Code No: R05311402 **Set No. 1**

III B.Tech I Semester Regular Examinations, November 2008
FINITE ELEMENT METHODS
(Mechatronics)

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

Answer any FIVE Questions
All Questions carry equal marks

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1. (a) With the help of a neat diagram, describe the various components of stress and strains.
   (b) Derive the stress, strain relationship and strain displacement elevation. [4+6+6]
2. Derive stiffness equations for a bar element from the one dimensional second order equation by variated approach. [16]
3. The members (1) and (2) are circular in cross section with diameters of 10 cm and 20 cm respectively. Determine the displacement at the node where load is acting.{As shown in the Figure3} [16]

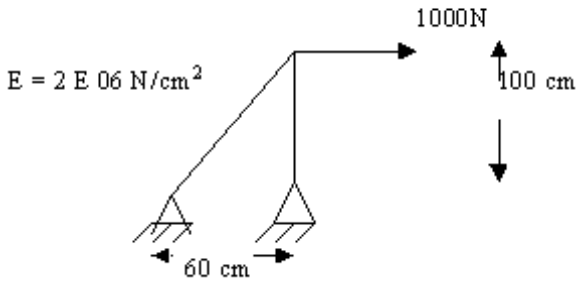

Figure 3

4. Show that the central deflection of the beam of length L m (both the ends are fixed) carries a load of P at the center is given by $PL^3/192$ EI using FEM by dividing the beam into two elements? [16]
5. (a) Prove that a three nodded triangle element has a constant strain or stress state.
   (b) For the triangular element shown in figure5b, find the consistent nodal load. [8+8]

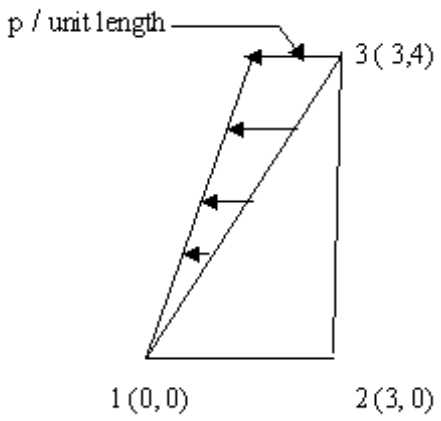

Figure 5b

6. Determine the temperature distribution in a circular tapered fin varies the diameter from 4 cm to 1 cm over a length of 1 m. The convection takes place on lateral surface as well as tip. The conductivity of the fin material is 200 W/m K, heat transfer coefficient over the surface is 980 W/m^{2}K and T$\propto$ = 22^{0}C. Assume base temperature is 100^{0}C. [16]

7. Explain the following with examples.

   (a) Lumped parameter model.

   (b) Consistant mass matrix model. [8+8]

8. (a) Name any three elements used in stress analysis of 3-dimensional problems.

   (b) Describe the procedure of obtaining stiffness matrix by properly choosing shape functions for tetrahedron element. [8+8]

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Code No: R05311402 **Set No. 2**

III B.Tech I Semester Regular Examinations, November 2008
FINITE ELEMENT METHODS
(Mechatronics)

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

Answer any FIVE Questions
All Questions carry equal marks

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1. What are the basic steps involved in finite element analysis and explain them briefly. [3+13]

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. Determine the displacements at nodes and the stresses in elements shown in figure3: [16]

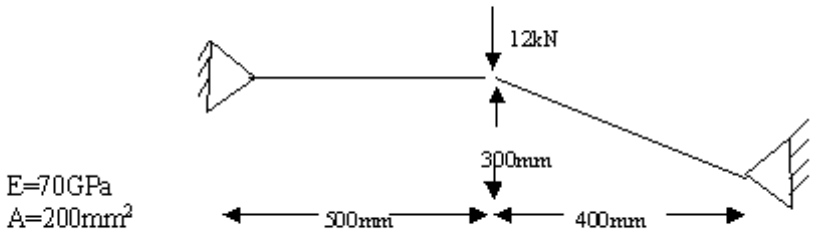

Figure 3

4. Derive the elemental stiffness matrix and load vector for two noded beam element? [16]

5. (a) Discuss the significance and applications of triangular elements.
   (b) Two dimensional simplex elements are used to find the pressure distribution in a fluid medium. The (x, y) coordinates of nodes i, j and k of an element are given by (2, 4), (4, 0) and (2, 6) respectively. Find the shape functions N_i, N_j and Nk of the element. [10+6]

6. 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]

7. Derive the elemental jumped and consistant mass matrices for 1-D bar element and 1-D plane truss element? [16]

8. (a) Describe the procedure for the convergence criterion.

(b) It is proposed that a beam element be based on a cubic polynomial but there are to be only lateral displacements Wi, where i = 1,2,3,4. Nodes are to be at either end and at the third points. What convergence criterion is violated by this element? [8+8]

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Code No: R05311402 **Set No. 3**

III B.Tech I Semester Regular Examinations, November 2008
FINITE ELEMENT METHODS
(Mechatronics)

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

Answer any FIVE Questions
All Questions carry equal marks

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1. (a) Define Geometric Variance.
   (b) What is meant by displacement function?
   (c) Give the importance of Pascal Triangle. [4+6+6]

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 element stiffness matrix for the plane truss element. [16]

4. Show that the central deflection of the beam of length L m (both the ends are fixed) carries a load of P at the center is given by $PL^3/192$ EI using FEM by dividing the beam into two elements? [16]

5. Triangular elements are used for stress analysis of a plate subjected to inplane load. The components of displacement parallel to (x, y) axes at the nodes i, j and k of an element are found to be (- 0.001, 0.01), (-0.002, 0.01) and (- 0.002, 0.02) cm respectively. If the (x, y) coordinates of the nodes i, j and j are (20, 20), (40, 20) and (40, 40) in cm respectively, find (a) the distribution of the (x, y) displacement components inside the element and (b) the components of displacement of the point (x_p, y_p) = (30, 25) cm. [16]

6. One side of the brick wall of width 5 m, height 4 m and thickness 0.5 m is exposed to a temperature of - 25^0C while the other surface is maintained at 32^0C. If the thermal conductivity is 0.75 W/m K and the heat transfer coefficient on the colder side is 50 W/m^2 K. Determine
   (a) The temperature distribution in the wall and
   (b) Heat loss from the wall. [16]

7. Explain the following with examples.
   (a) Lumped parameter model.
   (b) Consistant mass matrix model. [8+8]

8. 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]

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Code No: R05311402 **Set No. 4**

III B.Tech I Semester Regular Examinations, November 2008
FINITE ELEMENT METHODS
(Mechatronics)

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

Answer any FIVE Questions
All Questions carry equal marks

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1. Determine the circumference of a circle of radius 'r' using the basic principles of finite element method. [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. Consider the truss element with the coordinates i(10,10) & q(50,40) If the displacement vector is q=$[15\ 10\ 21\ 43]^T$ mm, then determine

   (a) The trace vector F

   (b) Stress in each element

   (c) Stiffness matrix if E= 70 GPA and A= 200 mm^2. [6+4+6]

4. Calculate the deflection at the center of the beam as shown in figure4.
   Take E = 220 Gpa; A = 40 mm × 40 mm. [16]

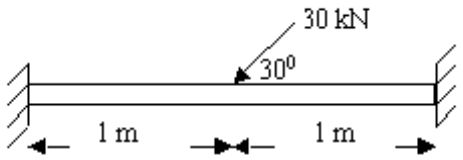

Figure 4

5. Explain in detail how the element stiffness matrix and load vector are evaluated in isoparametric formulations. [16]

6. 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]

7. Consider the axial vibrations of a steel bar shown in the figure7:

   (a) Develop global stiffness and mass matrices,

   (b) Determine the natural frequencies? [8+8]

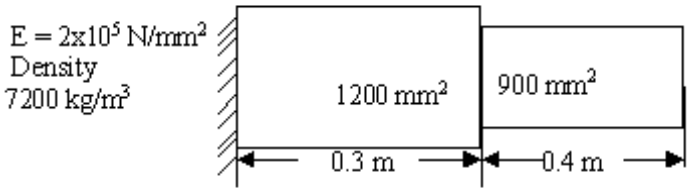

Figure 7

8. Explain the following semiautomatic mesh generation techniques
   (a) Conformal mapping approach
   (b) Mapped element approach. [4+4+4+4]

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