STRUCTURAL ANALYSIS - I
(CIVL 2201)

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) The deflection at any point of a frame can be obtained by applying a unit load at the joint in
(a) vertical direction
(b) horizontal direction
(c) inclined direction
(d) the direction in which the deflection is required.

(ii) Castigliano's theorem for deflection is true for
(a) linearly elastic structure (b) rigid structure
(c) non linearly elastic structure (d) any structure.

(iii) What is the degree of kinematic indeterminacy of the beam shown in Fig.1, if the axial deformation is ignored?

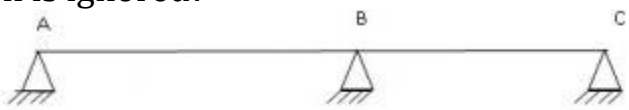

Fig.1

(a) 1 (b) 2 (c) 3 (d) 4.

(iv) The maximum bending moment due to train of wheel loads on a simply supported girder
(a) always occurs at centre of span
(b) always occurs under a wheel load
(c) always occur under the resultant of wheel loads
(d) never occurs under a wheel load.

(v) In influence line diagrams
(a) points remain fixed, position of load changes
(b) points change, position of loads remains fixed
(c) both of them changes
(d) alternately when one changes other remains fixed.

(vi) A single rolling load of 8 KN along a girder of 15 m spans. The absolute maximum bending moment will be
(a) 8 KN.m (b) 15 KN.m (c) 30 KN.m (d) 60 KN.m.

(vii) Three moment equation is applicable only when
(a) the beam is prismatic
(b) there is no settlement of supports
(c) there is no discontinuities such as hinges within the span
(d) the spans are equal

(viii) The castigliano's second theorem can be used to compute deflections
(a) in a statically determinate structures only
(b) for any type of structure
(c) at the point under the load only
(d) for beams and frames only.

(ix) When a load is applied to a structure with rigid joints
(a) there is no rotation or displacement of joint
(b) there is no rotation of the joint
(c) there is no displacement of joint
(d) there can be rotation and displacement of joint but the angle between the members connected to the joint remains same even after application of the load

(x) If in a pin-jointed plane truss (m + r) > 2j, then the truss is (Where 'm', 'r' and 'j' are standard notations)
(a) stable and statically determinate
(b) stable and statically indeterminate
(c) unstable
(d) internally stable but externally unstable.

Group – B

2. (a) Compute the stability, determinacy or indeterminacy of the following frames shown in Fig. 2(a), 2(b), 2(c).

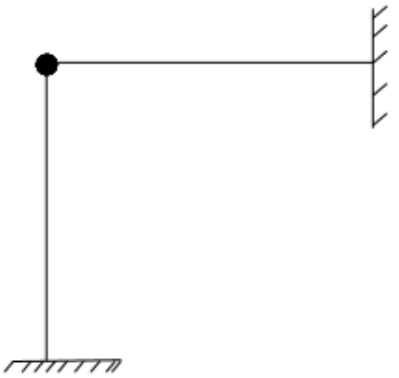

Fig. 2(a)

Fig. 2(b)

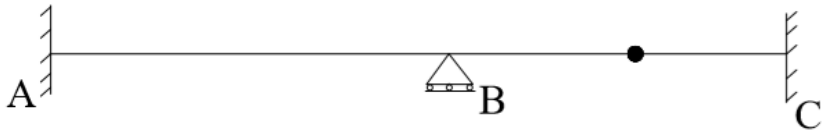

Fig. 2(c)

(b) Analyze the following portal frame as shown in Fig.3 and draw the bending moment diagram of the frame.

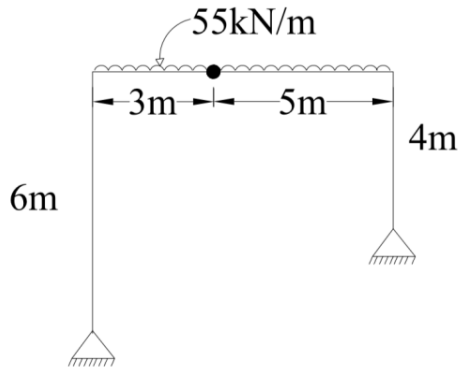

Fig.3

(3 × 2) + 6 = 12

3. (a) Calculate the deflection of joint B as shown in Fig.4 by unit load method.

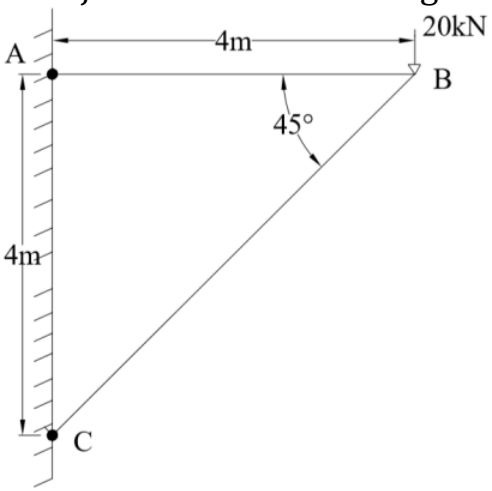

Fig.4

(b) A three hinged arch consist of two quadrantal parts AC and CB of radii 3m and 6m respectively as shown in Fig. 5. For the load system acting on the arch, calculate the reactions at the supports and the bending moments under the loads.

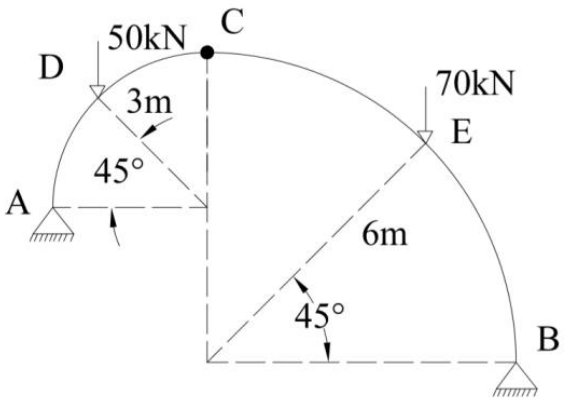

Fig.5

6 + 6 = 12

Group – C

4. Determine the maximum compressive force developed in member *BG* of the given truss (refer Fig.6) due to the right side wheel loads of the car and trailer. Assume the loads are applied directly to the truss and move only to the right.

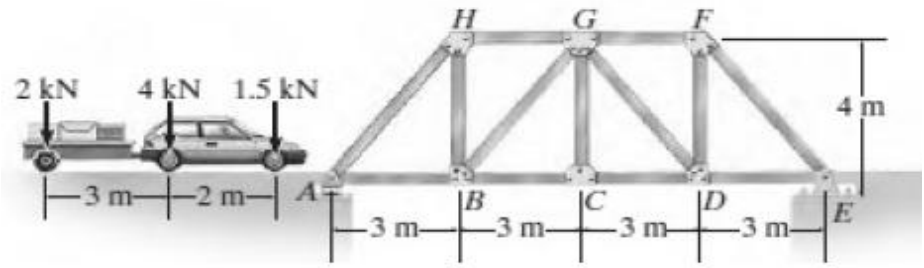

Fig.6

12

5. Determine the maximum positive moment at point *C* on the single girder shown in Fig.7 caused by the moving load.

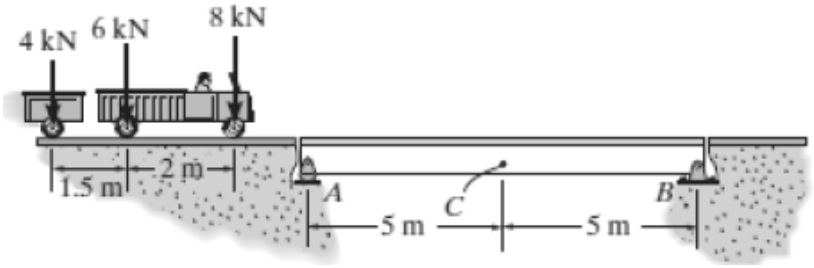

Fig.7

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Group – D

6. (a) A continuous beam ABC given in Fig.8, 15 m long is carried on supports at its end and is propped at the same level at points 7.5 m from left end A. It carries a concentrated load of 80 kN at 3.0 m from A and uniformly distributed load of 10 kN/m run over the span BC. Using three-moment equations, calculate bending moment and support reactions at three supports. Assume EI is constant.

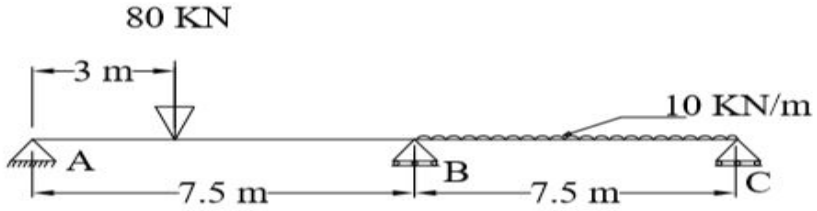

Fig.8

(b) Determine the reaction at the roller support B of the beam as shown in the Fig.9 using method of consistent deformation. Assume EI is constant.

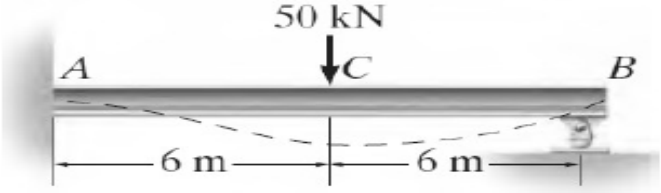

Fig.9

6 + 6 = 12

7. (a) A beam (refer Fig.10) of uniform section and of length 2L is freely supported by rigid supports at its ends and by an elastic prop at its centre. If the prop deflects by an amount λ times the load it carries and if the beam carries a total distributed load of W show that the load carried by the prop is $\frac{5W}{g(1+\frac{6EI\lambda}{L^3})}$

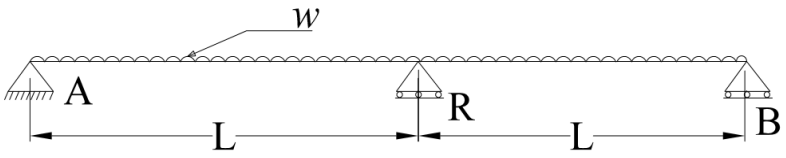

Fig.10

(b) A parabolic arch, hinged at the ends has a span (L) 30 m and rise 5 m. A concentrated load (W) of 12 KN acts at distance (x) 10 m from the left hinge. The second moment of area varies as the secant of the slope of the rib axis. Calculate the horizontal thrust and the reaction at the hinges. Also, calculate the maximum bending moment anywhere on the arch. (Refer Fig.11)

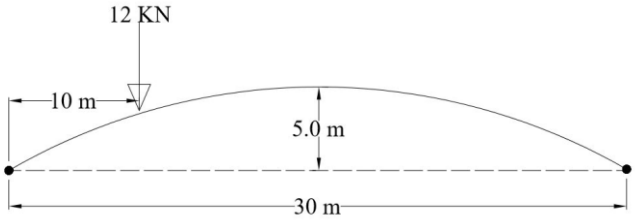

Fig.11

6 + 6 = 12

Group – E

8. Compute the ordinates of influence lines for reaction R_A for the beam shown (refer Fig. 12) at 1 m interval and draw the influence line diagram. The moment of inertia is constant throughout.

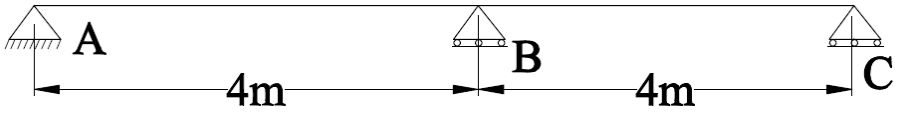

Fig.12

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9. A two-hinged parabolic arch has a horizontal span of 18m and a central rise of 1.8 m (refer Fig.13). Draw influence line diagrams for (i) Horizontal thrust at support (ii) B.M. at a section 6 m from the left support.

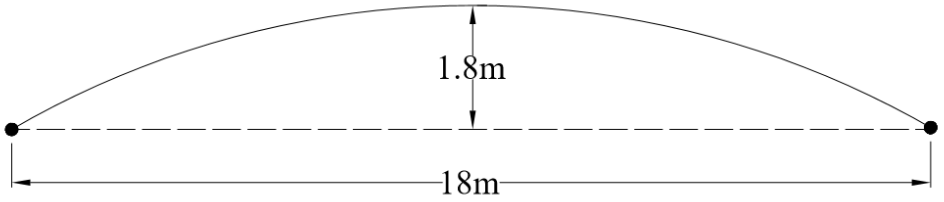

Fig.13

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