Seat No.: _____ *Enrolment No._____*

GUJARAT TECHNOLOGICAL UNIVERSITY

M. E. Sem. – II[nd] - Examination – June/July- 2011

Subject code: 1721501

Subject: Finite Element Method

Date:22/06/2011 **Time: 10:30 am – 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.**

Q.1 **(a)** Derive the load vector for a bar element having length 'L' , loaded along the length for following cases: **07**

(i) uniformly distributed load and uniformly varying load-two noded element

(ii) uniformly distributed load and uniformly varying load - three noded element having middle node at centre

(b) Derive the shape function for 3- noded bar element of length 'L', having middle node at a distance 0.25L from left node. **07**

Q.2 **(a)** Explain the isoparametric concept in finite element analysis. **07**

(b) List and draw, the shape functions and its variation, for two noded beam element. **07**

OR

(b) In a laboratory experiment of one dimensional flow through porous media over the section is shown in **fig -1**. Hydraulic head at entry and exit level are 200 mm and 100 mm respectively. Determine the distribution of hydraulic head over the length of a section and flow rate. **07**

Q.3 **(a)** For a given bar shown in **fig.2**, find nodal displacements & element stresses. Thickness of both elements are 20 mm, E=200 Gpa and unit weight of bar = 0.8×10^{-4} N/mm^3.Take two noded element -- two no.s. **07**

(b) For the plane truss shown in **fig.3**, determine the nodal displacements. Assume AE is same for each element. **07**

OR

Q.3 **(a)** Derive element stiffness matrix for beam element. Show sample calculation for K_{44}. **07**

(b) For the cantilever beam subjected to concentrated load 'P' at free end and uniformly distributed load 'w' acting over the whole length of beam. Determine the free end displacements and the nodal forces. Take EI=constant **07**

Q.4 **(a)** Differentiate between plane stress & plane strain condition. Also write their constitutive laws. **07**

(b) For a plane strain triangular element shown in **fig.-4** , **07**

Nodal displacements are given as

$u_1 = 0.005$ mm, $u_2 = 0$ mm, $u_3 = 0.005$ mm,

$v_1 = 0.002$ mm, $v_2 = 0$ mm, $v_3 = 0$ mm

Determine the element stresses, principle stresses and principal angle.

Take E=70 GPa, $\nu = 0.3$ and use unit thickness for plain strain.

The coordinates are given units of millimeters.

OR

Q.4 **(a)** What is displacement model? Explain about choice of model for 1-D & 2-D element. **07**

(b) Sketch the variation of shape function over the surface of CST element. **07**

Q.5 **(a)** Define axisymmetric problem. Discuss type of stresses & strains induced in axisymmetric element. **07**

(b) Determine the extension of tapered bar shown in **fig-5** at free end. Thickness of an element is 20 mm, E=200 Gpa and unit weight of bar = 0.8 X 10^{-4} N/mm^3. Choose your own elements. **07**

OR

Q.5 **(a)** Determine the consistent mass matrix for dynamic analysis of one dimensional bar element having modulus of elasticity E, mass m, density ρ and cross sectional area A. **07**

(b) Derive the expression for the finding out stiffness matrix & load vector for spring in series and spring in parallel. **07**

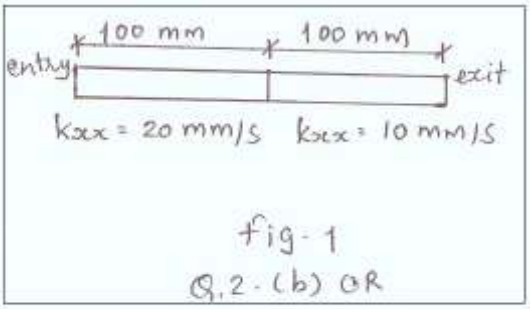

fig-1
Q.2-(b) OR

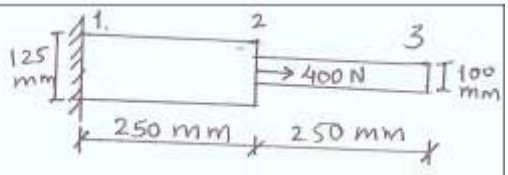

fig-2
Q.3 (a)

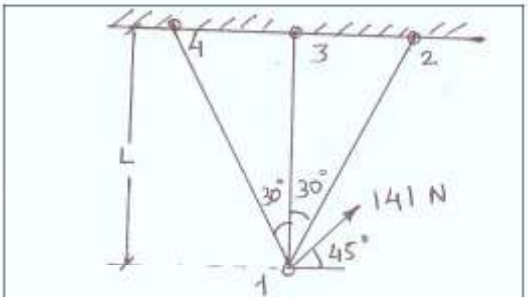

fig-3
Q.3 (b)

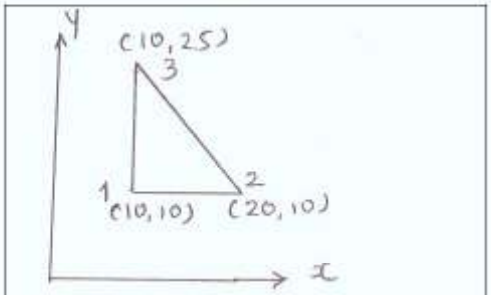

fig-4
Q.4 (a)

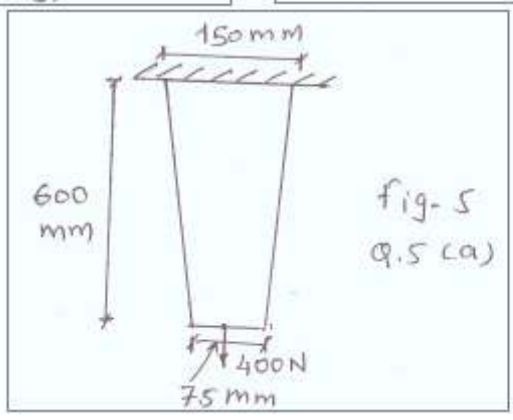

fig-5
Q.5 (a)

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