Printed Pages : 4 TMT702

(Following Paper ID and Roll No. to be filled in your Answer Book)

PAPER ID : 0421 Roll No.

B.Tech

(SEM VII) ODD SEMESTER THEORY EXAMINATION 2009-10

FINITE ELEMENT METHOD

Time : 3 Hours] *[Total Marks : 100*

Note : *(i) Attempt **all** questions.*

*(ii) Assume any missing **data** suitably.*

(iii) Be precise in your answer.

1 Attempt any **two** parts of the following : 10×2=20

(a) Using a suitable example, explain the steps involved in finite element method.

(b) Derive stiffiness matrix for a truss element using direct approach.

(c) Using Rayleigh-Ritz method, determine the displacement and stress in a bar of uniform cross section A and length L due to self weigth only. Consider only two terms of the approximating polynomial.

2 Attempt any **two** parts of the following : 10×2=20

(a) Briefly explain the local coordinates, global coordinates and natural coordinates in FEM using a suitable example.

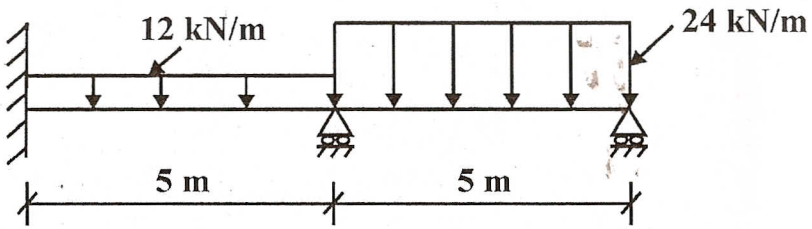
(b) Determine the shape functions for a two noded bar/truss element.

(c) Using the lagrange polynomial approach, determine the shape function for a four node rectangular element.

3 Attempt any **one** parts of the following : **20×1=20**

(a) Analyze the simply supported beam shown in the figure using finite element method. Develop the global stiffness matrix and global laod vector. State the boundary conditions and finally develop the FE equation after applying boundary conditions and solve for unknown variables.

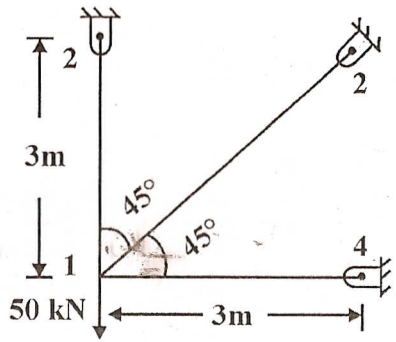
Assume $E=2\times10^5\,N/mm^2$ and $I=5\times10^6\,mm^4$.



(b) The thermal conductivity of a stainless steel rod of 0.1 m length and cross sectional area of $1\,cm^2$ is 20 W/m-°C. The rate of heat generation in the rod is $10^5\,W/m^3$. One end of the rod is kept at 0^oC and the other end is 100^oC. The rod is insulated except at the ends. Using finite element with two elements, find the temperature at the mid point of the rod and the heat flow at the ends of the rod.

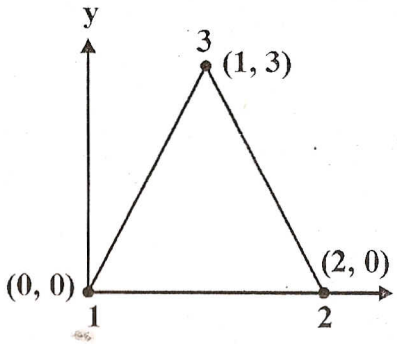
4 Attempt any **one** parts of the following : **20×1=20**

(a) For the plane truss shown in figure composed of three elements is subjected to a downward force of 50 kN applied at node 1. Determine the x and y displacements at node 1 and the stresses in each elements. Assume E=200 GPa and $A=1000mm^2$ for all elements.



(b) Determine the element stiffness matrix and the thermal load vector for the plane stress element vector shown in figure. The element experiences a 20^oC increase in temperature.

Take $E=15\times10^6\,N/cm^2$, possion's ratio v=0.25, thickness t=0.5 cm and coefficient of thermal expansion $\alpha=6\times10^{-6}/^oC$.



5 Attempt any **two** parts of the following : **10×2=20**

(a) What is meant by isoparametric formulation ? Explain the isoparametric representation of 2D elements.

(b) Evaluate the following integral using the Gauss-Legendre two point sampling formula.

$$I=\int_2^6 (x^2+5x+3)dx$$

Given that

Points (n)	*Weighting Factors* (w_i)	*Sampling points* (ξ_i)
2	$w_1 = 1.00000$	$\xi_1 = 0.577350269$
	$w_2 = 1.00000$	$\xi_2 = 0.577350269$

(c) Using a suitable example, explain the skyline assembly approach in programming implementation of a finite element analysis.