Second Semester Examination 2013
FINITE ELEMENT METHODS IN ENGINEERING

Time: 3 Hours
Max marks: 70

Answer Question No.1 which is compulsory and any five from the rest.

The figures in the right hand margin indicate marks.

1. Answer all Questions   2x10

a. What is meant by Finite Element Analysis?
b. What are the various steps in Finite Element Analysis?
c. Briefly describe about various types of elements used in FEM?
d. What is a iso-parametric element? Give example.
e. What is the importance of Pascal triangle?
f. What is weighted residual method?
g. Write down the shape function matrix for a 2D truss element..
h. What is Rayleigh-Ritz method?
i. What is meant by post processing in FEA?
j. What are the advantages of Finite Element Method.

2. For the spring assemblage with arbitrarily numbered nodes shown in figure 1. Find (a) the global stiffness matrix, (b) the displacement of nodes 3 and 4 (c) the forces in each spring. A force of 5 kN is applied at node 4 in x direction. The spring constants k_1=1 kN, k_2= 2 kN, and k_3=3 kN. Nodes 1 and 2 are fixed.   10
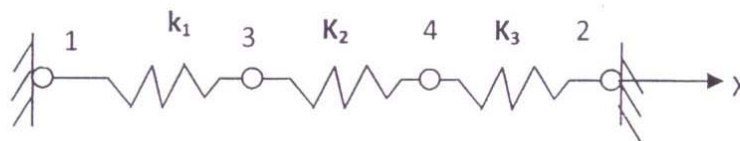

Figure 1

3. Derive the expression of transformation matrix and stiffness matrix for a bar in Three-Dimensional space.   10

4. The coordinate of a triangular element are given by (0,0), (3,0) and (1.5,4) mm respectively. Evaluate the shape function at a interior point P (2,2.5) mm for the element. Assuming plane stress condition, find the stiffness matrix for the element. Assume young's modulus E=$2x10^5$ N/mm^2, poission ratio v = 0.3, thickness =10mm. 10

5. A four noded rectangular element as shown in figure below. Evaluate the shape function at a interior point P (1,0.5). Also determine the (i) Jacobian matrix, and (ii) Strain displacement matrix for this element.
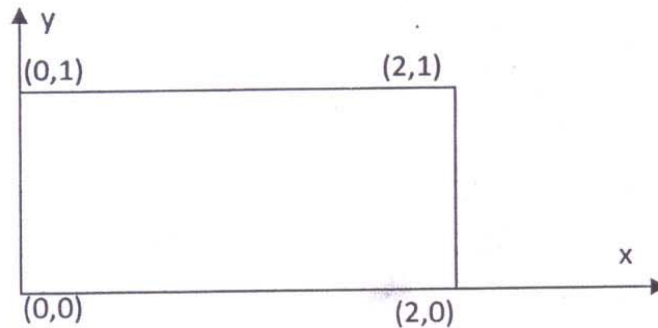
Take $E = 2 \times 10^5$ N/mm^2 , poission ratio $v = 0.25$. Assume plane stress condition.   10

6. For the one dimensional bar fixed at both ends and subjected to a uniform temperature rise T=50 ^{o}C, determine the reactions at the fixed ends and axial stress in the bar.

   Let E=200 GPa, A= 4 m^2, L =4 m, and α=0.57/K.
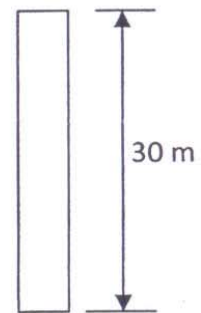

30 m

Figure 3

7. From basics derive the shape functions and strain-displacement matrix for axisymmetric element with constant strain triangular elements.   10

8. Write on (any two);   5x2
    (a) Briefly describe about Variational Approach.
    (b) Potential energy method.
    (c) Transverse vibration formulation in FEM.
    (d) Heat conduction formulation in FEM.