

STRUCTURAL ANALYSIS I (CIV2201)

Time Allotted : 2½ hrs

Full Marks : 60

Figures out of the right margin indicate full marks.

Candidates are required to answer Group A and any 4 (four) from Group B to E, taking one from each group.

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

Group – A

1. Answer any twelve:

12 × 1 = 12

Choose the correct alternative for the following

- (i) Which of the following is statically determinate structure?
 (a) Two hinged arch (b) Fixed beam
 (c) Cantilever beam (d) Continuous beam
- (ii) What is the degree of static indeterminacy of the beam shown in Fig.1 , if the axial deformation is ignored?

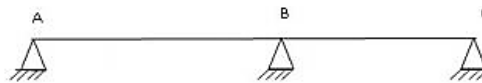


Fig.1

- (a) 1 (b) 2 (c) 3 (d) 4
- (iii) What does an influence line for a beam represent?
 (a) The bending moment at different points of the beam
 (b) The deflection at different points of the beam
 (c) The variation of a reaction, shear force, or bending moment at a specific point due to a moving unit load
 (d) The distribution of fixed loads along the beam
- (iv) The sum of ordinates of an influence line for reaction forces in a simply supported beam always equals
 (a) Zero (b) One (c) The span length of the beam (d) Two
- (v) The influence line for a reaction at a hinged support in a simply supported beam is a
 (a) Straight line decreasing from the support to the other end
 (b) Parabolic curve
 (c) Straight horizontal line
 (d) Sinusoidal curve
- (vi) Which of the following is true about statically indeterminate structures?
 (a) They can be solved using only equilibrium equations.
 (b) They have more unknowns than equilibrium equations.
 (c) They can be analyzed using only the force method.
 (d) They can be solved without considering compatibility of deformations.

- (vii) What is the primary approach used in the **Force Method** of structural analysis?
- To find the unknown displacements in a structure.
 - To introduce redundant forces and solve for internal forces and reactions.
 - To calculate the stiffness of each structural member.
 - To analyze only statically determinate structures.
- (viii) In the **Force Method**, when an additional equation is needed to solve for the redundant forces, which of the following conditions is used?
- Compatibility condition
 - Force equilibrium condition
 - Stress-strain relation
 - Slope condition
- (ix) When a unit load moves across a statically indeterminate beam, the reaction at a support is determined by
- Static equilibrium equations only
 - Compatibility equations only
 - Both static equilibrium and compatibility equations
 - None of the above
- (x) The influence line for bending moment in a fixed beam shows that the moment at a given section is influenced by
- The load position only
 - The stiffness of the beam only
 - The load position and the beam's boundary conditions
 - The cross-sectional shape of the beam only

Fill in the blanks with the correct word

- (xi) The horizontal thrust for the three hinged semicircular arch loaded with point load (w) at its crown having rise h and span l _____.
- (xii) Degree of kinematic indeterminacy of a pin-jointed plane frame is given by _____.
- (xiii) The maximum bending moment at a section of a simply supported beam due to a moving point load occurs when the load is placed _____.
- (xiv) The area under the influence line for a reaction force in a simply supported beam is always equal to _____.
- (xv) The Müller-Breslau principle states that the influence line for a function can be obtained by removing the corresponding constraint and applying a unit _____.

Group - B

2. Calculate the deflection of joint C as shown in Fig. 2 using unit load method. Take $E=2 \times 10^5$ N/mm². $I=12 \times 10^6$ mm⁴

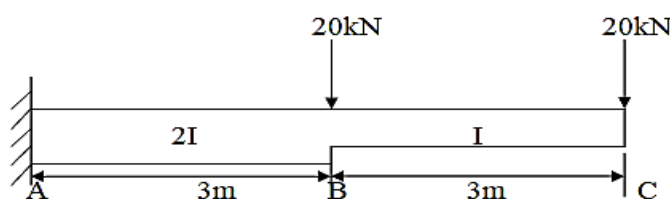


Fig. 2

[[CIV 2201.6](Evaluate/HOCQ)]

3. Analyse the portal frame shown in Fig. 3 and draw the bending moment diagram of the frame.

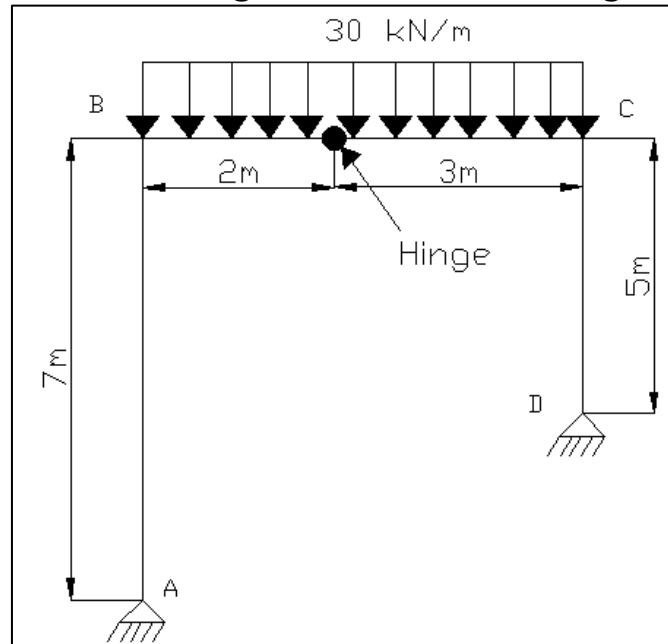


Fig. 3

[[CIV 2201.2, CIV 2201.3](Analyse/IOCQ)]

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Group - C

4. Prepare the ILD for reaction forces, shear forces and bending moments at section C as shown in Fig. 4. Evaluate the maximum value of positive shear and bending moment that can develop at section C under the given series of loading.

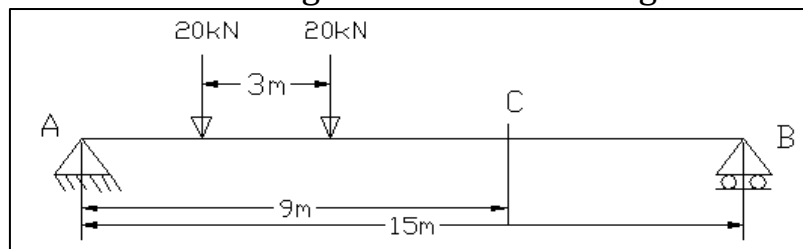


Fig. 4

[[CIV 2201.6](Analyse/IOCQ)]

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5. Construct the influence line diagram for the forces in member AB, AH and BH of the truss as shown in Fig. 5.

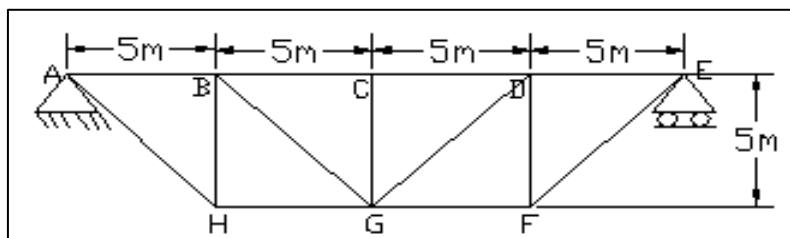


Fig. 5

[[CIV 2201.6](Analyse/IOCQ)]

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Group - D

6. Determine the deflection at point B of the propped beam as shown in Fig. 6 EI is constant throughout. Use Castigliano's second theorem to find support reactions.

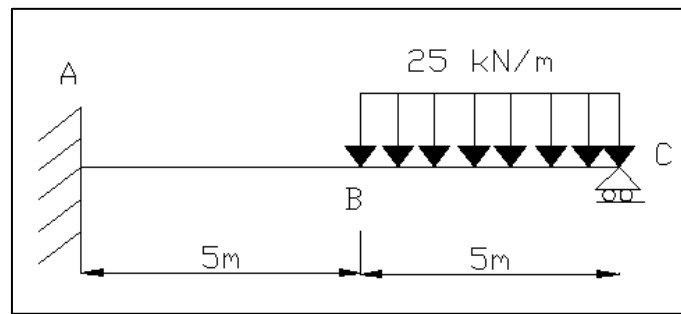


Fig. 6

[[CIV 2201.2, CIV 2201.3](Analyse/IOCQ)]

12

7. A continuous beam ABC shown in Fig. 7 is 15m long carried on supports at its end and is propped at the same level of points 7.5m from the left end A. It carries a concentrated load of 80kN at centre of the span and uniformly distributed load of 10kN/m run over the span BC. Using three moment theorem, calculate bending moments and support reactions at three supports. Assume EI is constant.

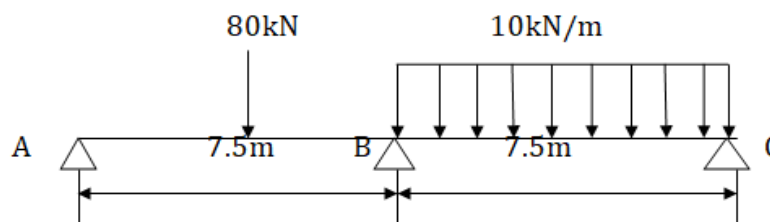


Fig. 7

[[CIV 2201.5](Analyse/IOCQ)]

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Group - E

8. Compute the ordinates of influence lines for reaction at A for the beam shown in Fig. 8 at 1m interval and draw the influence line diagram. The moment of inertia is constant throughout.

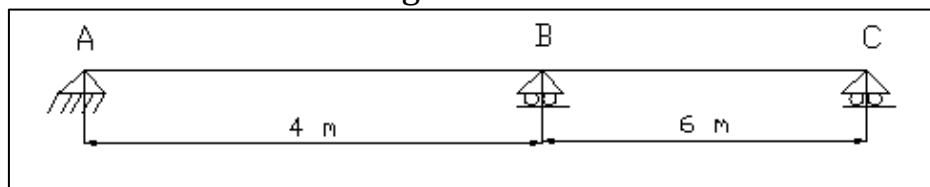


Fig. 8

[[CIV 2201.6](Analyse/IOCQ)]

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9. Draw the influence line diagram for shear force at D in the beam shown in Fig. 9 after computing the values of the ordinates at 1m interval. Flexural rigidity is as shown in the figure.

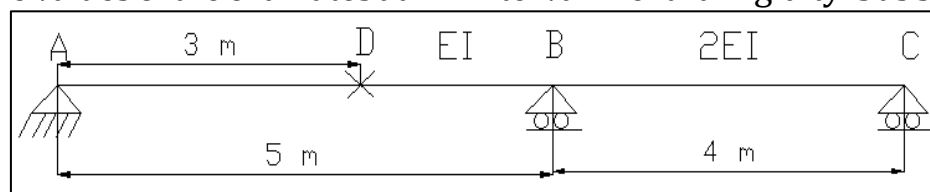


Fig. 9

[[CIV 2201.6](Analyse/IOCQ)]

12

Cognition Level	LOCQ	IOCQ	HOCQ
Percentage distribution	0	87.5	12.5