



B.Tech III Year II Semester Supplementary Examinations, January 2023
Finite Element Methods

(Mechanical Engineering)

Maximum Marks: 70

19/1/2023

Duration: 3 hours

- Note:
1. This question paper contains two parts A and B.
 2. Part A is compulsory which carries 20 marks. Answer all questions in Part A.
 3. Part B consists of 5 Units. Answer any one full question from each unit.
 4. Each question carries 10 marks and may have a, b, c, d as sub questions.

Part-A

All the following questions carry equal marks

(10x2M=20 Marks)

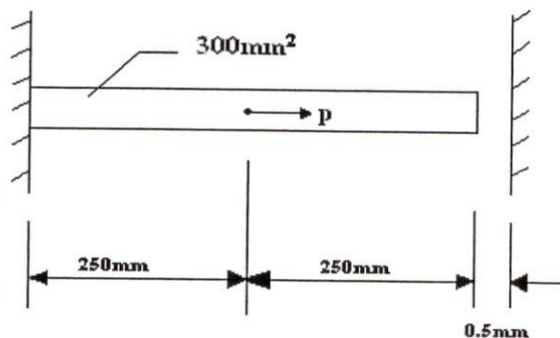
1. What boundary conditions are imposed for 1 Dimensional bar element.
2. The nodal displacements of a two noded axial element is (0, 0.075) mm. The length of the element is 0.6 m. Find the stress in the element. Assume the Young's modulus of the element as 200 GPa.
3. List the properties of the shape functions.
4. How local and global coordinates are related in a truss problem.
5. Write the hermite shape function of a beam element
6. What are the properties of a triangular coordinates.
7. Write the strain displacement equation of axisymmetric problems using a cylindrical coordinate system.
8. Write governing differential equation for two dimensional heat transfer problem
9. Differentiate lumped and consistent mass matrix.
10. List one requirement which is sufficient for convergence for a plate element.

Part-B

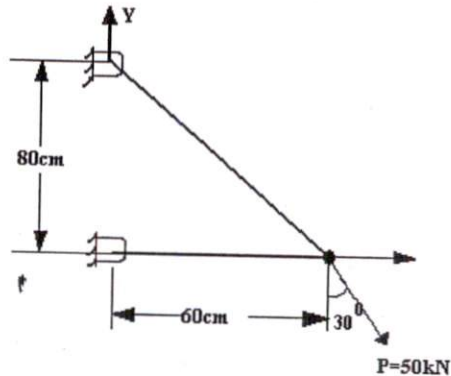
Answer All the following questions.

(10M X 5=50Marks)

11. Derive the stress strain relation for a plane stress condition starting from Hooke's law. 10
OR
12. Determine the nodal displacements for two rails separated by a gap of 0.5 mm shown in the figure $P = 100\text{KN}$ $E = 80 \times 10^3 \text{ MPa}$ 10

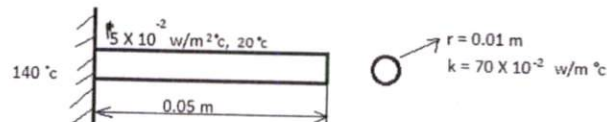


- 13 Calculate the nodal displacements and element stresses for the truss shown in the figure $E = 70 \text{ GPa}$, $A = 2 \text{ cm}^2$ for all truss members. 10



OR

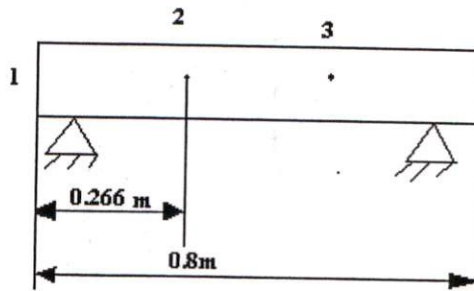
- 14 Explain Hermite shape functions in detail. 10
- 15 The (x,y) coordinates of nodes i, j and k of a triangular element are $(1,1)$, $(6,2)$ and $(4,5)$ respectively. The shape functions of a point P located inside the element are given by $N_1 = 0.12$ and $N_2 = 0.35$. Determine x and y coordinates of point P . 10
- OR
- 16 Derive the jacobian matrix of a four noded quadrilateral element. 10
- 17 Estimate the temperature distribution in 1-D fin as shown in the figure by making the fin into two elements. 10



OR

- 18 (a) Write the governing equation for the torsional analysis of non-circular shaft. 5
- (b) Write the application for the finite element analysis for thermal problems. 5

- 19 Find the natural frequency of simply supported beam of length 800mm, cross sectional area $75 \times 25 \text{ cm}$, $E = 200 \text{ GPa}$, $\rho = 7850 \text{ kg/m}$ 10



OR

- 20 Consider axial vibrations of the steel stepped bar as shown in the below figure 10
- (a) Develop global stiffness matrix and mass matrix
- (b) Find Natural Frequencies

