Code No: NR422105 **Set No.1**

**IV B.Tech. II Semester Supplementary Examinations, July -2005**
**FINITE ELEMENT METHODS**
**(Aeronautical Engineering)**

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

**Answer any FIVE Questions**
**All Questions carry equal marks**

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1. What are the different methods available for solving problems of structural mechanics? Name six different engineering applications of FEM.

2. Derive the stiffness matrix for a truss element with a varying cross section by using three nodes, the cross section varying from 2A to A through length L. Use static condensation procedure to condense out the internal degrees of freedom. Also use Gauss elimination procedure directly on internal degrees of freedom.

3. Derive the stiffness matrix for a plane frame member with three dof at each node using displacement model.

4. Describe a suitable displacement function for the simple three noded constant strain triangle, and examine the convergence criteria for this element

5. Construct shape functions for two noded and three noded axial element using Laganges equation and polynomial method. Sketch various patterns

6. (a) Obtain the steady state heat transfer problems governing equation with convective boundary conditions.
   (b) Explain briefly the following:
      i. steady state problem
      ii. propagation problem

7. From the basic principles obtain the equation of motion for axial flexural vibration of frame elements.

8. Write the subroutines to compute the shape functions at a given Gauss point for a four noded quadrilateral element. Using this subroutine develop a routine to compute the stress displacement matrix at a point in a quadrilateral element. Use the formulation for fast stiffness computation?

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Code No: NR422105 **Set No.2**

**IV B.Tech. II Semester Supplementary Examinations, July -2005**
**FINITE ELEMENT METHODS**
**(Aeronautical Engineering)**

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

**Answer any FIVE Questions**
**All Questions carry equal marks**

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1. Explain how a cycle frame can be descritized in to number of elements. With the help of a neat sketch, identify the different types of elements involved.

2. For an axially loaded member of length L, the cross sectional area of the member varies linearly with values $A_1$ and $A_2$ at the ends. Using a suitable interpolation function compute stiffness matrix of the element.

3. Write short notes on plain frames. Distinguish between axial element and beam element bring out two nodal d.o.f in each case.

4. Derive the expressions for the mass and stiffness matrices of a plate using triangular elements.

5. Prove how an isotropic axisymmetric solid element subjected to axisymmetric loading has effectively a 2-Dimensional state of stress.

6. 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 $N_i$, $N_j$, $N_k$ of the element.

7. Derive the stiffness and mass matrices for free vibrations in both lumped mass and consistent mass formulations for a bar element.

8. Write the subroutines to compute the shape functions. Using these routines develop a sub routine to compute the [B] matrix at a given Gauss point for a three noded triangular element.

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Code No: NR422105 **Set No.3**

**IV B.Tech. II Semester Supplementary Examinations, July -2005**
**FINITE ELEMENT METHODS**
**(Aeronautical Engineering)**

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

**Answer any FIVE Questions**
**All Questions carry equal marks**

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1. (a) Compare the finite element method with other methods of analysis.
   (b) What is general applicability and description of finite element method?
2. Starting from the basics derive the stiffness matrix and the load vector for a bar element under axial loading and also subjected to a temperature rise.
3. What is global stiffness matrix? Indicate the assemblage process of global stiffness matrix for a 8 noded beam element.
4. Distinguish the plane stress and plane strain problem.
5. (a) Obtain the properties of an isotropic axisymmetric solid element.
   (b) Derive the shape functions of any one of the 3-D structural element.
6. A constant strain triangle in a state of plane stress is subjected to a uniform temperature change of $\Delta$ T. Assuming that the coefficient of thermal expansion is $\alpha$ , derive the equation for the nodal forces due to temperature change.
7. (a) Explain Hamilton principle for natural vibrations.
   (b) Derive the consistent mass matrix for a four d.o.f flexural beam element.
8. Write the subroutines to compute the shape functions and [B] matrix. Using these subroutines develop a subroutine to compute the stiffness matrix [K] at a given Gauss point for a three noded triangular element.

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Code No: NR422105 **Set No.4**

**IV B.Tech. II Semester Supplementary Examinations, July -2005**
**FINITE ELEMENT METHODS**
**(Aeronautical Engineering)**

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

**Answer any FIVE Questions**
**All Questions carry equal marks**

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1. Explain various types of boundary conditions encountered in the finite element analysis of structural problems.
2. (a) What is displacement function?
   (b) Derive stresses and strains relations.
   (c) Derive equivalent nodal force vectors.
3. Derive the elemental stiffness matrix for two noded beam element and also load vector.
4. Explain the procedure adapted for deriving the stiffness matrix for a three noded triangular element in plane strain problem.
5. (a) What is meant by constant strain triangle element ? What are its advantages and disadvantages?
   (b) How the properties of isoparametric elements are formulated? Explain with the use of the mathematical modeling.
6. A large industrial furnace is supported on a long column of fire clay brick, which is 1 X 1 m on a side .During steady state operation, installation is such that three surfaces of the column are maintained at 600 K, while the remaining surface is exposed to an air stream for which $T_\alpha = 300$ K and h = 12 W/m$^2$k . Determine the temperature distribution in the column and the heat rate to the air stream per unit length of column. Take K= 1 W/mk.
7. (a) Explain Eigen value problems.
   (b) Derive the consistent mass matrix for a four d.o.f axial bar element.
8. Write the subroutines to compute the shape functions and Jacobian matrix [J] at a given Gauss point for a four noded quadrilateral element. U sing these subroutines develop a subroutine to compute the [B] matrix for a four noded isoparametric quadrilateral element using the formulation for fast stiffness computation.

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