Code No: 07A62105 **R07** **Set No. 2**

**III B.Tech II Semester Examinations,APRIL 2011**
**FINITE ELEMENT AND MODELING 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 techniques used in Semi automatic and fully automatic mesh generation? Explain with the suitable example. [16]

2. (a) Explain the two-point Gaussian quadrature method for the numerical integration.
   (b) What are the approximations and errors associated in two point Gaussian quadrature formula? Explain. [8+8]

3. (a) What are the properties of stiffness matrix.
   (b) Derive the element consistent mass matrix for a 2-dimensional beam element. [8+8]

4. (a) Derive the relation between natural and global coordinates.
   (b) In one-dimensional quadratic element, nodal displacement at $i^{th}$ node is $q_i$ = 6 mm and $j^{th}$ node is $q_j$ = 8 mm. The displacement at a point P is given as u = 6.25 mm and the corresponding shape functions are $N_i = 1/4$ and $N_j$, = 1/6. Find
      i. $N_k$ and
      ii. nodal displacement at $k^{th}$ node $q_k$. [8+8]

5. With suitable examples explain the meaning and formulations of properties of axisymmetric elements. State their applications. [16]

6. Calculate the nodal displacements and element stresses in the bar shown in figure 1. The temperature is exposed to a temperature of $50^0$C. [16]

7. (a) How do you generate an iso-parametric quadrilateral element for $C^2$ continuity?
   (b) What is the h-refinement process? How it would be useful for the improvement of the accuracy of the solution? [8+8]

8. (a) Discuss about equilibrium, compatibility and convergence requirements related to finite element analysis.
   (b) Explain about simplex, complex and multiplex elements with respect to degree of freedom. [8+8]

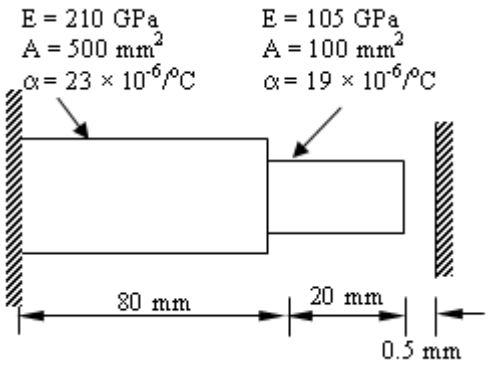
E = 210 GPa
A = 500 mm2
α = 23 × 10-6/°C
E = 105 GPa
A = 100 mm2
α = 19 × 10-6/°C
80 mm
20 mm
0.5 mm

Figure - 1

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Code No: 07A62105 **R07** **Set No. 4**

**III B.Tech II Semester Examinations,APRIL 2011**
**FINITE ELEMENT AND MODELING METHODS**
**Aeronautical Engineering**

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

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

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1. (a) Derive the strain displacement matrix for a 2D beam element.
   (b) Determine the deflection and slope under the point load for the beam shown in figure 2. E = 180GPa; I = $2\times10^{-6}$ $m^4$. [8+8]

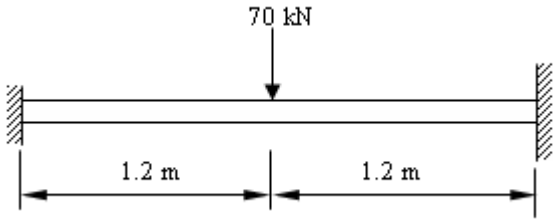


Figure 2:

2. (a) Explain about Finit Element formulations.
   (b) Explain the General procedure of F.E.M. [8+8]
3. (a) What are the general requirements of pre processor and post processor of a finite element packages? Explain.
   (b) Explain the single node and element mesh generation technique with simple example. [8+8]

4. What are different approximations involved in solving the finite element problems? Explain. [16]

5. (a) What are different applications of axi-symmetric boundary condition problems? Explain with suitable examples.

   (b) Derive the Jacobian matrix for the 2-D polar axi-symmetric problems from the first principles. [8+8]

6. Analyze the rigid frame shown in Figure 3 and find shear force and bending moment for the individual member. Each joint is a rigid joint where members are connected. [16]

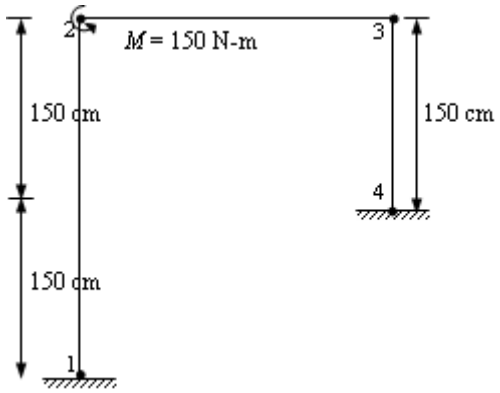


Figure 3:

7. (a) Derive the shape functions of a Quadratic one dimensional line element in a natural coordinates systems.

   (b) Discuss the significance and application of Isoparameters triangular element. [8+8]

8. Evaluate the Integral $I = \int_{-1}^{1} (\cos\frac{\pi x}{2} + \sin\frac{\pi x}{2})dx$ using 3 Gauss point quadrature. Check with the Exact solution. [16]

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Code No: 07A62105 **R07** **Set No. 1**

**III B.Tech II Semester Examinations,APRIL 2011**
**FINITE ELEMENT AND MODELING METHODS**
**Aeronautical Engineering**

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

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

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1. (a) Explain different methods of mesh generation techniques.
   (b) Describe the ANSYS package and its uses in finite element analysis. [8+8]

2. Derive the strain displacement relation matrix for the axi-symmetric problems for the polar co-ordinate system. [16]

3. (a) Derive the finite element equation using the potential energy approach.
   (b) Explain the various steps involved in solving a problem using finite element method. [8+8]

4. (a) For the uniformly varying load acting on the beam element shown in figure 4 estimate the equivalent nodal load vector.

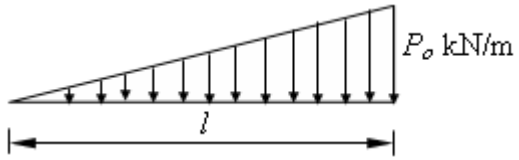


Figure 4:

   (b) Derive the stiffness matrix for a bar element with two degrees of freedom at each node from basics. [6+10]

5. (a) Using Gaussian quadrature with n=3,4 and 5 evaluate $I = \int\int {}^{y^2}/_{x}$ over the area of triangle.
   (b) Explain Newton-Cotes procedure with suitable example. [8+8]

6. Calculate the element stresses for the element shown in Figure 5 for plane stress and plane strain condition when nodal displacements are as given below: $q_1 = 0$, $q_2$= 0, $q_3$=0.001mm, $q_4$= 0.002mm, $q_5$= -0.003mm and $q_6$= 0.002mm E = 200GPa, $\nu$=0.25, thickness = 20mm. [16]

7. Determine the stiffness and Jacobian matrix for the isoparametric quadrilateral element starting from fundamentals. [16]

8. (a) Explain the natural coordinate system for one-, two- and three-dimensional elements.

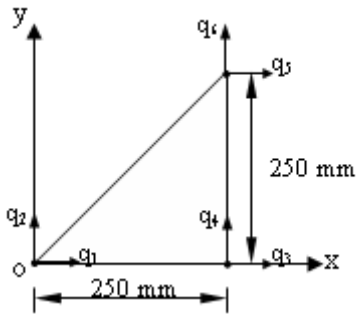


Figure 5:

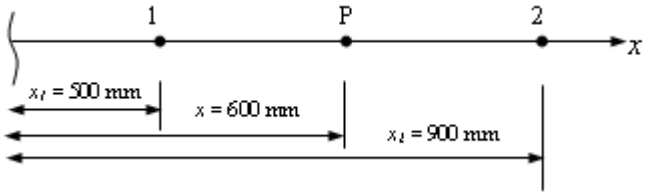


Figure 6:

(b) Evaluate the natural coordinate $\xi$, shape function $N_1$ and $N_2$ at point P shown in figure 6. If $q_1$ = 0.075 mm and $q_2$ = -0.125 mm determine the value of displacement q at point P. [6+10]

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Code No: 07A62105 **R07** **Set No. 3**

**III B.Tech II Semester Examinations,APRIL 2011**
**FINITE ELEMENT AND MODELING METHODS**
**Aeronautical Engineering**

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

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

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1. (a) Discuss the Gaussian quadrature two point formula along with their weights to be considered.
   (b) Derive the equation for det J in terms of the element area when the linear quadrilateral element is a Square. [8+8]
2. (a) Differentiate between Macro and Micro mechanical Models.
   (b) List the advantages and Disadvantages of Finite Element Method.
   (c) Differentiate between Geometric model and Finite Element Model. [6+6+4]
3. (a) Derive an expression relating local and global coordinates.
   (b) Explain the advantages of natural coordinates over other coordinates. [8+8]
4. (a) Explain the need for automatic mesh generation techniques.
   (b) Explain the terms mesh smoothing, Mesh density and mesh conformity. [8+8]
5. (a) Distinguish between consistent and lumped mass matrices.
   (b) Compute the eigen values and eigen vectors for a axial vibrating stepped bar shown in Figure 7. [6+10]

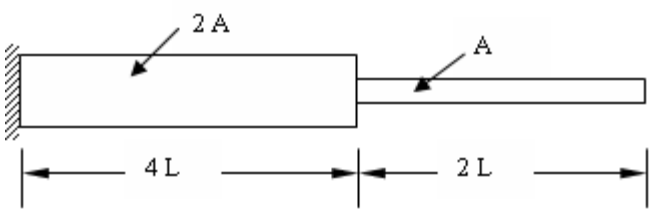


Figure 7:

6. (a) Differentiate between axi- symmetric boundary condition and polar symmetric boundary condition.
   (b) Derive the load vector for the axi-symmetric triangular element with the variable surface load on the surface. [8+8]
7. (a) Derive the load vector for the four nodded isoparametric element for the specified body force and variable load on one surface.

(b) Calculate the load vector for the quadrilateral element with the coordinates 1(0,0), 2(0.5,0.1), 3(0.7,0.9), 4(0.1,0.8) and the variable load is acting from 1 MPa to 4 MPa on the face of node 1 to node 2. Take thickness of the element as 0.01 m. [8+8]

8. Calculate the conductance matrix $[K^{(e)}]$ and load vector $\{F^{(e)}\}$ for the triangle element shown in figure 8. The thermal conductivities are $k_x = k_y = 4\ W/cm{-}^0$C and h = 0.3 W/$cm^2\ ^0C$. Thickness of the element is 1cm. All coordinates are given in cms. Convection occurs on the side joining modes i and j. [16]

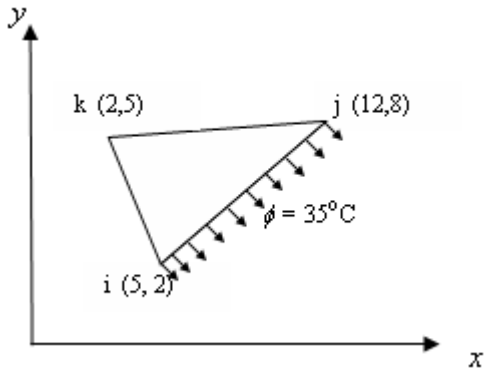


Figure 8:

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