

Enrollment No.....



Faculty of Engineering
End Sem Examination Dec-2023

ME3EL05 Finite Element Method

Programme: B.Tech.

Branch/Specialisation: ME

Duration: 3 Hrs.**Maximum Marks: 60**

Note: All questions are compulsory. Internal choices, if any, are indicated. Answers of Q.1 (MCQs) should be written in full instead of only a, b, c or d. Assume suitable data if necessary. Notations and symbols have their usual meaning.

- Q.1 i. Which option is not a characteristic of an analytical solution in mathematical modelling of a process? **1**
 (a) Mathematical equations are used to describe a process
 (b) Most practical problems cannot be solved
 (c) Exact information on the quantities of interest is obtained
 (d) Finite element method is used
- ii. Which of the following is not true regarding the elements used for a finite element mesh to be valid? **1**
 (a) The number of elements used is not exact
 (b) Elements can be of different orders
 (c) Elements can be of different types
 (d) The choice of elements and mesh is problem-independent
- iii. In which element continuum is discretized. **1**
 (a) Infinite (b) Finite (c) Unique (d) Equal
- iv. What are the basic unknowns on stiffness matrix method? **1**
 (a) Nodal displacements (b) Vector displacements
 (c) Load displacements (d) Stress displacements
- v. The truss element is a _____ when we see it in a local co-ordinate system. **1**
 (a) Three dimensional (b) One dimensional
 (c) Two dimensional (d) Thermal component
- vi. Plane truss element can be shown in _____. **1**
 (a) Local coordinate system
 (b) Global coordinate system
 (c) Local and global coordinate systems
 (d) Dimensional structure

[2]

- vii. For constant strain elements the shape functions are _____. **1**
 (a) Spherical (b) Quadratical
 (c) Polynomial (d) Linear
- viii. Principal stresses and their directions are calculated by using _____. **1**
 (a) Galerkin approach (b) Rayleigh method
 (c) Potential energy method (d) Mohr's circle method
- ix. In deformation of the body, the symmetry of _____ and symmetry of _____ can be used effectively. **1**
 (a) Stress and strain (b) Nodes and displacement
 (c) Geometry and strain (d) Geometry and loading
- x. Boundary conditions can be easily considered by using _____. **1**
 (a) Rayleigh method (b) Penalty approach method
 (c) Galerkin approach (d) Potential energy approach

- Q.2 i. Explain types of governing equations. **2**
 ii. For Figure 01 derive the finite element equations, **8**

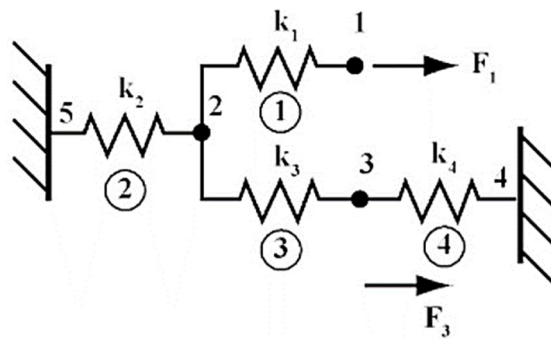


Figure 01

- OR iii. Determine the displacements of the nodes in Figure 02. **8**

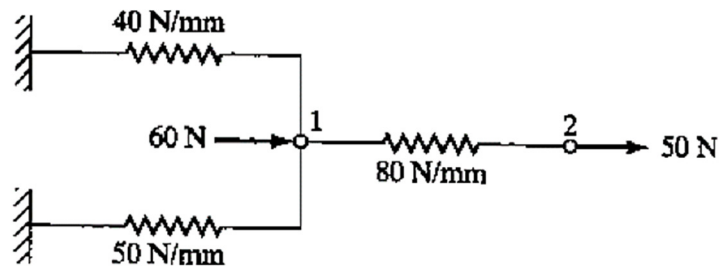


Figure 02

- Q.3 i. Differentiate between implicit and explicit mathematical models. **2**
 ii. Discuss the factors to be considered in selecting interpolation function. **8**
 OR iii. Explain elimination method for treatment of boundary conditions. **8**

[3]

- Q.4 i. Explain stress strain relationship in three dimensional stresses. **3**
 ii. Determine the Eigen values and Eigen vectors of the bar shown in Figure 03. Take $E=200$ Gpa, $\rho = 7862$ kg/m³, $A=6$ cm² and $L=2.5$ m. **7**

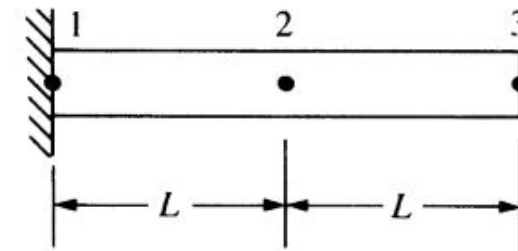


Figure 03

- OR iii. Derive and plot the shape functions for four node quadrilateral elements. **7**
- Q.5 i. Explain constant strain triangle (CST) element. **4**
 ii. Derive inverse of the jacobian transformation matrix (J^{-1}) for constant strain triangle (CST). **6**
 OR iii. With the suitable examples, explain the meaning and the formulations of properties of axi-symmetric elements. State their applications. **6**
- Q.6 Attempt any two:
 i. Obtain the governing equation of the one-dimension heat conduction. **5**
 ii. Explain the steps of FEM with the help of an example. **5**
 iii. Explain heat load matrix with example. **5**
