C 18254 (Pages : 2) Name.....

Reg. No.....

SIXTH SEMESTER B.TECH. (ENGINEERING) DEGREE EXAMINATION, JUNE 2011

ME 04 604—FINITE ELEMENT METHODS

Time : Three Hours Maximum : 100 Marks

Answer **all** *questions.*
Any missing data may be suitably assumed.

1. (a) What is a shape function ? State its characteristics.

   (b) Explain the properties of stiffness matrix.

   (c) Express the shape functions of a 1-D beam element.

   (d) Explain Local and Global coordinates.

   (e) Express the shape functions of a bilinear rectangular element.

   (f) Explain constant strain triangle.

   (g) What are essential and non-essential boundary conditions ?

   (h) Derive the shape functions for a general quadrilateral isoparametric elements.

(8 × 5 = 40 marks)

II. (a) Explain with suitable example the basic steps involved in finite element analysis of a structural problem.

Or

(b) Explain the mathematical interpretation of finite element method for one dimensional field problems.

III. (a) Derive the elemental stiffness matrix and load vector for two noded element.

Or

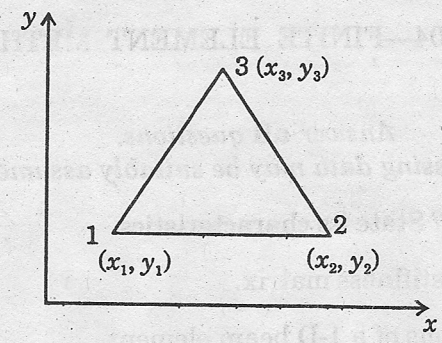
(b) A one dimensional simplex has been used to find the temperature distribution in a straight fin. It is found that the nodal temperature of the element are 140°C and 100°C at nodes i and j, respectively. If the nodes i and j are located at 2 and 8 cm. from the origin, find the temperature at a point 5 cm. from the origin. Also find the temperature at a point 5 cm. from the origin. Also find the temperature gradient inside the element.

IV. (a) The coordinates of the nodes 1, 2 and 3 of a triangular element are (1, 1), (8, 4) and (2, 7) in mm. The displacements at the nodes are $u_1 = 1$ mm., $u_2 = 3$ mm., $u_3 = -2$ mm., $v_1 = -4$ mm., $v_2 = 2$ mm., and $v_3 = 5$ mm. Obtain the strain-displacement relation matrix B and determine the strains ε_x, ε_y and γ_{xy}.

Or

Turn over

(b) For a three Noded Triangular element shown in Figure, derive the shape functions in terms of global coordinates.



V. (a) Describe the principle of stationary potential energy with a suitable example. Also comment on finite element formulation from a functional.

Or

(b) What do you mean by lumped and consistent Mass Matrix ? Derive the consistent Mass Matrix for (i) Axial element and (ii) 2D-beam element with 2 degrees of freedom (1 Translational and 1 rotation) at each node (for translational Mass only).

(4 × 15 = 60 marks)