

Reg. No. : V E E R A P A N D J A N

**Question Paper Code : 51333**

B.E./B.Tech. DEGREE EXAMINATION, APRIL/MAY 2015.

Seventh Semester

Mechanical Engineering

ME 1401 — FINITE ELEMENT ANALYSIS

(Regulation 2008)

Time : Three hours

Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. When do we use gauss elimination method?
2. What is mesh refinement?
3. What are interpolation functions?
4. Define principle of virtual work.
5. What is a plane strain condition?
6. What are scalar valued problems?
7. Write the basic equation for axi-symmetric formulation.
8. What are axi-symmetric elements?
9. Distinguish sub parametric and super parametric elements.
10. Define band width.

PART B — (5 × 16 = 80 marks)

11. (a) (i) Write short notes on mesh refinement. (8)
- (ii) Explain various convergence criteria. (8)

Or

- (b) What are the three processors in FEM? Explain. (16)

12. (a) (i) Explain the applications of the finite element method. (8)  
(ii) Explain the node numbering schemes in finite element analysis. (8)

Or

- (b) An iron rod of length  $L = 50$  cm, Diameter = 1 cm and thermal conductivity  $k = 65$  W/cm °C is attached to a large tank at temperature  $T_0 = 500^\circ\text{C}$ . The rod is dissipating heat by convection into ambient air at  $T_\infty = 20^\circ\text{C}$  with a heat transfer coefficient of  $h = 25$  W/cm<sup>2</sup>°C. Determine the temperatures at distances 20 cm and 30 cm from the tank surface. (16)

13. (a) Derive the element equation for a two dimensional problem in FEA. (16)

Or

- (b) Two dimensional simplex elements are used to find the temperature distribution in a heat transfer medium. The (x,y,z) co-ordinates of nodes i, j, k and l of an element are given by (2,4,2), (0,0,0), (4,0,0) and (2,0,0). Find the shape functions  $N_i$ ,  $N_j$ ,  $N_k$ , and  $N_l$  of the elements. (16)

14. (a) A long cylinder of inside diameter 80 mm and outside diameter 120 mm fits in a hole over its full length. The cylinder is then subjected to an internal pressure of 2 MPa. Using two elements on the length of 10 mm, find the displacements at the inner radius. Also calculate the element stresses. (16)

Or

- (b) (i) For a axi-symmetric triangular element, obtain the [B] matrix and constitutive matrix. (10)  
(ii) For a hollow cylinder subjected to internal and external pressure, indicate the steps in finding the radial stress. (6)

15. (a) (i) Derive the isoparametric representation for a triangular element. (10)  
(ii) Write short notes on lagrangean and serendipity elements. (6)

Or

- (b) (i) Explain the one point and two point Gaussian quadrature methods of numerical integration. (8)  
(ii) Derive the interpolation function of a corner node in cubic serendipity element. (8)