Exam Date & Time: 20-Jun-2024 (02:30 PM - 05:30 PM)

MANIPAL ACADEMY OF HIGHER EDUCATION

SIXTH SEMESTER B.TECH END SEMESTER EXAMINATIONS, JUNE 2024

FINITE ELEMENT METHOD [AAE 3253]

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

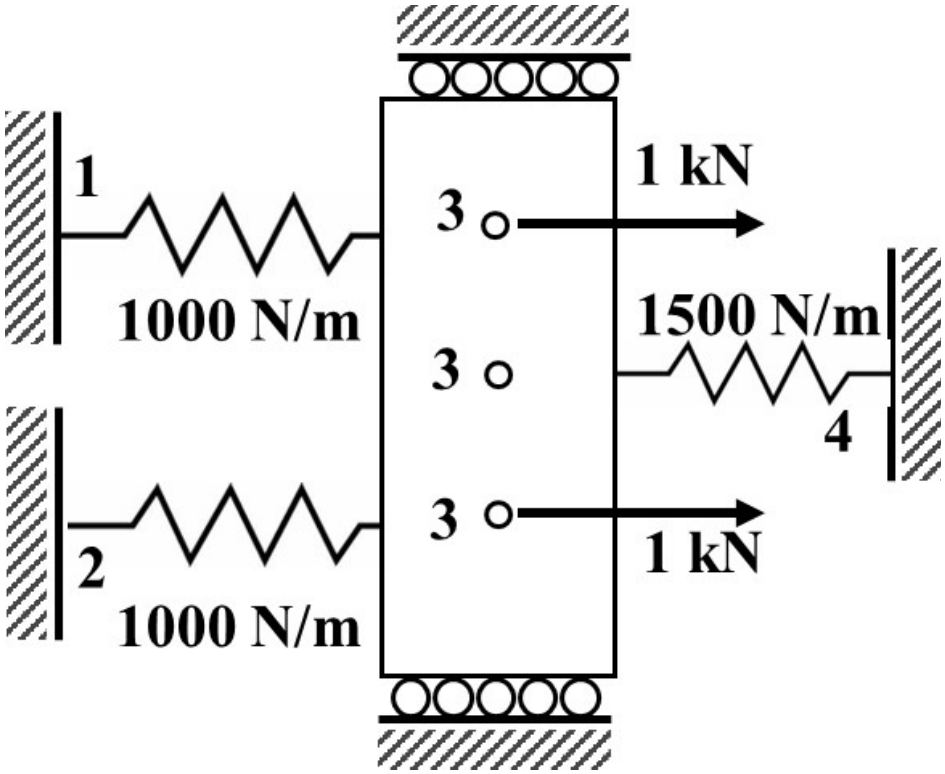
A

Answer all the questions.

Instructions to Candidates:
* Answer ALL questions
* Missing data may be suitably assumed

1) For the spring element shown in Figure 1 determine the nodal displacement and force in each element

A)



(3)

Figure 1

B) For the plane trusses supported by the spring at node 1 in Figure 2, determine the nodal displacements. (5)
Let E = 210 GPa and A = 5.0 x 10^{-4} m^2 for both truss elements.

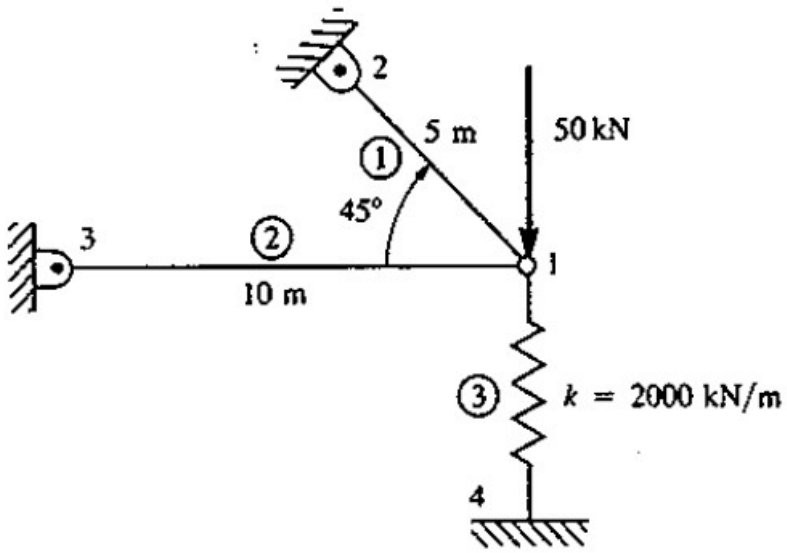
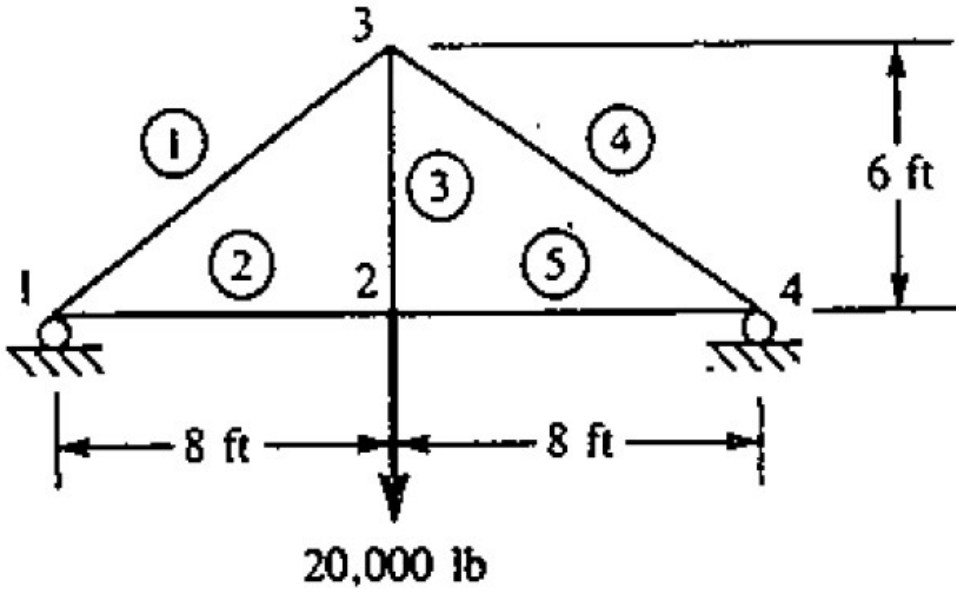


Figure 2

C) Determine the stresses in the truss elements of Figure 2. (2)

2) For the truss shown in Figure 3, use symmetry to determine the displacements of the nodes. All elements are made of a material with E = 30 x 10^6 psi. Elements 1, 2, 4, and 5 have a cross-sectional area of 10 in^2 and element 3 has a cross-sectional area of 20 in^2.

A)



(3)

Figure 3

B) For the beam shown in Figure 4 determine the nodal displacement. (5)

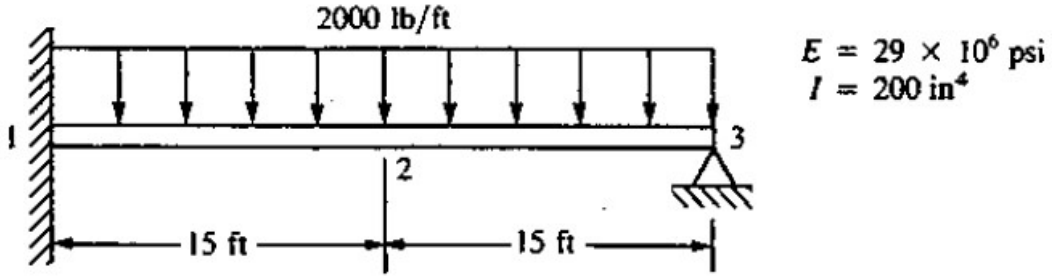
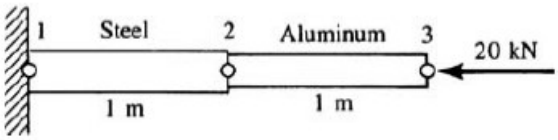


Figure 4

C) Determine the reactions at the support for the beam assembly shown in Figure 4. (2)

3) For the bar assembly shown in Figure 5, determine the nodal displacements, Use the direct stiffness method. Given Data: E_{st} = 200GPa, E_{al} = 70GPa, A_{st} = 4x10^{-4} m^2, A_{al} = 2x10^{-4} m^2.

A)

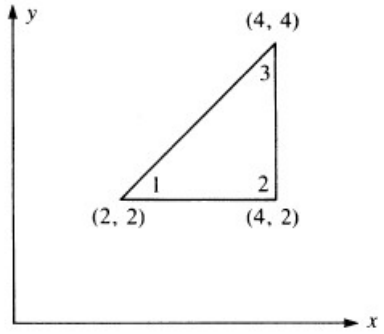


(3)

Figure 5

B) For the plane strain elements shown in Figure 6 , the nodal displacements are given as

u1 = 0.001 in: v1 = 0.005 in: u2 = 0.001 in: v2 = 0.0025 in: u3 = 0.0 in: v3 = 0.0 in: Determine stiffness matrix



(4)

Figure 6

C) For the Figure 6 determine the stresses in the elements. (3)

4) For the beam shown in Figure 7, Determine stiffness matrix Let E = 70 GPa and I =2 X 10^{-4} m^4 (5)

A)

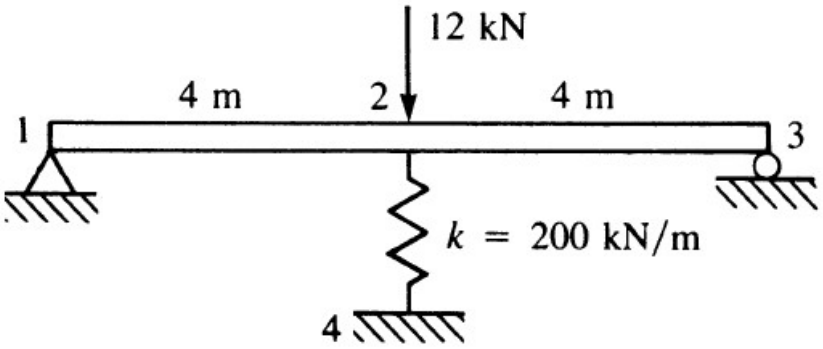


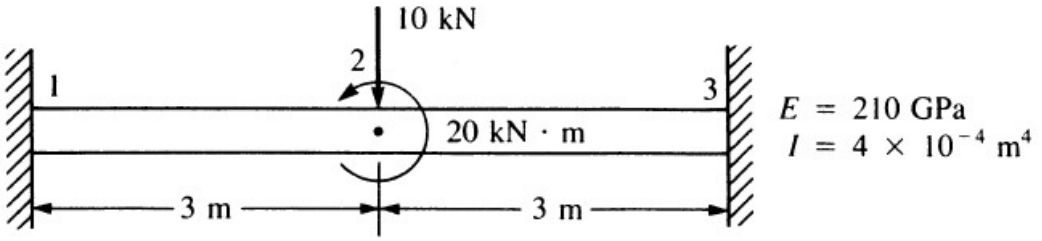
Figure 7

B) For the beam shown in Figure 7, Determine nodal displacements and slopes. (3)

C) A link element of length 1 m has its element coordinate system making an angle of 30° with the global coordinate system. If the global x-displacement of node 1 of the element is 0.0045 m and node 2 is 0 m, what are the element x-displacement of the respective nodes? (2)

5) For the beam shown in Figure 8. Determine the nodal displacements and slopes.

A)

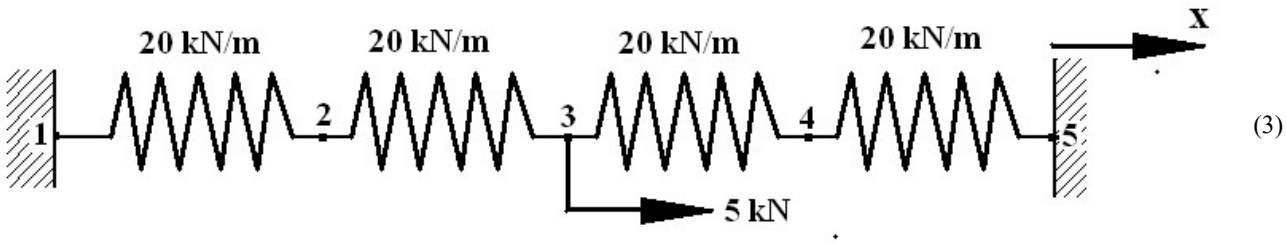


(4)

Figure 8

B) For the beam assembly in Figure 8, determine the reactions at the supports. (3)

C) Use the principle of minimum potential energy to determine the nodal displacements for the spring assembly shown in Figure 9.



(3)

Figure 9

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