

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY GURAJADA VIZIANAGARAM**  
**III B. Tech I Semester Regular/Supplementary Examinations, April/May -2025**  
**FINITE ELEMENT METHODS**  
**(MECHANICAL ENGINEERING)**

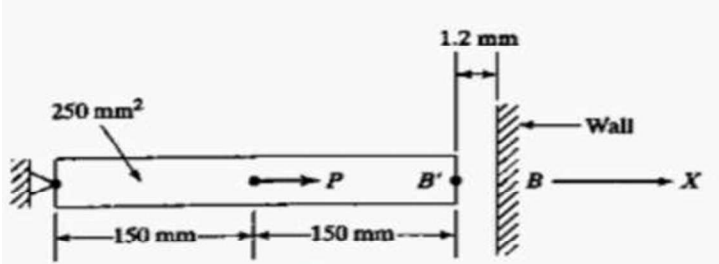
Time: 3 hours

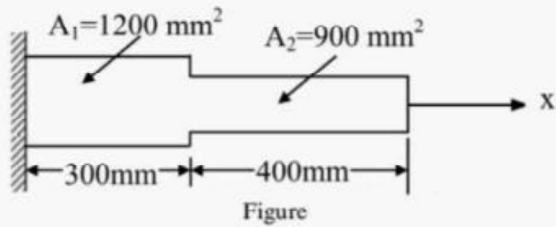
Max. Marks: 70

Answer any **FIVE** Questions **ONE** Question from **Each unit**

All Questions Carry Equal Marks

\*\*\*\*\*

		<b>UNIT-I</b>	
1.	a)	Use the Galerkin method to find the approximate deflection of a cantilever beam of length 'L' subjected to a uniformly distributed load 'w' N/m.	[9M]
	b)	Explain the advantages and disadvantages of the Finite Element Method.	[5M]
		(OR)	
2.		In the figure.1 shown, a load $P = 60 \times 10^3 \text{ N}$ is applied. Determine the displacement field, stress and support reactions in the body. Take $E = 20 \times 10^3 \text{ N/mm}^2$	[14M]
		 <p align="center">Figure.1</p>	
		<b>UNIT-II</b>	
3.	a)	Explain the penalty approach for handling boundary conditions in FEM.	[10M]
	b)	Discuss the requirements for selecting appropriate element size and aspect ratio in meshing	[4M]
		(OR)	
4.	a)	Define shape functions. Explain the characteristics of linear and quadratic shape functions.	[7M]
	b)	Describe different mesh generation techniques used in FEM.	[7M]
		<b>UNIT-III</b>	
5.		Derive the expression for the stiffness matrix and load vector for a two-node truss element.	[14M]
		(OR)	
6.		Derive the strain-displacement matrix for a linear triangular element.	[14M]
		<b>UNIT-IV</b>	
7.		Derive the stiffness matrix for a Constant Strain Triangle (CST) element.	[14M]
		(OR)	
8.	a)	Derive the shape functions of a 4-node rectangular element.	[7M]
	b)	Explain the concept of Gauss quadrature and its importance in numerical integration within FEM. Discuss the one-point Gauss quadrature method.	[7M]
		<b>UNIT-V</b>	
9.		Determine the natural frequencies and mode shapes of the stepped bar shown below using the consistent mass matrix.	[14M]

		 <p>Figure</p>	
		(OR)	
10.		<p>Explain the finite element formulation for one-dimensional heat transfer, including the derivation of the element equations. Discuss how boundary conditions such as fixed temperature and convection are applied in the formulation.</p>	[14M]

\*\*\*\*\*