

ANALYSIS OF STRUCTURES - 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.

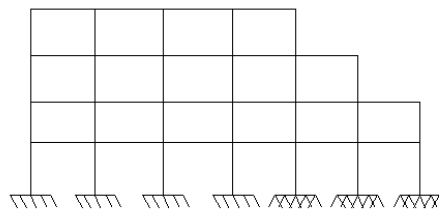
Candidates are required to give answer in their own words as far as practicable.

Group - A
(Multiple Choice Type Questions)

1. Choose the correct alternative for the following: **10 × 1 = 10**

- (i) When a uniformly distributed load, longer than the span of the girder, moves from left to right, then the maximum bending moment at mid-section of span occurs when the uniformly distributed load occupies
 (a) less than the left half span (b) whole of left half span
 (c) more than the left half span (d) whole span.

- (ii) Find out the degree of static indeterminacy of the following frame.



- (a) 52 (b) 42 (c) 63 (d) 68.
- (iii) A simply supported beam of flexural rigidity 'EI' and span l, carries an udl of value w kN/m throughout its span. The expression for deflection of the beam, at the midpoint will be
 (a) $5wl^4/584EI$ (b) $5wl^4/384EI$ (c) $wl^3/3EI$ (d) $wl^3/48EI$.

- (iv) A parabolic two hinged arch subjected to uniformly distributed loading per unit horizontal length over the entire span has
 (a) zero B.M. at all sections (b) maximum normal thrust at the crown
 (c) has varying radial shear over its length (d) a parabolic variation of BM over the span.

- (v) What is the degree of kinematic indeterminacy of the beam shown below, if the axial deformation is ignored?



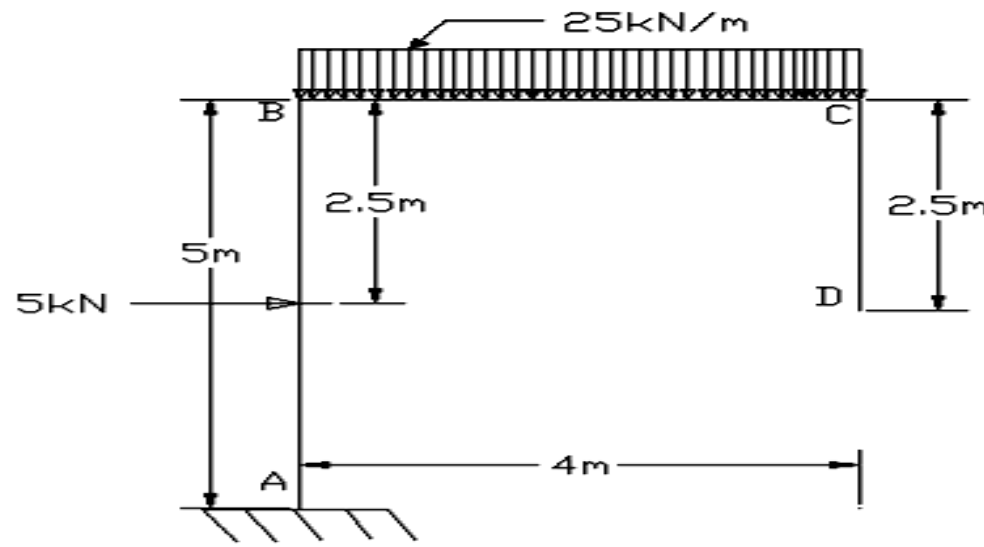
- (a) 2 (b) 3 (c) 4 (d) 5
- (vi) The three moments equation is applicable only when
 (a) the beam is prismatic (b) there is no settlement of supports
 (c) there is no discontinuity within the span (d) the spans are equal.
- (vii) The castigliano's second theorem can be used to compute deflections
 (a) 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.
- (viii) 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

- (ix) For a two-hinged arch if one of the support settles down vertically, then the horizontal thrust is
 (a) increased (b) decreased (c) remains unchanged (d) becomes zero.

- (x) Muller Breslau's principle for obtaining the influence lines is applicable to
 (a) trusses
 (b) statically determinate structures
 (c) statically indeterminate structures
 (d) material which is elastic and follows Hooke's law.

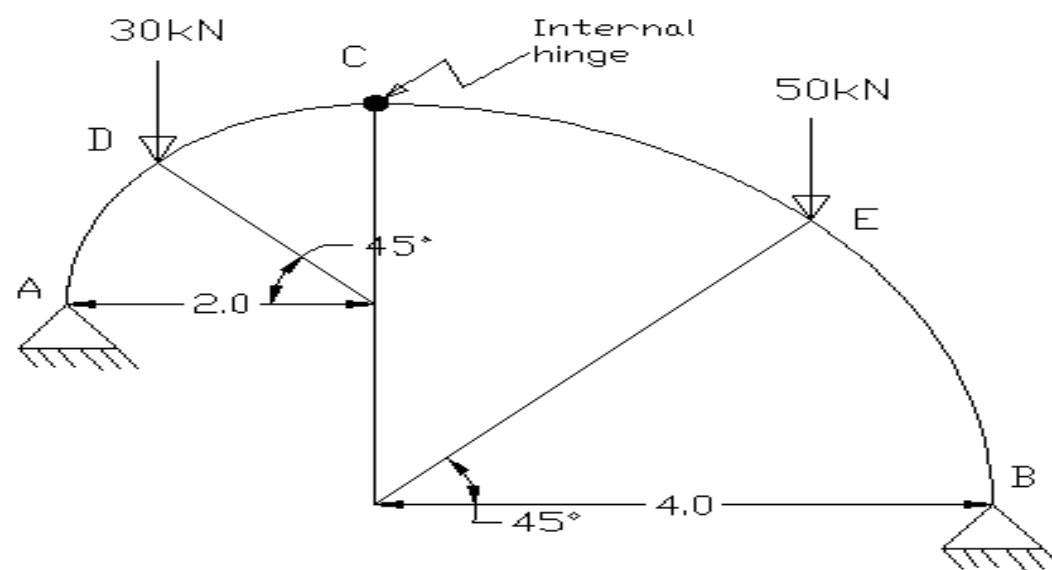
Group - B

2. Determine the vertical and horizontal displacement of the free end "D" in the following frame. Given, $EI = 12 \times 10^{13} \text{ N-mm}^2$. EI is constant throughout.

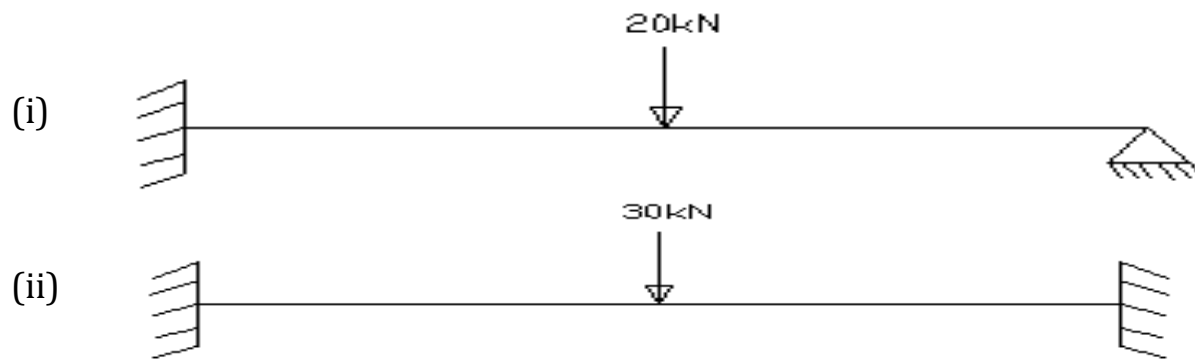


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3. (a) A three hinged arch consists of two quadrantal parts AC and CB of radii 2m and 4m respectively. For the load system acting on the arch, calculate the reactions at the supports and the bending moments under the loads.



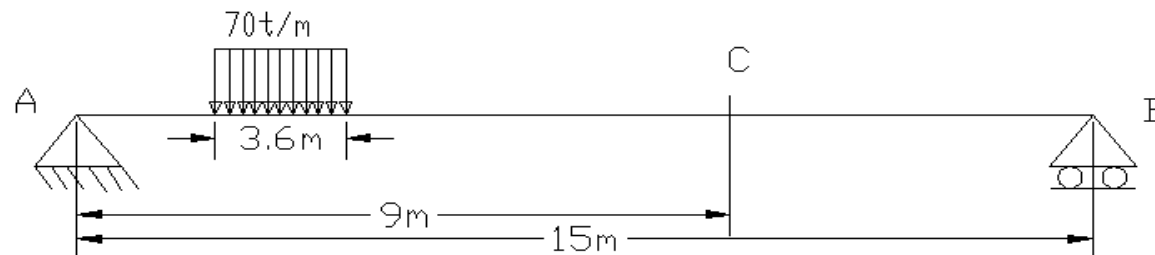
- (b) Find out the degree of Kinematic indeterminacy of the following:



8 + (2 + 2) = 12

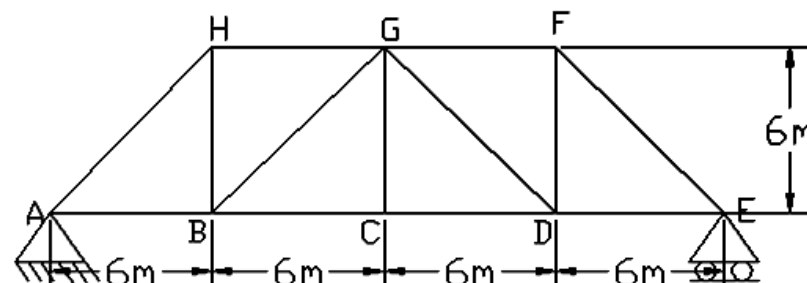
Group - C

4. Prepare the ILD for reaction forces, shear forces and bending moments at section C. Evaluate the maximum value of positive shear and bending moment that can develop at section C under a uniformly moving load of 70t/m of length 3.6m.



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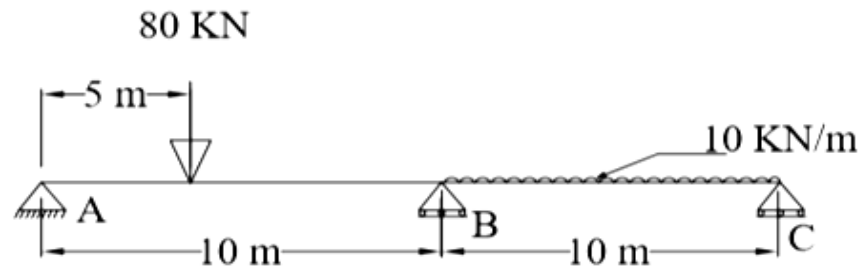
5. Construct the influence line diagram for the force in members AH, AB and BH of the truss shown below.



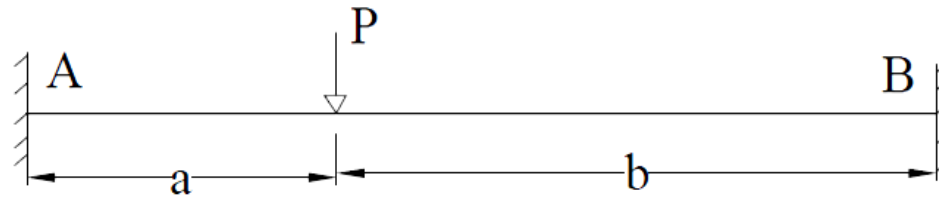
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Group - D

6. (a) A continuous beam ABC shown in the figure, 20 m long is carried on supports at its end and is propped at the same level at points 10 m from left end A. It carries a concentrated load of 80 kN at 5 m from A and uniformly distributed load of 10 kN/m run over the span BC. If the support B sinks by 2 mm below A and C. Find the B.M. and the reactions at the three supports using three-moment equations. Assume moment of inertia of the whole beam, $I = 85 \times 10^6 \text{ mm}^4$; and $E = 2.1 \times 10^5 \text{ N/mm}^2$.



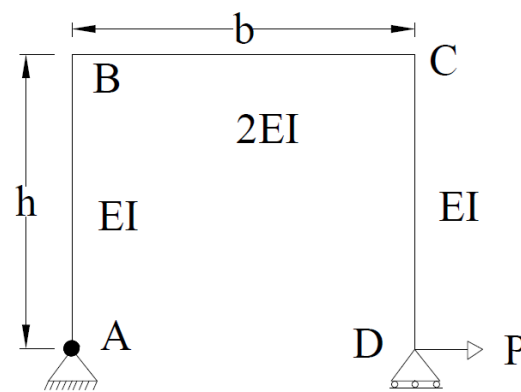
- (b) Calculate the moment at joint A shown in the figure below by using the consistent deformation method.



6 + 6 = 12

7. (a) A two-hinged parabolic arch of span l and rise h carries a concentrated load W at the crown. Show that the horizontal thrust equals $\frac{25}{128} \frac{Wl}{h}$, at each support.

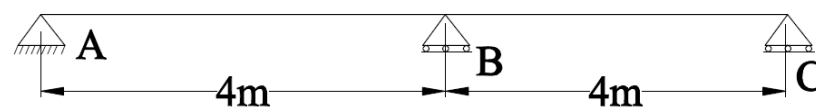
- (b) A portal frame ABCD shown in the figure, has its end A hinged while the end D is placed on rollers. A horizontal force P is applied on the end D. Determine the horizontal movement at D by using strain energy. EI of each members are designated along with the members.



6 + 6 = 12

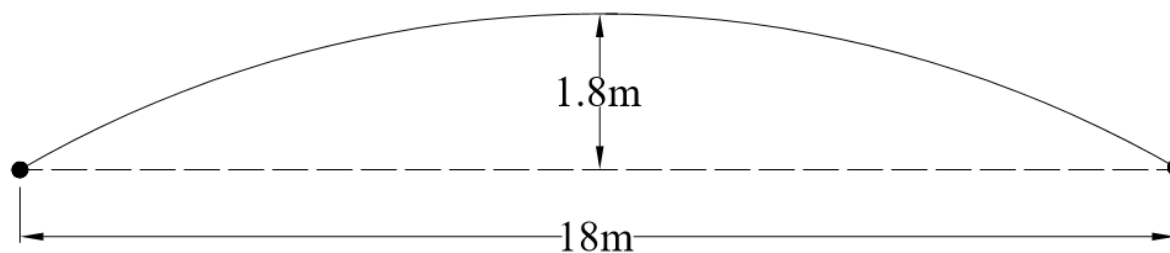
Group - E

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.



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



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