Seat No.: _____ Enrolment No._____

# GUJARAT TECHNOLOGICAL UNIVERSITY

**ME – SEMESTER –II-(Old) EXAMINATION – Summer-2019**

**Subject Code: 1720801** **Date: 09/05/2019**

**Subject Name: Finite Element Method**

**Time: 10:30 AM TO 01:00 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 in detail the discretization process with respect to **07**
i) Type of elements ii) Size of elements
iii) Location of nodes iv) Number of elements

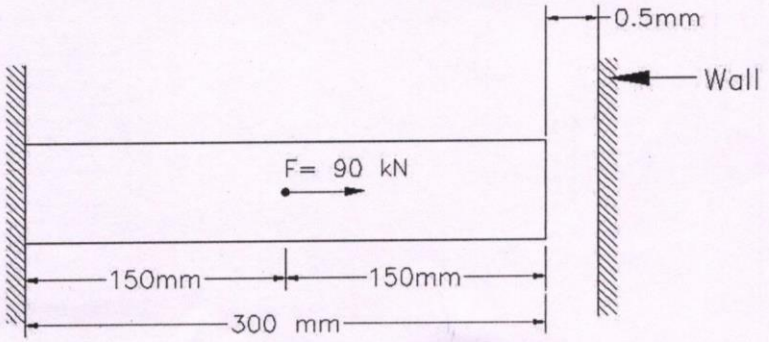
**(b)** Explain different types of non-linearity encountered in FEM analysis. **07**

**Q.2** **(a)** Describe the typical applications of FEA. Write down the procedure for finite element analysis. **07**

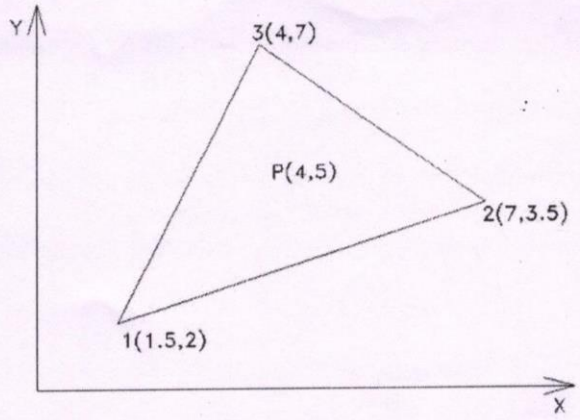
**(b)** Derive shape functions for quadratic distribution. **07**

**OR**

**(b)** For a system shown in figure below, determine the displacements and stresses. Assume modulus of elasticity E as 80 X $10^3$ N/mm$^2$ and area A = 225mm$^2$. **07**




**Q.3** **(a)** Evaluate the shape functions at the point P(4,5) for the triangular element shown below with nodes at node 1(1.5,2), node 2(7,3.5) and node 3(4,7). Also determine the Jacobian transformation **J** for the same element. **07**




**(b)** Explain mesh generation techniques in FEM. **07**

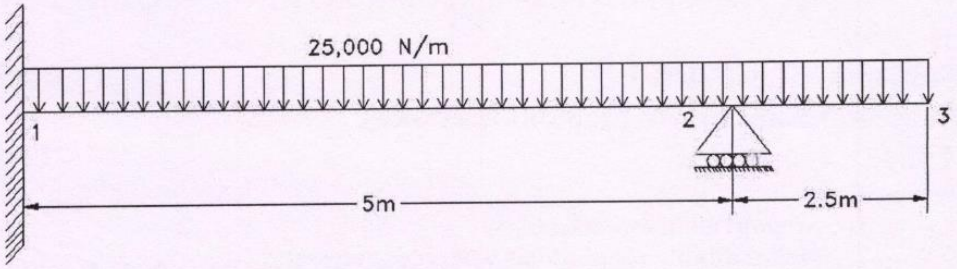
**OR**

**Q.3** **(a)** What is CST element? Obtain the strain matrix for CST element. **07**

**(b)** Explain Plane truss and Space truss in detail. **04**

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

**Q.4** **(a)** For the beam shown in the figure below, calculate the displacements and rotations at nodes 2 and 3. Assume beam with I = 118.6 X$10^6$ $mm^4$ and E = 2 X $10^5$ $N/mm^2$. **10**




**(b)** Explain plain stress and plain strain in brief. **04**

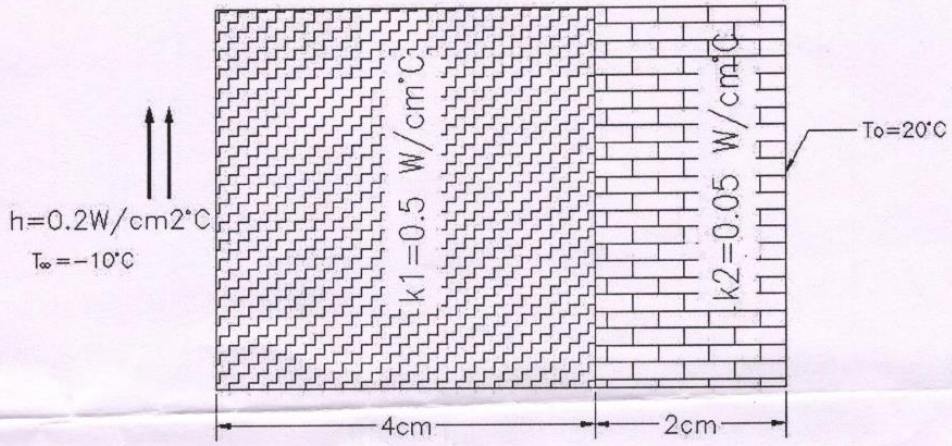
**OR**

**Q.4** **(a)** Using FEM find the temperature distribution in one dimensional fin. **07**

**(b)** Write the properties of global stiffness matrix of a bar element. **03**

**(c)** A 25mm long 1D element is having iinear shape function. If the temperature at node 1 is 50°C and at node 2 is -20°C, find the temperature at a point 5mm away from node 1. **04**

**Q.5** **(a)** Determine the temperature distribution through the composite wall shown in Figure 4 when convection heat loss occurs on the left surface. Assume unit area. Assume all thicknesses, t1 = 4 cm and t2 = 2 cm; k1 = 0.5 W/cm°C, k2 = 0.05 W/cm°C, h = 0.2 W/$cm^2$°C and T∞ = -10°C. **07**




**(b)** Derive the element stiffness matrix of a truss element. **07**

**OR**

**Q.5** **(a)** What are Eigen Value and Eigen Vector in FEM? Explain properties of Eigen vectors. **07**

**(b)** List various FEM softwares available in the market. Explain the following terms with reference to a FEA software **07**

i) Preprocessing ii) Solution iii) Post Processing

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