Name : .....

Roll No. : .....

Invigilator's Signature : .....

CS/B.Tech(CE)/SEM-7/CE-704/2009-10

2009

STRUCTURAL DESIGN - IV

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)

Use of IS 456, 875, 1893, 3370, 1343 and IRC 6, 21 (2000) is permitted

1. Choose the correct alternatives for any *ten* of the following : $10 \times 1 = 10$

   i) The average response acceleration coefficient for natural period of vibration of 0.1 sec is

      a) 2.50 b) 1.0

      c) 3.50 d) 2.0.

   ii) The natural period of vibration for unbraced RC building is given by

      a) $0.075\ h^{0.75}$ b) $0.085\ h^{0.75}$

      c) $0.075\ h^{0.85}$ d) $0.085\ h^{0.85}$.

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iii) The response reduction factor in case of Ordinary Moment Resisting Frame is

a) 3.0 b) 4.0

c) 2.0 d) 5.0.

iv) The design wind speed is 50 m/sec. The design wind pressure in N/m^2 will be

a) 1242 b) 1622

c) 1500 d) 1550.

v) The maximum permissible stress in direct tension and bending in N/mm^2 for M25 grade of concrete is

a) 1.3 and 1.8 b) 1.2 and 1.5

c) 1.0 and 1.2 d) 2.0 and 2.5.

vi) A section is said to develop a plastic hinge when due to flexure the stress at every point of the section is equal to

a) Yield stress b) Ultimate stress

c) Working stress d) None of these.

vii) The loss which occurs only in post-tensioned members is

a) Friction loss

b) Loss due to elastic shortening

c) Loss due to creep

d) None of these.

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viii) The axle load in case of IRC class A loading is

a) $11.4t$ b) 70 kN

c) 68 kN d) $4t$.

ix) The shape factor for a beam of circular section of radius R is

a) 1.3 b) 1.72

c) 1.698 d) 2.0.

x) The minimum clearance, f, between the outer edge of the wheel and the roadway face of the kerb is

a) 150 mm b) 130 mm

c) 110 mm d) 170 mm.

xi) If the design horizontal seismic coefficient A_{h0} is 0.4 and the total weight is 9317 kN, the design base shear is

a) 373 kN b) 350 kN

c) 300 kN d) none of these.

xii) The permissible stress in steel in case of HYSD bars to be used in design of water tank is

a) 150 N/mm ^{2} b) 230 N/mm ^{2}

c) 190 N/mm ^{2} d) 115 N/mm ^{2} .

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xiii) The pressure line can be obtained in case of

a) PCC members b) RCC members

c) Prestressed members d) Steel members.

GROUP – B

(Short Answer Type Questions)

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

2. What are the advantages and disadvantages of pre-stressed concrete w.r.t. reinforced concrete structures ?

3. What are the substructure components of an r.c.c. bridge ? Detail the limitations of Pigeau's method and the applicability conditions of Courbon's method used for the design of RCC bridges.

4. Detail the various types of losses in prestressed concrete both for pre-tensioned and post-tensioned cases. Explain the pressure line concept of stress analysis in prestressed concrete structures.

5. Define shape factor of a steel beam section. Calculate the shape factor of a solid circular beam section of diameter *D*.

6. Detail the various components of a typical through type steel truss railway bridge and explain the load transfer mechanism.

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GROUP – C

(Long Answer Type Questions)

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

7. Design by IRC method, the thickness of one of a series of simply supported RCC deck slabs of a road bridge for IRC standard class AA tracked loading, given the following data :

   * Clear span — 8 metres
   * Clear roadway width — 6.6 metres
   * Thickness of piers — 1.0 metres
   * Kerb width — 22.5 cm
   * Thickness of wearing course — 7.5 cm.

   Constant of dispersion (k) may be selected from the following table :

Ratio (L'/L)	k
0.6	0.49
0.7	0.53
0.8	0.55
0.9	0.59
1.0	0.62

8. Enumerate various losses of prestress and their respective remedies.

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9. A simply supported beam of length L, is subjected to a uniformly distributed load of intensity ω. The beam is having a triangular cross-section having width of base b, and height h as shown below. Determine the length of the plastic hinge, formed by the given load intensity.

Dia.

10. A post-tensioned prestressed concrete beam of 30 m span is subjected to a prestressing force of 2500 kN at 28 days strength. The profile of the cable is parabolic with maximum eccentricity of 200 mm at midspan. Determine losses of prestress and the jacking force required if jacking is done from both ends of the beam. The beam has a cross-section of 500 mm × 800 mm and is prestressed with 9 cables, each cable consisting of 12 wires of 5 mm diameter. Take $E_S = 2.1 \times 10^5$ N/mm^2 and $E_C = 3.5 \times 10^4$ N/mm^2. Assume one cable is tensioned at a time.

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11. i) Find out the collapse load P_U for the following frame. All the members are having equal plastic moment capacity P_P .

Dia

ii) Depict upper bound, lower bound and uniqueness theorem. 8 + 7

12. A multistoried building having 20 m × 30 m plan dimensions and overall height of 30 m (ground floor height is 5 m and heights of other floors are 4 m and parapet height is of 1 m) is to be constructed at Kolkata. Each floor consists of 4/6 panel each of 5 m × 5 m size. Determine the design wind pressure acting on the building and draw the pressure diagram. Also determine wind loads on an internal frame at node points. Values of K_2 at heights 10 m, 15 m, 20 m and 30 m are respectively 0.88, 0.94. 0.98 and 1.03. Values of K_1 and K_3 may be taken as 1.08 and 1.00.

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13. The typical floor plan of an unbraced building consists of 3 × 3 panel, each panel being 6 m × 6 m dimension having ground floor and five upper floors. The dead load and appropriate live load at the levels are shown in the following table :

Table : DL and LL at different levels :

Floor	*Level*	*External column load* (kN)	*Internal column load* (kN)	*Height from base* (m)
5th + 28.7m	6-6	141	216	30.6
4th + 23.7m	5-5	218	320	25.6
3rd + 18.7m	4-4	218	320	20.6
2nd + 13.7m	3-3	218	320	15.6
1st + 8.7m	2-2	218	320	10.6
GF + 3.7m	1-1	218	320	5.6
GG – 0.6m	0-0	27	37	1.3

The building is in zone IV. Analyze the building for earth-quake loads for an external frame.

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