

GUJARAT TECHNOLOGICAL UNIVERSITY
Bachelor of Engineering - SEMESTER - V EXAMINATION - WINTER 2025

Subject Code: 3150614

Date: 25-11-2025

Subject Name: Structural analysis-II

Time: 10:30 AM TO 01:00 PM

Total Marks: 70

Instructions

1. Attempt all questions.
2. Make suitable assumptions wherever necessary.
3. Figures to the right indicate full marks.
4. Simple and non-programmable scientific calculators are allowed.

- | | Marks |
|--|--------------|
| Q.1 (a) Define the influence line diagram and give statement of Muller Breslau principle. | 03 |
| (b) Explain following terms with suitable example: Stiffness, Distribution factor, Carry over factor, Carry over moment. | 04 |
| (c) Differentiate the methodology for Stiffness and Flexibility method. Also suggest the suitability of method in case of high degree of indeterminacy. | 07 |
| Q.2 (a) State and explain Castigliano's second theorem with example. | 03 |
| (b) Draw qualitative shapes of influence lines for reactions in two bay- two storeyed fixed based portal frame. | 04 |
| (c) Determine the deflection at the mid span of the beam given in the figure 1 below. $E = 200 \text{ GPa}$ and $I = 8 \times 10^6 \text{ mm}^4$ using Castigliano or Unit load method. | 07 |

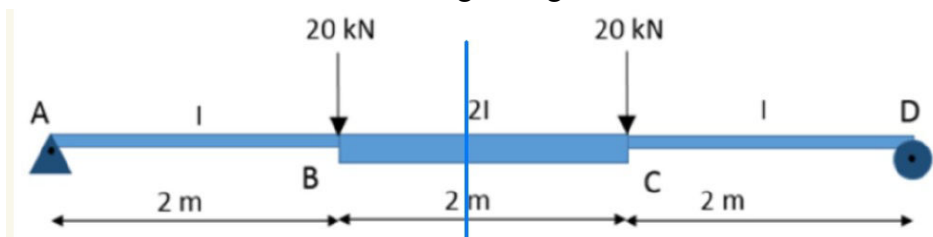


Fig. 1

OR

- (c)** Determine the Influence line diagram of Reaction at B i.e. R_B using the Muller Breslau's Principal for following Fig 2. Also find the ordinate of ILD at E and F. **07**

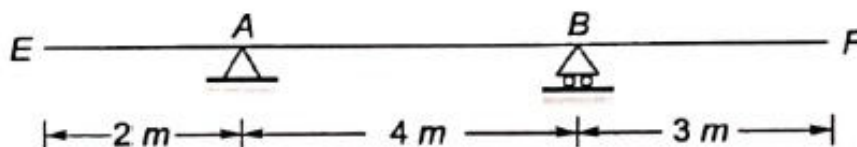
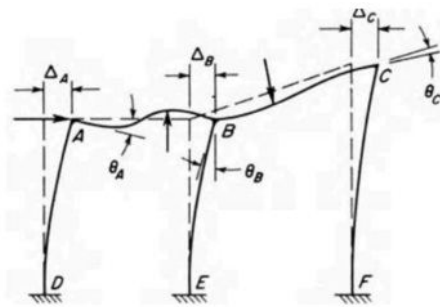


Fig 2

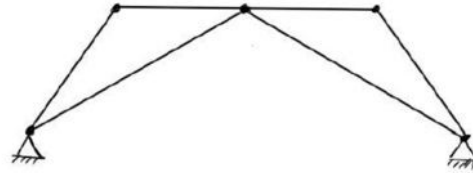
- Q.3 (a)** Draw "Restrained Structure" and "Released structure" for a three span continuous beam. **03**
- (b)** Discuss causes of sidesway in analysis of frame. **04**

(c) Determine the static Indeterminacy of problems given in Fig 3.

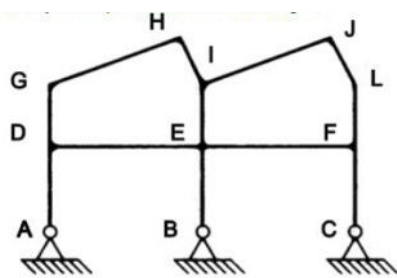
07



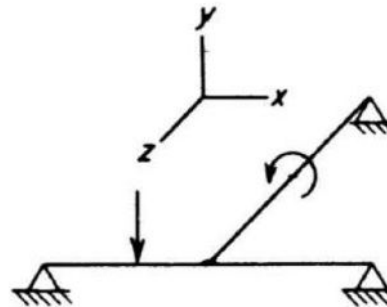
(i) Portal Frame



(ii) Truss



(iii) Plane Frame



(iv) Grid

Fig 3.

OR

(a) Differentiate between slope deflection method and moment distribution method for analysis of plane frame. 03

(b) Write steps for analysis of plane frame with sway by moment distribution method. 04

(c) Determine the Kinematic Indeterminacy or Degree of Freedom for problems given in Q. 3 Fig. 3. 07

Q.4 (a) List out the different types of displacement methods used in structural analysis. 03

(b) Two wheel loads, 50 kN and 150 kN spaced 2m move on a simply supported girder of 12 m long. Determine the values of maximum positive and negative shear force at a section 3m from the left end. Any wheel load can lead the other. 04

- (c) Calculate the final end moments for continuous beam as shown in Fig 4 using the slope deflection method. 07

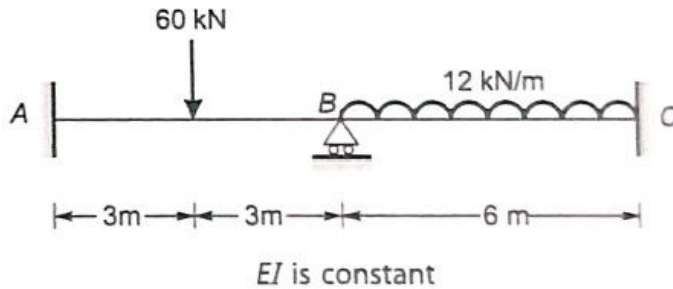


Fig 4

OR

- (a) Calculate the distribution factor of continuous beam shown in Fig 5. Portion AB has second moment of area $1.5 I$ and BC is I . 03

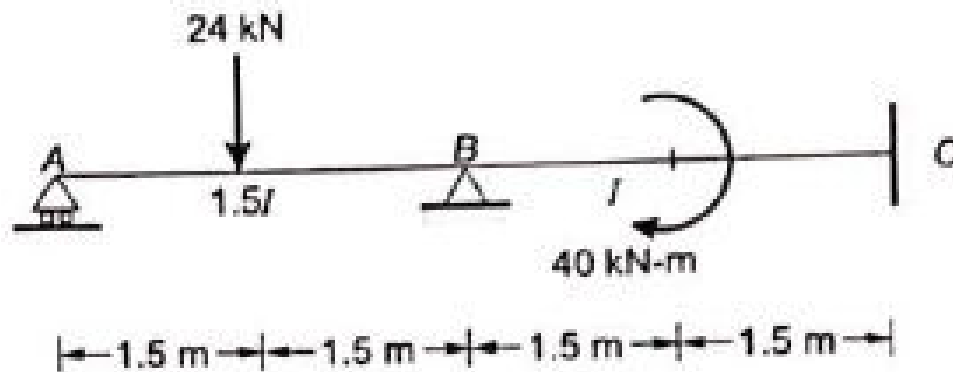


Fig 5

- (b) Two wheel loads of 120 kN and 80 kN spaced 2 m apart moves on the span of simple supported girder 16 m long. Determine the maximum bending moment at section 6 m from the left end. Any wheel load can lead the other. 04
- (c) Evaluate the final end moments and reactions at supports using the Moment Distribution method for the Fig 5 (OR Q.4a). 07

- Q.5** (a) A unit rotation, without any vertical displacement, is applied at support A of a prismatic beam AB with both ends fixed and of length L and flexural rigidity EI . Evaluate is the moment induced at support B? 03
- (b) Determine the stiffness matrix of a axially rigid Cantilever beam with span L and flexural rigidity EI . 04
- (c) In a simply supported beam, two end rotations are adopted as available degrees of freedom to express stiffness matrix of the structure. The half span of beam from left side has flexural rigidity two times more than remaining span. Determine the stiffness matrix. 07

OR

- (a) Assume that you are calculating deflection at the free end of a cantilever beam under some transverse load conditions. Now, if the stiffness matrix of this linear elastic beam is halved without changing loading condition, then what will be the deflection value at the free end now? **03**
- (b) Describe the properties of stiffness matrix for structural analysis. **04**
- (c) In a simply supported beam, two end rotations are adopted as available degrees of freedom to express stiffness matrix of the structure. The half span of beam from left side has flexural rigidity two times more than remaining span. Determine the flexibility matrix. **07**

GUJARAT TECHNOLOGICAL UNIVERSITY**BE- SEMESTER-V (NEW) EXAMINATION – WINTER 2024****Subject Code:3150614****Date:05-12-2024****Subject Name:Structural analysis-II****Time:10:30 AM TO 01:00 PM****Total Marks:70****Instructions:**

1. Attempt all questions.
2. Make suitable assumptions wherever necessary.
3. Figures to the right indicate full marks.
4. Simple and non-programmable scientific calculators are allowed.

		Marks
Q.1	(a) Write the statement and proof of Castiglino's 1 st theorem.	03
	(b) Explain any four terms: Stiffness, Distribution factor, Carry over factor, Carry over moment, Flexibility.	04
	(c) Using Castiglino's first theorem, calculate deflection at free end of cantilever beam shown in Figure: 1. Take $E = 2 \times 10^5 \text{ N/mm}^2$ and size of beam as 230x300 mm	07
Q.2	(a) Write assumptions made in slope deflection method.	03
	(b) Write the differences between statically determinate and indeterminate structures.	04
	(c) Derive Slope Deflection Equation using fundamentals with usual notations.	07
	OR	
	(c) Draw SFD and BMD diagram for a beam shown in Figure: 2 using Slope and deflection method.	07
Q.3	(a) Draw Restrained structure and Released structure for a propped cantilever beam.	03
	(b) Derive Shear equations for portal frames with side sway.	04
	(c) Analyze and Draw the SFD & BMD for the beam shown in Figure: 2 by Moment distribution method	07
	OR	
Q.3	(a) Differentiate: Stiffness method and Flexibility method. Which method is suitable for general computer programming? Why?	03
	(b) Write a short note on Castiglino's 2 nd Theorem and discuss its uses.	04
	(c) Analyze the beam shown in the Figure: 3 using moment distribution method and draw BMD.	07
Q.4	(a) Write assumptions made in cantilever method of approximate analysis.	03
	(b) Determine the reactions at the supports for a propped cantilever beam of length 'l' subjected to a UDL 'w' throughout its span using principle of minimum strain energy.	04
	(c) Analyze a propped cantilever beam subjected to a UDL throughout its span by Flexibility method	07
	OR	
Q.4	(a) Define the influence line diagram and give statement of Muller Breslau principle.	03
	(b) Calculate the central deflection for a simply supported beam of length 'l' subjected to a concentrated load of 'w' at centre on its span using Castiglino's 1 st Theorem.	04

(c) Formulate Flexibility and Stiffness Matrices for a cantilever beam. 07

Q.5 (a) State the characteristics of stiffness matrix. 03

(b) Draw only Qualitative influence line diagram for following functions of 2 span continuous beam having support reaction R_A , R_B and R_C . The point D is located at center of right span BC 04

(a) Influence line for R_C

(b) Influence line for R_A

(c) Influence line for shear at D

(d) Influence line for bending moment at D.

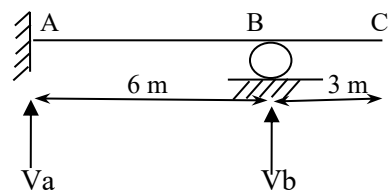
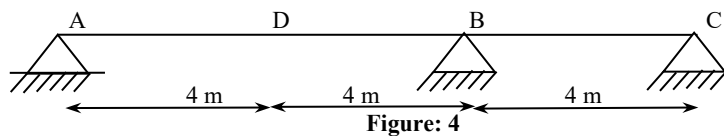
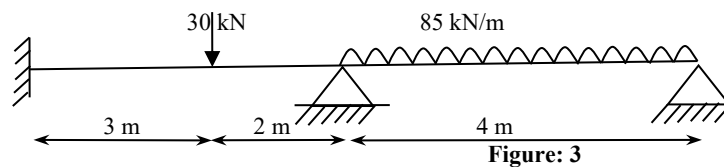
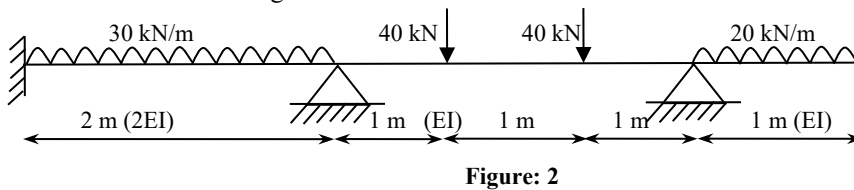
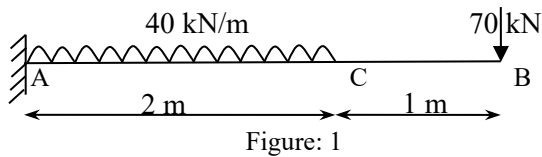
(c) Draw ILD for SF and BM at section D, 4 m from A, for a two span continuous beam as shown in Figure: . 4 07

OR

Q.5 (a) State the characteristics of flexibility matrix. 03

(b) A simply supported beam AB has span 6m. Draw influence lines for R_A , R_B , V_x and M_x for a section X at 2m from left hand support. 04

(c) Draw influence line diagrams for V_a and V_b for a beam shown in Figure: 5 07



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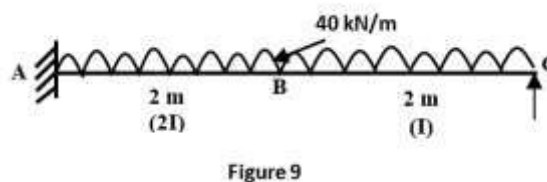
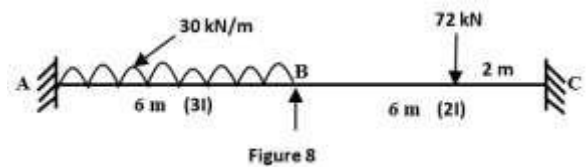
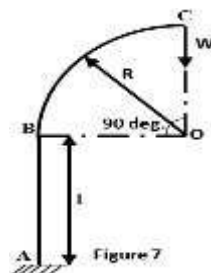
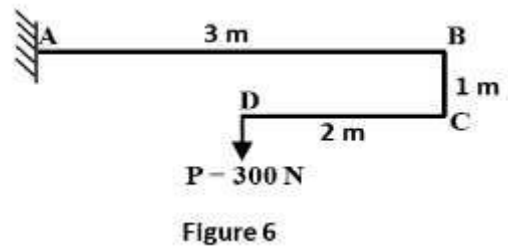
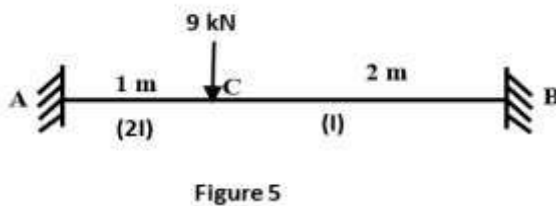
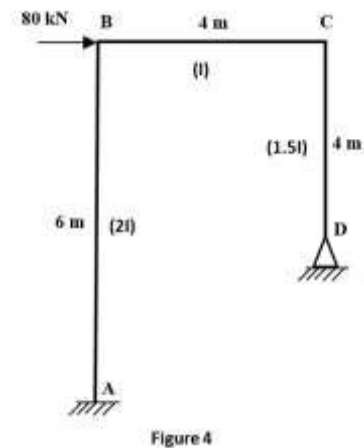
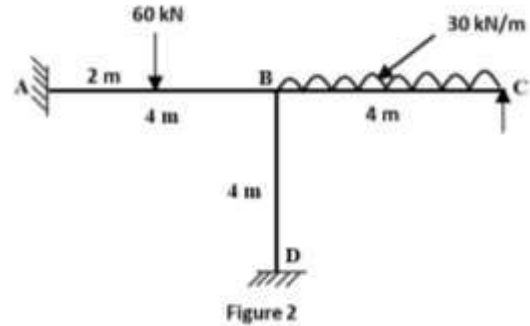
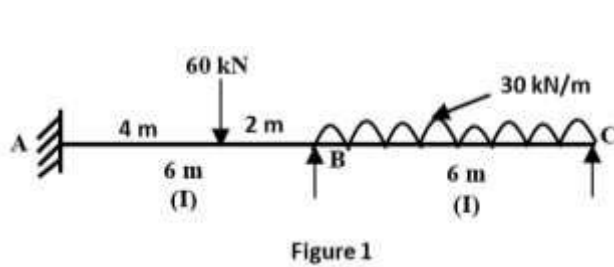
MARKS

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|------------|-----|--|-----------|
| Q.1 | (a) | Explain the terms degree of static and kinematic indeterminacy. | 03 |
| | (b) | Write characteristics of stiffness matrix. | 04 |
| | (c) | Analyze the continuous beam shown in Figure 1 by slope deflection method and draw bending moment diagram. | 07 |
| Q.2 | (a) | What is influence line diagram? What is the use of influence line diagram? | 03 |
| | (b) | Derive shear equation in the case of analyzing the portal frame with side sway. | 04 |
| | (c) | Analyze the frame shown in Figure 2 by slope deflection method and draw bending moment diagram. EI is same for all members. | 07 |
| | | OR | |
| | (c) | Draw the influence line diagram for reaction at B in the continuous beam shown in Figure 3 . EI is constant throughout. | 07 |
| Q.3 | (a) | State the assumptions made in deriving slope-deflection equations. | 03 |
| | (b) | Calculate the central deflection for a simply supported beam of length 'l' subjected to a udl 'w' throughout its span using Castiglino's 1 st theorem. | 04 |
| | (c) | Analyze the rigid frame shown in Figure 4 by moment distribution method. | 07 |
| | | OR | |
| Q.3 | (a) | Differentiate: Stiffness method and Flexibility method. Which method is suitable for general computer programming? | 03 |
| | (b) | Derive slope and deflection method equations from first fundamentals. | 04 |
| | (c) | Calculate the fixed end moment for the beam shown in Figure 5 using Castiglino's 2 nd theorem. | 07 |
| Q.4 | (a) | Define: Sway. What are the causes for sway in portal frames? | 03 |
| | (b) | Enlist steps of unit load method to analyze indeterminate structures. | 04 |
| | (c) | For a mild steel bent of 200 mm diameter as shown in Figure 6 , find the vertical deflection at D. $E = 2 \times 10^5 \text{ N/mm}^2$. | 07 |
| | | OR | |
| Q.4 | (a) | Write assumptions made in slope deflection method. | 03 |
| | (b) | Explain characteristics of influence line diagram for statically indeterminate structures. | 04 |
| | (c) | A steel bar bent to the shape as shown in Figure 7 is fixed at A and carries a vertical load W at C. Calculate the vertical deflection of C. EI is constant throughout. | 07 |
| Q.5 | (a) | Enlist various categories of framed structures. | 03 |
| | (b) | State and explain Muller-Breslau principle. | 04 |

- (c) Analyze the continuous beam shown in **Figure 8** by moment distribution method and draw bending moment diagram. 07

OR

- Q.5 (a) Draw restrained structure and released structure for a propped cantilever beam. 03
- (b) Explain the terms: 04
- (a) Carryover moment, (b) Carryover factor, (c) Flexural stiffness of a member, (d) Distribution factor
- (c) Analyze the propped cantilever beam shown in **Figure 9** by flexibility method. 07



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1. Attempt all questions.
2. Make suitable assumptions wherever necessary.
3. Figures to the right indicate full marks.
4. Simple and non-programmable scientific calculators are allowed.

		Marks
Q.1	(a) Write the differences between statically determinate and indeterminate structures.	03
	(b) Write the statement and proof of Castiglino's 1 st theorem.	04
	(c) Discuss Castiglino's second theorem to solve an indeterminate truss.	07
Q.2	(a) Define: 1) Action and 2) Displacement	03
	(b) Define: 1) Distribution Factor 2) Relative stiffness 3) stiffness 4) Carryover factor	04
	(c) A bent up bar of 100 mm diameter is shown in figure-1. Find vertical deflection at point D using Castiglino's first theorem. Take $E=2 \times 10^5 \text{ N/mm}^2$	07
	OR	
	(c) Calculate the horizontal displacements of the end B of a semicircular arch shown in the figure-2 using Castiglino's first theorem. Take $EI=6 \times 10^{13} \text{ Nmm}^2$	07
Q.3	(a) Discuss the uses of slope deflection method.	03
	(b) Draw influence line diagrams for support reactions of a simply supported beam.	04
	(c) For a cantilever beam, show that stiffness and flexibility matrices are reciprocal to each other.	07
	OR	
Q.3	(a) Draw Restrained structure and Released structure for a propped cantilever beam.	03
	(b) What is a portal frame? Discuss the causes of sway in a portal frame..	04
	(c) Formulate Flexibility and Stiffness Matrices for a cantilever beam .	07
Q.4	(a) Define Influence line diagram. Discuss its use.	03
	(b) Write a short note on Castiglino's 2 nd Theorem and discuss its uses.	04
	(c) Analyze a propped cantilever beam subjected to a udl throughout its span by Flexibility method.	07
	OR	
Q.4	(a) Derive Shear equations for portal frames with side sway	03
	(b) State and Explain Muller-Breslau's Principle	04
	(c) A three span continuous beam ABCD is shown in the figure-3. Write slope deflection equations only if the support A settles by 10mm, B settles by 30mm and C by 20mm.	07

- Q.5 (a) Explain Fictitious load method used to solve deflection problems 03
 (b) Write the differences between Stiffness and Flexibility matrix methods. 04
 (c) Analyze the frame shown in figure-4 by Moment distribution method 07
 OR
 Q.5 (a) Enlist various categories of framed structures 03
 (b) A simply supported beam AB has span 8m. Draw influence lines for shear force and bending moment at a section X at 3m from left hand support. 04
 (c) Draw influence line diagrams for V_a and V_b for a beam shown in figure-5 07

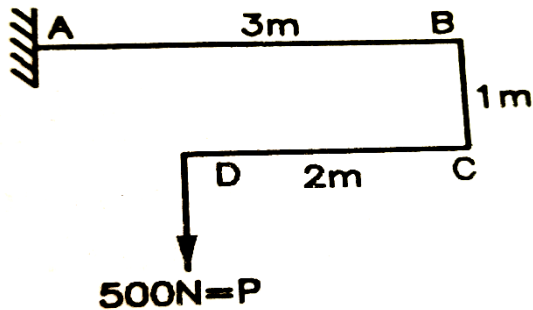


Figure-1

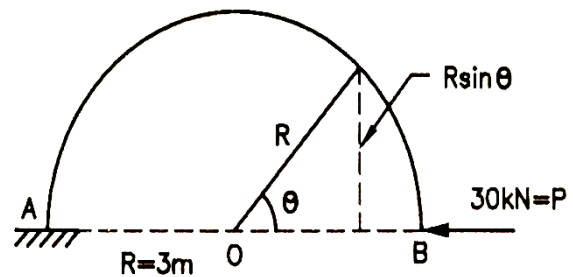


Figure-2

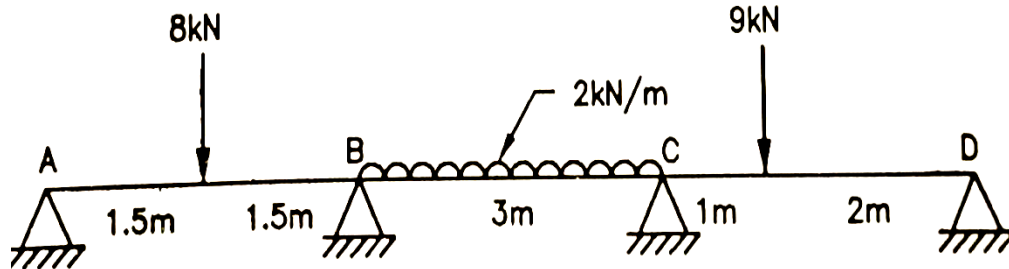


Figure-3

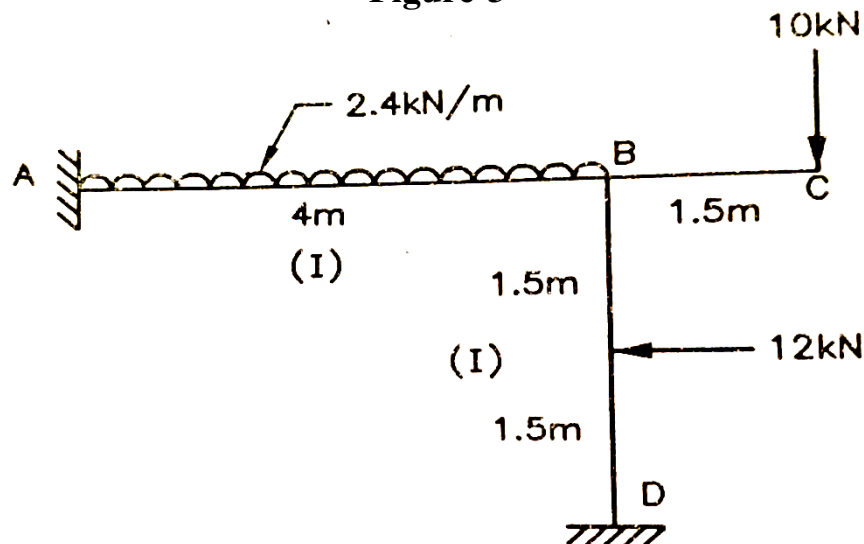


Figure-4

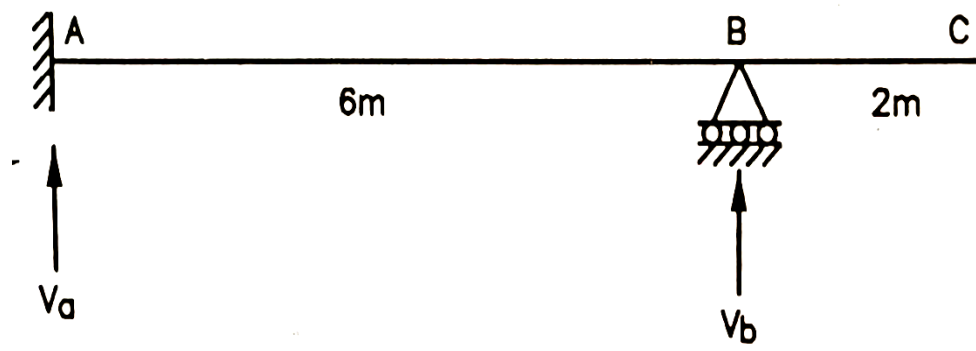


Figure-5
