Enrollment No: _____ Exam Seat No:_____

C.U.SHAH UNIVERSITY

Summer Examination-2019

Subject Name : Finite Element Methods

Subject Code : 5TE02FEM1 Branch: M.Tech Mechanical (CAD/CAM)

Semester : 2 Date :20/04/2019 Time : 02:30 To 05:30 Marks : 70

Instructions:

(1) Use of Programmable calculator and any other electronic instrument is prohibited.
(2) Instructions written on main answer book are strictly to be obeyed.
(3) Draw neat diagrams and figures (if necessary) at right places.
(4) Assume suitable data if needed.

SECTION – I

Q-1 Attempt the Following questions

a.	Name three commonly used methods for deriving the element equation.	**02**
b.	Write the properties of stiffness matrix.	**02**
c.	Enlist any two conditions to be satisfied by any interpolation function.	**02**
d.	Enlist the different forces acting on an elastic body.	**01**

Q-2 Attempt all questions

a.	Explain about different types of elements used in FEM.	**05**
b.	Enlist the properties of stiffness matrix.	**05**
c.	What do you understand by "treatment of boundary conditions"- Explain.	**04**

OR

Q-2 a.	List and explain the properties of approximate function.	**05**
b.	Explain basic steps involved in Finite Element Method and illustrate them with example.	**05**
c.	What are the different steps used in FEA?	**04**

Q-3 Attempt all questions

a. Consider the problem of finding the function u(x) that satisfies the differential equation, **07**

$$-\frac{d}{dx}\left(a \cdot \frac{du}{dx}\right) + cu - f = 0 \quad for\ 0 < x < L$$

and the boundary conditions

$$u(0) = u_0 \cdot \left(a \cdot \frac{du}{dx}\right)_{x=L} = Q_0$$

Where a, c and f are constants, Develop the weak form for this equation.

b. By using the finite element method for the loaded bar shown in Figure 1, determine the nodal displacements, element stresses and support reactions. Assume E = 200 x 10^9 N/mm^2. **07**

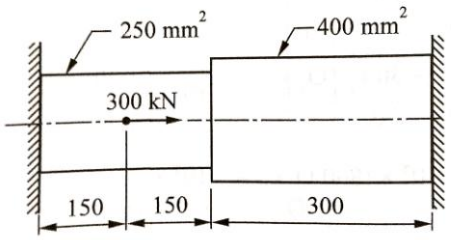

Figure: 1

OR

Q-3 **a.** An axial stepped bar is as shown in Figure 2. Model of the bar by considering it is as made of 1 element, 2 elements or 3 elements and determine the deflection in each of the cases. Plot the deflection in the bar at 100 mm, 200 mm and 300 mm from the fixed end for each of the cases. Assume the modulus of elasticity as 200 GPa. **14**

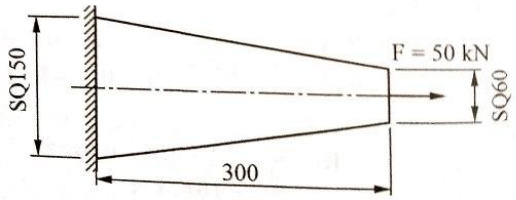

Figure: 2

SECTION – II

Q-4 **Attempt the Following questions**

a. Enlist the software used for finite element analysis. **02**
b. What is meshing? Explain it. **02**
c. Give the practical example of 2D heat conduction problem. **02**
d. Explain FEA and FEM. **01**

Q-5 **Attempt all questions**

a. What is Natural or Intrinsic coordinate system? Explain it. **05**
b. What do you mean by mesh convergence? Give its importance in FEM. **05**
c. Using FEM find the temperature distribution in one dimensional fin. **04**

OR

Q-5 **a.** Temperature at Node 1 is 100˚C and at Node 2 is 40˚C. The length of the elements shown in Figure 3 is 200mm. Evaluate the shape function associated with Node 1 and Node 2. Calculate the temperature at point 'P' situated at 150 mm from Node 1. Assume a linear shape function. **07**

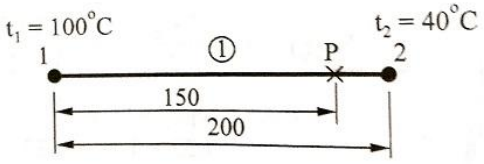

Figure: 3

b. A thin plate as shown in Figure 4 has a uniform thickness of 20 mm and a modulus of elasticity is 200 x 10^3 N/mm^2 and density of 7800 kg/m^3. In addition of its self-weight, the plate is subjected to a point load P of 500 N which is applied as shown in Figure 4. **07**

Find:

1. Displacement at nodal points
2. Stresses in each element
3. Reaction at the support

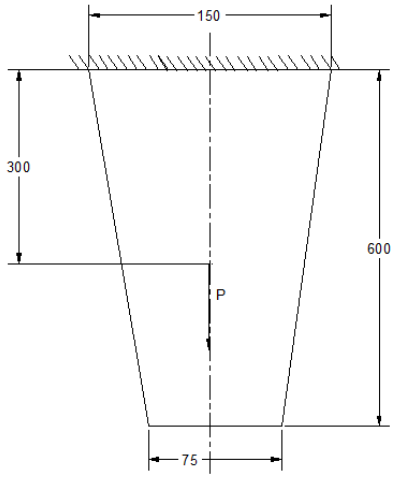

Figure: 4

Q-6 **Attempt all questions**

a. Derive a relation to determine the jacobian function for a Constant Strain Triangular (CST) element. **07**

b. Figure 5 shows a truss consisting of three elements whose AE/L value is 1000 N/mm. Calculate the deflection at node 2. **07**

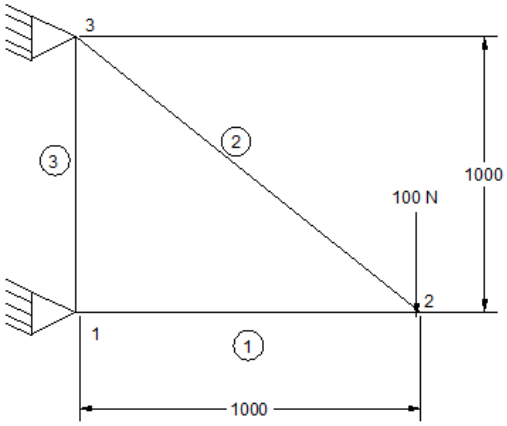

Figure: 5

OR

Q-6 **a.** Explain how to model and apply boundary conditions to following types of problem: **07**

a) A flat plate with a central hole, subjected to tensile pull.
b) Hollow cylinder under internal pressure, with one end closed.
c) Long hollow cylinder subjected to external pressure.

b. Consider the bar as shown in Figure 6. Determine the nodal displacements, element stresses and reactions, if the temperature rises by 60˚C. Assume modulus of elasticity for the complete bar as 200 GPa and coefficient of thermal expansion as $12*10^{-6}$ per ˚C. **07**

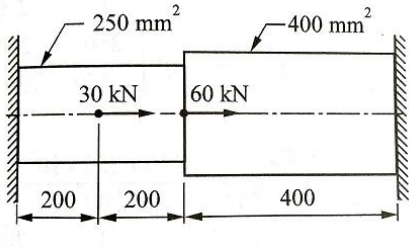

Figure: 6