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

III B.Tech. I Semester Regular Examinations, November -2005
FINITE ELEMENT METHOD
(Mechatronics)

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) Engineering application of finite element method
   (b) Discretization process

   [8+8]

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

3. For the truss structure shown in figure1 is subjected to a horizontal load of 4 kN in positive x-direction at node 2. Calculate
   (a) stiffness matrix and
   (b) stresses.

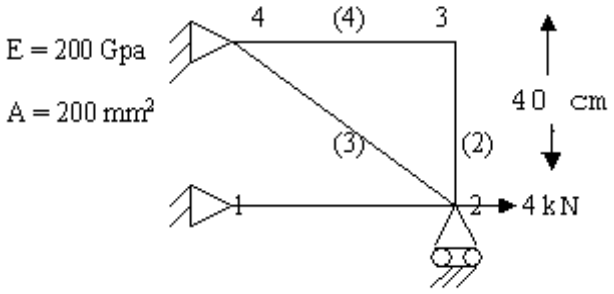

Figure 1:

[10+6]

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. Explain the concept of triangular elements and explain the functional relationship in terms of co-ordinate values and shape functions. [4+12]

6. A composite slab consists of three materials of different thermal conductivities i.e 20 W/m K, 30 W/m-^{0}K, 50 W/m-^{0}K of thickness 0.3 m, 0.15 m, 0.15 m respectively. The outer surface is 20^0C and the inner surface is exposed to the convective heat transfer coefficient of 25 W/m^2-K at 300^0C. Determine the temperature distribution within the wall? [16]

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

8. The coordinates of the nodes of a 3-D simplex elements are given below.

Node number	Coordinate of the node		
	X	Y	Z
i	0	10	0
j	10	0	0
k	0	15	0
l	0	0	20

Determine the shape function of the element. [16]

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

III B.Tech. I Semester Regular Examinations, November -2005
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 the significance of node numbering and element numbering during the discretization process.
   (b) Explain the natural and geometric boundary conditions.

   [8+8]

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. Derive the element stiffness matrix for the 2-noded beam element [16]

5. An axisymmetric ring element is shown in figure2. Derive the matrices, [B] and [D]. Take E = 2×10^5 N/mm^{2}and $\mu = 0.33$.

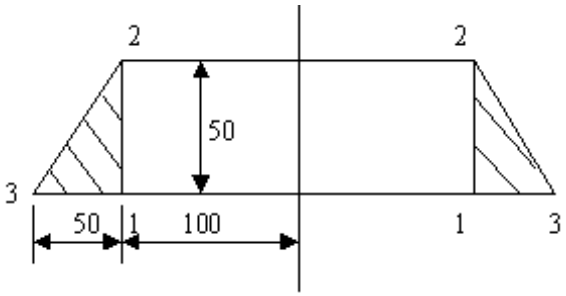

Figure 2:

[16]

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

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

[8+8]

8. Establish Jacobian matrix for a Tetrahedron element. [16]

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Code No: RR311403 **Set No.3**

III B.Tech. I Semester Regular Examinations, November -2005
FINITE ELEMENT METHOD
(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. 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}

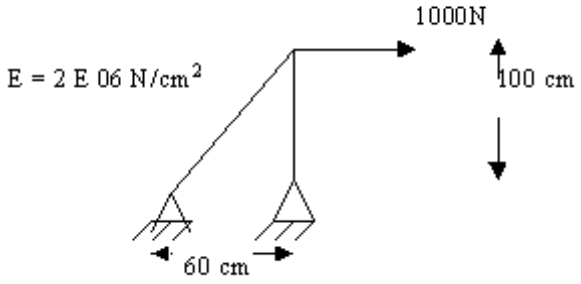

Figure 3:

[16]

4. A simply supported beam of l m length carries a single point load P at the center of the span. Descritize the span into two elements, find the value of central deflection using FEM? [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) Write about fully automatic and semi-automatic mesh generation concepts.
   (b) Explain 3-D eight nodded iso-parametric solid element.

[8+8]

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

III B.Tech. I Semester Regular Examinations, November -2005
FINITE ELEMENT METHOD
(Mechatronics)

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) Engineering application of finite element method
   (b) Discretization process

   [8+8]

2. Derive the finite element equations from the one dimensional second order equation by variational approach. [16]

3. For the pin jointed truss shown in figure. If E = 200 Gpa, determine{As shown in the Figure4}
   (a) Element stiffness matrices
   (b) Global stiffness matrix
   (c) Stress in the element 1
   (d) Strain in the element 2

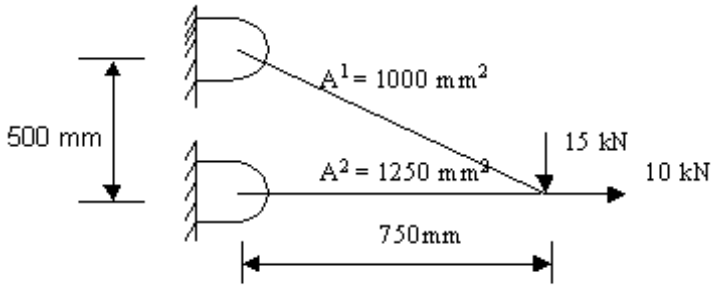

Figure 4:

[6+4+3+3]

4. Derive the element stiffness matrix for the 2-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. 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^2K and $T\propto = 22^0C$. Assume base temperature is 100^0C. [16]

7. Explain the following with examples.

   (a) Lumped parameter model.

   (b) Consistant mass matrix model.

   [8+8]

8. Starting from first principles determine the stiffness matrix for 8 noded brick element. [16]

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