or 1.4N/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.

4 + 8 = 12

Group – D

6. (a) Explain the basis of the empirical relations developed by IS code to compute the transverse tensile stress and bursting tension in end blocks.