Seat No.: _____ Enrolment No.

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–VII (NEW) EXAMINATION – WINTER 2018

Subject Code: 2172008 **Date: 03/12/2018**

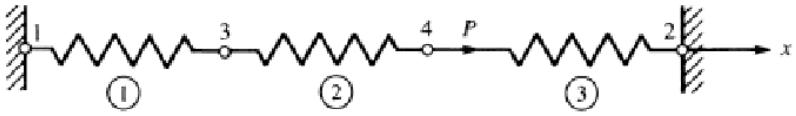
Subject Name: Finite Element Analysis of Mechatronic Systems

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.**

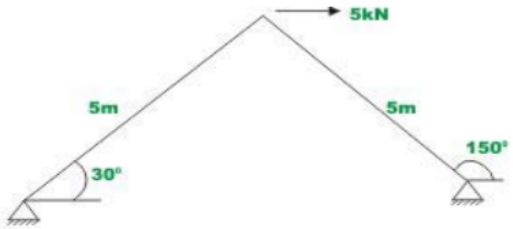
			MARKS
Q.1	**(a)**	Explain Descretization in FEM.	**03**
	(b)	What are the merits and demerits of FEA?	**04**
	(c)	Explain the steps for solving problems using FEM.	**07**
Q.2	**(a)**	Evaluate: FEA gives Approximate solution.	**03**
	(b)	For the spring assemblage with arbitrarily numbered nodes shown in Figure & obtains (a) the global stiffness matrix, (b) the displacements of nodes 3 and 4. Force P=5000N is applied at node 4 in X direction. The spring constant K_1=1000N/mm, K_2=2000N/mm & k_3=3000N/mm.	**04**



	(c)	Discuss the different types of elements used in FEA with its application.	**07**

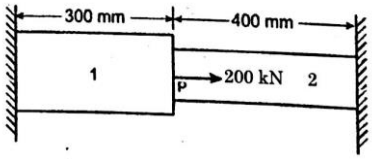
OR

	(c)	Derive element stiffness matrix for 1D bar element.	**07**
Q.3	**(a)**	Define local and global coordinate system in trusses.	**03**
	(b)	Give the practical application of axisymmetric elements.	**04**
	(c)	Find the displacement at each node and reaction forces for the two member truss shown in fig. Assume EA to be constant for all members.	**07**



OR

Q.3	**(a)**	What are the conditions necessary to be followed for considering a problem as axisymmetric?	**03**
	(b)	Source of error in FEA.	**04**
	(c)	Consider the bar as shown in fig. an axial load of 200 kN is applied at point P. Take A_1=2400 mm^2 , E_1 =70 x 10^9 N/mm^2, A_2 = 600 mm^2, E_2= 200 x 10^9 N/mm^2. Calculate the following, (1) The nodal displacement at point P, (2) Stress at each element.	**07**



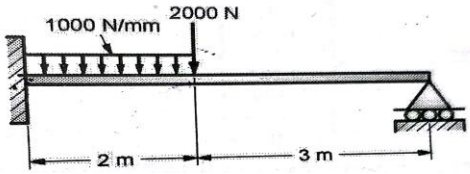
Q.4	**(a)**	Higher number of elements leads to getting a solution closer to the exact	**03**

one.

(b) Differentiate between spring, bar and beam elements from general and application point of view. **04**

(c) For the beam and loading shown in Fig . determine the deflections at node 2 and 3. **07**

Take: EI=400 x 10^3 N-m^2

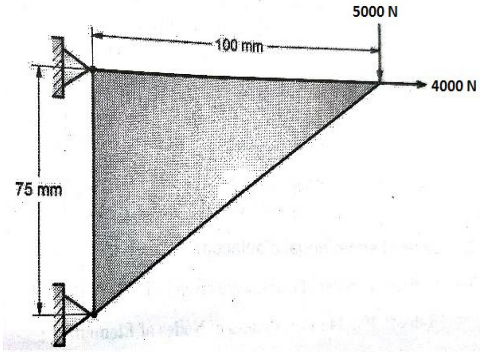


OR

Q.4 **(a)** How does axisymmetry differ from planer symmetry? **03**

(b) Differentiate between plane stress and plane strain analysis giving a suitable example. **04**

(c) A triangle plate of size 100 X 75 X 12.5mm is subjected to the loads of 5000 N & 4000N, as shown in fig. the modules of elasticity and poisson's ratio for the plate material are 2 x 10^5 N/mm^2 and 0.25 respectively. Model the plate with CST element and Determine the element stiffness matrix. **07**



Q.5 **(a)** Explain evaluation of eigenvalues and eigenvectors in dynamic consideration **03**

(b) Write down the expression of shape function N and displacement u for one dimensional bar element. **04**

(c) Discuss the importance of dynamics in Finite Element Analysis. Also explain the different types of nonlinearities. **07**

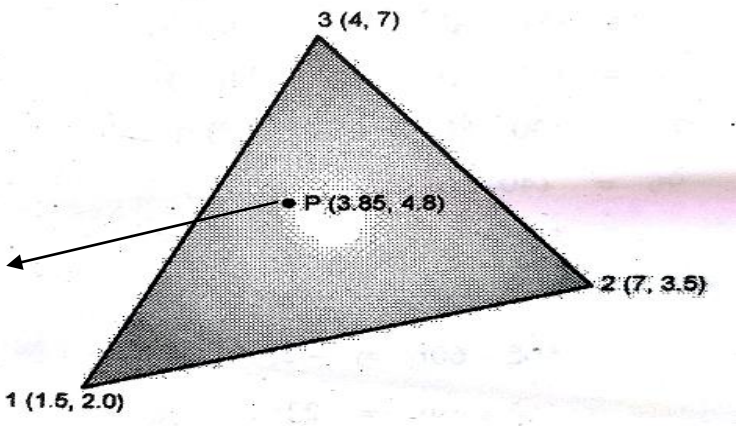
OR

Q.5 **(a)** What are the ways which a 3D problems can be reduced to a 2D approach? **03**

(b) Explain in brief : CST & LST **04**

(c) Evaluate the shape function & Find the Jacobian matrices for triangle shown in Fig. **07**

P (3.85,4.8)



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