Name : .....

Roll No. : .....

Invigilator's Signature : .....

CS/B. TECH (CE)/SEM-5/CE-504/2010-11

2010-11
STRUCTURAL ANALYSIS - II

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) An arch resists the external load by

      a) Normal thrust

      b) Normal thrust and bending moment

      c) Bending moment and radial shear.

      d) Normal thrust, radial shear and bending moment.

   ii) Bending moment in a two hinged parabolic arch carrying U.D.L throughout

      a) Varies linearly

      b) is maximum at the crown

      c) is zero everywhere

      d) none of these.

iii) Castigliano's theorem is applied when
   a) the system behaves elastically
   b) the system behaves inelastically,
   c) only principle of support position is valid
   d) none of these.

iv) The moment distribution method is best suited for
   a) indeterminate pin jointed truss
   b) rigid frames
   c) space frames
   d) trussed beam.

v) In a rigid jointed structure at any joint
   a) the members undergo the same rotation
   b) the members have zero bending moment
   c) there is no deflection
   d) the bending moment in the members are indeterminate.

vi) The rotational stiffness of a cantilever beam at its free end is
   a) EI/l b) 2EI/l
   c) 3EI/l d) 4EI/l.

vii) Clockwise moments are applied to both the ends of a uniformly simply supported beam. If the ratio of the rotation of two ends is 2 then the ratio of the applied moments will be
   a) 3/2 b) 5/3
   c) 7/5 d) 5/4.

viii) In a portal frame with columns of same height and fixed base, the sum of displacement factors of column in Kani's method is

a) –2 b) –1.5

c) –1 d) +1.5

ix) In Kani's method, errors mode during iteration from one cycle to another cycle get stored.

a) True

b) True if number of cycles is too large

c) False

d) True for frames only.

x) The moment of inertia of analogous column of a propped cantilever of length, I and constant EI is equal to

a) $l^3/3EI$ b) $l^3/4EI$

c) $l^3/12EI$ d) $l^3/48EI$.

xi) If the sag of the cable suspended between two points decreases then horizontal component of tension will

a) Increase b) Decrease

c) Remain same d) Zero.

GROUP – B

(Short Answer Type Questions)

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

2. A three hinged arch as shown in Fig. (1) consists of two quadrantal parts AC and CB of radii R_1 and R_2. The arch carries a concentrated load W on the crown. Find the horizontal thrust at each support.

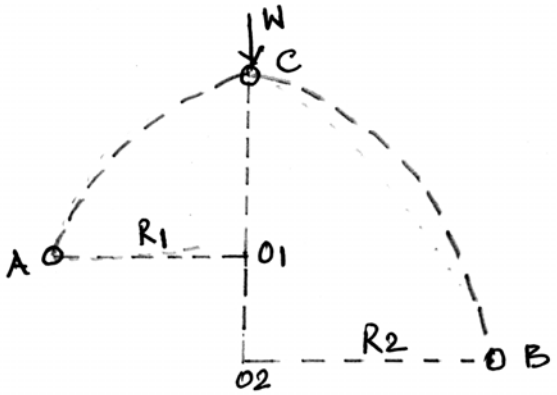

Fig. (1)

3. A beam AB of span 4 metres fixed at A and simply support at B carries two point loads 100kN and 60kN at a distance of 2 m and 3 m from the fixed end A as shown in Fig. (2). Find the support moment and draw the BM Diagram.

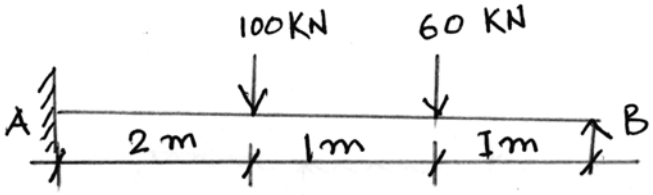

Fig. (2)

4. A fixed beam of span *l* carries a point load W at mid-span. The beam is of uniform cross-section. Determine the fixed end moment using column analogy method.

5. A flexible cable weighting 10 N/metre hangs between two supports 50 metres horizontally apart as shown in Fig (3). The left support is 8 metres below the right support. The cable also supports a point load of 1200 N at a point 15 metres below this support. Assuming that the weight of the cable is spread uniformly on the horizontal span, find the maximum tension for the cable.

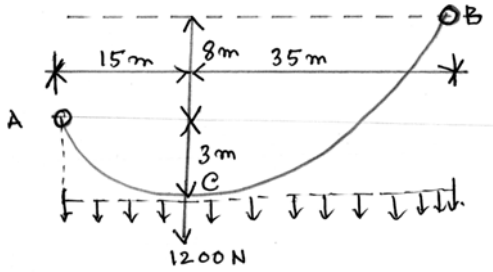

Fig. (3)

6. Analyse the culverts from ABCD as shown in Fig. (4). Assume all members have the same flexural rigidity.

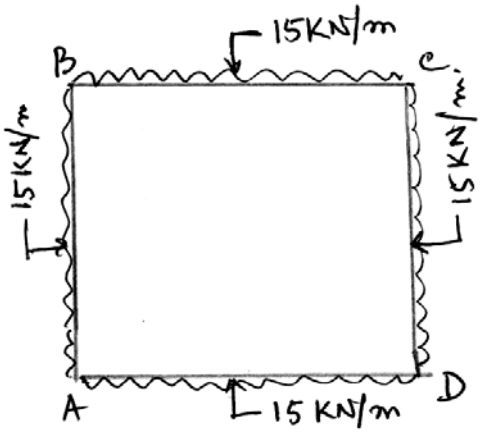

Fig. (4)

7. Derive the slope deflection equation.

GROUP – C

(Long Answer Type Questions)

Answer any *three* of the following. $3 \times 15 = 45$

8. A three hinged parabolic arch has a span of 40 metres and a rise of 8 metres. Draw influence lines for the following :

   i) Horizontal thrust.

   ii) Bending moment for the section 15 metres from the left end.

   iii) Normal thrust at above section.

   iv) Radial shear at the above section.

9. A continuous beam ABCD is fixed at A and supported over B, C and D respectively. The length of span AB, BC and CD are 4 m, 4 m and 6 m respectively. The moment of inertia of span AB, BC are I and moment of inertia of span CD is 2I. The span AB is loaded with u.d.1. 30 kN/m. A 60 kN point load is acting at the middle of BC. Another point load of 60 kN is acting in the span CD at a distance 2 m from C.

   Analyse the continuous beam ABCD by slope deflection method and draw bending moment diagram.

10. A continuous beam ABCD is fixed at A and simply supported on B, C and D. The flexural rigidity of the beam is constant all along. A point load 50 kN is acting on the mid-span of AB, a u.d.1. of 20 kN/m is acting over the entire span of BC and another point load 50 kN is acting at mid-span of CD. The

length of AB,BC and CD are equal of 4 m each. Calculate the moments at different supports by Kani's method as well as draw the BM diagram of the beam.

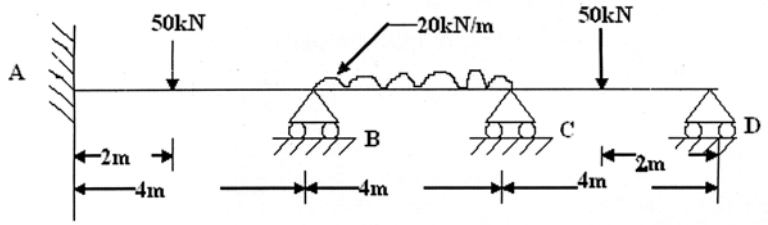

Fig. (5)

11. A symmetrical portal frame consists of vertical members AB and CD and a horizontal member BC. The modulus of rigidity of the entire portal frame is constant. The span of AB and BC are of 4 m each. The span of BC is of 6 m. Two point loads of 30 kN are acting at a distance of 2 m as well as of 4 m from the left support of beam BC. UDL of magnitude 12kN/m is acting over the entire span of AB and CD directing inward. Find out the moment at support point and also draw B.M. diagram.

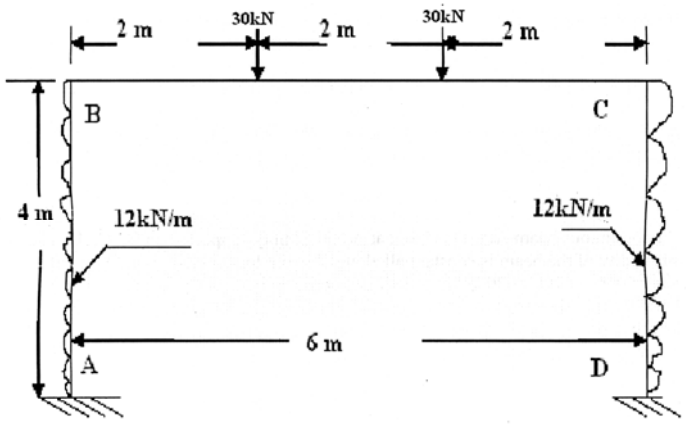

Fig. (6)

12. A semicircular curved beam of radius R lies in a horizontal plane. The curved beam is simply supported on three equally spaced supports A,B and C. The arcs AC and BC are equal. A uniformly distributed load of intensity w acts vertically on the horizontal curved beam over entire length. Analyze the curved beam and draw the shear force diagram, bending moment diagram and twisting moment diagram.

13. A continuous beam ABCD is simply supported over B and C and fixed at ends A and B. The spans of AB, BC and CD are of 3 m, 2 m and 3 m respectively. If the support B sinks by an amount 2.5 cm, find the support moments. Given $I=3.50 \times 10^7$ mm^4. E = 200 kN/mm^2.