Registration No : | | | | | | | | | | |

Total Number of Pages : 03 **B.Tech.**
FEME6301

6th Semester Back Examination 2017-18
FINITE ELEMENT METHOD
BRANCH : MECH
Time : 3 Hours
Max Marks : 70
Q.CODE : C322

Answer Question No.1 which is compulsory and any five from the rest.
The figures in the right hand margin indicate marks.

Q1 **Answer the following questions :** **(2 x 10)**

a) State the use of Finite element method.

b) State the characteristics of shape functions.

c) What types of element are used in finite element method?

d) Explain about weak formulation.

e) What is the importance of Pascal's triangle in FE analysis?

f) What are the necessary conditions for a problem to be axisymmetric?

g) What is a CST element?

h) What is oparametric elements signify?

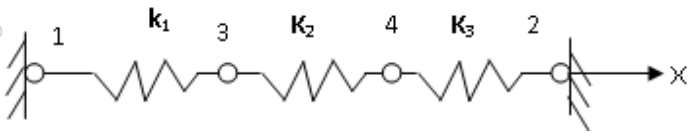
i) Write down the shape functions for a four noded rectangular element.

j) What are the different commercial FE codes available?

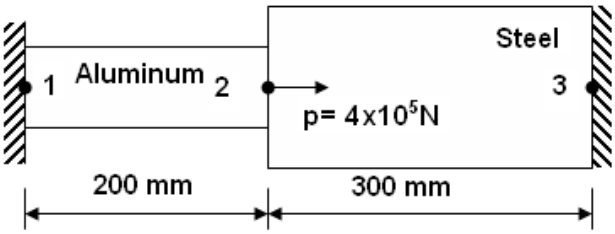
Q2 **a)** Derive the shape functions and strain displacement matrix for a 2-noded 1-D bar element. **(5)**

b) Describe about Gelerkin's approach used in finite element method. **(5)**

Q3 For the spring assemblage with arbitrarily numbered nodes shown in figure 2. Find (a) the global stiffness matrix, (b) the displacement of nodes 3 and 4 (c) the reaction forces at node 1 and 2, and (d) 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)**

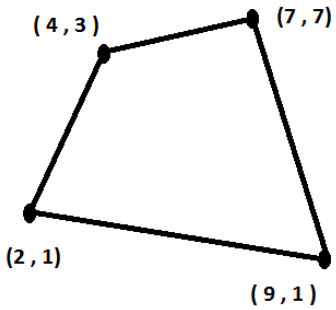


Q4 An axial load of $4x10^5$N is applied at 30^0C to the rod as shown in figure below. The temperature is then raised to 80^0C. Find the stiffness matrix. Calculate the nodal displacements and stresses in each material. For aluminum : A_{al}=900 mm^2, E_{al} =0.7x10^5 N/mm^2, $\alpha_{al} = 23x10^{-6}/^0C$ and for steel : A_{st}=1225 mm^2, E_{st} =2x10^5 N/mm^2, $\alpha_{st} = 12x10^{-6}/^0C$. **(10)**

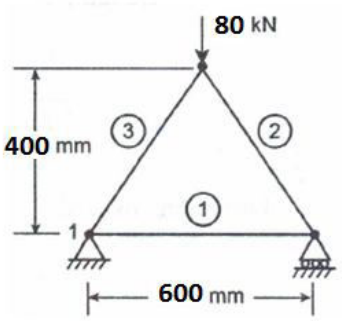


Q5 **a)** Write the stress-strain relation for an isotropic material in solving axisymmetric problem. **(4)**

b) For the iso-parametric four noded quadrilateral element shown in figure below, determine the cartesian co-ordinates of point P which has local co-ordinates ξ = 0.4 and η = 0.6. **(6)**



Q6 **a)** Consider a three bar truss with cross sectional area of 200 mm^2 as shown in figure below. It is given that E = 2 x 10^5 N/mm^2. Calculate (i) Nodal displacements, (ii) Stress in each member and (iii) Reactions at the support. **(5)**



b) In a rectangular element the nodes are as follows in the x-y plane : **(5)**
(x_1= 1, y_1= 1), (x_2= 5,y_2 =1) , (x_3=5, y_3= 5) and (x_4= 1, y_4= 5). The temperature distribution is computed at each node as T_1= 50°C, T_2 = 40°C, T_3=40°C and T_4= 60°C. Compute the temperature at (x=4, y=4).

Q7 From fundamental principle derive the stiffness matrix and the load vector for fluid mechanics in two dimensional finite element analysis. **(10)**

Q8 **Write short notes on any TWO :** **(5 x 2)**

a) Minimum potential energy principle.

b) Explain the basic steps involved in FEM.

c) Write the advantages, disadvantages and limitations of FEM.

d) Variational methods used for FEM.