Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

ME – SEMESTER – II(New)• EXAMINATION – SUMMER - 2020

Subject Code:3720801 **Date: 26/10/2020**

Subject Name: Finite Element Analysis

Time: 02:30 PM To 05:00 PM **Total Marks: 70**

Instructions:

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**

Q.1 **(a)** Explain generalized procedure to solve a problem with FEM. Clearly explain engineering applications of FEM. **07**

(b) Explain with neat sketches various types of elements used in FEM with their applications. **07**

Q.2 **(a)** Explain Pre-processing, Solution and Post-processing with regards to FEM. **07**

(b) For a system shown in figure 1 below, determine the displacements and stresses. Assume modulus of elasticity E = 20 X 10^3 N/mm^2 and area A = 250 mm^2 and F = 60 kN. **07**

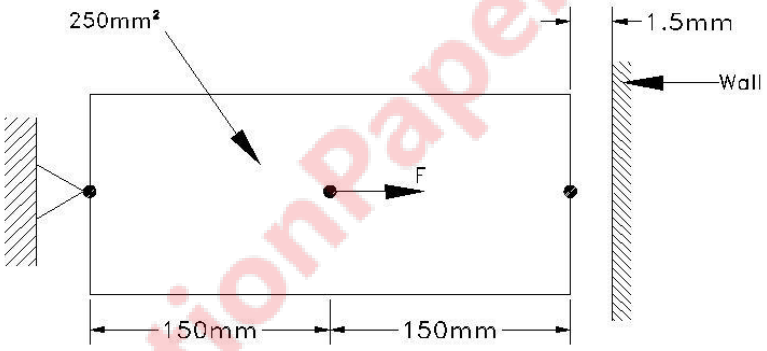

Figure 1

OR

(b) An axial stepped bar is subjected to a load of F = 50 kN as shown in figure 2 below. If the modulus of elasticity of the material is 200 GPa, determine the displacements and stresses of each section. **07**

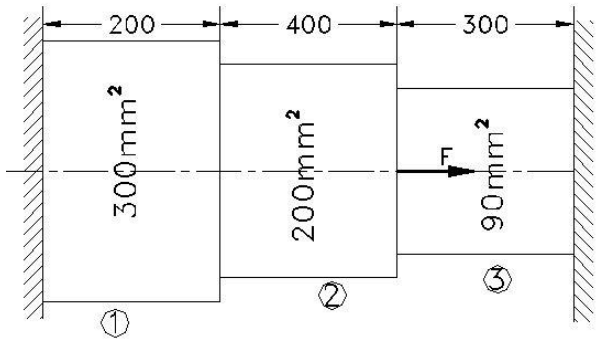

Figure 2

Q.3 **(a)** Derive the stiffness matrix of truss element in global coordinate system. **07**

(b) What do you mean by convergence in FEM ? State its importance in FEM. **03**

(c) Explain automatic mesh generation. **04**

OR

Q.3 **(a)** Discuss the properties of global stiffness matrix. **03**

(b) With the help of neat sketches explain Kirchoff and Mindlin plate elements and compare their capabilities. **04**

(c) A three element truss as shown in figure 3 below has modulus of elasticity E = 200 GPa. The area of each element is 50 mm^2. The length L_1 = 1000 mm and L_2 = 750 mm. The loads P_1 = 50kN and P_2 = 40kN and applied as shown. Determine the nodal displacements. **07**

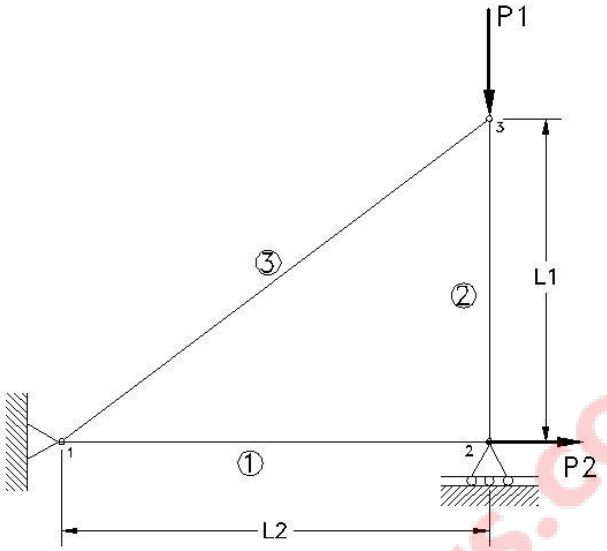

Figure 3

Q.4 **(a)** Derive shape functions for quadratic distribution. **07**

(b) Determine the displacement and rotation at the nodes under the force and moment located at the center of the beam as shown in figure 4 below. The beam is fixed at each ends. A downward force of 10 kN and an applied moment of 20 kN-m act at the center of the beam. Let E = 210 GPa and I = 4 X 10^{-4} m^4. **07**

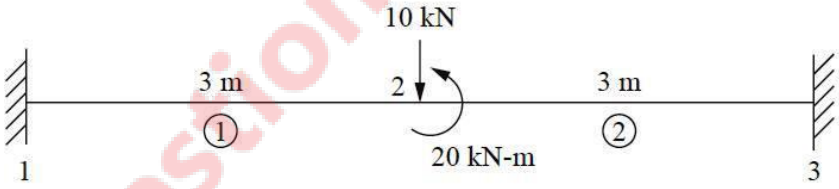

Figure 4

OR

Q.4 **(a)** Find the temperature distribution in one dimensional heat transfer in thin fins using FEM. **07**

(b) Aluminum fin of rectangular cross section is used to remove heat from a surface whose temperature is 100°C. The temperature of the ambient air is 20°C. The convective heat transfer coefficient of surrounding air is 30 W/m^2°C. The thermal conductivity of aluminium is 168 W/m°C. The fin is 80 mm long, 5 mm wide and 1 mm thick. Determine the temperature distribution along the fin using 4 element finite element model. **07**

Q.5 **(a)** Explain Galerkin's approach for derivation of element matrices with suitable example. **07**

(b) The nodal coordinates of the triangular element are as shown in figure 5 below. At the interior point P, the x-coordinate is 3.3 and $N_1 = 0.3$. Determine N_2, N_3 and the y-coordinate of point P. Also determine Jacobian of the transformation J of the element. **07**

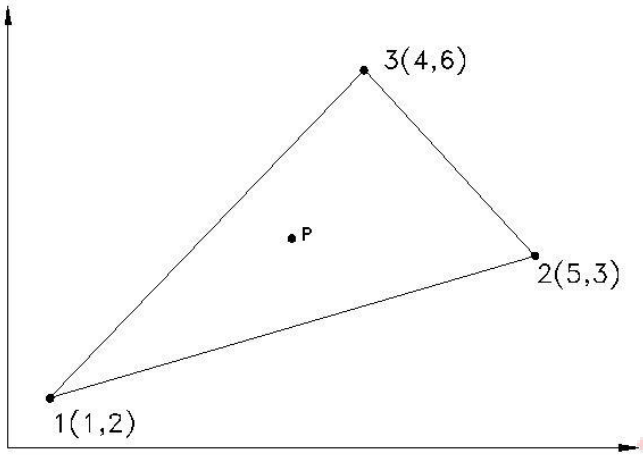

Figure 5

OR

Q.5 **(a)** Explain various types of nonlinearities giving suitable examples. **07**

(b) Explain the difference between plane truss and space truss. **03**

(c) Explain the properties of Eigen vectors **04**

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