Exam Date & Time: 04-May-2024 (02:30 PM - 05:30 PM)

MANIPAL ACADEMY OF HIGHER EDUCATION

VI Semester End Semester Examination

FINITE ELEMENT METHOD [AAE 3253]

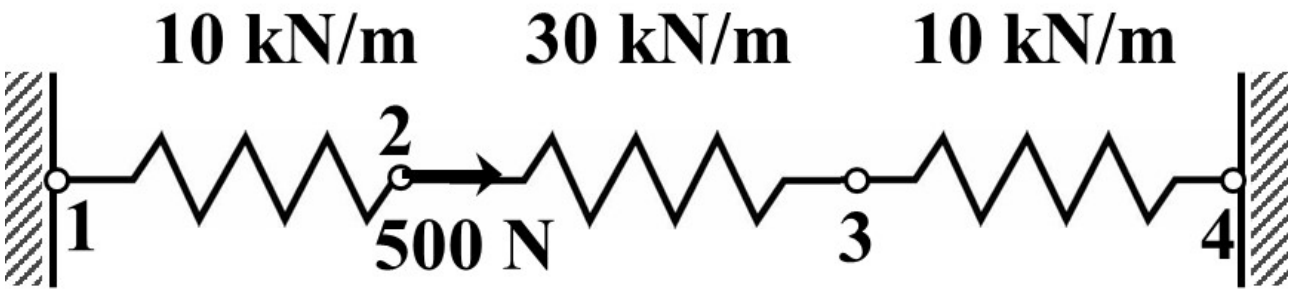
Marks: 50 **Duration: 180 mins.**

Descriptive Questions

Answer all the questions. Section Duration: 180 mins

1) Determine the unknown displacements for the spring assembly given in Figure 1.

A)



(3)

Figure 1

B) For the spring assembly shown in Figure 1, determine the reactions at the supports. (2)

C) For the bar hanging under its own weight shown in Figure 2, determine the nodal displacements considering (a) two equal-length elements and (b) three equal-length elements. Let $A=12\times10^{-4}$ m^2, E=210 GPa, and mass density 7800 kg/m^3.

(5)

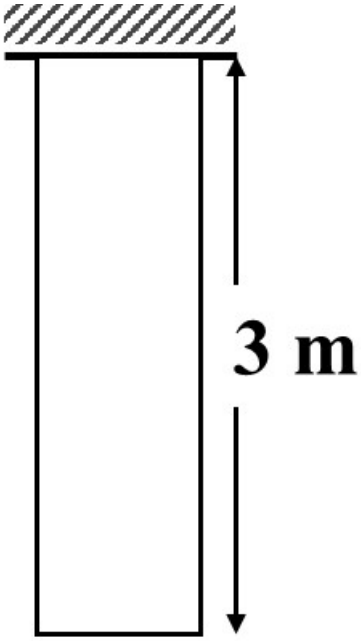


Figure 2

2) For the plane truss shown in Figure 3, determine the horizontal and vertical displacements of node 1. All elements have E = 200 GPa and A = 4×10^{-4} m^2.

A)

(4)

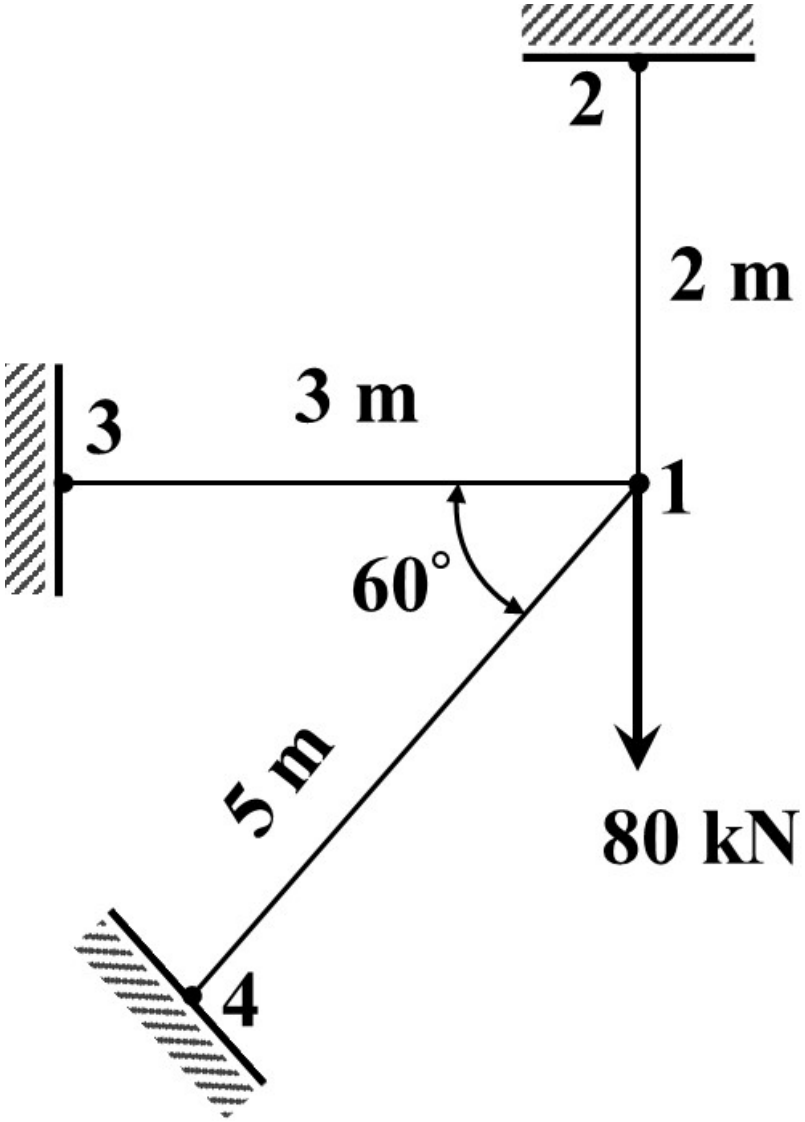


Figure 3

B) For the plane truss shown in Figure 3, determine the reactions at the supports. (3)

C) For the plane truss shown in Figure 3, determine the stresses in each element. (3)

3) For the beam assembly shown in Figure 4, determine the unknown displacements and rotations.

A) (5)

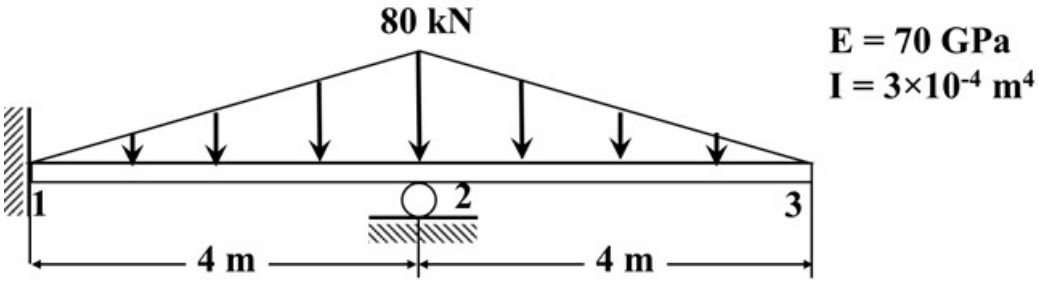


Figure 4

B) For the beam assembly in Figure 4, determine the forces in each element and the reactions at the supports. (3)

C) For the bar element shown in Figure 5, the global displacements have been determined to be $d_{1x} = 0$ mm, $d_{1y} = 2.5$ mm, $d_{2x} = 5$ mm, $d_{2y} = 3$ mm. Determine the axial deformation at nodes 1 and 2 in the element coordinate system. (2)

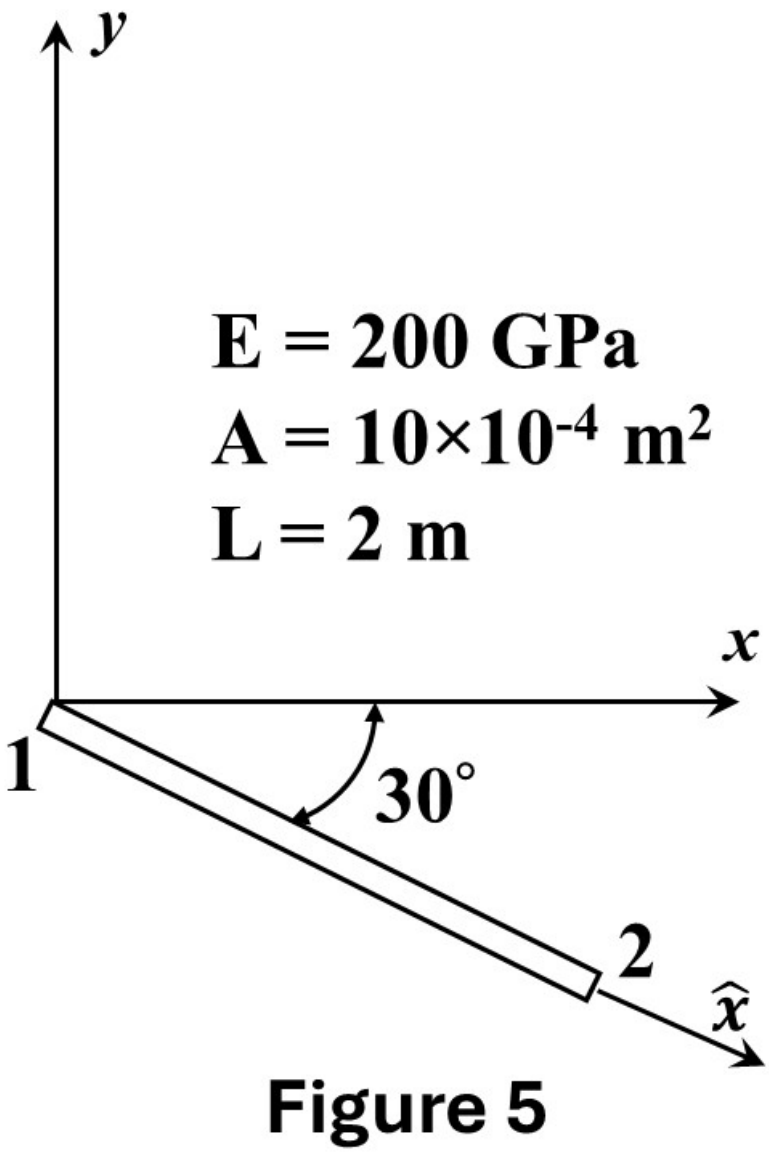


Figure 5

4) Discretize the 2D Plane Stress domain shown in Figure 6 and determine the stiffness matrix for each discretized element. Given E= 190 GPa, υ=0.26, t=0.03 m.

A)

(5)

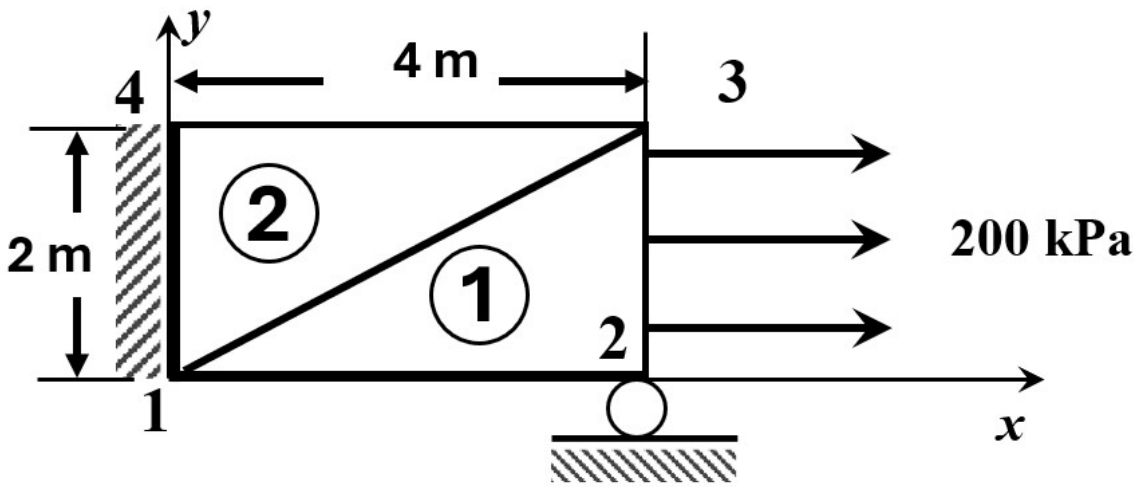


Figure 6

B) For the 2D Plane Stress problem shown in Figure 6, establish the force-displacement relation in terms of the global stiffness matrix. (3)

C) For the 2D plate in Figure 6, determine the unknown displacements. (2)

5) For the 2D plate in Figure 6, find out the reactions at the supports. (3)

A)

B) For the beam assembly shown in Figure 7, determine the unknown displacements and rotations. (5)

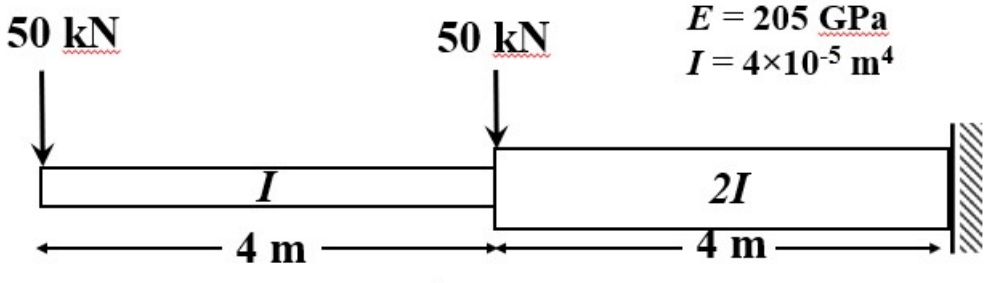


Figure 7

C) For the beam assembly shown in Figure 7, determine the reactions at the supports. (2)

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