PRESTRESSED CONCRETE (SEMESTER - 8)

CS/B.TECH(CE-NEW)/SEM-8/CE-802/4/09

1. .....
Signature of Invigilator

2. .....
Signature of the Officer-in-Charge

Reg. No. | | | | | | | | | | | | | | |

Roll No. of the Candidate | | | | | | | | | | | | | | |

CS/B.TECH(CE-NEW)/SEM-8/CE-802/4/09

ENGINEERING & MANAGEMENT EXAMINATIONS, APRIL – 2009

PRESTRESSED CONCRETE (SEMESTER - 8)

Time : 3 Hours] [Full Marks : 70

INSTRUCTIONS TO THE CANDIDATES :

1. This Booklet is a Question-cum-Answer Booklet. The Booklet consists of **32 pages**. The questions of this concerned subject commence from Page No. 3.
2. a) In **Group – A**, Questions are of Multiple Choice type. You have to write the correct choice in the box provided **against each question**.
   b) For **Groups – B** & **C** you have to answer the questions in the space provided marked 'Answer Sheet'. Questions of **Group – B** are Short answer type. Questions of **Group – C** are Long answer type. Write on both sides of the paper.
3. **Fill in your Roll No. in the box** provided as in your Admit Card before answering the questions.
4. Read the instructions given inside carefully before answering.
5. You should not forget to write the corresponding question numbers while answering.
6. Do not write your name or put any special mark in the booklet that may disclose your identity, which will render you liable to disqualification. Any candidate found copying will be subject to Disciplinary Action under the relevant rules.
7. **Use of Mobile Phone and Programmable Calculator is totally prohibited in the examination hall.**
8. You should return the booklet to the invigilator at the end of the examination and should not take any page of this booklet with you outside the examination hall, **which will lead to disqualification**.
9. Rough work, if necessary is to be done in this booklet only and cross it through.

No additional sheets are to be used and no loose paper will be provided

FOR OFFICE USE / EVALUATION ONLY

Marks Obtained

	Group – A										Group – B			Group – C			***Total Marks***	***Examiner's Signature***
Question Number																		
Marks Obtained																		

.....
Head-Examiner/Co-Ordinator/Scrutineer

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Relevant IS Codes are allowed for use in examination hall.

GROUP – A

(Multiple Choice Type Questions)

1. Choose correct answer for any *ten* of the following : 10 × 1 = 10

i) In prestressed concrete members, the steel is under

a) compression

b) tension

c) torsion. ☐

ii) The grade of concrete for prestressed members should be in the range of

a) M-20 to M-30

b) M-80 to M-100

c) M-30 to M-60. ☐

iii) Freyssinet system is based on the principle of

a) direct bearing on concrete from bolt heads at the end of wires

b) looping of the wires around concrete

c) wedge action producing frictional grip between steel and concrete. ☐

iv) In a prestressed concrete beam subjected to prestress only

a) pressure line shifts from the cable line towards the top of beam

b) pressure line coincides with the cable line

c) pressure line shifts from cable line towards the soffit of beam. ☐

v) Loss of stress due to creep of concrete is influenced by

a) friction

b) creep coefficient

c) anchorage slip. ☐

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vi) Maximum permissible final deflection of a beam should not exceed

a) span/350

b) span/250

c) span/480. ☐

vii) The maximum effective reinforcement ratio of a bonded prestressed concrete beam at failure according to IS : 1343 is limited to a value of

a) 0·15

b) 0·4

c) 0·25. ☐

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

a) rectangular section

b) I-section

c) hollow box girder section. ☐

ix) Stressing concordant cables in continuous structures result in

a) primary reactions

b) zero redundant reactions

c) axial thrust. ☐

x) Prestressed concrete poles are mass produced using

a) separate forms for each unit

b) long line method of pretensioning

c) post-tensioning each unit. ☐

xi) Excessive upward deflections are likely in the case of member designed as

a) partially prestressed

b) moderately prestressed

c) fully prestressed

d) reinforced cement concrete. ☐

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xii) 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) 20 kN-m. [ ]

xiii) In Magnel's graphical method of solving eccentricity (e) and prestresing force (P), the value of P is determined corresponding to

a) maximum e

b) minimum e

c) both maximume and minimum e

d) average e. [ ]

GROUP – B

(Short Answer Type Questions)

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

2. A prestressed concrete beam 200 mm wide and 300 mm deep is prestressed with wires (area = 320 mm ^{2}) located at a constant eccentricity of 50 mm and carrying an initial stress of 1000 N/mm ^{2} . The span of the beam is 10 m. Calculate the percentage loss of stress in wires if the beam is pre-tensioned using the following data :

E_S = 210 kN/mm ^{2} , E_c = 35 kN/mm ^{2}

Relaxation of steel stress = 5 per cent of initial stress

Shrinkage of concrete = 300 × 10 $^{-6}$ per unit length

Creep coefficient = 1·6.

3. A concrete beam with a cross-sectional area of 32 × 10 ^{3} mm ^{2} and radius of gyration of 72 mm is prestressed by a parabolic cable carrying an effective stress of 1000 N/mm ^{2} . The span of the beam is 8 m. The cable composed of 6 wires of 7 mm diameter, has an eccentricity of 50 mm and zero at the supports. Neglecting all losses, find the central deflection of the beam as follows :

a) Self-weight + prestress.

b) Self-weight + prestress + L.L. of 2 kN/m.

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4. Derive the expressions for prestressing force and eccentricity required in the design of flexure. Your answer should consist of stress diagrams applicable in design of sections for flexure.

5. Explain the stresses developed in the anchorage zone with sketch. Also explain bursting tension and splitting crack.

6. What is partial prestressing ? What are the advantages of partial prestressing ? What is the use of non-prestress reinforcement in partial prestressing ?

7. List the various types of losses of prestress in pretensioned and post-tensioned members.

GROUP – C

(Long Answer Type Questions)

Answer any *three* questions. $3 \times 15 = 45$

8. Design for shear, torsion & bending in case of a post-tensioned bonded prestressed concrete beam subjected to T_u = 70 kN–m, V_u = 100 kN & M_u = 250 kN–m.

   Take b = 400 mm, D = 550 mm, f_{ck} = 40 N/mm^2 ,

   A_p = 506 mm^2 , f_p = 1820 N/mm^2 , P_e = 500 kN & e = 150 mm.

   Take f_y = 250 N/mm^2 for stirrups.

   Use IS : 1343 – 1980. 15

9. A precast pre-tensioned beam of rectangular section has a breadth of 100 mm and a depth of 200 mm. The beam with an effective span of 5 m is prestressed by tendons with their centroids coinciding with the bottom kern. Compute the resultant stresses developed in the precast pretensioned beam and cast-in-situ slab shown in *Fig. 1* for the propped case if the moduli of elasticity of concrete in precast beam and cast-in-situ slab are same. Take, P_i = 150 kN, λ (Losses) = 15%, L.L. = 8 kN/m^2 . 15

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Fig. 1

10. A two-span continuous prestressed concrete beam *ABC* has a uniform cross-section as shown in *Fig. 2*. A cable carrying an effective prestressing force of 500 kN is parallel to the axis of the beam and located at an ecentricity of 200 mm.

    a) Determine the secondary and resultant moment developed at the mid-support Section - *B*.

    b) If the beam supports a L.L. of 2·4 kN/m, calculate the resultant stress developed at the top and bottom at *B*. Also locate the resultant line of thrust through the beam *AB*. 15

Fig. 2

11. a) The end block of a post-tensioned prestressed member is 250 mm wide and 250 mm deep. Four cables, each made up of 7 wires of 12 mm diameter strands and carrying a force of 100 kN, are anchored by plate anchorages, 150 mm by 150 mm, located with their centres at 125 mm from the edges of the end block. The cable duct is of 50 mm diameter. The 28 - day cube strength of concrete f_{cu} is 45 N/mm ^{2} . The cube strength of concrete at transfer f_{ci} is 25 N/mm ^{2} . Permissible bearing stresses behind anchorages should conform with IS : 1343. The characteristic yield stress in mild steel anchorage reinforcement is 260 N/mm ^{2} . Design suitable anchorages for the end block.

    b) The end block of a post-tensioned bridge girder is 600 mm wide by 1200 mm deep. Two cables, each comprising 97 high tensile wires of 7 mm diameter, are anchored using square anchor plates of side length 410 mm with their centres located at 600 mm from the top and bottom edges of the beam. The jacking force

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in each cable is 4500 kN. Design a suitable anchorage zone reinforcement using Fe – 415 grade HYSD bars conforming to IS : 1343 code provisions.

9 + 6 = 15

12. A post-tensioned prestressed beam of rectangular section 250 mm wide is to be designed for an imposed load of 12 kN/m, uniformly distributed 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 per cent. Calculate

a) the minimum possible depth of the beam

b) for the section provided the minimum prestressing force and the corresponding eccentricity. 8 + 7 = 15

13. A partially prestressed pre-tensioned mast is to be designed to suit the following data :

Free standing height of pole above the ground = 10 m.

The pole is subjected to a working moment of 25·5 kN-m due to wind load and working torsional moment of 3 kN-m due to tension from conductor in high voltage line. 28 day cube strength of concrete = 50 N/mm ^{2} . Modulus of elasticity of concrete = 40·5 kN/mm ^{2} . Modulus of rupture of concrete = 5N/mm ^{2} . High tensile wires of 5 mm diameter is available. Ultimate tensile strength = 1600 N/mm ^{2} .

Loss ratio = 0·7. Permissible stress in concrete under service load. Compressive stress in concrete under service loads. Compressive stress in concrete f_{cw} = 18 N/mm ^{2} . Tensile stress in concrete f_{tw} = 5 N/mm ^{2} .

a) Design the section.

b) Check for limit state of collapse

c) Check for torsion due to skew snapping of wires. 5 + 5 + 5 = 15

END

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