Code No: 126EE **R13**

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
B. Tech III Year II Semester Examinations, May - 2017
FINITE ELEMENT METHODS
(Common to AE, ME, MSNT)

Time: 3 hours **Max. Marks: 75**

Note: This question paper contains two parts A and B.
Part A is compulsory which carries 25 marks. Answer all questions in Part A. Part B consists of 5 Units. Answer any one full question from each unit. Each question carries 10 marks and may have a, b, c as sub questions.

PART - A

(25 Marks)

1.a) List the properties of the shape functions. [2]

b) The nodal displacements of a two noded axial element is (0, 0.075) mm. The length of the element is 0.6 m. Find the stress in the element. Assume the Young's modulus of the element as 200 GPa. [3]

c) How many DOFs does a two-nodal, planar truss element have in its local coordinate system, and in the global coordinate system? [2]

d) Represent the Hermite shape functions graphically. [3]

e) What are the strain displacement relations for axisymmetric element? [2]

f) Differentiate among the Iso-parametric, Sub-parametric and super-parametric formulation. [3]

g) What is Thermal conductivity matrix for 2D heat transfer problems? [2]

h) Derive the governing equation for steady-state, one-dimensional conduction with convection and heat generation? [3]

i) Define Hamilton principle and compare with the principle of minimum potential energy principle. [2]

j) Differentiate between the transient dynamic analysis and eigenvalue analysis. [3]

PART - B

(50 Marks)

2.a) Derive the stress strain relation for a plane stress condition starting from Hook's law.

b) A bar of uniform cross section and length L is fixed at one end and is subjected to an axial load of P. If the body is also subjected to a constant body load of F_b throughout its length, develop the total potential energy expression. [5+5]

OR

3. For the three stepped bar shown in figure 1, determine the displacements at node 2 and 3 and the reactions at the supports. Also find the stresses in each section. [10]

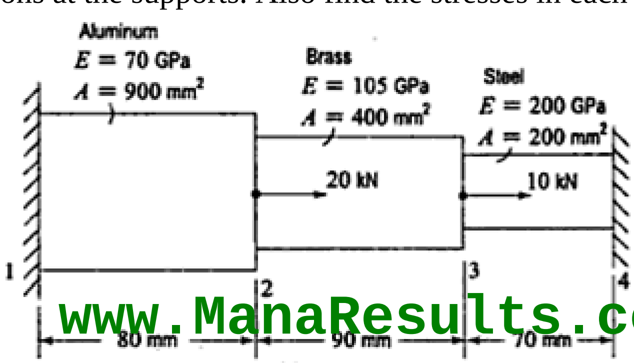

Figure 1

4. The plane truss is loaded with force P as shown in figure 2. Constants E and A for each bar are as shown in the diagram. Determine the nodal displacements, the reaction forces and the stresses in bar elements. [10]

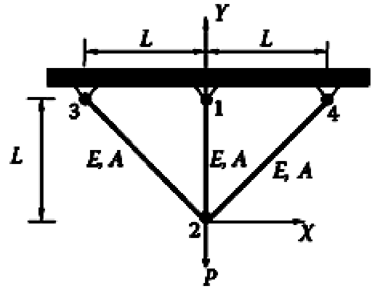

Figure 2

OR

5. A simply supported beam of length of 8 m and uniform cross section of width 300 mm and depth 200 mm is subjected to a uniformly distributed load of 10 kN/m over the entire length. Compute the maximum deflection if the Young's modulus is 200 GPa. Also estimate the slope at the supports. [10]

6. For the four noded quadrilateral element shown in figure 3, find the nodal load vector if p_o is 2MPa. Also find the determinant of the Jacobian for one point gauss quadrature. [10]

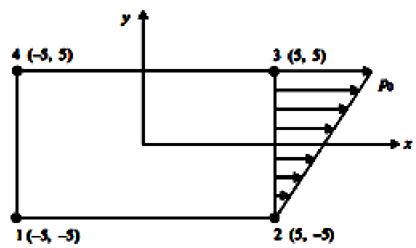

Figure 3

OR

7. An axisymmetric triangular element is described by the following details. Determine the element stresses at the centroid for the Young's Modulus 80 GPa and Poisson's Ratio 0.25. [10]

	Node 1	Node 2	Node 3
Radial Coordinate from the axis (r)	5 mm	1 mm	3 mm
Axial coordinate (z)	5 mm	5 mm	2mm
Deformation in radial direction (u)	0.02 mm	0.06 mm	0.01 mm
Deformation in axial direction (u)	-0.04 mm	0	0.02 mm

8. Estimate the temperature profile in a pin fin of diameter 25 mm, whose length is 500mm. The thermal conductivity of the fin material is 50 W/m K and heat transfer coefficient over the surface of the fin is 40 W/m^2 K at 30^0C. The tip is insulated and the base is exposed to a temperature of 150 ^{0}C. Evaluate the temperatures at points separated by 100 mm each. [10]

OR

9. For a two dimensional heat transfer in a square slab shown in figure 4, each element equilibrium equation are given by the same expression. All the edges are maintained at zero degree temperature. What is the final form of equations after assembly and incorporating the boundary conditions? [10]

$$\begin{bmatrix} 25 & -1 & 21 \\ -1 & 18 & -7 \\ 21 & -7 & 41 \end{bmatrix} \begin{Bmatrix} T_i \\ T_j \\ T_k \end{Bmatrix} = \begin{Bmatrix} 300 \\ 500 \\ 800 \end{Bmatrix}$$

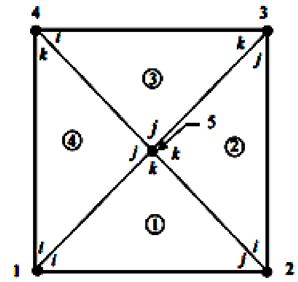

Figure 4

10. Consider a uniform cross section bar of length L made up of a material whose Young's modulus and density are given by E and ρ. Estimate the natural frequencies of axial vibration of the bar using both consistent and lumped mass matrices. [10]

OR

11.a) What are the convergence and compatibility requirements? Discuss in detail.

b) Derive the shape functions for a four noded tetrahedral element using natural coordinate system. [5+5]

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