Name : .....

Roll No. : .....

Invigilator's Signature : .....

CS/B.TECH(CE)/SEP.SUPPLE/SEM-7/CE-704/2012

2012

STRUCTURAL DESIGN-III

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)

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

   i) The ratio of ultimate load to working load is called

   a) Load factor b) Factor of safety

   c) Impact factor d) Any of these.

   ii) The expression of factored load for the combination of D.L and L.L. for limit state of collapse is

   a) (D.L. + L.L) b) 1·5 D.L. + L.L.

   c) 1·2 (D.L. + L.L.) d) none of these.

   iii) Design wind pressure (N/m^2) corresponding to design wind speed of 56·5 m/sec is

   a) 1596·9 b) 1915·35

   c) 1276·9 d) none of these.

iv) Pigeaud's method is applicable in case of deck slabs for computing

a) bending moment b) shear force

c) torsional moment d) none of these.

v) The impact factor for live load on a bridge is

a) directly proportional to span

b) inversely proportional to span

c) proportional to square of span

d) constant.

vi) In a portal frame, if a point load is only placed on any column, then the mechanism on column is known as

a) Beam b) Column

c) Sway d) Composite.

vii) 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.

viii) 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.

ix) 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.

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

a) 11.4 t b) 70 kN

c) 68 kN d) 4t.

xi) If the design horizontal seismic coefficient (A_h) 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.

GROUP – B

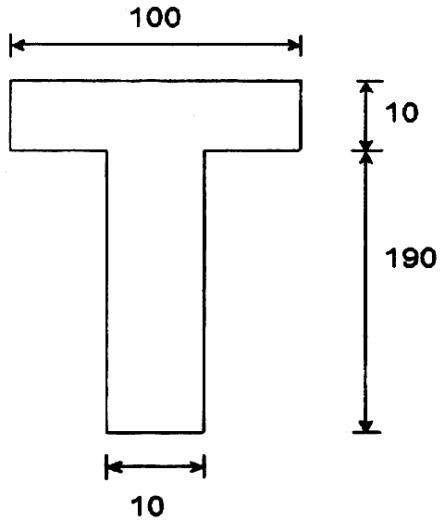
(Short Answer Type Questions)

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

2. Prove the statement for Bridge Engineering "For most Economical Span-the cost of the Superstructure equals to the cost of the substructure".

3. Briefly explain the difference between IRC class AA Loading and IRC 70R Loading, as per IRC 6-1984.

4. Determine the shape factor and plastic moment capacity of the 'T' section as shown below. The centroidal axis is located at a distance of 129·48 mm from the bottom fibre and the moment of inertia of the section is $1{\cdot}22 \times 10^7$ mm^4. Take yield stress of steel as 250 N/mm^2.



All dimensions are in mm

5. What are the substructure components of an RCC bridge ? Detail the applicability conditions of Courbon's method used for the design of RCC Bridge.

6. Find out the differences of dispersion of live load by Piegeaud's Method with any other rational method.

7. A beam fixed at both ends has a span of 9 m carries two point loads of 60 kN and 120 kN at 3 m and 6 m respectively from the left hand support. Taking the yield stress as 250 N/mm^2, design the section allowing a load factor of 1·15.

GROUP – C

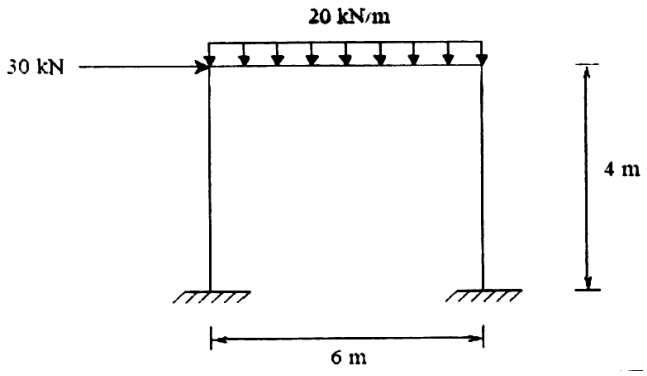
(Long Answer Type Questions)

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

8. Design a circular tank for a capacity of 450 kilolitres. The tank rests on firm ground. The walls are fixed at base and free at top. The elevation of the tank is shown below for consideration of design parameters. Use IS 3370. Use grade of concrete M20 and steel as Fe 415.

9. A rectangular concrete beam of cross-section 30 cm deep and 20 cm wide is prestressed by means of 15 wires of 5 mm diameter located 6·5 cm from the bottom of beam and 3 wires of diameter 5 mm, 2.5 cm from top. Assuming the prestress in steel 840 N/mm^2, calculate the stress at extreme fibres of the mid-span section of the beam when the beam is supporting its own weight and an imposed load of 6 kN/m over a span of 6 m. The density of concrete is 24 kN/m^3. Also compute the losses due to elastic deformation of concrete.

10. Determine the load factor (minimum value considering different mechanisms) for the portal frame as shown below if plastic moment capacity of all members is 100 kN-m (use kinematic method)

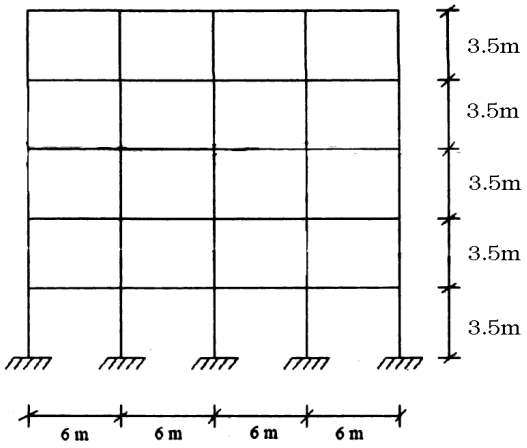


11. Calculate the seismic load at different floor levels for the external frame as shown below of a building. The building is situated at Guwahati. Type of soil on which the building is constructed is medium hard.

The D.L. + L.L. on the internal spans of floor slab is 5 kN/m

The DL. + L.L. on the external spans of floor slab is 6 kN/m

The D.L. + L.L. on the roof slab span is 4 kN/m



12. Design a reinforced concrete slab culvert for a National Highway to suit the following data :

Carriage Way -Two Lane-7·5 m wide

Footpaths -1 m on either side

Clear Span-6m

Wearing coat-80 mm

Width of bearing = 400 mm

Loading IRC class AA

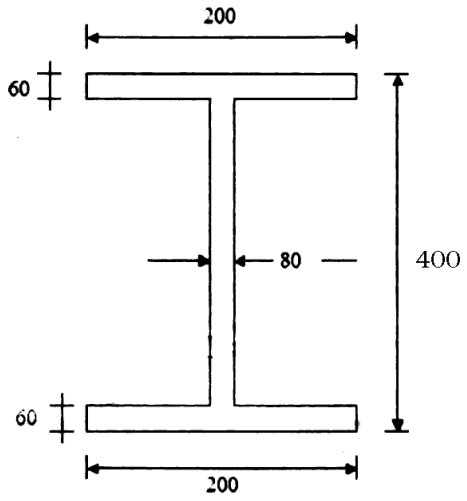
Materials to be used M30 grade concrete and Fe 415 HYSD reinforcement.

13. A prestressed concrete beam of *I* section supports a live load of 4 kN/m over a simply supported span of 8 m. The beam is to be prestressed such that effective stress at the soffit of the beam at the centre of span is zero. Assume density of concrete is 24 kN/ m^3.

    a) Find the eccentricity required

    b) Find the location of pressure line or thrust line

    c) If the tendon is concentric, what should be the magnitude of the pre-stressing force for the resultant stress to be zero at the bottom fibre of the central span section ?



All dimensions are in 'mm'