Total number of printed pages – 4 **B. Tech**

PEME 6411

Eighth Semester Examination – 2008

FINITE AND BOUNDARY ELEMENT METHOD

Full Marks – 70

Time : 3 Hours

*Answer Question No. **1** which is compulsory and any **five** from the rest.*

The figures in the right-hand margin indicate marks.

1. Answer the following questions : 2×10

   (i) Write down the properties of shape functions.

   (ii) How does the nodal numbering system affect the bandwidth of the global matrix ?

   (iii) What do you mean by Implicit and Explicit methods ?

   (iv) Explain the weighted residual method in FEM.

   (v) Discuss different types of element used in finite element method.

   (vi) What is an isoparametric element ? State its importance in finite element method.

   (vii) Draw the Pascal's triangle and state its importance.

   (viii) Explain the Quadtree and Octree methods of mesh generation.

   (ix) Write down the equation for potential problems.

   (x) Why is mesh refinement necessary ? Name two adaptive mesh refinement techniques commonly used in finite element method.

2. Explain the procedural steps involved in finite element method with reference to discretization of the domain, choice of shape functions, formation of element stiffness matrices and solution of the global matrix. 10

3. A triangular-element has node points located at ($x_1 = 1$, $y_1 = 1$), ($x_2 = 6$, $y_2 = 1$) and ($x_3 = 3$, $y_3 = 4$). A function has been computed to have nodal values of $\phi_1 = 900$, $\phi_2 = 600$ and $\phi_3 = 1200$. Use the interpolating function for a three-noded triangular element and compute the value of ϕ at (x = 3, y = 2). 10

4. In a rectangular element the nodes are located at the coordinate points as follows: ($x_1 = 2$, $y_1 = 2$), ($x_2 = 4$, $y_2 = 2$) and ($x_3 = 4$, $y_3 = 3$) and ($x_4 = 2$, $y_3 = 3$). The temperature distribution is computed at each node as $T_1 = 100$ °C, $T_2 = 60$ °C, $T_3 = 50$ °C and $T_4 = 90$ °C. Compute the temperature at (x = 2.5, y = 2.5). 10

5. A deflection of a simply supported beam of length *L* with uniform flexural rigidity *EI* and bending moment *M* is governed by the following equation and boundary conditions :

$$EI\left(\frac{d^2y}{dx^2}\right)+M=0 \quad 0<y<L$$

$$y(0) = y(L) = 0$$

Solve the problem by finite element method using two linear elements of equal length and find the deflection at $x = L/2$. 10

6. (a) Describe the variation approach used in finite element method. 4

   (b) Find out the shape functions for a 8-noded quadrilateral element. 6

7. What are the advantages and disadvantages of BEM over FEM ? What are the limitations of BEM ? Discuss the importance of Dirac-Delta function in boundary element method. Discuss the BEM for potential problems. 10

8. Write short notes on any *three* : 10

   (a) Minimum potential energy principle

   (b) Axisymmetric elements in FEM

   (c) Plane stress and plain strain problems

   (d) Galerkin method

   (e) Constant Strain Triangle elements.

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