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**B.E./B.Tech. DEGREE EXAMINATIONS, April/May 2012**
**VI – SEM, Material Science Engineering, R 2004**
**ME473 – Finite Element Analysis**

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

**PART - A (10 x 2= 20 Marks)**

1 State with example the degrees of freedom at a node in Finite Element analysis.
2 What is the reason for solution error of a problem solved using Finite element analysis in compare with the analytical solution?
3 State the important properties of an element stiffness matrix.
4 What are the degrees of freedom at each node of one-dimensional plane beam element?
5 List out the various 2-dimesional finite elements that are generally used.
6 What are the advantages of using higher order elements?
7 Write the material stiffness matrix for plane stress elements.
8 For what type of problems shell elements can be preferred?
9 State the importance of shape functions that are used in finite element analysis.
10 What are the material properties to be provided for analyzing a thermal problem?

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

11 A metallic fin 0.2 cm thick and 15 cm long is attached to a furnace whose wall temperature is 250°C. If the thermal conductivity of the material of the fin is 400 W/m °C and convective heat transfer is 10 W/m$^2$ °C, determine using any weighted residual technique or the Ritz technique, the temperature distribution, if the width of the fin is 3 cm. Assume that the tip of the fin is open to the atmosphere and that the ambient temperature is 30°C. (16)

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

**[OR]**

12 b) Consider the bar shown in Fig.12b. Determine the nodal displacements, element stresses and support reactions. E = 200 GPa. (16)

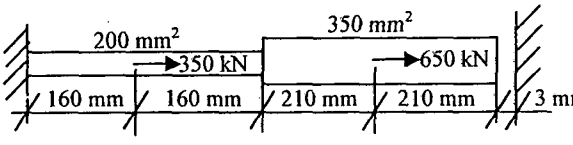

Fig.12b

13 a) (i) Derive the shape function for a beam element with one vertical translation and one rotational degree of freedom per node. (8)

(i) Derive the shape function for a truss element with one vertical translation and one horizontal translation degree of freedom per node. (8)

[OR]

13 b) For the beam shown in Fig. 13b, compute the displacement at the free end and force and moment reactions at the fixed end using FE approach. Take E = 200 GPa, $I = 2000\ cm^4$ (16)

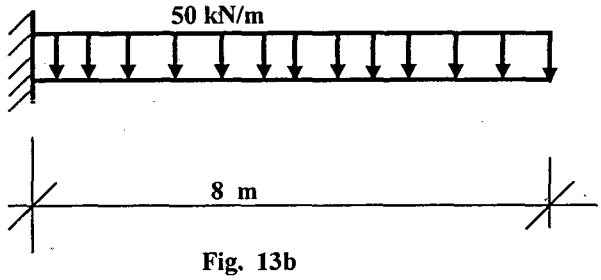


Fig. 13b

14 a) Find the stresses in the plate shown in Fig. 14a using one CST element. E = 200 GPa, $\nu = 0.3$, t = 10 mm. (16)

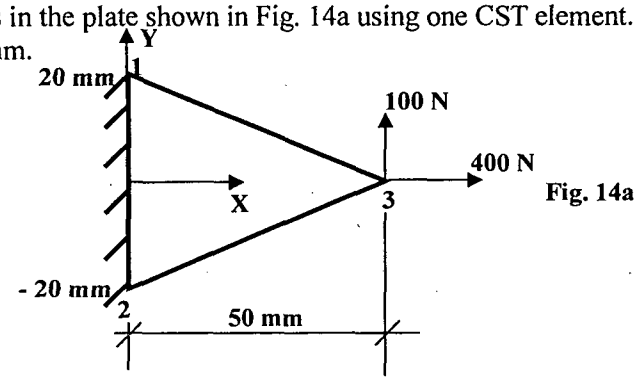


Fig. 14a

[OR]

14 b) Explain the following

(i) Material stiffness matrix for Plane strain and axisymmetric problems (6)

(ii) Shell Elements (6)

(iii) Body forces and temperature effects (4)

15 a) i) Explain the concept of iso-parametric element formation in finite element analysis and hence derive the stiffness matrix of a 1D iso-parametric bar element. (8)

ii) What are natural coordinates? What are the advantages of the same (3)

iii) Explain by taking an example how dynamic problem can be analyzed using FE software. (5)

[OR]

15 b) What are the various steps to solve 2D plane structural problems using the preprocessor of any commercial software such as ANSYS/ABAQUS etc. (Take an example of a square plate with central circular hole subjected to axial force along 'x' and 'y' directions) (16)