Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

M.E –IIst SEMESTER–EXAMINATION – JULY- 2012

Subject code: 1721501 Date: 06/07/2012

Subject Name: Finite Element Method

Time: 10:30 am – 13:00 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)	Give advantages and disadvantages in the usage of finite element method for analysis.	**04**
	(b)	Give the stepwise procedure of solution by finite element method.	**06**
	(c)	Explain the discretisation process by suitable illustrations.	**04**
Q.2	(a)	Select a suitable displacement function for a beam element and show that it satisfies the convergence criteria.	**07**
	(b)	Using the theorem of minimum potential energy, derive the expression for element stiffness matrix $K = \int B^T D B \, dV$.	**07**
		OR	
	(b)	Obtain the stiffness matrix of a bar element of length L and Young's Modulus E whose cross-sectional area varies linearly from area A1 to area A2 along the longitudinal direction.	**07**
Q.3	(a)	Distinguish between a plane stress and plane strain problem giving suitable example. Also give their strain-stress linking matrices.	**07**
	(b)	Explain the term "element aspect ratio".	**03**
	(c)	State the rule for labeling the nodes of elements for minimum bandwidth.	**04**
		OR	
Q.3	(a)	Determine the shape functions for the Constant Strain Triangle (CST). Use polynomial functions.	**07**
	(b)	For a CST element having co-ordinates (1,1), (2,5) and (4,3) , obtain the strain–displacement matrix. Assume Possion's ratio is zero and Young's modulus is constant.	**07**
Q.4	(a)	Derive the expression for shape function for a two noded bar element taking natural coordinate ζ as varying from -1 to 1.	**07**
	(b)	Determine the nodal displacement at node 2, stresses in each material and support reactions in the bar shown in Fig. 1, due to applied force P = 500 kN. Given: A1 = 2000 mm^2 , A2 = 1000 mm^2 , L1 = 400 mm, L2 = 400 mm E1 = 0.7 × 10^5 N/mm^2 and E2 = 2 × 10^5 N/mm^2.	**07**
		OR	
Q.4	(a)	Using generalized coordinate approach, find shape functions for two noded bar/truss element.	**07**
	(b)	For pin-jointed truss shown in fig.2, determine unknown displacements using FEM.	**07**
Q.5	(a)	(i) Enlist atleast four software of FE Analysis. (ii) Discuss roll of computer in FE Analysis. (iii) List 2-D elements used in any standard software.	**07**
	(b)	For a beam shown in fig.3, determine unknown displacements using FEM.	**07**
		OR	
Q.5	(a)	Derive the expression for the finding out stiffness matrix and load vector for spring in series and spring in parallel.	**07**
	(b)	What do you understand by axsymmetric problem? Explain type of stresses and strains induced in these type of problems.	**07**

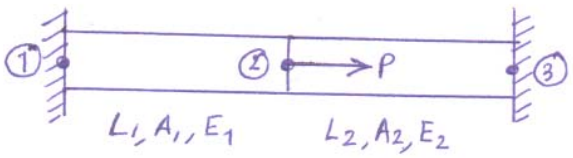


fig. 1

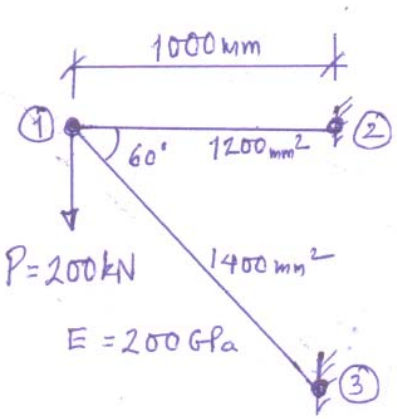
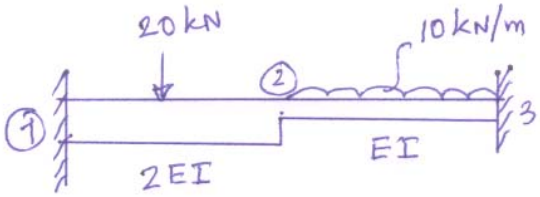
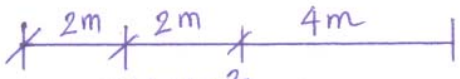


fig. 2





$EI = 800\ kN \cdot m^2$

fig. 3