Roll No. | | | | | | | | | | | | Total No. of Pages : 03

Total No. of Questions : 09

B.Tech.(Aerospace Engg.) (2012 Batch) (Sem.–6)

FINITE ELEMENT METHODS

Subject Code : ASPE-313

Paper ID : [72458]

Time : 3 Hrs. Max. Marks : 60

INSTRUCTIONS TO CANDIDATES :

1. SECTION-A is COMPULSORY consisting of TEN questions carrying TWO marks each.
2. SECTION-B contains FIVE questions carrying FIVE marks each and students have to attempt any FOUR questions.
3. SECTION-C contains THREE questions carrying TEN marks each and students have to attempt any TWO questions.

SECTION-A

1. Answer briefly :

a. What is weight function in Galerkin's method?

b. Taking a suitable example of governing equations explain essential boundary conditions. What makes a condition to qualify as essential boundary condition?

c. Explain practical application of finite element method, giving suitable examples.

d. Describe different types of errors in solution calculates using finite element method.

e. What is Stiffness matrix? Explain its properties.

f. Draw and explain typical element used in finite element method. Label all the information possible.

g. Derive the interpolation functions for a four-node iso--parametric quadrilateral element.

h. What do you understand by convergence of solution in FEM?

i. Derive the expression for shape function for:

   i. 8 node 2D quadrilateral element.

   ii. 5 node 2D quadrilateral transition element.

j. What is Jacobian matrix?

SECTION-B

2. Given function $f(s,t) = (s^2+st)t^4$, integrate f(s,t) in the domain where both 's' and 't' varies from -1 to 1. Use thumb rule to determine number of points for integration. (2+3=5)

3. a) Illustrate the conditions for valid iso-parametric mapping both for 1D and 2D problem.

   b) Determine if the iso-parametric mapping for the 4 node quadrilateral element is valid. Xn=[0 2 0 3] and Yn=[0 0 2 3]

4. Use a tree node element of length 2L and derive the corresponding force matrix that defines the distribution of body force for each node.

5. Use Hermite's interpolation formula to derive cubic shape functions for transverse deflection of beam.

6. The one dimensional steady state heat conduction equation is :

$$\frac{d^2T}{dx^2}\ \frac{Q}{k}$$

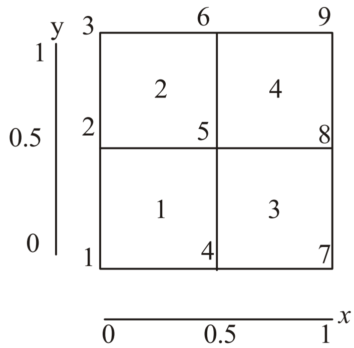
Assume boundary condition as T(0) = T(L) = 0 and the exact solution is

$$T = \frac{Q}{2k}(x^2 - xL)$$

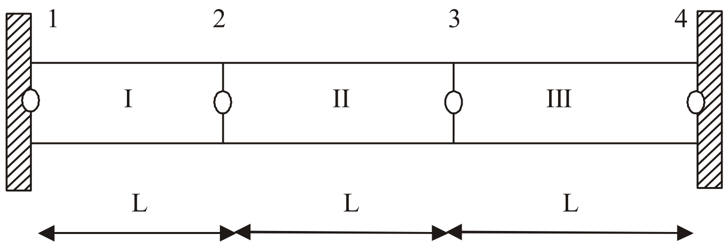
Obtain approximate solution using Galerkin's method.

SECTION-C

7. Solve 2D Boundary value problem in the form of given laplace equation $\frac{\partial^2 u}{\partial x^2} + \frac{\partial^2 u}{\partial y^2} = 0$ $0 < x < l$ and 0<y<l The given boundary conditions are: u(0,y)=0; u(l,y)=0; u(x,0)=x(l–x); u(x,l)=0. Solve using 4 square elements as shown



8. Assume a uniform rod of elastic material fixed at both ends with constant cross-section, and length 3L. A uniform body force (f) is acting on it in upward direction. Use three element of length L and formulate the Rayleigh-Ritz solution using shape functions rather than interpolation formulas to find out nodal displacement, reaction forces. If the exact solution is such that; u = $f\dfrac{3lx - x^2}{2E}$ then find the error at node 2 and 3.



9. A quadrilateral element is shown in x,y coordinate system in figure below. The temperature at each node is such that; T_1=100°, T_2=60°; T_3=50°, and T_4=90°. Derive the shape function to calculate the temperature at x = 2.5 and y = 2.5