CODE NO: 07A70102

R07

SET - 1

IV B.TECH - I SEMESTER EXAMINATIONS - MAY, 2011

FINITE ELEMENT METHODS IN CIVIL ENGINEERING

(CIVIL ENGINEERING)

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

Answer any FIVE questions
All Questions Carry Equal Marks

- - -

1. List the advantages, disadvantages and applications of Finite Element Method. [16]

2. Deformation of a finite element is shown in Figure 1.
   a) Develop a deformation field u(x,y), v(x,y).
   b) Determine ε_x, ε_y, γ_{xy}. [8 +8]

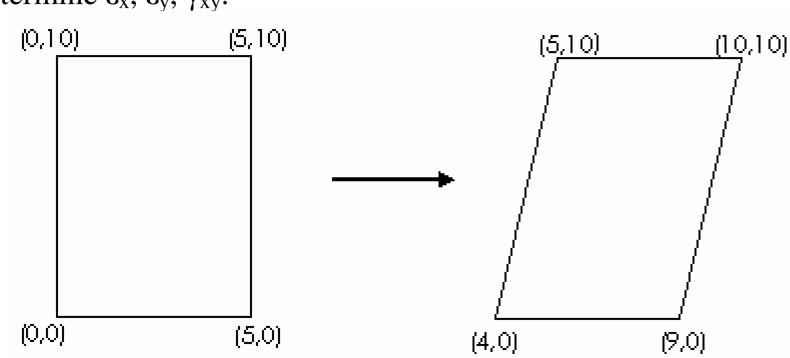

Figure: 1

3. Derive an expression of shape functions and the stiffness matrix for one dimensional bar element. [16]

4. a) What are natural coordinates and enumerate its advantages.
   b) For the point P (2.5, 4.5) located inside the triangle as shown in figure 2, find the area coordinates. [6 + 10]

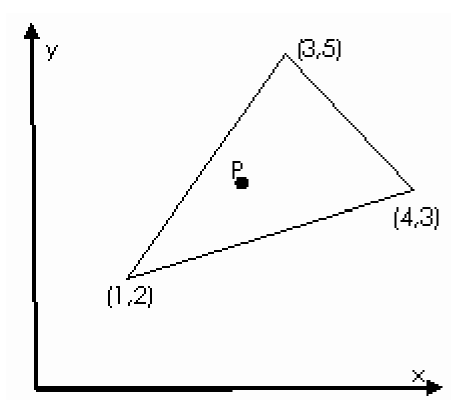

Figure: 2

5. Derive the element stiffness matrix for a linear isoparametric quadrilateral element. [16]

6. For a 4 noded rectangular element shown in Figure 3, determine the following at $\varepsilon = 0$; $\eta = 0$. Take $E = 2x10^5$ N/mm^2 ; $\nu = 0.25$ and u = [0,0,0.002,0.003,0.005,0.003,0,0]. Assume plane stress condition:
   a) Jacobian matrix.
   b) Strain displacement matrix.
   c) Element stresses. [5+6+5]

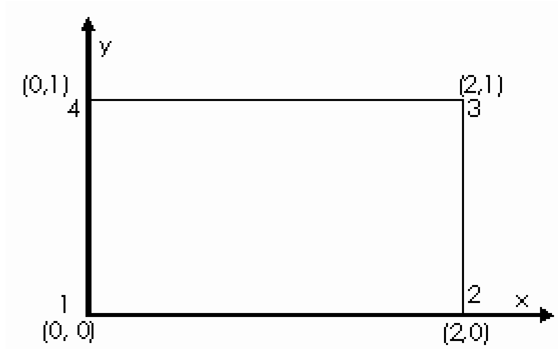

Figure: 3

7. Derive the strain – displacement matrix [B] for axisymmetric triangular element. [16]

8. Evaluate the integral I = ∫1-1/ [$3e^x + x^2$ +1/(x+2)]dx using one point and two point gauss quadrature. [16]

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SET - 2

IV B.TECH - I SEMESTER EXAMINATIONS - MAY, 2011
FINITE ELEMENT METHODS IN CIVIL ENGINEERING
(CIVIL ENGINEERING)

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

Answer any FIVE questions
All Questions Carry Equal Marks
- - -

1. A simply supported beam subjected to uniformly distributed load 'q_o' over entire span and also point load of magnitude 'P' at the centre of the span. Calculate the bending moment and deflection at mid span by using Rayleigh-Ritz method and compare with the exact solution. [16]

2. Derive the constitutive relationship for a axisymmetric body subjected to axisymmetric loading. [16]

3. Consider the stepped bar shown in Figure 1. Assemble the stiffness and force matrix. Also, determine the nodal displacements, element stresses and support reactions. [16]

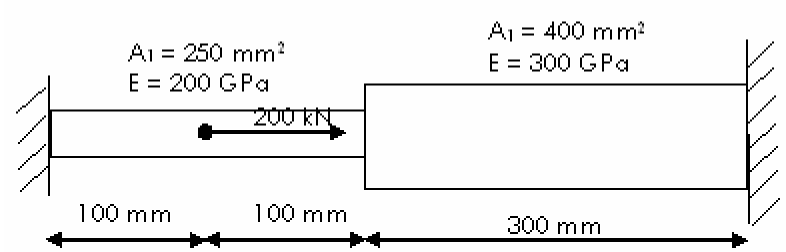

Figure: 1

4. Explain the following terms with respect to finite element analysis:
   a) Convergence and compatibility.
   b) Geometric Invariance. [8 + 8]

5. Derive the element stiffness matrix for a 4-noded rectangular element in generalized coordinates. [16]

6. a) Define isoparametric elements and state its advantages.
   b) A four- noded quadrilateral element is shown in figure 2. Determine the generalized coordinates of point P whose location in the master element is given by $\xi = 0.5$ and $\eta = 0.5$. [8+8]

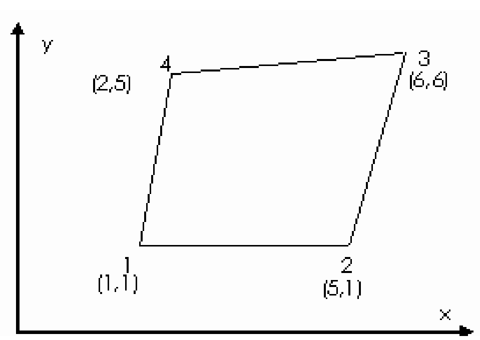

Figure: 2

7. The nodal co-ordinates for an axisymmetric triangular are given as follows: r_1 = 15 mm, z_1 = 15 mm; r_2 = 25 mm, z_2 = 15 mm; r_3 = 35 mm, z_3 = 50 mm. Determine strain-displacement matrix[B]for the element. [16]

8. List the various solution techniques used in finite element analysis and explain any one of the methods in detail. [16]

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IV B.TECH - I SEMESTER EXAMINATIONS - MAY, 2011
FINITE ELEMENT METHODS IN CIVIL ENGINEERING
(CIVIL ENGINEERING)

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

Answer any FIVE questions
All Questions Carry Equal Marks
- - -

1. A cantilever beam subjected to uniformly distributed load 'q_o' over entire span and also point load of magnitude 'P' at free end. Calculate the bending moment and shear force at the fixed end by using Rayleigh-Ritz method and compare with the exact solution. [16]

2. A displacement field $u = 1+3x+4x^3 + 6xy^2$, $v = xy - 7x^2$ is imposed on a square element whose coordinates are

Node No.	Coordinates
1	(-1,-1)
2	(1,-1)
3	(1,1)
4	(-1,1)

a) Write down the expression for strains ε_x, ε_y, γ_{xy}
b) Find the strains at nodes
c) If E = 210 GPa, Find the stresses σ_x, σ_y, τ_{xy}. Assume plane strain condition.
[5+6+5]

3. A uniformly tapering rod is shown in Figure 1. Determine the elongation of the rod and the reaction developed at the fixed end when the rod is subjected to self-weight and given loading. [16]

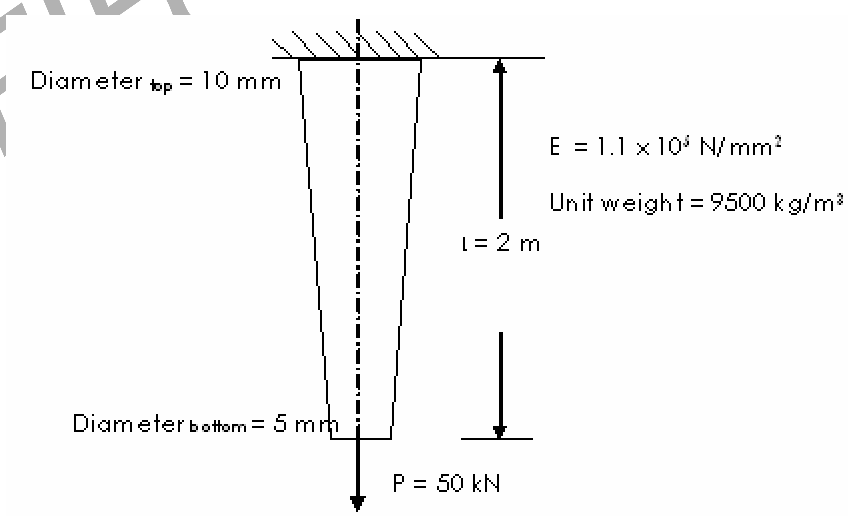

Figure: 1

4. For the triangular element shown in figure 2. Determine the Jacobian matrix and strain – displacement matrix. [16]

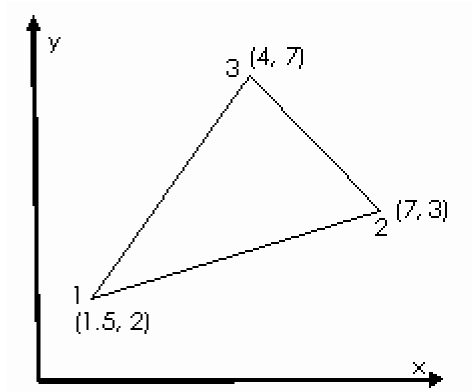

Figure: 2

5. Derive the element stiffness matrix for a three noded triangular element. [16]

6. Derive the shape function for an eight-node quadrilateral element in natural coordinates. [16]

7. An open ended cylinder of length 200 mm, outer diameter 100mm and wall thickness 16 mm is subjected to an internal pressure of 1 MPa. Identify the type of problem and explain in detail how the problem can be solved by finite element method. [16]

8. Using a 2 x 2 rule evaluate the integral $\iint_A (3x + 2x^2 + xy^2)\,dx\,dy$ over the given area by Gaussian quadrature as shown in figure 3. [16]

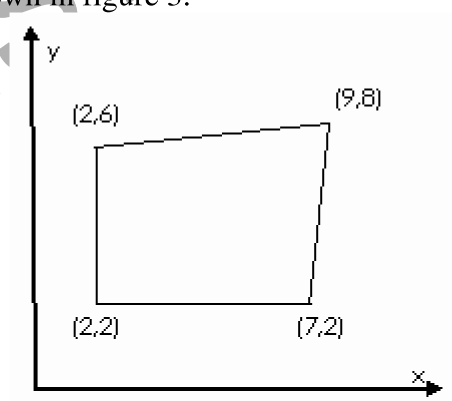

Figure: 3

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CODE NO: 07A70102 | R07 | SET - 4

IV B.TECH - I SEMESTER EXAMINATIONS - MAY, 2011
FINITE ELEMENT METHODS IN CIVIL ENGINEERING
(CIVIL ENGINEERING)

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

Answer any FIVE questions
All Questions Carry Equal Marks
- - -

1. Explain briefly the following:
   a) Importance of Boundary condition
   b) Discretization of structures to apply finite element method. [8+8]

2. Derive the constitutive relationship for plane stress condition and plane strain condition. [16]

3. Consider the plane truss system shown in Figure 1. Determine the element stiffness matrix for each element and assemble the global stiffness matrix for the entire truss. Area = 500 mm^2 for all elements and E = 2.12 x 10^5 N/mm^2. [16]

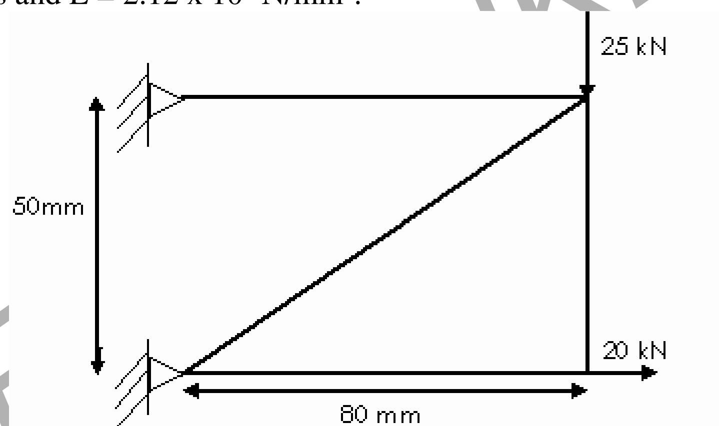

Figure: 1

4. a) What is a shape function and enumerate its characteristics.
   b) Determine the shape function for two noded bar element using polynomial functions and generalized coordinates. [6+10]

5. Determine the strain-displacement matrix for the element shown in Figure 2.

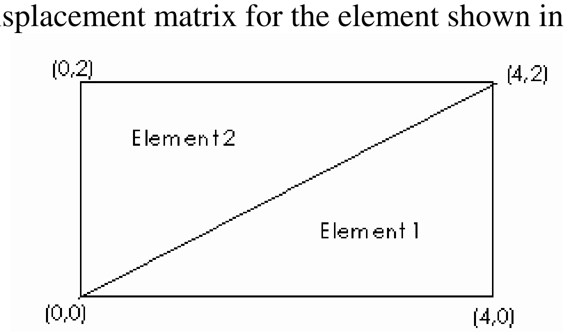

Figure: 2

6. Derive the shape function for CST element. [16]

7. Derive the stress-strain relationship matrix [D] for the axisymmetric triangular element. [16]

8. Explain in detail the following:
   a) Full integration.
   b) Selective integration. [8+8]

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