Regd. No. | | | | | | | | | |

B.E./B.Tech. DEGREE EXAMINATIONS, April/May 2011
VI – SEM, Material Science Engineering, R 2004
ME473 – Finite Element Analysis

Time: 3 Hours **Max. Marks: 100**

14

PART - A (10 x 2= 20 Marks)

1 What is the field variable for i) Structural problem ii) Thermal problem
2 State the principle of minimum potential energy.
3 Differentiate between local and global stiffness matrices.
4 Name the degrees of freedom at a node in a 1D beam element.
5 Differentiate between CST and LST elements.
6 Define shape functions.
7 Differentiate between plane stress and plane strain problems.
8 Name any two problems related to axisymmetric case.
9 What is meant by isoparametric formulation?
10 How to analyze a dynamic problem into equivalent static problem? Give an example.

PART - B (5 x 16 = 80 Marks)
Q11 – Compulsory, from Q12 onwards answer either (a) or (b)

11 An iron rod of length L = 35 cm, diameter d = 1 cm and thermal conductivity K = 70 W/m-°C is attached to a large tank at temperature T_o = 220°C. The rod is dissipating heat by convection into ambient air at T_∞=25°C with a heat transfer coefficient of h = 20 W/m^2-°C. Determine the temperature distribution in the rod using any of the weighted residual methods and hence determine the temperature at distances 10 and 20 cm from the tank surface. (16)

12 a) Determine the nodal displacements, element stresses and support reactions for the stepped bar loaded as shown in Fig. 12a using FEA. (16)

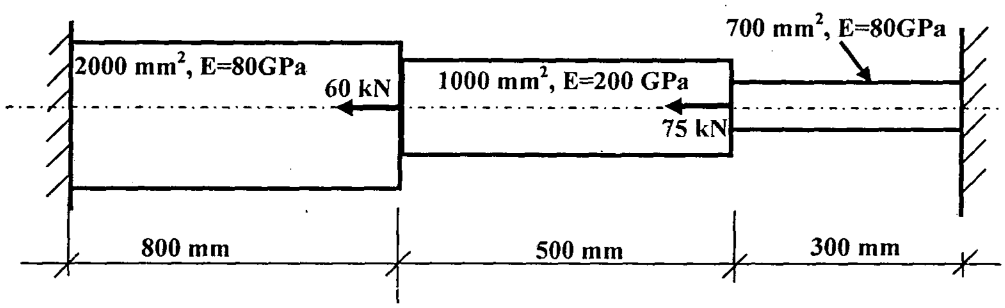

Fig. 12a

[OR]

12 b) Explain the various steps involved in formulating the problem using finite element method (take simple example to explain the same) (16)

13 a) Derive the shape functions for a beam element taking one translation and one rotation per node. (16)

[OR]

13 b) Determine the deflection and slope in the beam, loaded as shown in Fig. 13b, at the mid-span and a length of 0.5 m from left support. Determine also the reactions at the fixed ends. E = 200 GPa, $I_1 = 20\times10^{-6}\ m^4$, $I_2 = 10\times10^{-6}\ m^4$. (16)

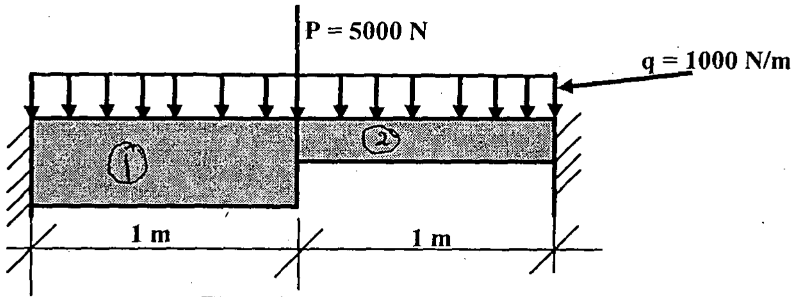

Fig. 13b

14 a) Derive the stiffness matrix for a constant strain triangle element using variational approach. (16)

[OR]

14 b) A thin plate is loaded as shown in Fig. 14b. Determine the stiffness matrix for the same assuming that the plate thickness is 10 mm, Young's modulus E = 80 GPa, ν = 0.3. (16)

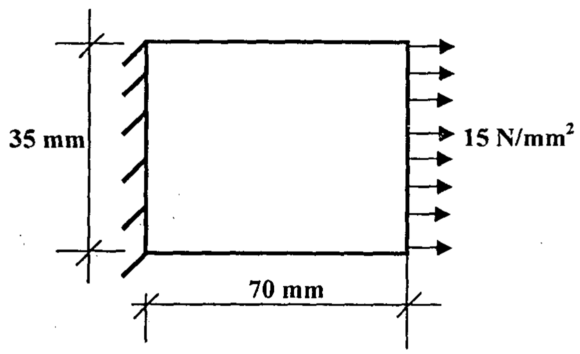

Fig. 14b

15 a) Derive element stiffness matrix for a linear isoparametric quadrilateral element. (16)

[OR]

15 b) Write short notes on:

(i) Material stiffness matrix for plane stress and plane strain case (6)
(ii) 'h'& 'p' refinement (4)
(iii) Isoparametric elements (3)
(iv) Numerical integration by Gauss Quadrature (3)