Code No: 37200 **Set No. 1**

IV B.Tech I Semester Supplimentary Examinations, May/Jun 2009
FINITE ELEMENT METHODS
(Common to Mechanical Engineering, Production Engineering and Automobile Engineering)

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 the shape function for a Quadratic one dimensional line element in Natural Co-ordinate system. [16]

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

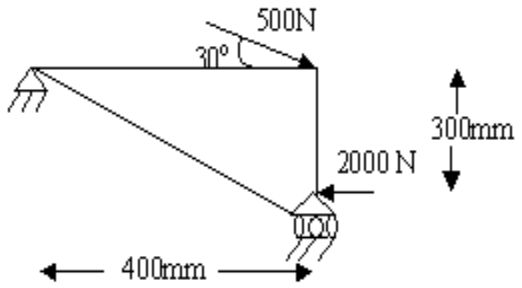

Figure 3

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

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. [8+8]

7. Discuss the methodology to solve the Eigen value problem for the estimation of natural frequencies of a stepped bar? [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: 37200 **Set No. 2**

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FINITE ELEMENT METHODS
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Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
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1. Write notes on the following:
   (a) Engineering application of finite element method
   (b) Discretization process. [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. 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 Figure 3} [16]

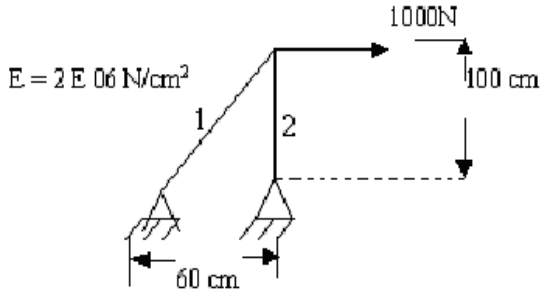

Figure 3

4. A cantilever beam of 1 m length carries a single point vertical load at the end of the beam of 10 kN. Calculate the deflection at the end of the beam using FEM, if E = 70 Gpa, A=500 mm^2 and I = 2500 mm^4. [16]
5. Establish the Jacobian operator [J] of the two dimensional element shown in figure 5 also find the Jacobian determinant. [16]

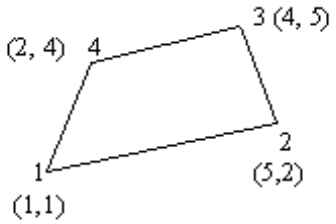

Figure 5

6. Estimate the temperature distribution in 1-Dimensional slab as shown in figure 6. $K_1 = 25$ W/m K; $K_2 = 10$ W/m K; $K_3 = 5$ W/m K; h = 55 W/m^2 K; T$\infty = 20^0$C. [16]

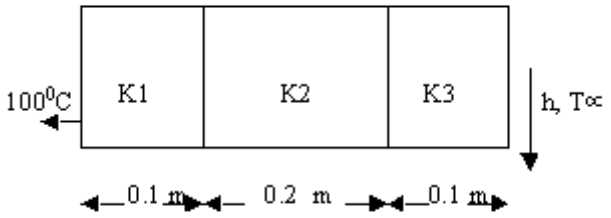

Figure 6

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

8. (a) Explain the convergence criteria in finite element discretization.
   (b) Derive the shape function for a 8 node brick element. [8+8]

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Code No: 37200 **Set No. 3**

IV B.Tech I Semester Supplimentary Examinations, May/Jun 2009
FINITE ELEMENT METHODS
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Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
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1. Explain the different approaches of getting the finite element equations. [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. Estimate the displacement vector, stresses and reactions for the truss structure as shown below Figure 3:

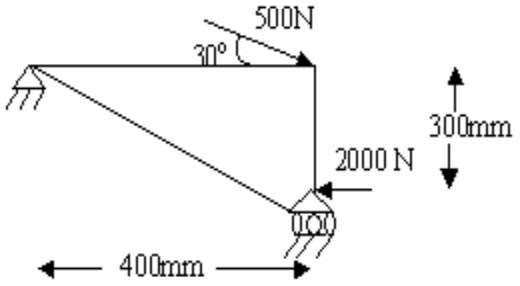

Figure 3

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. (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. Consider a brick wall (0.7 W/m K) of thickness 30 cm. The inner surface is at 28^0C and the outer surface is exposed to cold air with heat transfer coefficient of 36 W/m^2 K at -15^0C. Determine the steady state temperature distribution and heat flux through the wall. [8+8]
7. Explain the following with examples.
   (a) Lumped parameter model.

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

8. (a) How do you calculate the element stresses for 3-Dimensional body?

(b) Derive the element stiffness term and force term for four noded tetrahedral elements. [8+8]

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Code No: 37200 **Set No. 4**

IV B.Tech I Semester Supplimentary Examinations, May/Jun 2009
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Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
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1. Determine the circumference of a circle of radius 'r' using the basic principles of finite element method. [16]
2. Derive stiffness equations for a bar element from the one dimensional second order equation by variated approach. [16]
3. For the truss structure shown in figure 3 is subjected to a horizontal load of 4 kN in positive x-direction at node 2. Calculate
   (a) stiffness matrix and
   (b) stresses. [10+6]

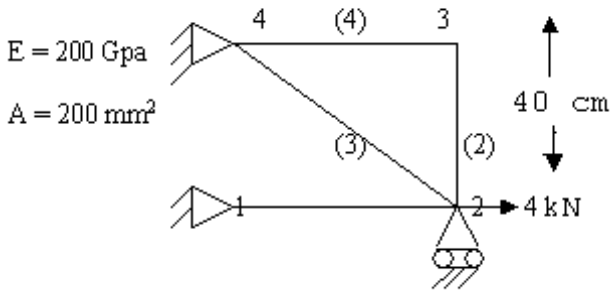

Figure 3

4. Derive the methodology to develop a stiffness matrix and load vector for a 2-noded beam element with 4 degrees of freedom? [16]
5. Explain in detail how the element stiffness matrix and load vector are evaluated in isoparametric formulations. [16]
6. Explain the methodology for the treatment of all three boundary conditions in a 1-D heat transfer element? [16]
7. Find the natural frequencies and the corresponding mode shapes for the longitudinal vibrations for the stepped bar. Assume $A_1 = 2A$ and $A_2 = A$;$I_1 = I_2 = I$ & ; $E_1 = E_2 = E$. [8+8]
8. (a) Compare the capabilities of ANSYS software with NISA software

(b) List and sketch the various 3-D solid structural elements available in ANSYS software. [8+8]

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