Exam Date & Time: 25-May-2023 (02:30 PM - 05:30 PM)

MANIPAL ACADEMY OF HIGHER EDUCATION

VI Semester B.Tech. Aeronautical/ Automobile End Semester Examination May 2023

FINITE ELEMENT METHOD [AAE 3253]

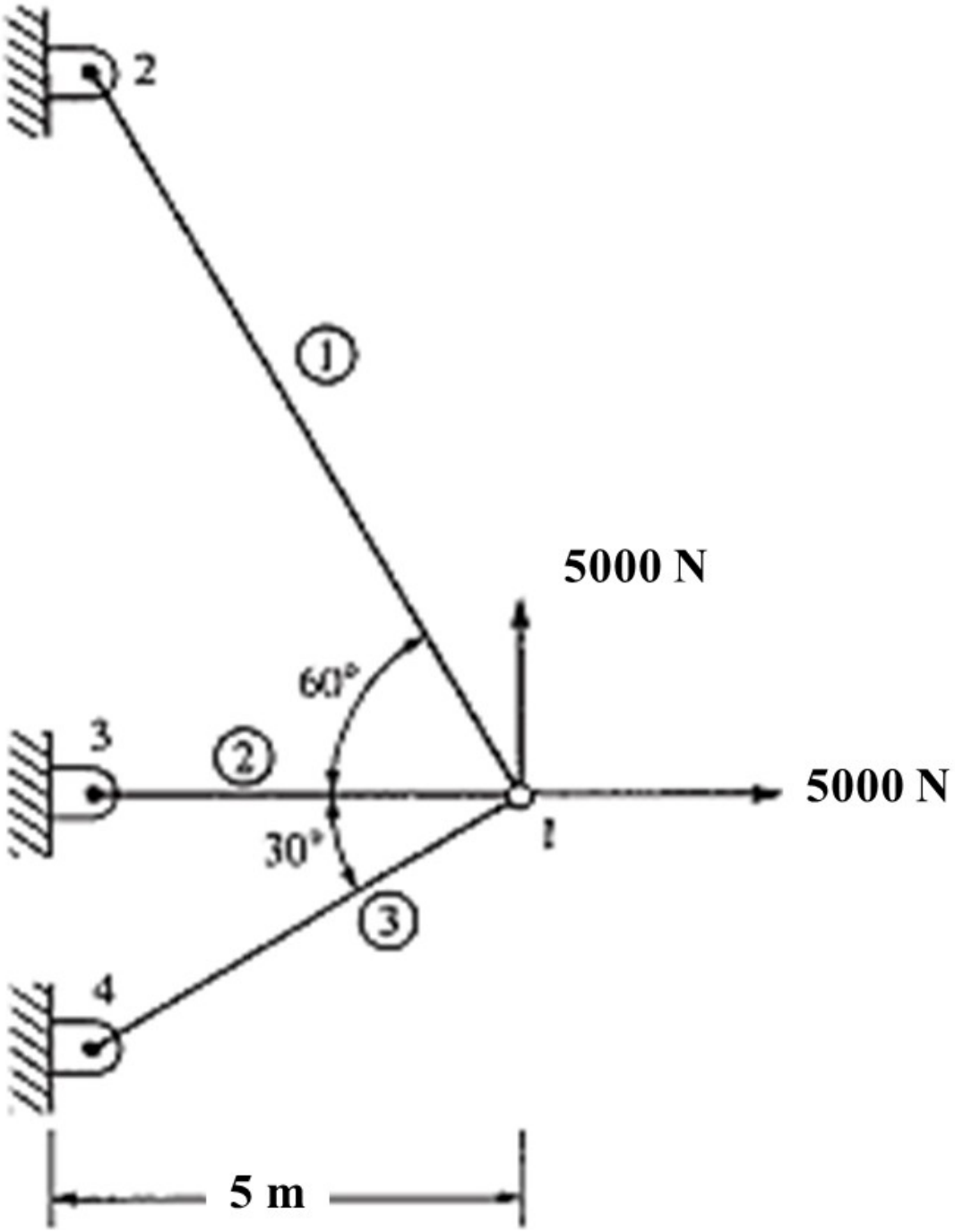
Marks: 50 **Duration: 180 mins.**

Descriptive Questions

Answer all the questions. Section Duration: 180 mins

1) Assemble the global stiffness matrix for the truss shown in Figure 1. All the elements are made of steel (E=200 GPa) and have a cross-section of 4×10^{-4} m^2.

A)



(5)

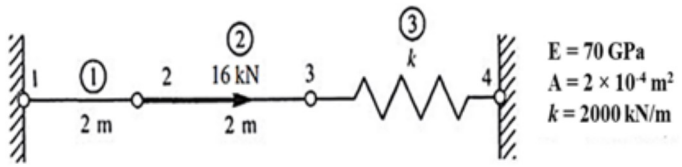
Figure 1 Three-membered Truss

B) For the truss in Figure 1, determine the unknown displacements and the reactions at the supports. (2)

C) For the truss shown in Figure 1, solve for the axial stresses in each of the bar elements. (3)

2) For the bar assemblage shown in Figure 2, determine the unknown nodal displacements.

A)

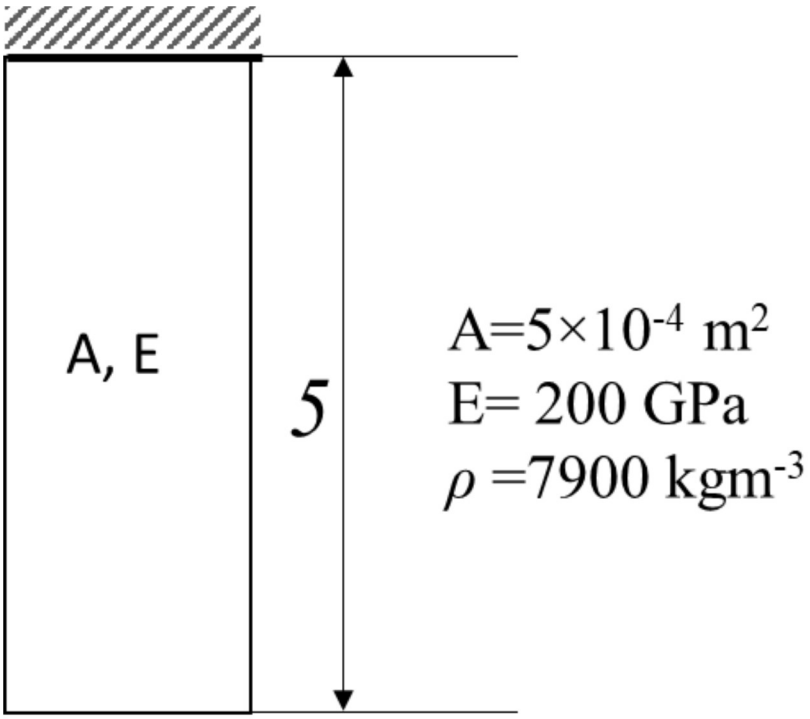


(5)

Figure 2 Bar assemblage

B) Evaluate the reactions at the support for the bar assemblage shown in Figure 2. (2)

C) A bar of length 3 m is suspended vertically as shown in Figure 3. It is found to deform under its own weight. Determine the displacement at the free end of the bar, considering the entire bar as a single element.



(3)

Figure 3 Suspended Bar

3) For the assemblage in Figure 4, determine the force-displacement relationship in terms of the global stiffness matrix.

A)

(5)

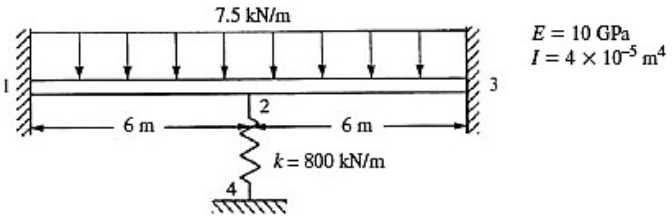


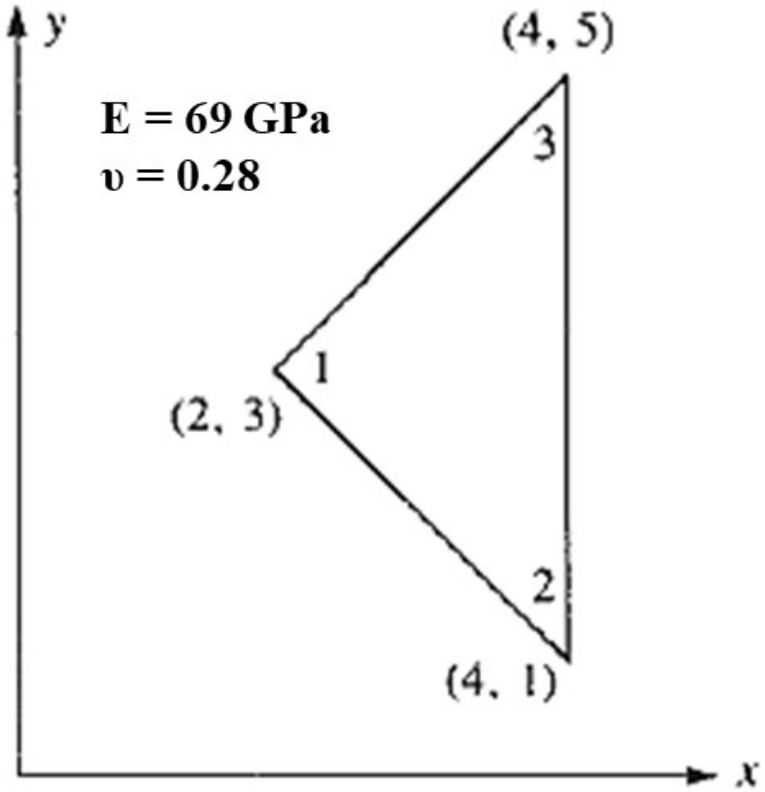
Figure 4 Assemblage subjected to distributed loading

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

C) For the beam assembly in Figure 4, determine the reactions at the supports. (2)

4) Evaluate the stiffness matrix for the element shown in Figure 5. Assume plane stress conditions and element thickness t=1 cm.

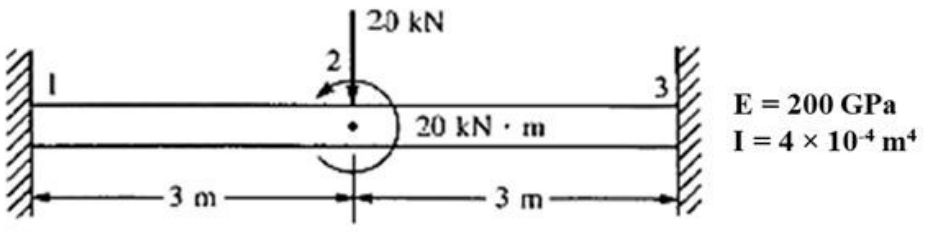
A)



(5)

Figure 5 Triangular plane element

B) For the beam assembly shown in Figure 6, determine the unknown displacements and rotations.

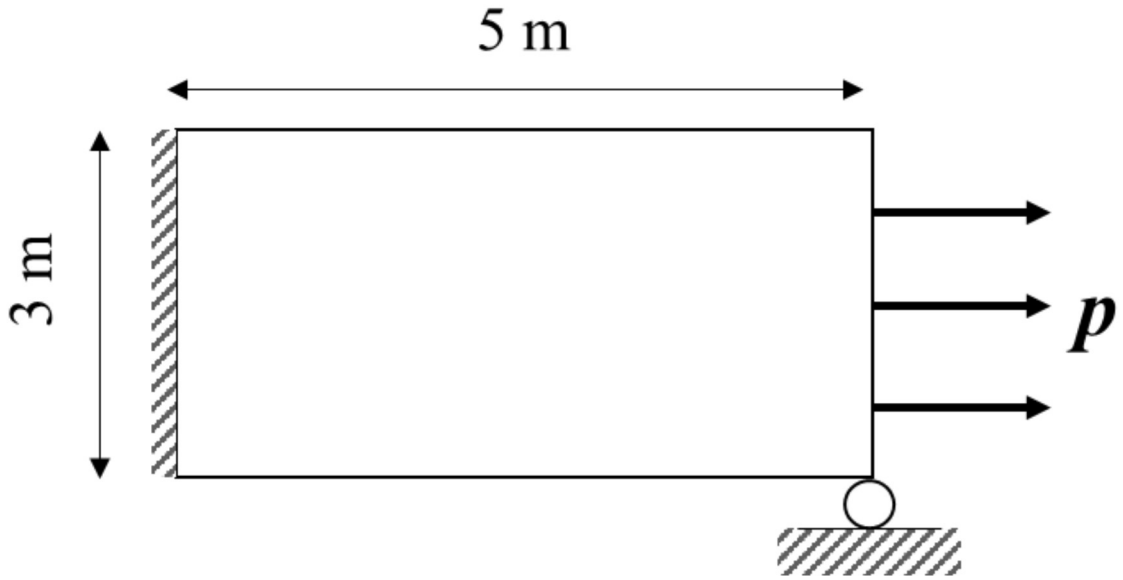


(5)

Figure 6 Beam assembly

5) For the 2D Plane Stress problem as shown in Figure 7, establish the force-displacement relation in terms of the global stiffness matrix. Given E= 200 GPa, υ=0.3, t=0.02 m. p= 80 kPa.

A)



(5)

Figure 7 2D plate subjected to pressure in x-direction.

B) For the 2D plate in Figure 7, determine the unknown displacements and reactions at the supports. (3)

C) For the 2D plate in Figure 7, solve for the unknown stresses within the plate. (2)

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