Code No: **R42016**

# R10

Set No. 1

**IV B.Tech II Semester Regular/Supplementary Examinations, April- 2015**
## FINITE ELEMENT METHODS
### (Civil Engineering)

**Time: 3 hours**  **Max. Marks: 75**

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

1  a)  State and discuss the strain displacement relations of a deformation body.  [8]

   b)  List and briefly describe the general steps of the finite element method.  [7]

2  Determine the deflection and stresses in the three different rods as shown in below figure.
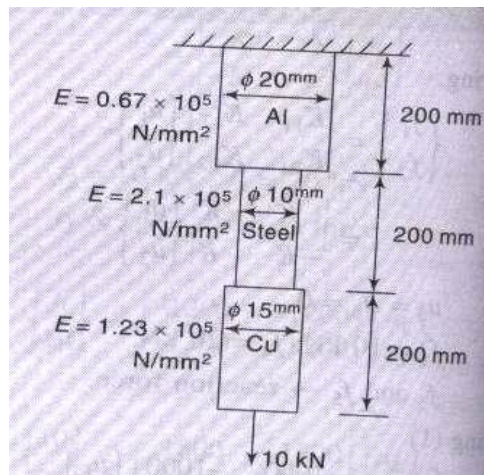


[15]

3  For the vertical rod shown in below figure, find the deflection at A and the stress distribution. Use E = 100 MPa and weight per unit volume = 0.06 N/cm$^3$. (Hint: Introduce weight contribution to the nodal loads and solve using two elements and four elements). Comment on the stress distribution.
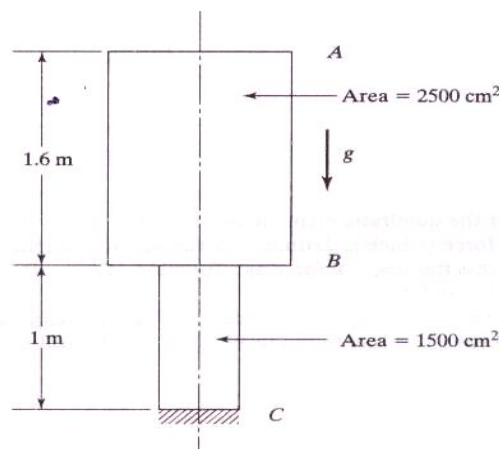


[15]

4  a)  For the two dimensional loaded plate shown in below figure, determine the
       displacements of nodes 1 and 2 and the element stresses using plane stress
       conditions. Body force may be neglected in comparison with the external
       forces.
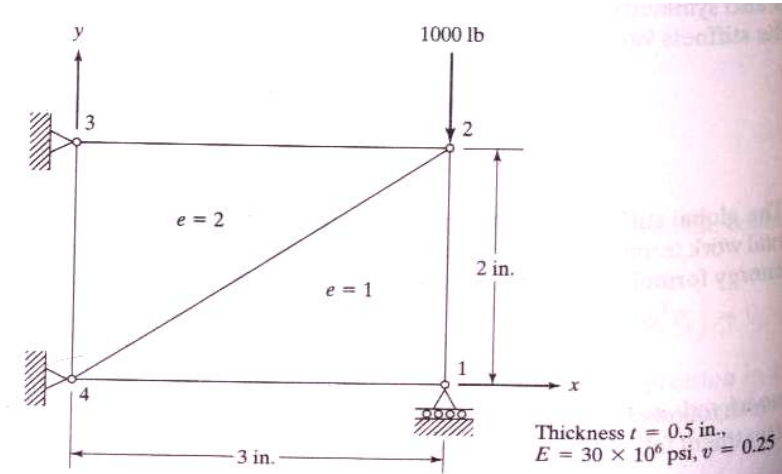


   b)  Distinguish between 3-node triangular element and four node rectangular   [6]
       element.

5      The beam of shown in below figure is statically determinate, and computations
       for the reactions $R_A$ and $R_B$ are elementary using the equations of statics.
       However, the beam will serve the purpose of illustrating the displacement
       method. Use the displacement method to compute the reactions for the beam of
       figure.



       [15]
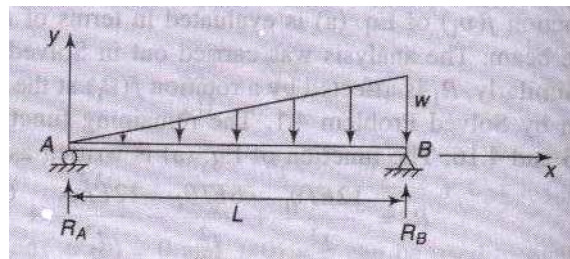
6  a)  Compare isoparametric quadrilateral and triangular elements.   [7]

   b)  State and discuss the governing equations for axi-symmetric elasticity problem
       and also write its any two practical applications.   [8]

7      What do you understand by finite element modeling of axi symmetric
       triangular element using iso parametric representation?   [15]

8      Write a short notes on
           a)  Equilibrium conditions for 2-dimentisonal stress distribution
           b)  Numerical integration
           c)  Linear constitutive relation
           d)  Constant strain triangle   [15]

Code No: **R42016** **R10** Set No. 2

**IV B.Tech II Semester Regular/Supplementary Examinations, April- 2015**
**FINITE ELEMENT METHODS**
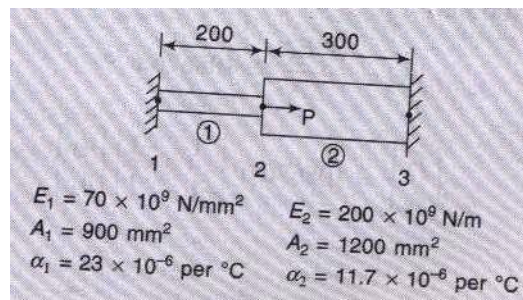**(Civil Engineering)**

Time : 3 hours                                                                Max. Marks: 75
**Answer any FIVE Questions**
**All Questions carry equal marks**
*****

1 a) List five typical areas of engineering where the finite element method is
     applied? And also write its any two practical examples.                  [8]
  b) What do you understand by discretization and write its any two applications.  [7]

2    An axial load $P = 400 \times 10^3$ N is applied at $20^0$C to the rod as shown in below
     figure. The temperature is then raised to $60^0$C. Determine the elemental
     stresses.



$E_1 = 70 \times 10^9$ N/mm²
$A_1 = 900$ mm²
$\alpha_1 = 23 \times 10^{-6}$ per °C

$E_2 = 200 \times 10^9$ N/m
$A_2 = 1200$ mm²
$\alpha_2 = 11.7 \times 10^{-6}$ per °C                                          [15]

3    Consider the bar in below figure loaded as shown. Determine the nodal
     displacements, element stresses, and support reactions. Solve this problem by
     hand calculation, adopting the elimination method for handling boundary
     conditions.
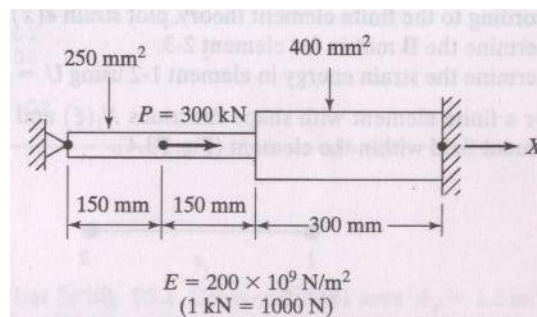


$E = 200 \times 10^9$ N/m²
(1 kN = 1000 N)                                                                 [15]

4  a)  For the configuration shown in below figure, determine the deflection at the point of load application using a one-element model. If a mesh of several triangular elements is used, comment on the stress values in the elements close to the tip.

100 N

30 mm

50 N

20 mm

$t = 10$ mm
$E = 70,000$ MPa
$v = 0.3$
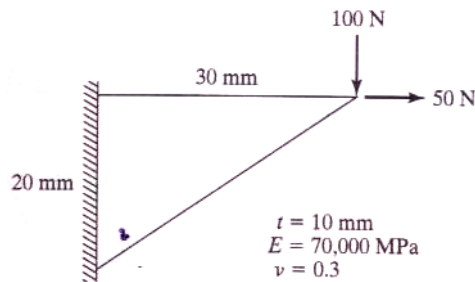
[9]

   b)  Distinguish between natural coordinate and volume coordinates also write their mathematical analysis                                                   [6]

5      The two-span beam of below figure is fixed at both ends and supported between the ends with a simple support that allows rotation. Compute the rotation at the simple support and reactions at all supports. Construct the corresponding shear and moment diagrams.

w

2

A                                                   C

1

B

3

L

2L
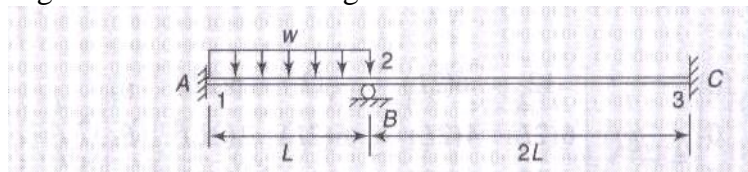
[15]

6  a)  Discuss the isoparametric triangular elements and write its mathematical analysis.                                                                     [8]
   b)  Write a short notes on isoparametric quadrilateral elements                    [7]

7      Explain in detail axi symmetric solids subjected to axi symmetric loading using its potential energy approach.                                            [15]

8      Write a short notes on
         a)  Static condensation
         b)  Convergenence criteria
         c)  Gauss elimation and matrix decomposition.
         d)  Solution techniques for static loads.                                    [15]

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**IV B.Tech II Semester Regular/Supplementary Examinations, April– 2015**
## FINITE ELEMENT METHODS
### (Civil Engineering)

**Time: 3 hours**                                                         **Max. Marks: 75**
**Answer any FIVE Questions**
**All Questions carry equal marks**
**\*\*\*\*\***

1  Determine the displacements of nodes of the spring system shown in below figure.



[15]

2  Determine the displacement of two bar truss shown in below figure. A force of 500 kN is applied at node 1 in the positive y direction while node 1 series an amount $\delta = 50$mm in the negative x direction. Let E = 210 GPa and A = 6.00 x $10^{-4}$ m$^2$ for each element.



[15]

3  In below figure, a load P = 60 x $10^3$ N is applied as shown. Determine the displacement filed, stress, and support reactions in the body. Take E = 20 x $10^3$ N/mm$^2$.



[15]

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4  a)  What do you understand by convergent criteria?   [6]

b)  A two dimensional plate is shown in the below figure. Determine the equivalent point loads at nodes 7, 8 and 9 for the linearly distributed pressure load acting on the edge 7-8-9.



Thickness = 10 mm    [9]
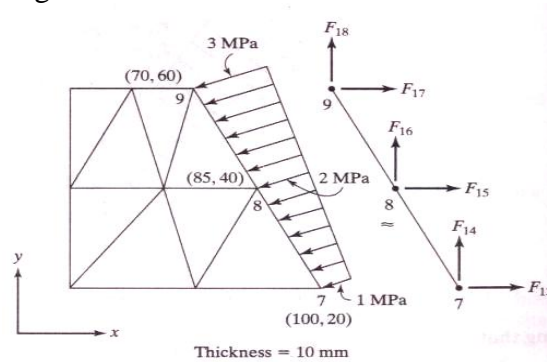
5      For the beam and loading shown in below figure, determine (1) the slopes at 2 and 3 and (2) the vertical deflection at the midpoint of the distributed load.



$E = 200\ GPa$      $I = 4 \times 10^6\ mm^4$    [15]
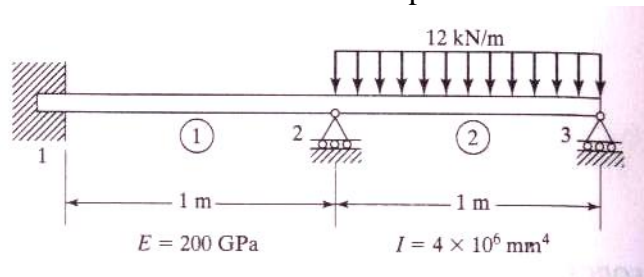
6  a)  Write a short note on isoparametric quadrilateral elements.   [7]

b)  A rectangular element has sides that are parallel to the x and y axes of a cartesian coordinate system. Derive the jacobian matrix and compute the value of the determinant of the jacobian.   [8]

7   In below figure a long cylinder of inside diameter 80 mm and outside diameter 120 mm snugly fits in a hole over its full length. The cylinder is then subjected to an internal pressure of 2 MPa. Using two elements on the 10-mm length shown, find the displacements at the inner radius.



[15]
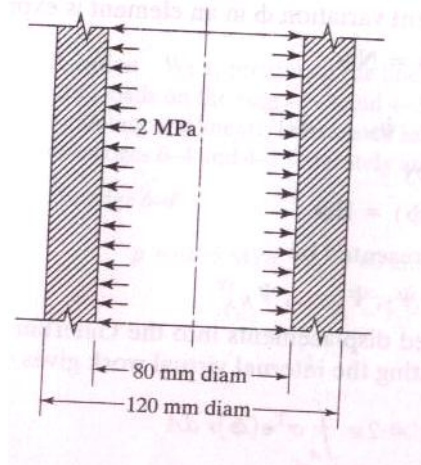
8   Write a short notes on
   a) Shape functions for second order rectangular element
   b) Lag range and serpendity elements
   c) Plane stress and plane strain analysis
   d) Axi symmetric solid element.                    [15]

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# R10

Set No. 4

**IV B.Tech II Semester Regular/Supplementary Examinations, April– 2015**
## FINITE ELEMENT METHODS
### (Civil Engineering)

**Time: 3 hours** Max. Marks: 75

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

1  a)  Classify boundary conditions explain each one of them. [9]

   b)  What do you understand by interpolation function? Also write its mathematical
       analysis. [6]

2       Consider the bar in below figure. Cross sectional area $A_e = 1.2$ in.$^2$, and Yong's
        modulus $E = 30$ x $10^6$ psi, if $q_1 = 0.02$ in. and $q_2 = 0.025$ in., determine the
        following
        a)  The displacement at point P,
        b)  The strain $\varepsilon$ and stress $\sigma$
        c)  The element stiffness matrix, and
        d)  The strain energy in the element



[15]
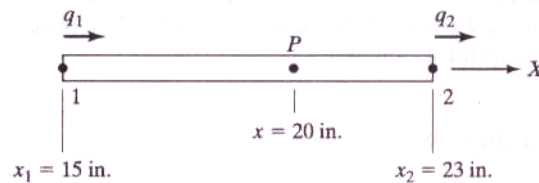
3       Consider the bar shown in below figure. An axial load $P = 200$ x $10^3$ N is
        applied as shown. Using the penalty approach for handling boundary
        conditions, do the following
        a)  Determine the nodal displacements.
        b)  Determine the stress in each material.
        c)  Determine the reaction forces.



[15]

# R10
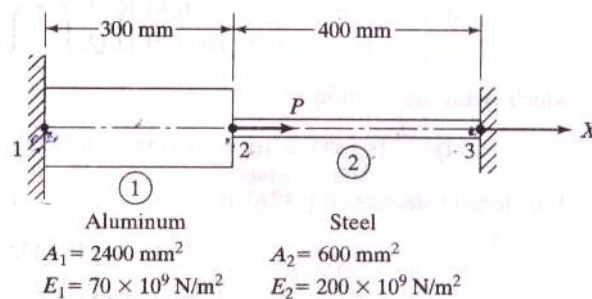
4 a) A CST element is shown in below figure. The element is subjected to a body force $f_x = x^2$ N/m$^3$. Determine the nodal force vector f$^e$. Take element thickness = 1 m.
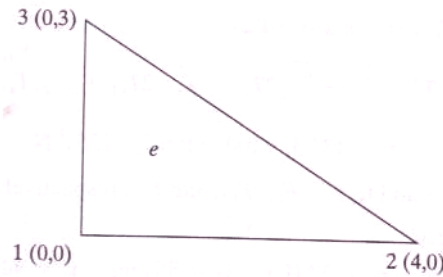


[8]

b) Discuss the analysis of plane stress and plane strain. Also write their examples. [7]

5 Derive element stiffness matrix and load vector of beam element using potential energy approach [15]

6 a) What is shape function? Write the shape function for triangular finite element [7]

b) An isoparametric parent element is shown in below figure, and a corresponding isoparametric distorted element is show in figure. Discuss the transformation athat relates partial derivatives in the original x, y coordinates to the generalized $\delta$, $\eta$ coordinates.
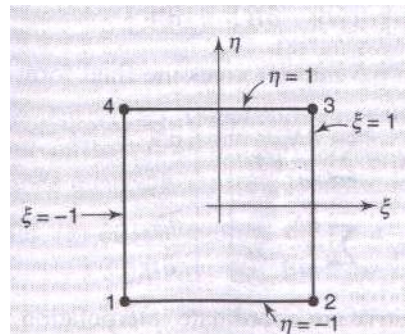


[8]

7 For the axisymmetric pressure loading show in below figure, determine the equivalent point loads $F_1$, $F_2$, $F_3$, $F_4$, $F_7$, and $F_8$.



[15]
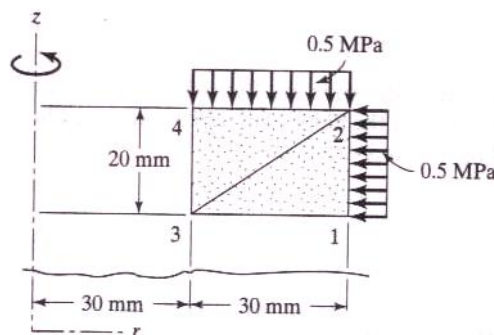
8 Write a short notes on
a) Solution techniques for static load      b) Galerkin approximation
c) Isoparametric representation      d) Numerical integration [15]