Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

ME – SEMESTER – II (New)– EXAMINATION – WINTER-2019

Subject Code: 3720801 **Date: 25-11-2019**

Subject Name: Finite Element Analysis

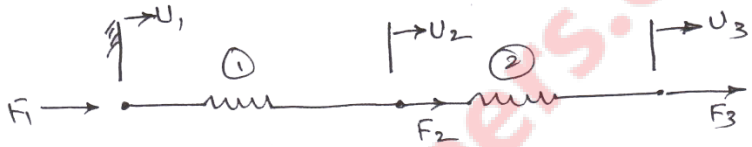
Time: 02:30 PM TO 05:00 PM **Total Marks: 70**

Instructions:

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

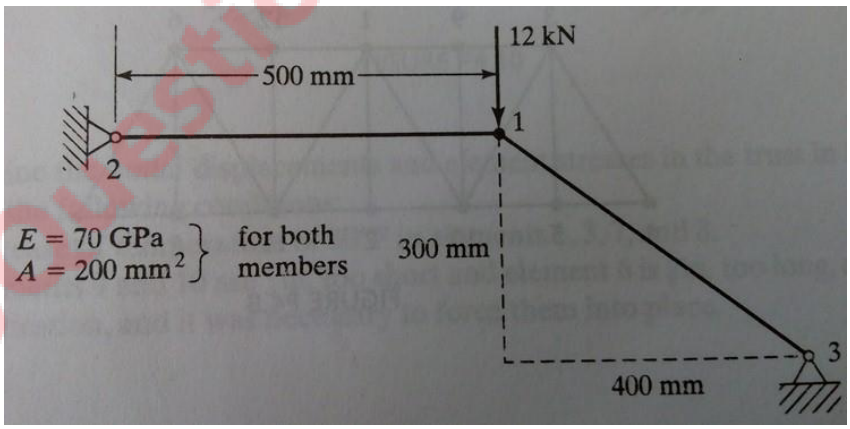
Q.1 **(a)** Write comparison of Finite Element and Finite difference methods. Giving suitable example, explain Lagrange's method for a three degree of freedom spring mass system. Get the required equations of motion **07**

(b) Explain in brief: "Free body diagrams of elements and nodes" of below given figure. Also derive K matrix **07**



Q.2 **(a)** Giving suitable example, explain Lagrange's method for a three degree of freedom spring mass system. Get the required equations of motion. **07**

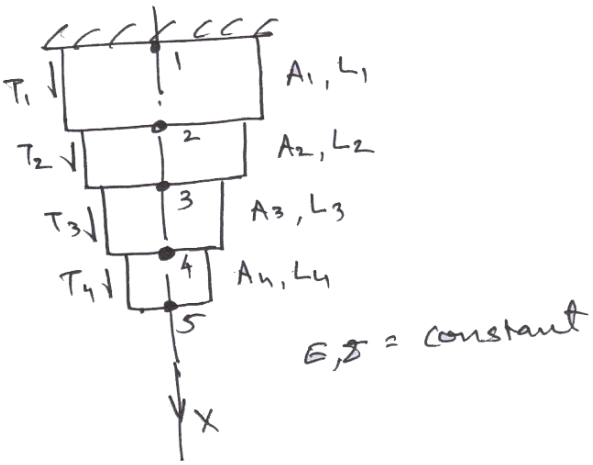
(b) For the two bar truss shown below figure, determine the displacements of node 1 and stress in element 1-3. **07**



OR

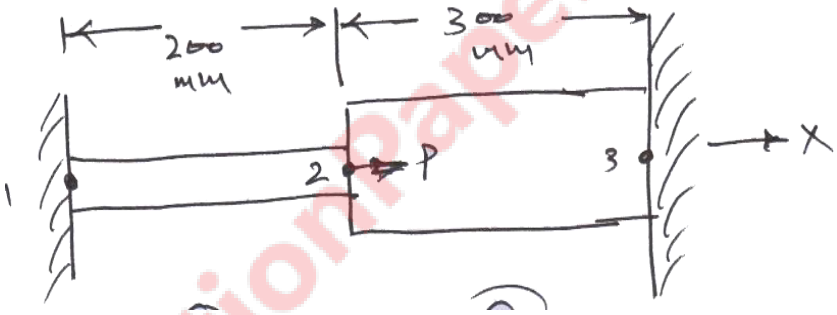
(b) Consider the bar shown below. **07**

For each element i, A_i and l_i are the cross sectional area and length respectively. Each element i, subjected to a traction force T_i, per unit length and body force f per unit volume. The units of Ti, f, Ai and so on are assumed to be consistent. The Young's modules of the material is E. A concentrated load P_2 is applied at node 2. Derive step by step structured stiffeners matrix and nodal load vector



Q.3 **(a)** In axial load p = 300 x 10^3N is applied at 20^0c to the rod as shown below. The temperature is then raised to 60^0c. Assemble L and F matrices and determine the nodal displacement and element stress. **07**

(1)	(2)
Aluminum	Steel
E – 70 x 10^9N/m^2	200 x 10+9$^{N/m+2}$
A – 900 mm^2	1200 mm^2
X – 23 x 10^{-6} per ^{0}c	11.7 x 10^{-6} per ^{0}c

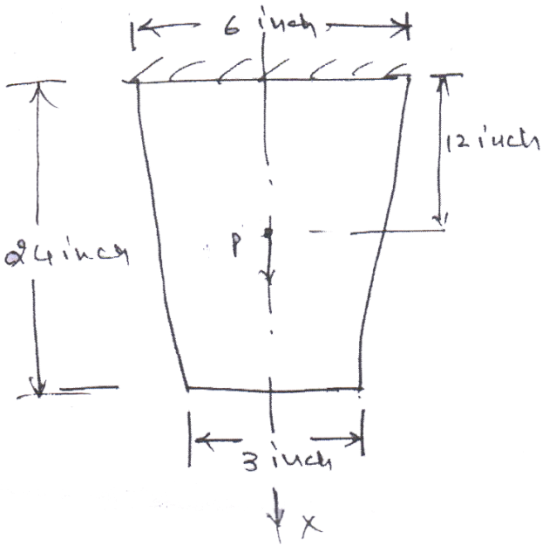


(b) Differentiate the following **07**
(i) Transient and Eigen value problems
(ii) Completeness and compatibility of elements

OR

Q.3 **(a)** Consider the thin plate as below: **07**
The plate has a uniform thickness t=1 inch. Having Young's modules E = 30 x 10^6 psi and weight density ρ = 0.2836 lb/in^3. The plate is subjected to a point load P = 100 lb at its midpoint.
Find:

a) Model the plate and write expression for the stiffness materials and element body force vectors.
b) Assemble the structural stiffness material K and global load vector F.
c) Using elimination approach, solve the global displacement vector Q
d) Evaluate the stresses in each element
e) Determine the reaction force at the support



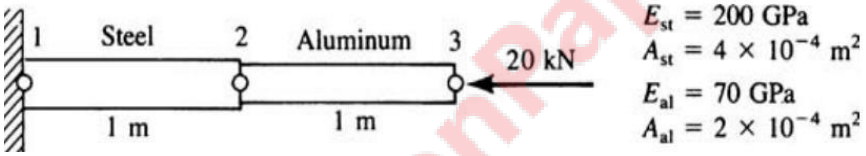
(b) Discuss the shape function for 4-node quadrilateral element and define isoparametric formulation. **07**

Q.4 **(a)** The quality of the result of FEA mainly depends upon the type of elements selected, size of the element and number of elements. Justify the statement giving examples. **07**

(b) Explain the "procedure to model the object" with reference to a FEA software. Also explain in brief: i) Preprocessing ii) Solution iii) Post Processing **07**

OR

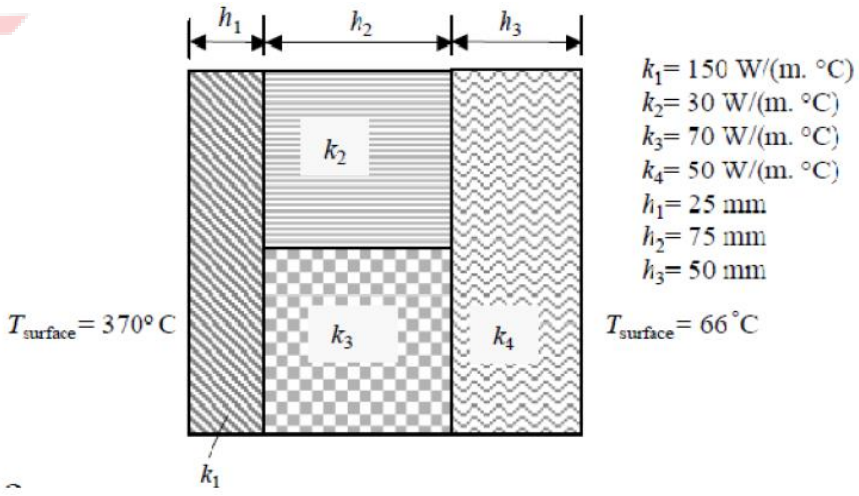
Q.4 **(a)** Determine nodal displacement and stresses in each elements for the bar assemblage in the below figure. **07**



(b) Explain following terms: (1) Sub-parametric formulation (2) Super parametric formulation (3) Mass lumping **07**

Q.5 **(a)** Discuss the effect of node numbering. Also differentiate between Kirchoff plate and Mindlin plate elements in terms of their capabilities and limitations. **07**

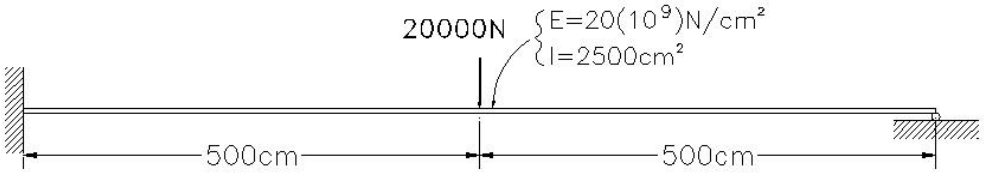
(b) Find the heat transfer per unit area through the composite wall shown below. Assume one dimensional heat flow. **07**



OR

Q.5 **(a)** Explain the terms Plane Stress and Plane Strain. Explain how will you solve a plane stress problem using FEA software . **07**

(b) A beam fixed at one end and supported by a roller at the other end, has a 20 KN concentrated load applied at the center of the span (Figure 5). Calculate the deflections under the load . **07**



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