

Allowed Tables and Charts: (None)

Read carefully the given data and solve all questions. (Total Marks: 100)

Question (1)

[25 marks]

- Define: Stiffness matrix, Degrees of freedom, Symmetric matrix, Transformation matrix and The order of the matrix. [6M]
- Classify framed structures showing degrees of freedom in each category. [6M]
- Explain the two fundamental assumptions associated with linear analysis. [5M]
- For the plane truss element, derive the stiffness matrix in local coordinate system. [8M]

Question (2)

[25 marks]

For the truss shown in **Figure (1)**, use matrix method to write and solve equations of equilibrium required to find displacements at joints. Then, compute reactions at supports and bar forces.

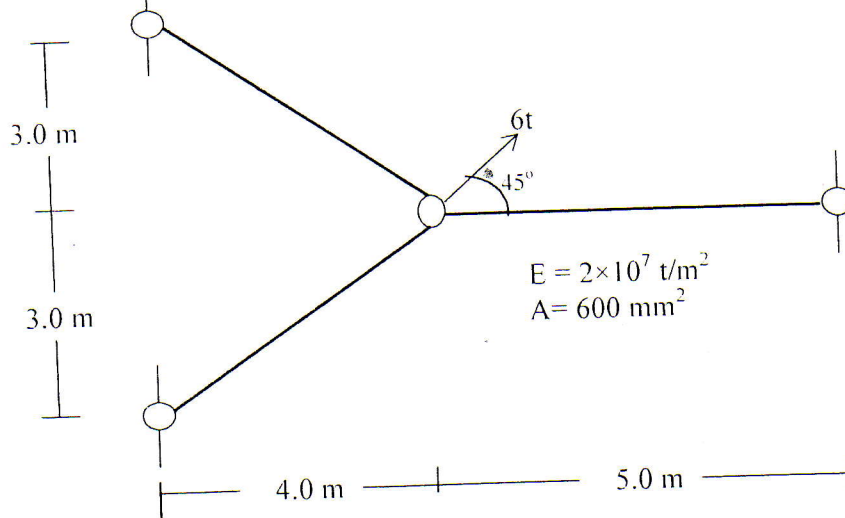


Figure (1)

Question (3)

[25 marks]

Determine the joint displacement, member end forces and support reactions for the beam shown in **Figure (2)**. Draw the deformed shape of the beam.

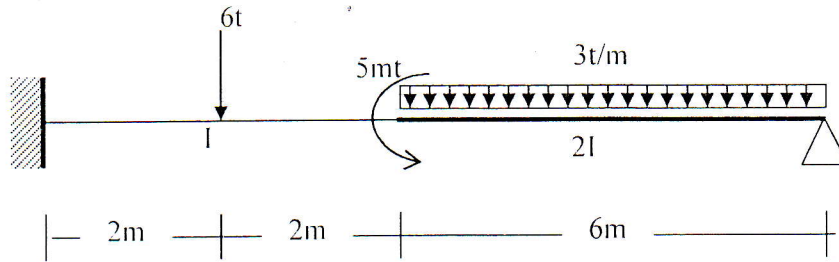


Figure (2)

Question (4)

[25 marks]

The frame shown in **Figure (3)** is subjected to the loads.

- Identify by numbers the degrees of freedom and restrained coordinates. Also form joint load vector, P.
- If the global displacements of the inclined member are:

$$\begin{bmatrix} 0.00441m \\ -0.001m \\ -0.02851rad \\ 0 \\ 0 \\ 0 \end{bmatrix}$$

Calculate end forces of this member in both local and global coordinate systems. Is the member in equilibrium?

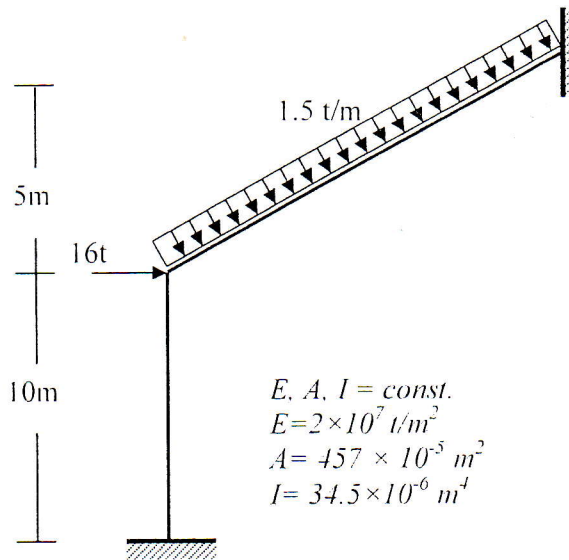
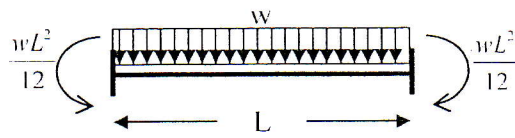


Figure (3)



Our best wishes,

This exam measures the following ILOs												
Question Number	Q1-a	Q1-b	Q1-c	Q1-d	Q2	Q3	Q4-a			Q4-b		
	A1	A2	A4	A3	B1	B2	B3			C4		
Skills	Knowledge & Understanding Skills				Intellectual Skills				Professional Skills			