Code No: R31031 **R10** **Set No: 1**

III B.Tech. I Semester Supplementary Examinations, May - 2013

FINITE ELEMENT METHODS

(Common to Mechanical Engineering & Auto Mobile Engineering)

Time: 3 Hours **Max Marks: 75**

Answer any FIVE Questions

All Questions carry equal marks

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1. (a) Derive the Stress-Strain relations come from the generalized Hooke's L
   (b) If a displacement field is described by
   $u= (-x^2+2y^2+6xy)\ 10^{-4}$
   $v= (3x+6y-y^2)10^{-4}$
   Determine $\epsilon_X, \epsilon_Y, \gamma_{XY}$ at the point x=1, y= 0.

2. (a) What are boundary conditions? Explain Principle of potential energy.
   (b) Consider the 1-D model of the structure shown in Fig: 1. Show that the assembled stiffness matrix K is singular.

Fig: 1

3. (a) Explain local and Global Co-ordinate system of a truss element?
   (b) A four- bar truss as shown in Fig: 2 is subjected to the loading conditions. The modulus of elasticity of material is 20000 N/mm^2.The area of the bar used for the truss is 60 mm^2 for all elements. The length l_1=75 cm, and l_2=100 cm. The load P_1 = 20 k N and P_2= 25 k N. Assemble the structural stiffness matrix for the entire truss.

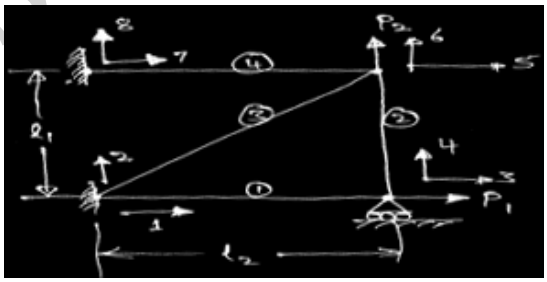

Fig: 2

4. For the beam shown in Fig: 3. Find slopes at nodes and vertical deflection at the midpoint of distributed load P, E=2 X 10^5 N/ mm^2. I= 4 x 10^{-6} m^4.

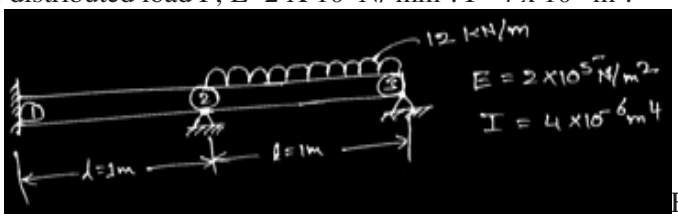

Fig: 3

Code No: R31031 **R10** **Set No: 1**

5. (a) Explain triangular coordinates?
   (b)For the elements given in Fig: 4 the nodal displacements are given a
   u_{x1}=2.0 mm, u_{x2}=0.5 mm, u_{x3}=3.0 mm
   u_{y1}= 1.0 mm, u_{y2}=0.0 mm, u_{y3}=0.5 mm.
   Evaluate the element stresses. Consider the plane stress condition. Assume E= 160 GPa, Poisson's ration μ=0.25 and t=10 mm.

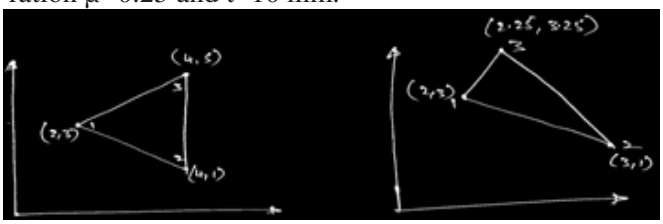

Fig: 4

6. (a) What is an Isoparametric Elements?
   (b) Explain the shape functions of Isoparametric Elements?

7. (a) Discuss the finite element formulation for the solution of one dimensional steady state heat transfer problems
   (b) Discuss one dimensional formulation of Fin?

8. (a) What is Dynamic Analysis?
   (b) Explain Hamilton's Principle?

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Code No: R31031 **R10** **Set No: 2**

III B.Tech. I Semester Supplementary Examinations, May - 2013

FINITE ELEMENT METHODS

(Common to Mechanical Engineering & Auto Mobile Engineering)

Time: 3 Hours **Max Marks: 75**

Answer any FIVE Questions

All Questions carry equal marks

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1. (a) What is the Finite Element Analysis? Explain the Engineering applications of FEM?
   (b) Derive the element stiffness matrix of a bar element for 1-Dimensional Problems?

2. (a) What is discretization process? Explain the node numbering scheme?
   (b) Consider a steeped bar as shown in Fig. 1. Write Global Stiffness matrix?

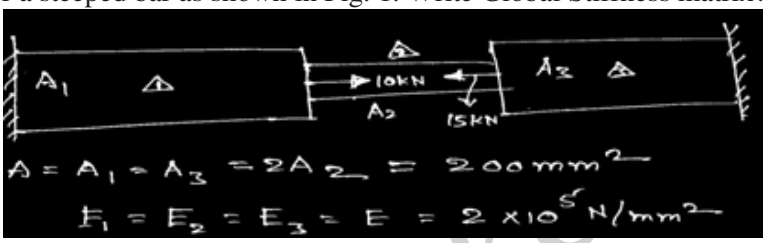

Fig: 1

3. (a) Differentiate between bar element and truss element?
   (b) For the plane truss composed of three elements shown in Fig: 2 subjected to a downward force of 50 k N applied at node 1. Determine the x and y displacements at node 1 and the stresses in each element. Assume E=200 G pa and A=1000 mm^2 for all elements.

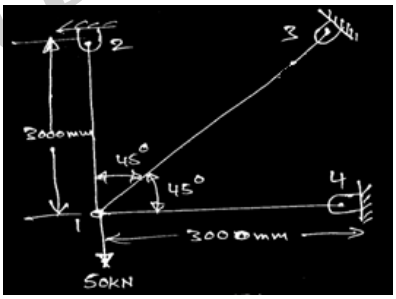

Fig: 2

4. A beam fixed at one end and supported by roller at the other end has a 20 kN concentrated load applied at the centre of the span (Fig:3).Calculate the deflection under the load and construct the shear force and bending moment diagrams for the beam.

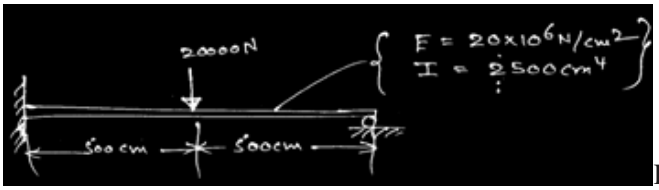

FIG: 3

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Code No: R31031 **R10** **Set No: 2**

5. (a) Explain strain and stress field of a triangular element?
   (b) Evaluate the stiffness matrix for the elements shown in Fig: 4.Assume plane stress conditions. Take E= 210 GPa, Poisson's ratio μ =0.28 and t=10 mm.

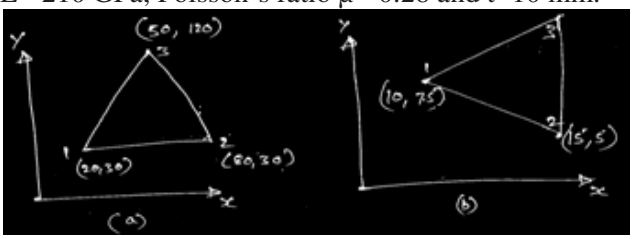

Fig: 4

6. (a) Write the shape function of Isoperimetric elements?
   (b)For the triangle shown in Fig: 5, find the shape functions N_3 and Y at a point 'P' if N_1=0.3 and x= 3.3. (x_1 y_1)=(1,2), (x_2 y_2)=(5,4), (x_3,y_3)=(3,7).

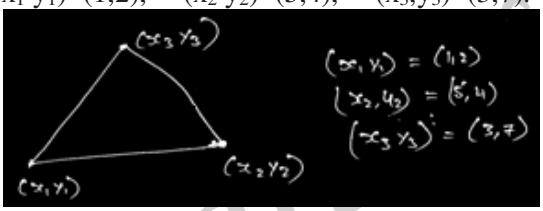

Fig: 5

7. (a) Discuss two dimensional formulation analysis of thin plate?
   (b) Derive the stiffness matrix of a one dimensional thermal element?

8. Consider axial vibration of the steel bar shown in Fig: 6. Develop the global stiffness and mass matrices?

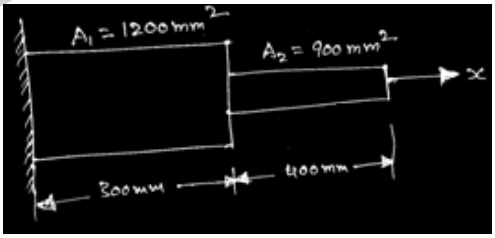

Fig: 6

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Code No: R31031 **R10** **Set No: 3**

III B.Tech. I Semester Regular Examinations, November/December - 2012

FINITE ELEMENT METHODS

(Common to Mechanical Engineering & Auto Mobile Engineering)

Time: 3 Hours **Max Marks: 75**

Answer any FIVE Questions

All Questions carry equal marks

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1. (a) What are Shape functions?
   (b)For the cantilever bar shown in Fig. 1, find the displacement stresses and strains developed by idealizing the bar as '1' and '2' elements. E= 2 X10^5 N/mm^2. Poisson's ratio= 0.3.

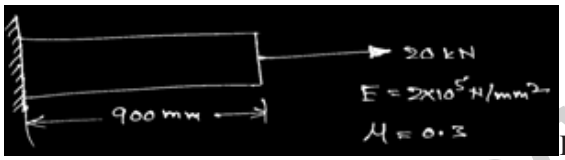

Fig: 1

2. (a) What is degree of freedom? What is the discretization of the freedom?
   (b) For taper bar as show in Fig: 2, thickness, 't' =10 mm, E= 30 X 10^5 N/mm^2. Mass density ρ= 28.36 kg/m^3. The plate is subjected to a point load P= 1 kN, write global stiffness matrix?

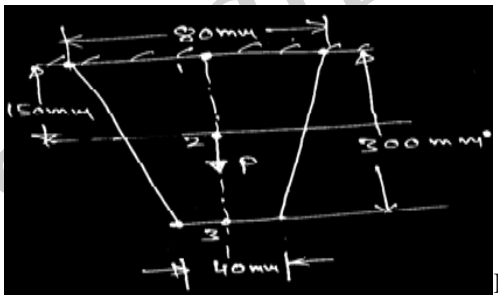

Fig: 2

3. (a)What is a plane truss?
   (b) For the four-bar truss shown in Fig: 3. Determine the nodal displacements, stresses in each element and the reaction forces. All the elements have E= 200 GPa and A= 500 mm^2.

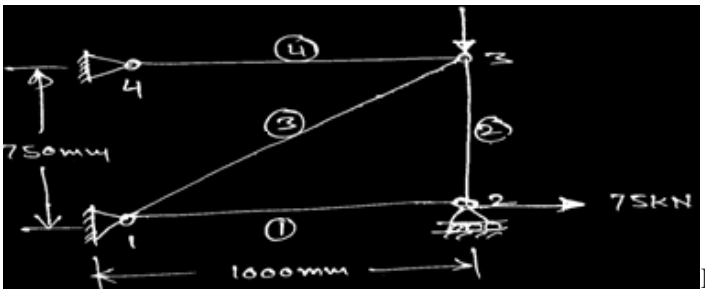

Fig: 3

Code No: R31031 **R10** **Set No: 3**

4. For the cantilever beam shown in Fig: 4 , determine the nodal displacements. Constructs the shear force and bending moment's diagrams. Compare the results. Given E=200 GPa, I= 5000 cm^4.

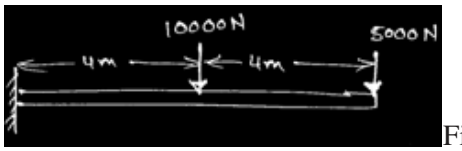

Fig: 4

5. For the elements given in Fig:5,the node displacements are given as:
u_{x1}=0.01 mm, u_{x2}=0.001 mm u_{x3}= 0.0 mm
u_{y1}=0.005 mm u_{y2}=0.0025 mm, u_{y3}=0.0 mm
Evaluate the element stresses. Consider the plane stress conditions. Assume E=200 GPa, Poisson's ratio μ = 0.28 and t = 10 mm.

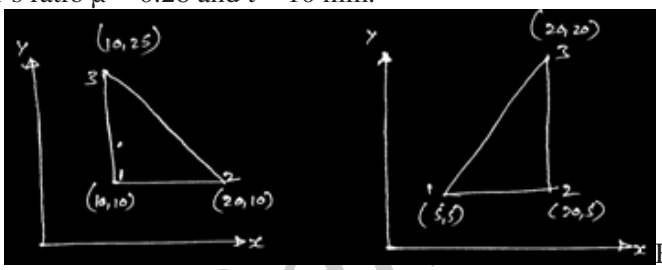

Fig: 5

6. (a) What is Isoperimetric representation?
(b)What are the shape functions of four node bilinear quadrilateral element?

7. Derive the stiffness matrix of a one dimensional thermal element.

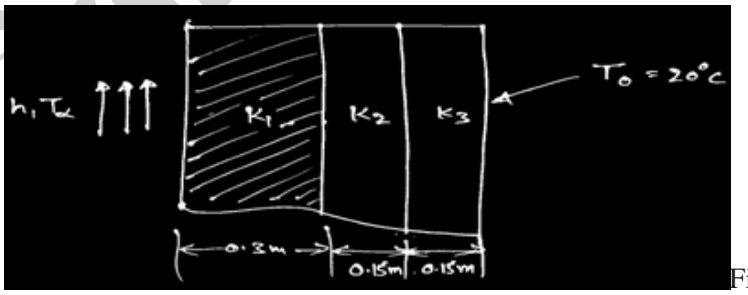

Fig: 6

8. For the stepped bar shown in Fig: 7, Find Eigen values. Eigen vectors and node shapes?

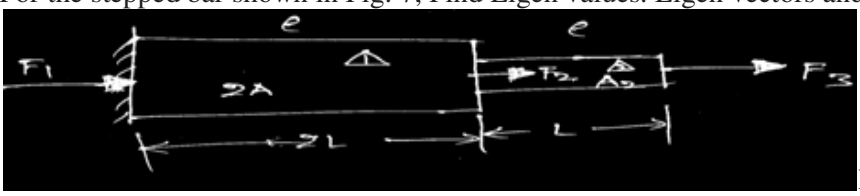

Fig: 7

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Code No: R31031 **R10** **Set No: 4**

III B.Tech. I Semester Supplementary Examinations, May - 2013

FINITE ELEMENT METHODS

(Common to Mechanical Engineering & Auto Mobile Engineering)

Time: 3 Hours **Max Marks: 75**

Answer any FIVE Questions

All Questions carry equal marks

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1. (a) Derive stress-strain relation?
   (b) Consider the bar as shown in Fig. 1. Determines the nodal displacements, element stresses and support reaction?

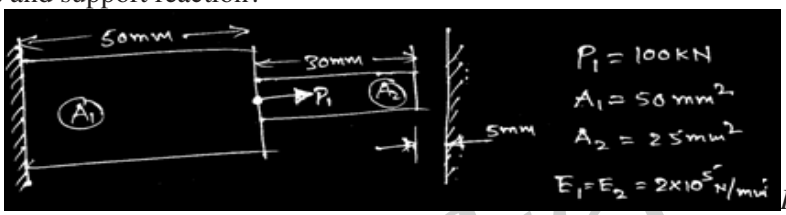

Fig. 1

2. (a) State minimum potential energy principle and derive the shape function for a One Dimensional bar elements?
   (b)A link of four-bar mechanism (Fig: 2) which is rotating at constant angular velocity ω = 50 rad/sec is hinged at one end. Determine the nodal displacements of the link. Consider only the centrifugal force. Ignore bending of the link.

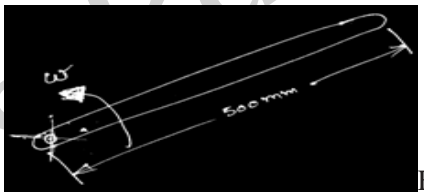

Fig: 2

3. For the truss in Fig: 3 a horizontal load of P= 4000 N is applied in the 'X' direction at node 2.
   (i) Write down the element stiffness matrix k for each element.
   (ii) Assemble the K matrix.
   (iii) Using the elimination approach, solve for Q.
   (iv) Evaluate the stress in elements 2 and 3.
   (v) Determine the reaction force at node 2 in the y direction.

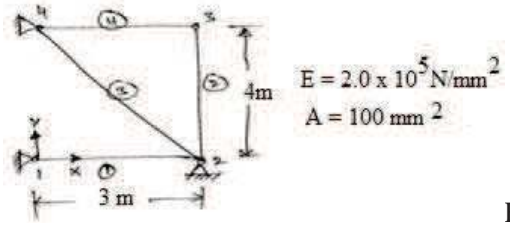

Fig: 3

Code No: R31031 **R10** **Set No: 4**

4. For the cantilever beam shown in the Fig: 4 determine the nodal displacements. Construct the shear force and bending moment diagrams. Compare the results. Given E= 210 GPa and I= 5000 cm^4.

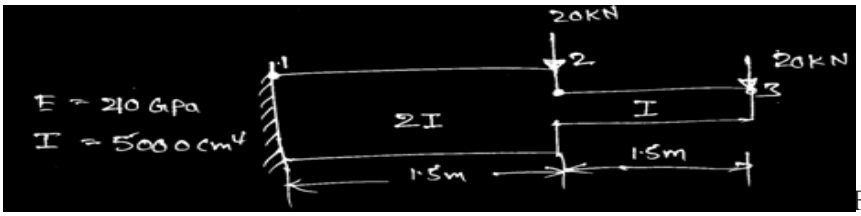

Fig: 4

5. (a) What is constant strain triangle (CST)?
(b) A plate as shown in Fig: 5 is discretized in to two triangular elements. Determine strain-displacement matrices for elements.

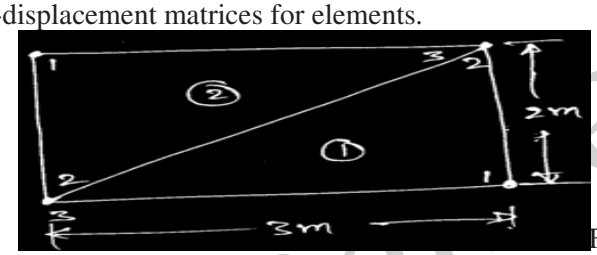

Fig: 5

6. (a) What is Isoparametric representation of CST?
(b) For the triangle element shown in Fig: 6, find shape functions at a 'P' also find the stiffness matrix, stresses and strains if E = 2 X 10^5 N/mm^2, Poisson's ratio μ = 0.3 for plane stress and plane strain conditions.

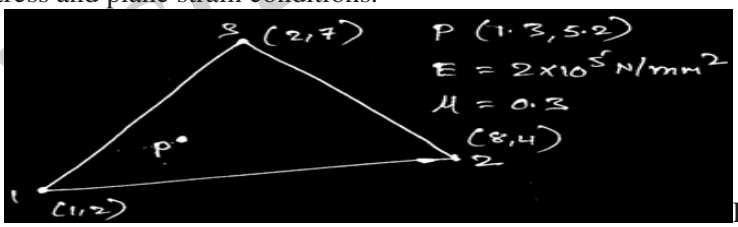

Fig: 6

7. (a) Discuss the analysis of a uniform shaft subjected to torsion?
(b) Explain steady state heat transfer analysis?

8. (a) Explain the methods to find natural frequency?
(b)What are Eigen values and Eigen vectors?

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