Allowed Tables and Charts: *(None)*

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

Question (1)   [25 marks]

a) Define: Global stiffness matrix, Main diagonal of the matrix, Symmetric matrix, Transformation matrix and The order of the matrix.   [7M]

b) Explain the difference between classical, matrix and finite element methods of structural analysis.   [6M]

c) Classify framed structures showing degrees of freedom in each category. [6M]

d) Explain the two fundamental assumptions associated with linear analysis. [6M]

. 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.
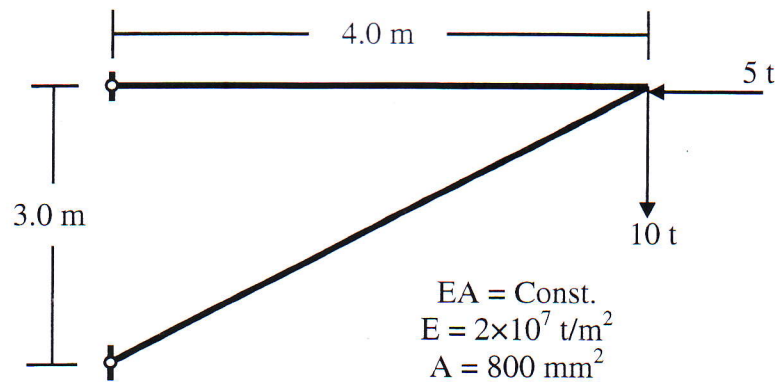

4.0 m

5 t

3.0 m

10 t

$EA = Const.$
$E = 2\times10^7 \ t/m^2$
$A = 800 \ mm^2$

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, BMD and SFD of the beam.
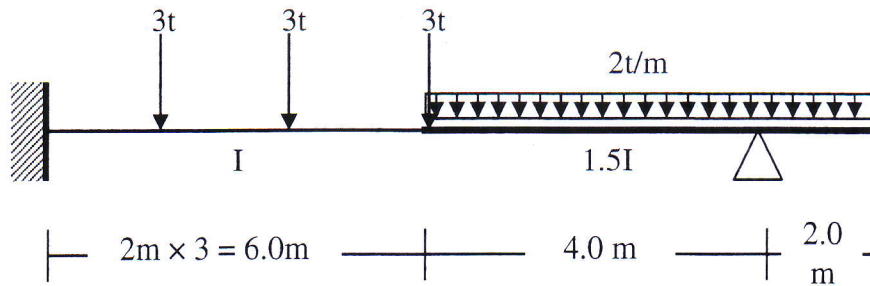
Figure (2)

Question (4)   [25 marks]

For the frame shown in **Figure (3)**,

    a)   Identify by numbers the degrees of freedom and restrained coordinates. Also form joint load vector, P.

    b)   If the global displacements of the inclined member are:

$$\begin{bmatrix} 1.884 \times 10^{-4}\,m \\ -5.35 \times 10^{-5}\,m \\ -4.806 \times 10^{-4}\,rad \\ 0 \\ 0 \\ 0 \end{bmatrix}$$

Calculate end forces of this member in both local and global coordinate systems. Is the member in equilibrium?
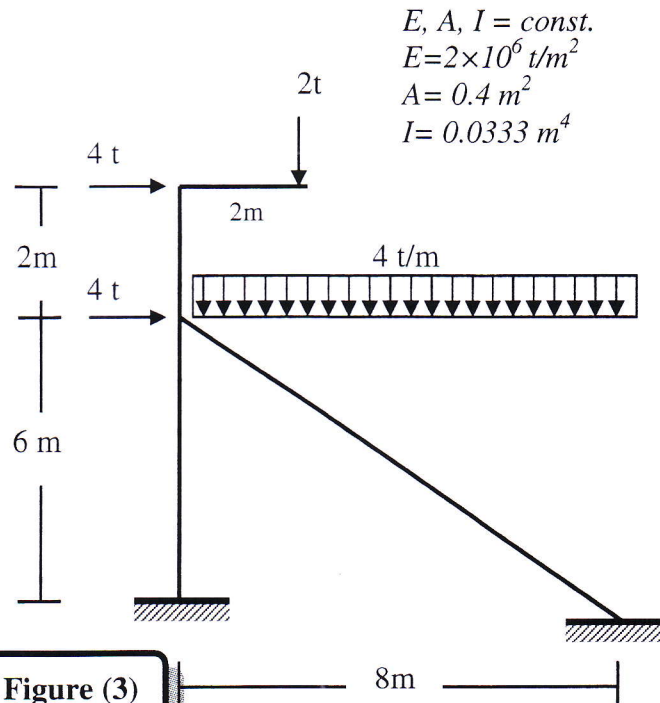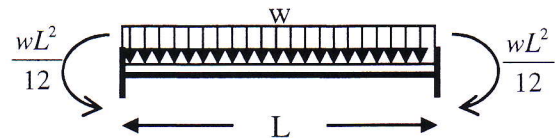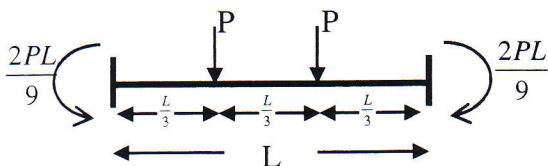
$E, A, I = const.$
$E = 2 \times 10^6\ t/m^2$
$A = 0.4\ m^2$
$I = 0.0333\ m^4$

Figure (3)

$$\frac{2PL}{9} \qquad \frac{2PL}{9}$$

$$\frac{wL^2}{12} \qquad \frac{wL^2}{12}$$

Our best wishes,

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				

This exam measures the following ILOs

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