Code No: RR311403 **Set No. 1**

III B.Tech I Semester Regular Examinations, November 2006
FINITE ELEMENT METHOD
(Mechatronics)

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

Answer any FIVE Questions
All Questions carry equal marks

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1. Explain the different approaches of getting the finite element equations. [16]

2. Derive stiffness equations for a bar element from the one dimensional second order equation by variated approach. [16]

3. Estimate the displacement vector, stresses and reactions for the truss structure as shown below Figure3:

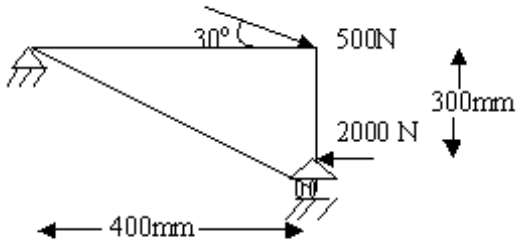

Figure 3

Note: - Area is not given and assumed as $A^{(e)} = 1mm^2$ 'E' is not given. Assumed as E=2×10^5 N/mm^2 [16]

4. Find the deflection at the point of the load of the steel shaft as shown in figure4 : take E = 200 Gpa. [16]

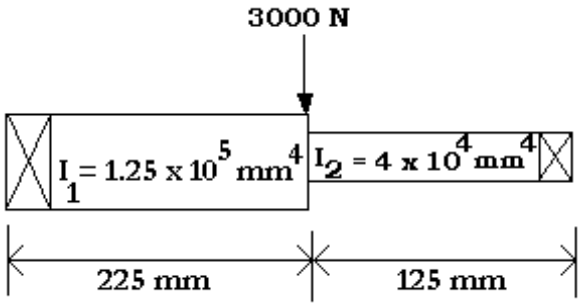

Figure 4

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 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$\propto$ and with internal heat generation of q W/m^3. [16]

7. Explain the following with examples.

   (a) Lumped parameter model.

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

8. Describe the use of linear interpolation polynomials for a three-dimensional tetrahedron element in terms of natural (volume) coordinate system. [16]

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Code No: RR311403 **Set No. 2**

III B.Tech I Semester Regular Examinations, November 2006
FINITE ELEMENT METHOD
(Mechatronics)

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

Answer any FIVE Questions
All Questions carry equal marks

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1. (a) Explain briefly a plane strain problem with suitable examples.
   (b) Derive the material constitutive matrix for a plane stress problem. [8+8]

2. Derive stiffness equations for a bar element from the one dimensional second order equation by variated approach. [16]

3. Estimate the displacement vector, stresses and reactions for the truss structure as shown below Figure3:

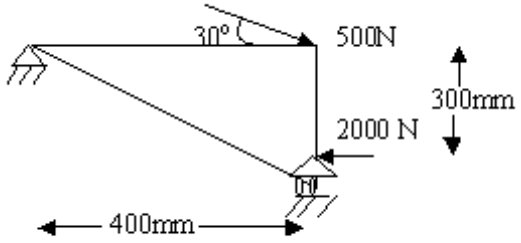

Figure 3

Note: - Area is not given and assumed as $A^{(e)} = 1mm^2$ 'E' is not given. Assumed as $E=2\times10^5$ N/mm^2 [16]

4. Estimate the stiffness matrix and the deflection at the center of the simply supported beam of length 3 m. A 50 kN of load is acting at the center of the beam. Take EI = 800×10^3 N-m^2. [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. The coordinates of the nodes of a triangular element are 1(-1,4), 2(5,2) and 3(3,6) of thickness 0.2 cm. The convection takes place over all surfaces with a heat transfer coefficient of 150 W/m^{2}K and T$\propto$= 30^0C. Determine the conductivity matrix and load vector if the internal heat generation is 200 W/cm^3. Assume thermal conductivity the element is 100 W/m K. [16]

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

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: RR311403 **Set No. 3**

III B.Tech I Semester Regular Examinations, November 2006
FINITE ELEMENT METHOD
(Mechatronics)

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

Answer any FIVE Questions
All Questions carry equal marks

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1. Explain the different approaches of getting the finite element equations. [16]

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

3. (a) Compare the characteristics of beam element with the truss element?
   (b) Derive the load vector for the specified uniform distributed load over the plane truss element? [6+10]

4. Consider a beam with uniform distributed load as shown in the figure4. Estimate the deflection at the centre of the beam.
   E = 200 Gpa ; A = 25 mm ×0 25 mm. [16]

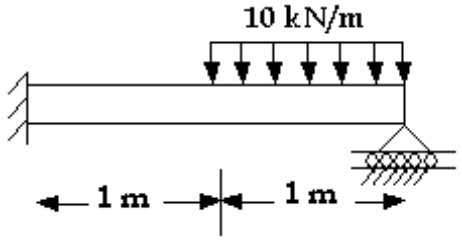

Figure 4

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

6. Compute the elemental conductivity matrix and load vector for the 2-D triangular element as shown in figure6. The faces 1-3 and 2-3 are exposed to a convection and there is an internal heat generation of 50 W/cm^3. Assume thermal conductivity is 60 W/m K. [16]

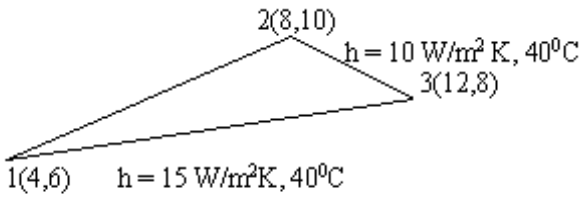

Figure 6

7. Explain the following with examples.

(a) Lumped parameter model.

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

8. Explain the following semiautomatic mesh generation techniques

(a) Conformal mapping approach

(b) Mapped element approach. [4+4+4+4]

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Code No: RR311403 **Set No. 4**

III B.Tech I Semester Regular Examinations, November 2006
FINITE ELEMENT METHOD
(Mechatronics)

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. An elastic bar is having a uniform cross sectional of area 'A' mm^2 and length 'L' mm. It is fixed at one end and other end is allowed to move along the axis of the elastic bar. A force 'F' KN is acting at the free end and the Youngs Modulus is 'E' N/mm^2. Calculate the displacement at the free end. [16]

3. Estimate the displacement vector, stresses and reactions for the truss structure as shown below Figure3:

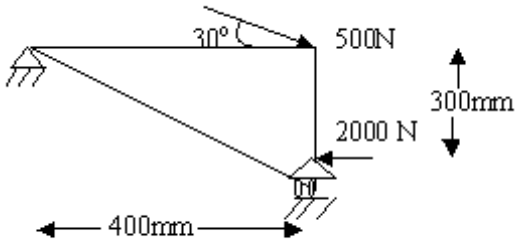

Figure 3

Note: - Area is not given and assumed as $A^{(e)} = 1mm^2$ 'E' is not given. Assumed as $E=2\times10^5$ N/mm^2 [16]

4. Define and derive the Hermite shape functions for a two nodded beam element? [16]

5. Calculate the nodal forces of the four node axisymmetric finite element shown in figure5 when the element is subjected to centrifugal loading. [16]

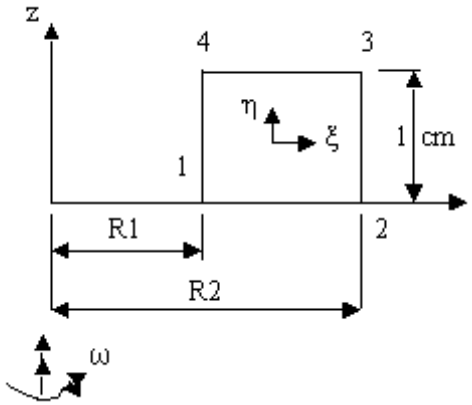

Figure 5

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]

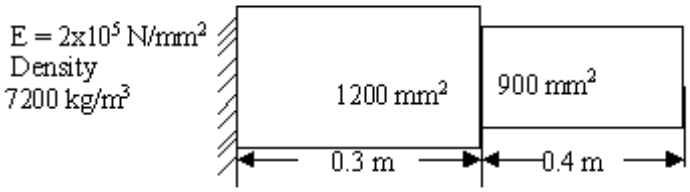

Figure 7

8. (a) Sketch any three 3-D structural element showing their degrees of freedoms.

   (b) Derive the shape function of any one of the 3-D structural element. [8+8]

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