Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

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

Subject code: 1724301 **Date: 067/2012**

Subject Name: Finite Element Method in Geotechnical Engineering

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)	Enlist four application of Finite Element Analysis in Geotechnical Engineering domain.	**04**
	(b)	Discuss the general steps of FEM.	**06**
	(c)	Explain the step " Discretize and Select the Element Types " by suitable illustrations.	**04**
Q.2	(a)	Using polynomial functions (generalized coordinates), determine shape functions for a two noded beam element.	**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)	What do you understand by axsymmetric problem? Explain type of stresses and strains induced in these type of problems.	**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)	Briefly explain various methods available to reduce memory requirement in storing stiffness matrix.	**04**
		OR	
Q.3	(a)	Derive expressions for natural coordinates in a CST element. Show that they are nothing but area coordinates.	**07**
	(b)	For a CST element having co-ordinates (0,0), (6,12) and (12,0) , 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)	For the bar assemblages shown in fig.1, determine the nodal displacements, the forces in each element, and the reactions.	**07**
		OR	
Q.4	(a)	Using Lagrange polynomial find shape functions for two noded bar element	**07**
	(b)	For pin-jointed truss shown in fig.2, determine unknown displacements using FEM.	**07**
Q.5	(a)	(i) Enlist useful software of FE Analysis. (ii) Discuss roll of computer in FE Analysis. (iii) Discuss on convergence of solution.	**07**
	(b)	For a beam shown in fig.3, determine unknown displacements using FEM.	**07**
		OR	
Q.5	(a)	Derive strain-displacement matrix for bar element.	**07**
	(b)	Obtain the stiffness matrix of a tapered bar element of length L and Young's Modulus E whose cross-sectional area varies linearly along the longitudinal direction.	**07**

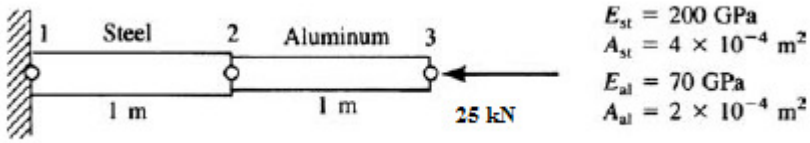

Fig.1

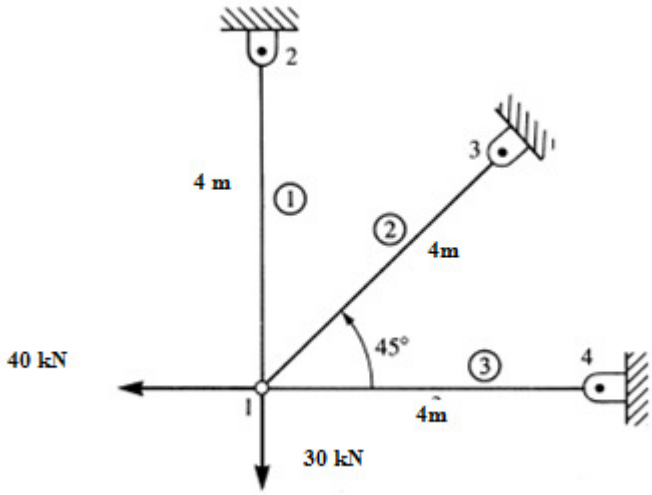

Fig.2

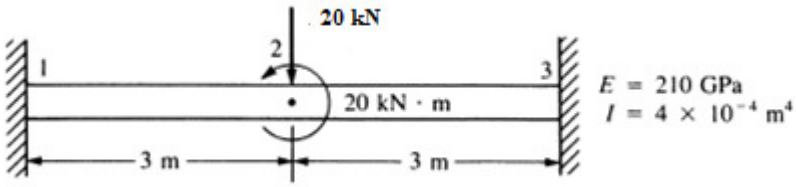

Fig.3