Birla Institute of Technology & Science Pilani
First Semester 2023-2024
Mid-Semester Exam

Course No.	: ME G512
Course Title	: Finite Element Methods
Nature of Exam	: Open Book
Weightage	: 25%
Duration	: 90 minutes
Date of Exam	: 10/10/2023

No. of Pages = 2
No. of Questions = 4

Note to Students:
1. All parts of a question should be answered consecutively. Each answer should start from a fresh page.
2. Assumptions made if any, should be stated clearly at the beginning of your answer.

Q.1. Find one parameter approximate solution of the following equation using weighted residual Galerkin method

$$-2u\frac{d^2u}{dx^2}+\left(\frac{du}{dx}\right)^2=4 \;\; for \quad 0<x<1$$

subjected to the boundary conditions $u(0)=1 \; and \; u(1)=0$.

[7]

Q.2. (a) Strains (ϵ_{xx}) are continuous across elements if a bar member is discretized using a 2-noded bar element with axial displacement as the only degree of freedom. ***True*** *or* ***False****. Explain briefly.*

(b) Use **minimum** number of **2-noded elements** to discretize the structure in **Fig. 2** and write the global load vector for the structure shown below:

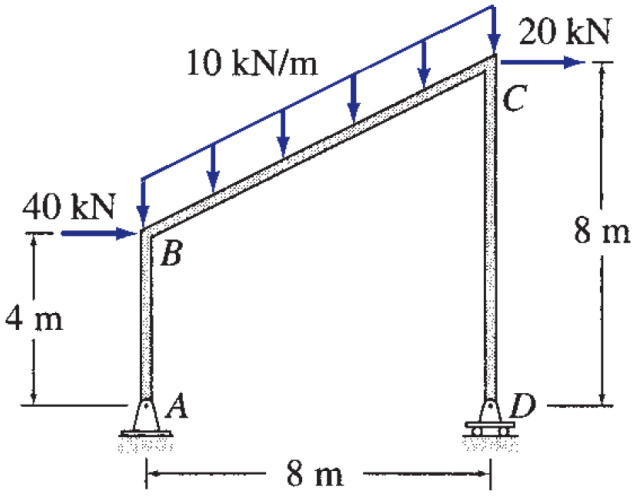

Fig 2

[2 + 4 = 6]

Q.3. Consider the assembly of rigid and flexible members as shown in the **Fig 3**. The material properties are as follows:
Steel members: E = 200 GPa
Copper member: E = 123 GPa

If the applied load **P = 200 kN**, use minimum number of 2-noded elements and
(a) Determine global stiffness matrix
(b) Determine the displacement of the rigid plate.
(c) Determine stresses in each member.

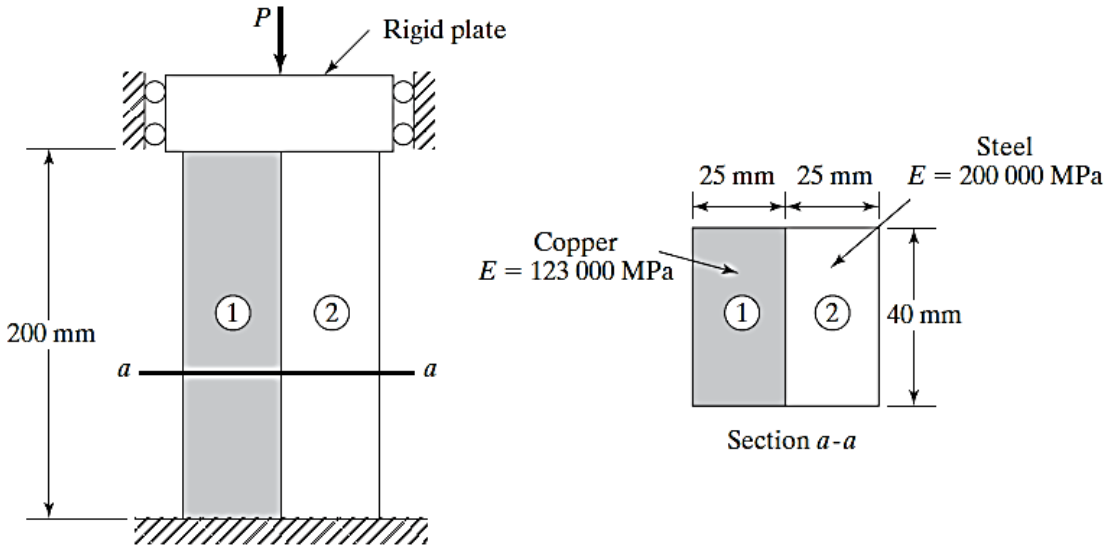

Fig 3

[2 + 2 + 1 = 5]

Q.4. Use **minimum** number of **2-noded elements** to discretize the structure and determine:

(a) Element Stiffness Matrices
(b) Displacement at Point 1.

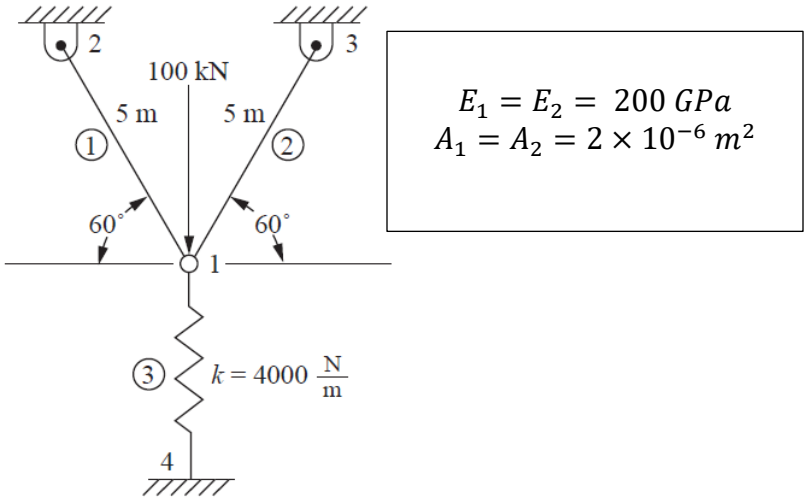

Fig 4

[3 + 4 = 7]