Code.No: 07A70102 | R07 | SET-1

IV B.TECH – I SEM EXAMINATIONS, NOVEMBER - 2010
FINITE ELEMENT METHODS IN CIVIL ENGINEERING
(CIVIL ENGINEERING)

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

Answer any FIVE questions
All questions carry equal marks
- - -

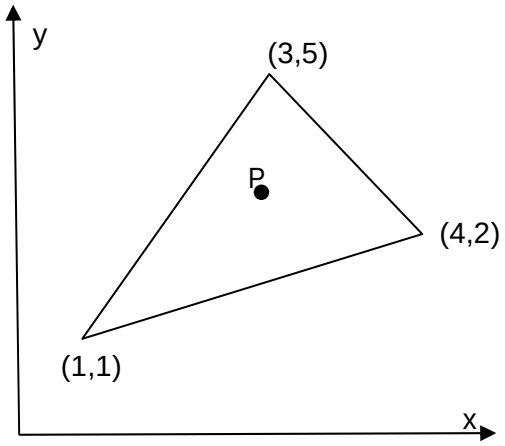
1. Discuss in detail the general steps involved in Finite Element Method. [16]

2. If a displacement field is described by
$u = (-x^2 + 2y^2 + 6xyz + 2z^2 + 4yz)\ 10^{-4}$
$v = (3x + 6y - y^2 + 6yz + 3z)\ 10^{-4}$
$w = (x^2 + 2y^2 + z^2 - 2z + 2xyz)\ 10^{-4}$
Determine the strain field at the point x = 1 and y =0. [16]

3. a) Define natural coordinate system. Establish a relationship between local or Cartesian coordinates and natural coordinates for a 2-noded bar element.
b) For the given 1-dimensional bar element

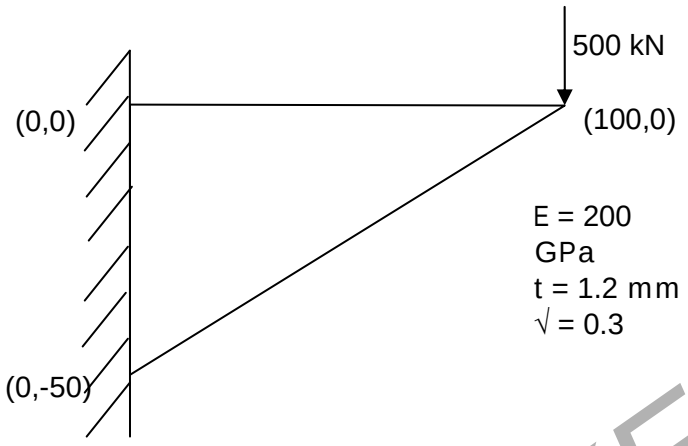
i) Evaluate ξ, N_1 and N_2 at point P .
ii) If displacement at nodes is $\delta_1 = 0.002$ mm and $\delta_2 = 0.001$ mm. Determine the value of the displacement δ at the point P. [8 + 8]

4. a) Explain the basis for choosing a displacement function.
b) The nodal coordinates of a triangular element are shown in Figure.



At the interior point P, the X- coordinate is 3.3 and the shape function at node 1 is N_1 is 0.3. Determine the shape functions at Node 2 and Node 3 and also the y coordinate of the point P. [8+8]

5. Derive the element stiffness matrix for the triangular plate shown in Figure. Assume plane stress condition. [16]



6. a) Explain briefly the advantages of isoparametric elements.
   b) Derive the shape function for a 4-noded isoparametric element in ξ and η coordinates. [6+10]

7. a) What do you understand by axisymmetric problems? Identify conditions in which axisymmetry is encountered.
   b) Derive the constitutive relationship for an axisymmetric problem. [8 +8]

8. a) Explain Guassian Quadrature method of integration.
   b) Evaluate the integral $I = \int_{-1}^{1}\left[x^3 + 2x^2 + \frac{1}{(x+2)}\right]dx$, using 2-point Guassian quadrature. [8+8]

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FINITE ELEMENT METHODS IN CIVIL ENGINEERING
(CIVIL ENGINEERING)

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

Answer any FIVE questions
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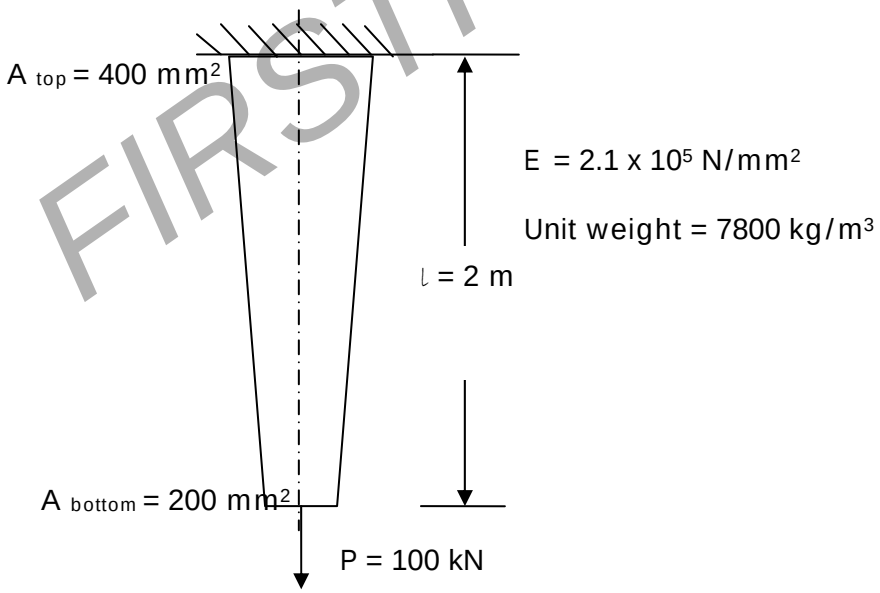
- - -

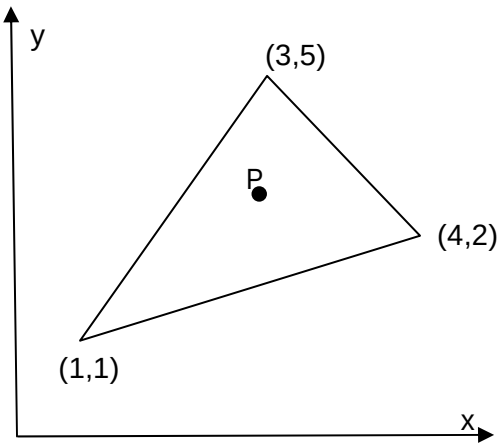
1. A rod of constant area of cross-section, fixed at both ends is subjected to a varying body force $f = x^2$. Use Rayleigh- Ritz method with an assumed displacement field $u = a_o + a_1x + a_2x^2$ to determine the displacement u(x) and stress σ(x). [Assume E = 1, A= 1, L= 1]. [16]

2. a) Explain briefly the plane strain condition.
   b) In a plane strain problem, we have $\sigma_x = 200$ kN/m^2, $\sigma_y = -100$ kN/m^2, E = 3 x 10^{-5} MPa and μ = 0.3. Determine the value of the stress σ_z. [4 + 12]

3. Determine the following for the tapered rod given in Fig. Model the rod into two elements.
   a) Displacement at the free end.
   b) Reaction at the support. [16]

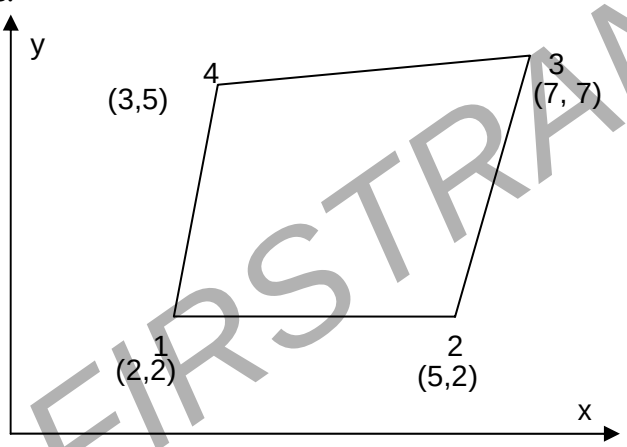


4. a) Explain Natural coordinate system and generalized coordinate system.
   b) For the point P located inside the triangular element, the shape function N_1 and N_2 are 0.15 and 0.25 respectively. Determine the x and y coordinates of Point P. [6+10]



5. Determine the element stiffness matrix for a 3-noded triangular element. [16]

6. The x,y coordinates of each node of a four-noded quadrilateral element is shown in figure.



The element displacement vector is given by q = [0, 1, 1.5, 0, 0.75, 0, 0.25, 0.5]^T. Find the following:

a) The x, y coordinates of point P whose location in the master element is given by $\xi = 0$ and $\eta = 0.5$.

b) The displacements u and v of the point P. [16]

7. A long cylinder of inside diameter 50 mm and outside diameter 70 mm snugly fits in a hole over its full length. The cylinder is subjected to an internal pressure of 2 N/mm^2. Explain in detail how the problem can be solved by finite element method. [16]

8. Explain in detail the following:

a) Full integration.

b) Under integration and spurious modes. [8+8]

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IV B.TECH – I SEM EXAMINATIONS, NOVEMBER - 2010
FINITE ELEMENT METHODS IN CIVIL ENGINEERING
(CIVIL ENGINEERING)

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

Answer any FIVE questions
All questions carry equal marks

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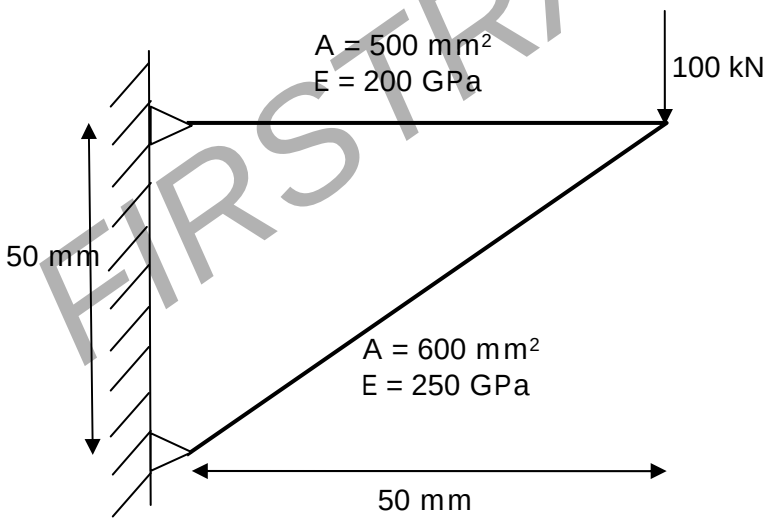
1. A simply supported beam of length l is subjected to a uniformly distributed load of magnitude w. Calculate the deflection at the mid-point of the beam by Rayleigh- Ritz method. Use a trial function $\delta = a_o \sin\left(\frac{\pi x}{l}\right)$ [16]

2. a) Explain briefly the plane stress condition.
   b) Identify situations in which plane stress and plane strain conditions can be used.
   c) Derive the constitutive relationship for plane stress and plane strain conditions from the generalized Hooke's Law relationship. [4+4+8]

3. a) Explain briefly local and global coordinates system.
   b) Consider a truss system shown in Fig. Assemble the global stiffness matrix for the entire truss. [6+10]



4. a) Explain convergence and compatibility criteria.
   b) Explain geometric invariance in finite element formulations. [10+6]

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

6. Derive the shape function for a 8-noded isoparametric quadrilateral element. [16]

7. Derive the stiffness matrix for a 3-noded triangular element for axisymmetric analysis. [16]

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

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IV B.TECH – I SEM EXAMINATIONS, NOVEMBER - 2010
FINITE ELEMENT METHODS IN CIVIL ENGINEERING
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Time: 3hours **Max.Marks:80**

Answer any FIVE questions
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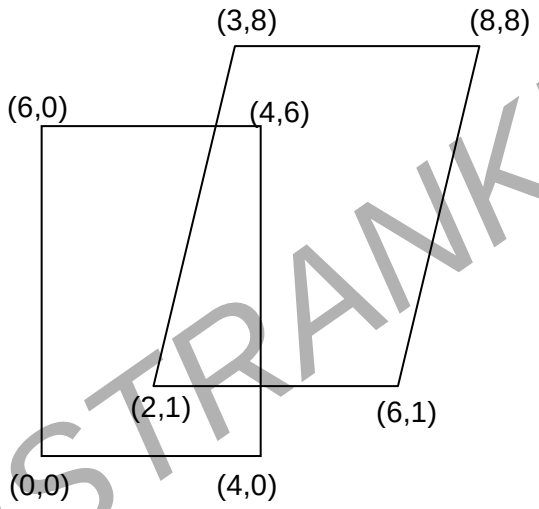
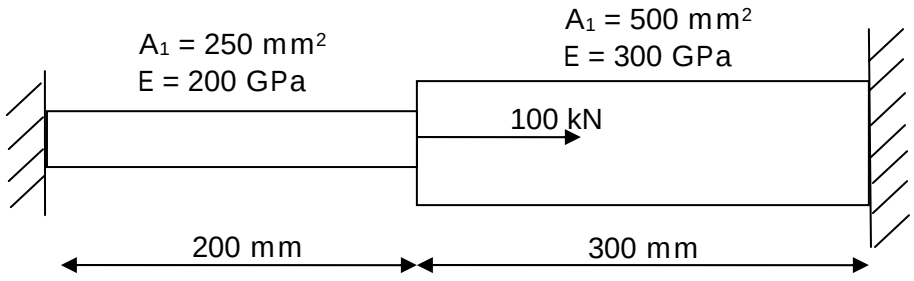
1. a) Enumerate the merits and demerits of Finite Element Method.
   b) Explain the principle of stationary potential energy. [8+8]

2. Deformation of a finite element is shown in Figure.



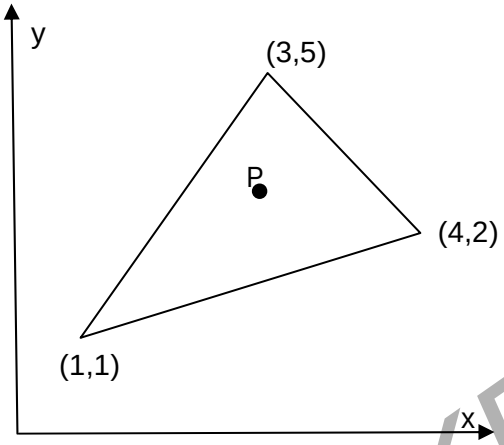
   a) Calculate the various components of strains.
   b) If E = 200 GPa and μ = 0.3. Compute the stresses. [10+6]

3. A stepped bar is shown in Figure.

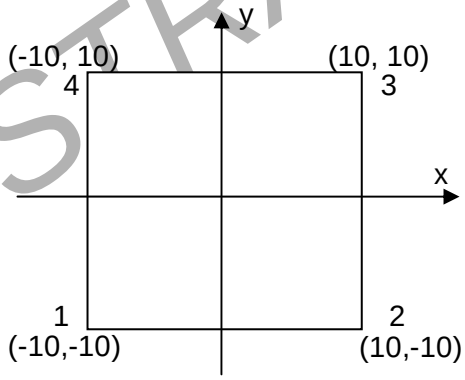


   Compute the Nodal Displacements, Element stresses and Support reactions. [16]

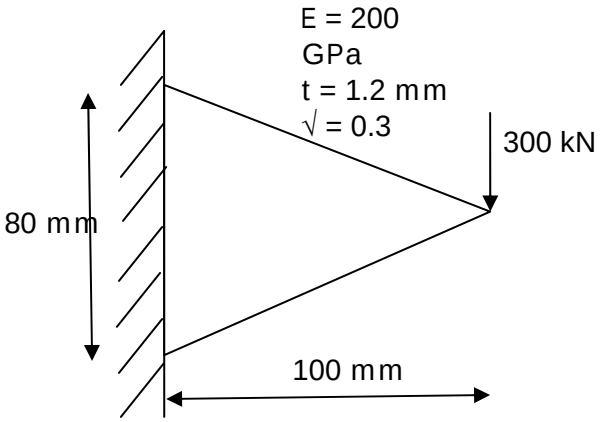
4. a) Define area coordinates and state its applications.
   b) For the point P (2, 3) located inside the triangle, find the area coordinates. [6+10]



5. A linear 4-noded quadrilateral element is shown in Fig. Assume plane stress formulation, $E = 2.1 \times 10^5$ N/mm^2 $\mu = 0.3$ and displacement field, $q = [0, 0, 2, 0, 1, -1, 0, 0]^T$. Evaluate the displacement at the centre. [16]

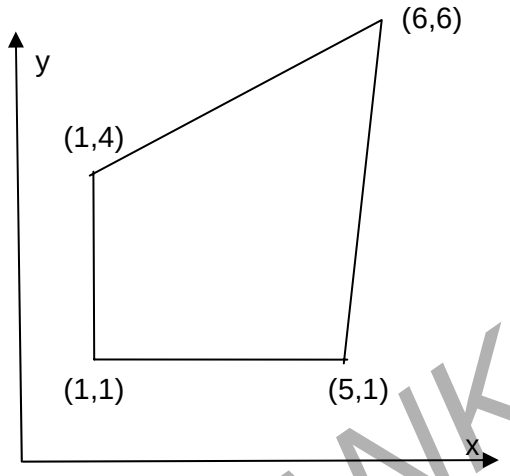


6. Assemble the element stiffness matrix for the thin triangular plate shown in Figure. [16]



7. Derive the strain displacement matrix for a 3-noded triangular element for axisymmetric analysis. [16]

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



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