Reg. No. | | | | | | | | | | | |

Question Paper Code : 57576

B.E./B.Tech. DEGREE EXAMINATION, MAY/JUNE 2016

Sixth Semester

Mechanical Engineering

ME 6603 – FINITE ELEMENT ANALYSIS

(Common to Mechanical and Automation Engineering and Manufacturing Engineering)

(Regulations 2013)

Time : Three Hours **Maximum : 100 Marks**

Answer ALL questions.

PART – A (10 × 2 = 20 Marks)

1. What are the methods generally associated with the finite element analysis ?
2. If a displacement field in x direction is given by $u = 2x^2 + 4y^2 + 6xy$. Determine the strain in x direction.
3. Write down the expression of governing equation for free axial vibration of rod and transverse vibration of beam.
4. What is the stationary property of total potential energy ?
5. Define path line and streamline.
6. Write a displacement function equation for CST element.
7. Write down the stress-strain relationship matrix for an axisymmetric triangular element.
8. What are the types of shell element ?
9. What is the purpose of isoparametric elements ?
10. What is the difference between natural coordinates and local coordinates ?

PART – B (5 × 16 = 80 Marks)

11. (a) The following differential equation is available for a physical phenomenon. **(16)**

$$\frac{d^2y}{dx^2} - 10x^2 = 5;\ 0 \le x \le 1$$

The boundary conditions are : y(0) = 0

y(1) = 0

Find an approximate solution of the above differential equation by using Galerkin's method of weighted residuals and also compare with exact solution.

OR

(b) A beam AB of span 'l' simply supported at ends and carrying a concentrated load W at the centre C as shown in fig.l. Determine the deflection at midspan by using Rayleigh-Ritz method and compare with exact solution. **(16)**

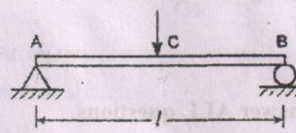

Figure 1

12. (a) Derive the shape functions for One-Dimensional Quadratic Bar element. **(16)**

OR

(b) A steel bar of length 800 mm is subjected to an axial load of 3 kN as shown in fig. 2. Find the nodal displacements of the bar, and load vectors. **(16)**

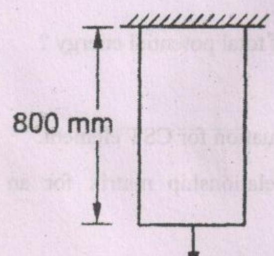

Figure 2

13. (a) **Calculate the element stiffness matrix and the temperature force vector for the plane stress element shown in fig. 3. The element experiences a 20 °C increase in temperature. Assume coefficient of thermal expansion is 6×10^{-6} C.**

Take $E = 2 \times 10^5$ N/mm^2, $v = 0.25$, $t = 5$ mm. **(16)**

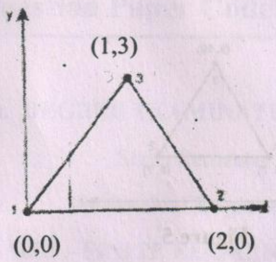

Figure 3

OR

(b) **Derive the shape function for the constant strain triangular element.** **(16)**

14. (a) **The nodal co-ordinates for an axisymmetric triangular element are given in figure 4. Evaluate strain-Displacement matrix for that element.** **(16)**

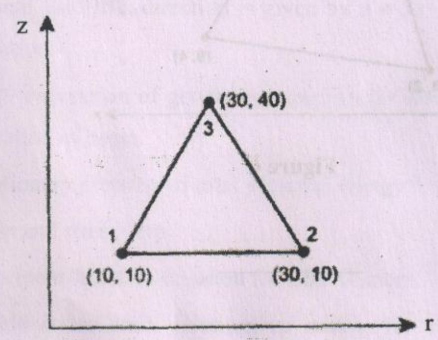

Figure 4

OR

(b) Calculate the element stiffness matrix for the axisymmetric triangular element shown in Fig 5. The element experiences a 15 °C increase in temperature. The coordinates are in mm. Take $\alpha = 10 \times 10^{-6}$/ °C, E = 2 × 105 N/mm^2, v = 0.25. **(16)**

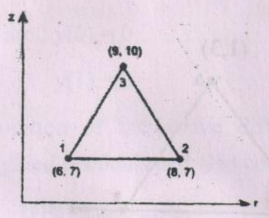

Figure 5

15. (a) Derive the shape functions for 4-noded rectangular element by using natural coordinate system. **(16)**

OR

(b) Evaluate the Cartesian coordinate of the point P which has local coordinates $\varepsilon = 0.6$ and $\eta = 0.8$ as shown in fig. 6. **(16)**

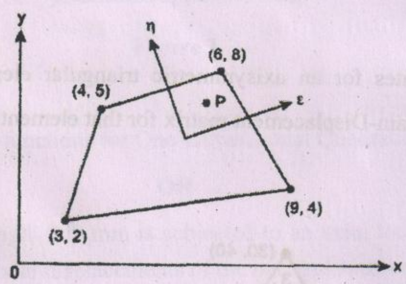

Figure 6