Regd. No.

B.E./B.Tech. DEGREE EXAMINATIONS, Nov/Dec 2011
VI – SEM, Material Science Engineering, R 2008
ME9351 – Finite Element Analysis

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

PART - A (10 x 2= 20 Marks)

1 What is the difference between Ritz technique and Galerkin technique?

2 State the principle of minimum potential energy.

3 List the properties of the stiffness matrix.

4 Differentiate between local stiffness matrix with global stiffness matrix.

5 Define shape function.

6 Name and differentiate two triangular elements commonly used for 2D plane problems.

7 Write the material stiffness matrix for (i) plane stress (ii) plane strain 2D structural problems.

8 Briefly explain about axisymmetric problems with example.

9 Obtain the value of integral $\int_2^5 (x^3 + 4x^2 - 3)dx$ using Gauss two point integration scheme $u_{1,2} = \pm 0.57735, w_{1,2} = 1$

10 Name any two important commercially available FEA packages.

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

11 Detrmine the temperature distibution using any of weighted residual methods along a circular fin of length 6 cm and radius 1 cm. The fin is attached to a boiler whose wall temperature is 150°C and the free end is open to the atmosphere. Assume h= 10 W/cm^2 °C, T_∞ = 30°C, K= 70 W/cm °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) Derive the stiffness matrix for a 1D linear element. Using the same determine the reactions R_1 and R_2 for the axial bar shown in Fig. 12b (16)

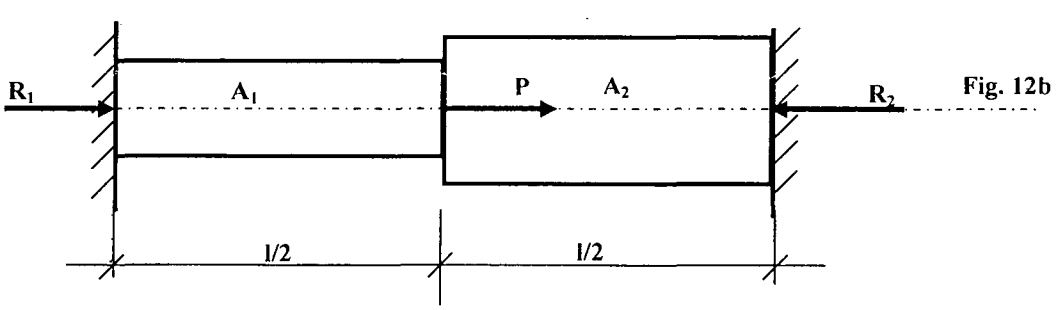

Fig. 12b

13 a) For the beam shown in Fig. 13a, compute the deflection and slope at its mid point. E = 200 GPa, $I_1 = 2\times 10^{-5}$ m^4, $I_2 = 1.5\times 10^{-5}$ m^4 (Use finite element approach) (16)

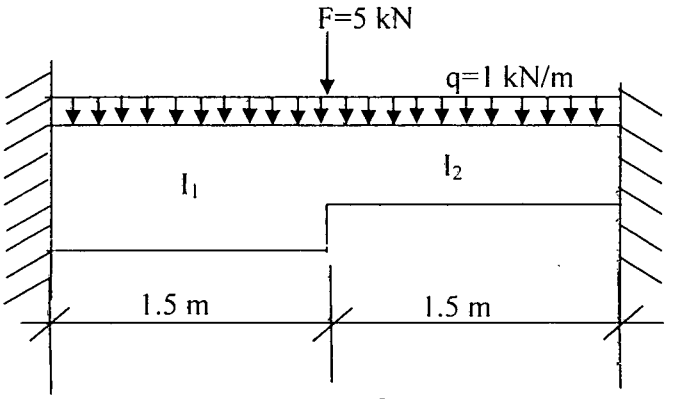

Fig. 13a

[OR]

13 b) Derive the stiffness matrix for a beam element from the fundaments.

14 a) Find the stresses in the plate shown in Fig. 14a using one CST element. E = 200 GPa, $\nu = 0.3$, t = 5 mm. (16)

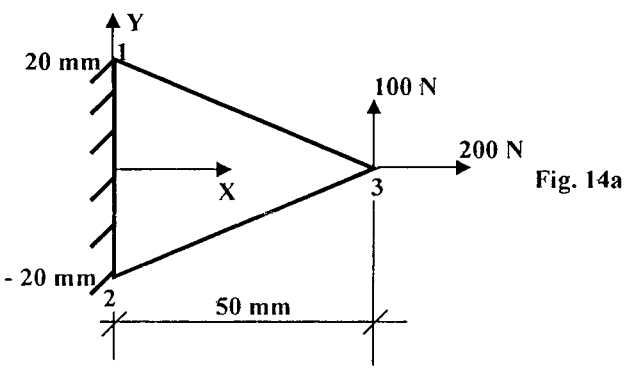

Fig. 14a

[OR]

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

15 a) 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. (16)

[OR]

15 b) A man weighing 60 kg is travelling by motor cycle whose weight is 100 kg. He starts his motor bike and reaches to the maximum velocity of 80 kmph in 3 minutes of time. The handle of the motor cycle is to be analyzed for these given conditions and the design for the handle is to be validated using FEA. Explain various steps which are to be followed for this problem considering as equivalent static structural one using any commercial FE package and hence to calculate the cross-section of the handle bar. (16)