Seat No.: _____ Enrolment No.

GUJARAT TECHNOLOGICAL UNIVERSITY

BE- SEMESTER–VII (NEW) EXAMINATION – WINTER 2020

Subject Code:2172008 **Date:28/01/2021**

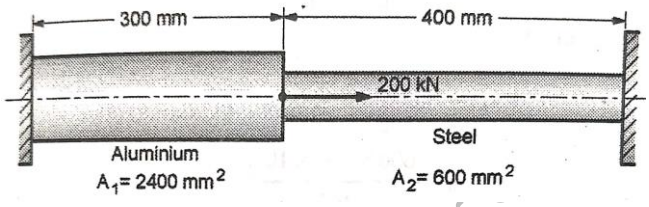
Subject Name:Finite Element Analysis of Mechatronic Systems

Time:10:30 AM TO 12:30 PM **Total Marks: 56**

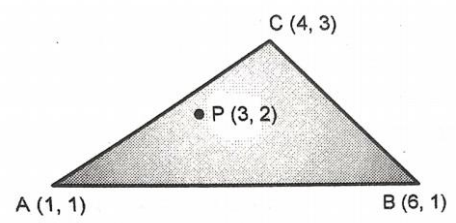
Instructions:

1. **Attempt any FOUR questions out of EIGHT questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**

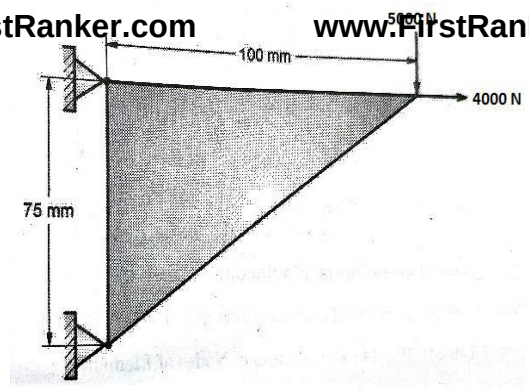
			MARKS
Q.1	**(a)**	Explain the types of boundary conditions identified in Finite element analysis.	**03**
	(b)	Define Isoparametric element.	**04**
	(c)	Explain the procedural steps to be followed for solving a problem using Finite Element Method.	**07**
Q.2	**(a)**	Give three applications of Finite Element Method.	**03**
	(b)	Explain Descretization in FEM.	**04**
	(c)	A stepped bimetallic bar made of Aluminium (E=70 x 10^3 N/mm^2) and steel (E=200x 10^3 N/mm^2) is subjected to an axial load of 200 KN as shown in fig. using penlty approach, determine the nodal displacement.	**07**



Q.3	**(a)**	Define the Shape function in FEM.	**03**
	(b)	Differentiate between plane stress and plane strain.	**04**
	(c)	Derive the elemental and global stiffness matrix of a spring and bar element using direct stiffness approach.	**07**
Q.4	**(a)**	Give name of different types of 2D element with their applications.	**03**
	(b)	For a point P located inside triangle, as shown in fig. find the shape function.	**04**



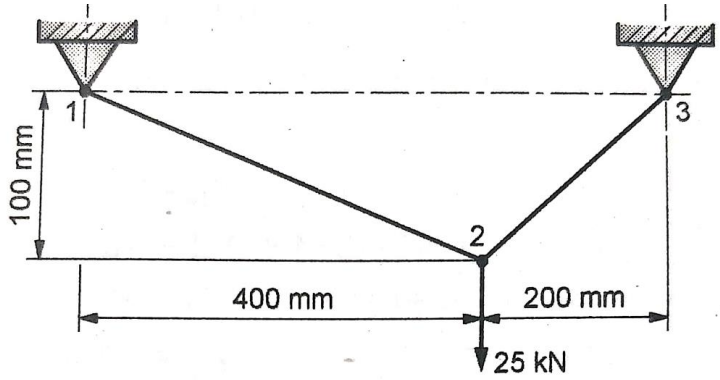
(c) A triangle plate of size 100 X 75 X 12.5mm is subjected to the loads of 5000 N & 4000N, as shown in fig. the modules of elasticity and poisson's ratio for the plate material are 2 x 10^5 N/mm^2 and 0.25 respectively. Model the plate with CST element and Determine the element stiffness matrix. **07**



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

(b) Discuss the different types of elements used in FEA from application point of view. **04**

(c) The plane truss, shown in fig., is subjected to a downward vertical load at node 2. If the cross sectional area of both the element is 30mm^2 and E=2.1 x 10^5 N/mm^2, Determine the global stiffness matrix. **07**



Q.6 **(a)** Explain the common sources of errors in FEA and procedure to measure them. **03**

(b) Consider the following displacement function for the two noded bar element : u = a + b x^2. Is this a valid displacement function? Discuss why or why not **04**

(c) Differentiate between dynamics and statics in FEA. Also explain the different types of nonlinearities that can be incorporated during analysis. **07**

Q.7 **(a)** Evaluate: FEA gives an approximate solution. **03**

(b) Define the following: Axisymmetric analysis **04**

(c) Give Potential Energy Approach to Derive Beam Element Equations. **07**

Q.8 **(a)** Differentiate between spring, bar and beam elements from general and application point of view. **03**

(b) The two noded one dimentional elements has nodes 1 and 2 located at the distance of 200 and 360 mm respectively from y axis. The displacement sof node 1 and 2 are 0.03mm and -0.05mm respectively. At point P, located at a distance 40mm from node 1 within the element determine (1) the natural coordinates, (2) the linear functions and (3) the displacement. **04**

(c) Differentiate between CST and LST. **07**

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