Code No: RR420302 **Set No. 1**

IV B.Tech II Semester Regular Examinations, Apr/May 2006
FINITE ELEMENT METHODS
(Common to Mechanical Engineering and Production Engineering)
Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
All Questions carry equal marks
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1. Write notes on the following:
   (a) Weighted Residual method.
   (b) Initial and Boundary value problems. [8+8]
2. With a suitable example explain the formulation of finite element equations by direct approach. Assume suitable data for the example. Use I-D analysis. [16]
3. Define and derive the Hermite shape functions for a two nodded beam element? [16]
4. (a) Show that the value of the shape function N_1 of node i and node k of a simplex triangular element is zero and at node I is one.
   (b) The (x, y) coordinates of the nodes i, j and k of a triangular element are (1, 1), (4, 2) and (3, 5) respectively. The shape functions of a point P located inside the element are given by $N_1 = 0.15$ and $N_2 = 0.25$. Determine the x and y coordinates of the point P. [6+10]
5. Derive the conductivity matrix and vector for the 2-D element when one of the faces is exposed to a heat transfer coefficient of h at T∝ and with internal heat generation of q W/m^3. [16]
6. Explain the following with examples.
   (a) Lumped parameter model.
   (b) Continuous system model. [8+8]
7. Write a procedure for model creation and mesh generation for aerofoil shape turbine blades. [16]
8. Give the necessity of rotating and offsetting the work plane in ANSYS environment. What are the useful features of CAEFEM package in analysis? [16]

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Code No: RR420302 **Set No. 2**

IV B.Tech II Semester Regular Examinations, Apr/May 2006
FINITE ELEMENT METHODS
(Common to Mechanical Engineering and Production Engineering)
Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
All Questions carry equal marks

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1. Explain the following with neat sketches.
   (a) Mathematical Finite Element method.
   (b) Physical Finite Element Method. [8+8]

2. Explain the mathematical interpretation of finite element method for one dimensional field problems. [16]

3. For the pin jointed truss shown in figure1. If E = 200 Gpa, determine
   (a) Element stiffness matrices .
   (b) Global stiffness matrix .
   (c) Stress in the element 1.
   (d) Strain in the element 2. [6+4+3+3]

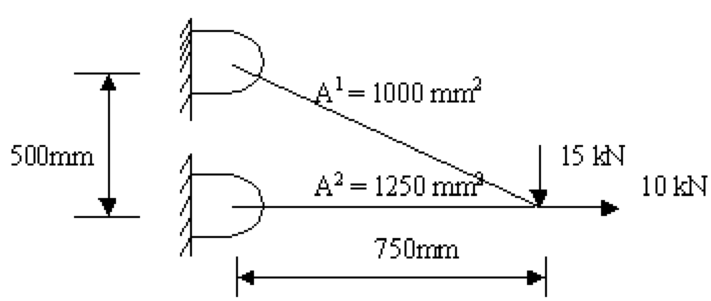

Figure 1:

4. (a) Show that the value of the shape function N_1 of node i and node k of a simplex triangular element is zero and at node I is one.
   (b) The (x, y) coordinates of the nodes i, j and k of a triangular element are (1, 1), (4, 2) and (3, 5) respectively. The shape functions of a point P located inside the element are given by $N_1 = 0.15$ and $N_2 = 0.25$. Determine the x and y coordinates of the point P. [6+10]

5. Explain the methodology for the treatment of all three boundary conditions in a 1-D heat transfer element? [16]

6. Find the natural frequencies and the corresponding mode shapes for the longitudinal vibrations for the stepped bar. Assume $A_1 = 2\text{A}$ and $A_2 = \text{A}$; $I_1 = I_2 = \text{I}$; $E_1 = E_2 = \text{E}$. [16]

7. When will a finite element is called an element from the Lagrange family? Establish shape functions and write Jacobian matrix for any two, three dimensional elements of Lagrange family. [6+5+5]

8. (a) Describe C^0 ,C^1 ,C^2 classes.

   (b) Write features of the ANSYS, NISA, NASTRAN. [8+8]

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Code No: RR420302 **Set No. 3**

IV B.Tech II Semester Regular Examinations, Apr/May 2006
FINITE ELEMENT METHODS
(Common to Mechanical Engineering and Production Engineering)

Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
All Questions carry equal marks

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1. Derive the various equations for static equilibrium of an elastic body. [16]

2. With a suitable example explain the formulation of finite element equations by direct approach. Assume suitable data for the example. Use I-D analysis. [16]

3. Derive the methodology to develop a stiffness matrix and load vector for a 2-noded beam element with 2 degree of freedom? [16]

4. (a) Derive strain displacement [B] matrix for a 3 noded Triangular element?
   (b) The nodal coordinates and the nodal displacements of a triangular element, under a specific load condition are given below:
   $X_i = 0$, $Y_i = 0$, $X_j = 1$ mm , $Y_j = 3$ mm, $X_k = 4$ mm, $Y_k = 1$, $u_1 = 1$ mm, $u_2 =$ -0.05 mm, $u_3 = 2$ mm, $V_1 = 0.5$ mm , $V_2 = 1.5$ mm and $V_3 =$ -1 mm. If E = 2 X 10^5 N / mm^2 and $\mu = 0.3$. find the stresses in the element. [8+8]

5. Discuss the finite element methodology to solve the torsion problems from the first principles? [16]

6. Explain the following with examples.
   (a) Lumped parameter model.
   (b) Continuous system model. [8+8]

7. (a) Derive the shape functions for a Hexahedral element.
   (b) Explain the various convergence requirements. [8+8]

8. What are the advantages and limitations of NISA Package over ANSYS, CAEFEM and NASTRAN? [16]

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Code No: RR420302

Set No. 4

IV B.Tech II Semester Regular Examinations, Apr/May 2006
FINITE ELEMENT METHODS
(Common to Mechanical Engineering and Production Engineering)

Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
All Questions carry equal marks

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1. With the help of a neat diagram, describe the various components of stress and strains. [4+6+6]

2. With a suitable example, explain the physical interpretation of finite element method for one dimensional analysis. [16]

3. Find the deflection at the load of the steel shaft as shown in figure 1: take E = 200 Gpa [16]

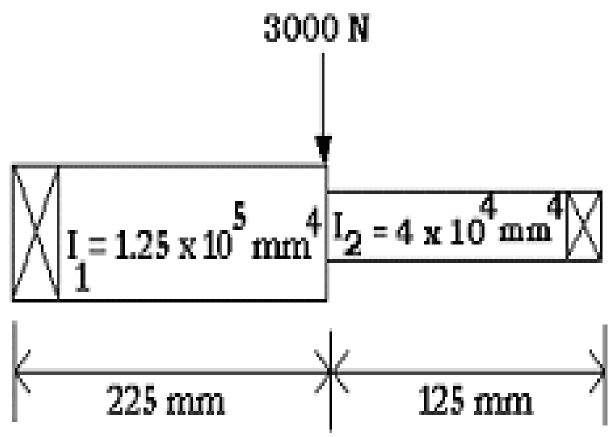

Figure 1:

4. Derive the shape functions for a triangular linear element in global Co-ordinate system. [16]

5. Derive the element conductivity matrix and load vector for solving 1- D heat conduction problems, if one of the surfaces is exposed to a heat transfer coefficient of h and ambient temperature of T∞? [16]

6. Determine the natural frequencies of a simply supported beam of length 800 mm with the cross sectional area of 75 cm X 25 cm as shown in the figure2.
Take E= 200 Gpa and density of 7850 kg/m^3. [16]

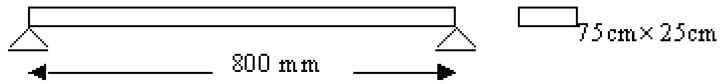

Figure 2:

7. Discuss about the following mesh generation methods
   (a) Mesh topology first.
   (b) Nodes first.
   (c) Adaptive mesh template.
   (d) Nodes and elements simultaneously. [4+4+4+4]

8. With an example, explain the procedure involved in solving an engineering problem in computational finite element analysis using computer software. [16]

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