Registration no: | | | | | | | | | | |

Total Number of Pages: 03 **M.TECH**

MDPE205

2nd Semester Back Examination – 2016-17

FINITE ELEMENT METHODS IN ENGINEERING

BRANCH(S): DESIGN AND DYNAMICS, MACHINE DESIGN, MECH. SYSTEM DESIGN

Time: 3 Hours

Max Marks: 70

Q.CODE: Z815

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) What is global coordinates and local coordinates?
b) What is Rayleigh-Ritz method?
c) State the characteristics of shape functions ?
d) How frame structure is different from bars?
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) How many engineering constants are to be evaluated for finding out the elasticity matrix for an orthotropic material?
h) What isoparametric elements signify?
i) Write down the stiffness matrix equation for one dimensional heat conduction element.
j) Why post processing is required in FEA.

Q2 The differential equation of a physical phenomenon is given by (10)

$$\frac{d^2y}{dx^2} + 500x^2 = 0; \qquad 0 \le x \le 1$$

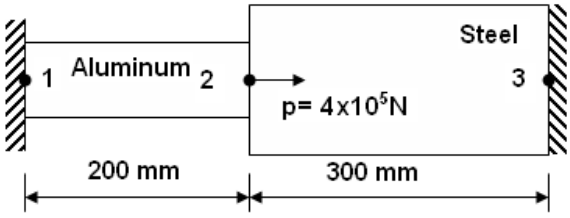
The boundary conditions are : y (0) = 0 and y(1) = 0.

Using Gelerkin method, calculate the values of parameter a_1 and a_2 of the trial function used, $y = a_1(x - x^3) + a_2(x - x^5)$

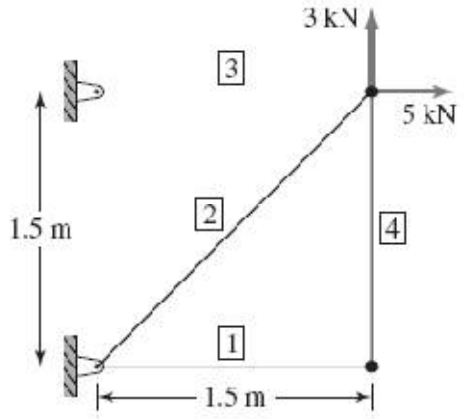
Q3 An axial load of $4x10^5$N is applied at 30^0C to the rod as shown in figure below. The temperature is then raised to 60^0C. Find the stiffness matrix. Calculate the nodal displacements and stresses in each material. (10)

For aluminum : A_{al}=1000 mm^2, E_{al} =0.7x10^5 N/mm^2, $\alpha_{al} = 23x10^{-6}/^0C$ and

For steel : A_{st}=1500 mm^2, E_{st} =2x10^5 N/mm^2, $\alpha_{st} = 12x10^{-6}/^0C$

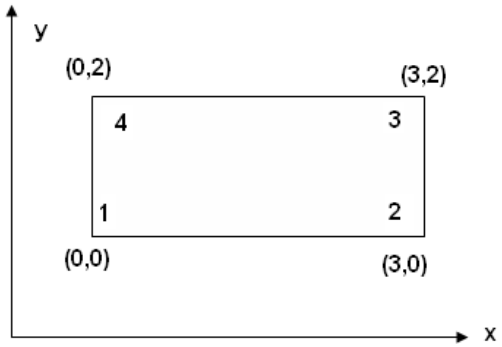


Q4 The plane truss shown in Figure below is composed of members having a square 15 mm × 15 mm cross section and modulus of elasticity *E* = 69 GPa. (10)
a). Assemble the global stiffness matrix.
b). Express the finite element equation for this truss.



Q5 From basics derive the shape functions and strain-displacement matrix for axisymmetric element with constant strain triangular elements. (10)

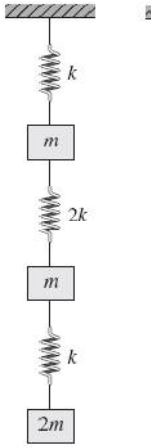
Q6 A four noded rectangular element as shown in figure below. Determine the (i) Jacobian matrix, and (ii) Strain displacement matrix and element stresses for this element. (10)



Take E=2x10^5 N/mm^2 , poission ratio v = 0.25. Assume plane stress condition. The displacements of nodes 1, 2, 3 and 4 in x-direction 0,0.002,0.005,0 and in y-direction 0,0.003,0.003,0 mm respectively.

Q7 a) Derive the stiffness matrix and the load vector for fluid mechanics in two dimensional finite element. (5)

b) Give the FE modeling for vibration of the system given in figure below (5)



Q8 Write Short Notes (Any Two) (5x2)

a) Plane stress and plain strain problems

b) Galerkin Methods in FEM

c) Potential energy method.

d) Advantages and disadvantages of FEM