Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

ME – SEMESTER II (OLD) EXAMINATION – SUMMER 2017

Subject Code:1720901 **Date:09/05/2017**

Subject Name:Finite Element Method

Time:10:30 A.M. to 01:00 P.M. **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)** Describe the typical applications of FEA and also describe the procedure of finite element analysis. **07**

(b) A step bar having three elements is as shown in Fig 1. The step bar is subjected to load P_2=60000 N at node 2 and P_3=75 KN is applied at node 3 as shown in the figure. **07**

1. Displacement at nodal point.
2. Stresses in the element.
3. Support reaction in the body.

Take L_1=800mm, L_2=600mm, L_3=400mm

A_1=2400mm^2 , A_2=1200mm^2, A_3=600mm^2

Modulus of elasticity E_1=85000 KN/ mm^2

E_2=70000 KN/ mm^2

E_3=200000 KN/ mm^2

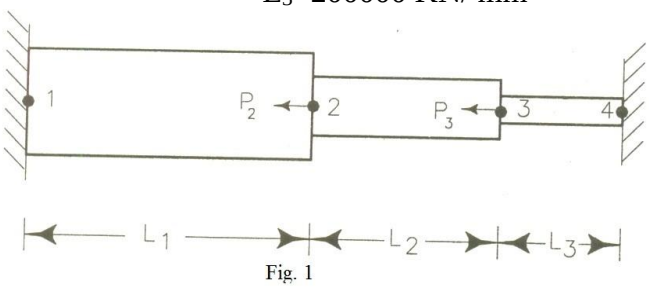

Fig. 1

Q.2 **(a)** Derive the shape function for quadratic bar element in natural coordinate system. **07**

(b) Consider the bar as shown in Fig. 2. Determine the nodal displacements and element stresses, if the temperature rises by 60°C. Assume modulus of elasticity for the complete bar as 200 GPa and coefficient of thermal expansion as 12e^{-6} per °C. **07**

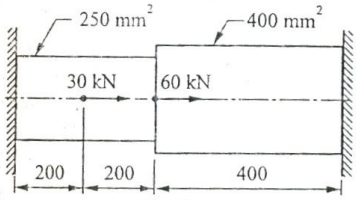

Fig. 2

OR

(b) A three spring system is shown in Fig. 3 having stiffnesses k_1=40N/mm, k_2=50N/mm and k_3=80N/mm. The loads are applied at node 1 and 2 as F_1=60N and F_2=50N. Calculate the displacement at nodal points. **07**

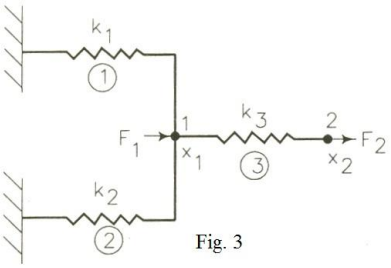

Fig. 3

Q.3 **(a)** Using the Galerkin approach method derive the following relation. **07**

$$KQ=F$$

Where K = Global stiffness Matrix
Q = Global Displacement vector and
F = Global Load vector

(b) For the two bar truss which is shown in Fig. 4. Determine the displacements and stresses in bar. Take E=70GPa and A=200mm^2. **07**

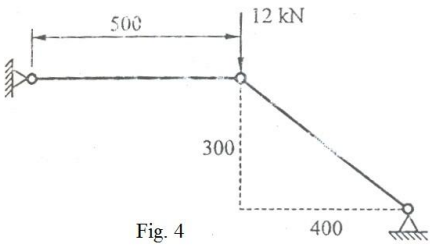

Fig. 4

OR

Q.3 **(a)** Derive the stiffness matrix for beam element. **07**

(b) A tapered bar is as shown in Fig. 5. Model the bar by considering it as 2 elements and determine the deflections in each of node. Take E=200GPa. **07**

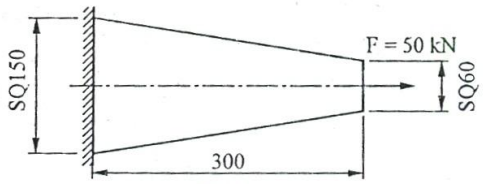

Fig. 5

Q.4 **(a)** Explain the formulation of a frame element that would enable us to model a buckling problem. **07**

(b) Name any four FEA software. Explain Preprocessing, Solution and Post processing with reference to FEA software. **07**

OR

Q.4 **(a)** Explain the following elements used in FEA stating their applications. Draw their sketches showing position of nodes. **07**
(i) Plate bending elements (ii) Curved shell elements (iii) 3 D solid elements.

(b) For the beam and loading as shown in Fig. 6. Determine the slopes at 2 and 3 and the vertical deflection at the midpoint of the distributed load. **07**

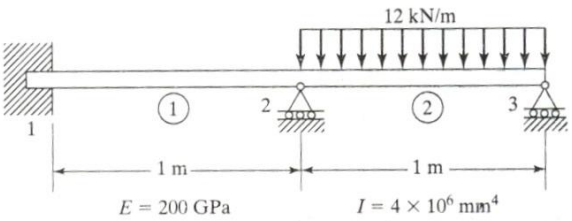

Fig. 6

Q.5 **(a)** What is CST element? Obtain the strain matrix for CST element. **07**

(b) Explain with example, the meaning of plane stresses and plane strains in detail. **07**

OR

Q.5 **(a)** Explain isoparametric element formulations. **07**

(b) The coordinate of the three nodes for a triangular element are (1.5,2), (7,3.5) and (4,7) respectively. The coordinate of a point P is (3.85,4.8). Evaluate the shape function N1, N2 and N3 for the three nodes. If the temperatures at node 1, 2 and 3 are 250°C, 150°C and 100°C respectively. What would be the temperature at point P. **07**

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