Code No: M0322/R07 **Set No. 1**

IV B.Tech. I Semester Supplementary Examinations, February/March - 2011

FINITE ELEMENT METHODS

(Mechanical Engineering)

Time: 3 Hours **Max Marks: 80**

Answer any FIVE Questions
All Questions carry equal marks
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1. a) What are the merits and the demerits of Finite Element Methods?
   b) If a displacement field is described as follows:
   $u = (-x^2+2y^2+6xy)10-4$and $v = (3x + 6y - y^2)10-4$,
   Determine the strain components $€_{xx}$, $€_{yy}$, and $€_{xy}$ at the point x = 1; y = 0.

2. Determine the displacements and the support reactions for the uniform bar shown in Fig.1. Given P=300KN

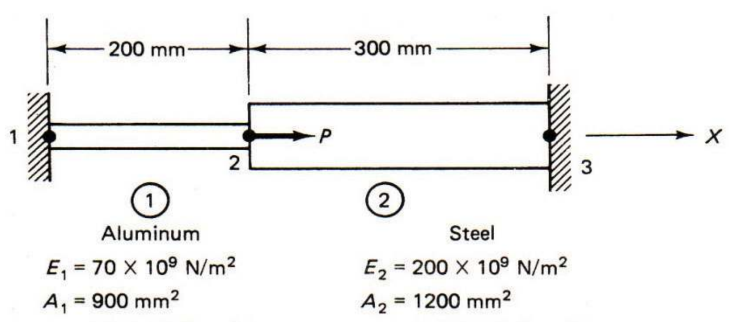

Fig.1.

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3. A cantilever beam of 1 m length carries a single point vertical load at the end of the beam of 10 kN. Calculate the deflection at the end of the beam using FEM, if E = 70 Gpa, A=500 mm^2 and I = 2500 mm^4.

4. With suitable examples, explain the meaning and formulations of properties of axi-symmetric elements. State their applications.

5. Explain Gauss quadrature approach for evaluating one-dimensional and two-dimensional integrals with an example.

6. Derive the Stiffness matrix for a CST element using Potential Energy approach.

7. Find the temperature distribution in the square plate as shown in Fig 2. Assume K = 30 W/m K, T/ = 500^C and q = 100 W/m^3.

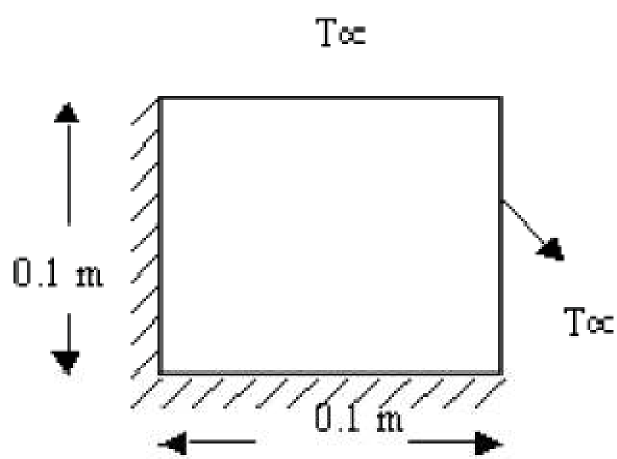

Fig.2

8. Find the natural frequencies and the corresponding mode shapes for the longitudinal vibrations for a stepped bar having A1 = 2A and A2 = A ; I1 = I2 = I & ; E1 = E2 = E.

Code No: M0322/R07 **Set No. 2**

IV B.Tech. I Semester Supplementary Examinations, February/March - 2011

FINITE ELEMENT METHODS

(Mechanical Engineering)

Time: 3 Hours **Max Marks: 80**

Answer any FIVE Questions

All Questions carry equal marks

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1. Explain the following:
   (a) Variational method and
   (b) Importance of Boundary conditions.

2. Determine the displacements and support reactions for the uniform bar shown in Fig.1. P=300KN

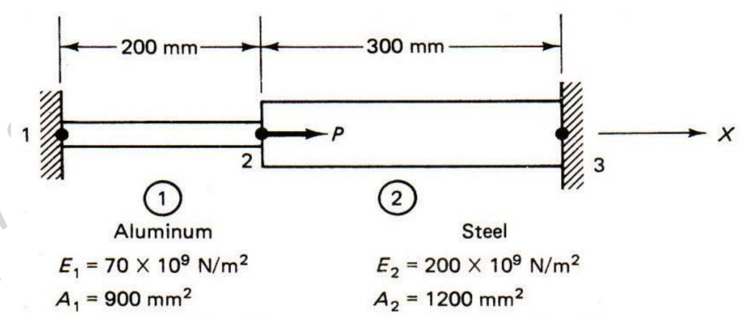

Fig.1.

3. A beam of length 2 m is fixed at both ends. Estimate the deflection at the center of the beam where load is acting vertically downward of 10 kN. Divide the beam into two elements. Compare the solution with theoretical calculations. Take $E = 2 \times 10^{11}$ N/m^2, $A = 250$ mm^2.

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4. Derive the shape functions for a 4 node (corner) rectangular element using Lagrange method.

5. Explain in detail how the element stiffness matrix and the load vector are evaluated in isoparametric formulations.

6. With suitable examples explain the meaning and formulations of properties of ax-isymmetric elements. State their applications.

7. A composite wall consists of three materials as shown in Fig.2. The outer temperature is $T^0 = 20^0C$. Convection heat transfer takes place on the inner surface of the wall with $T_\infty = 800^0C$ and h= 25 $W/m^{2o}C$. Determine the temperature distribution in the wall.

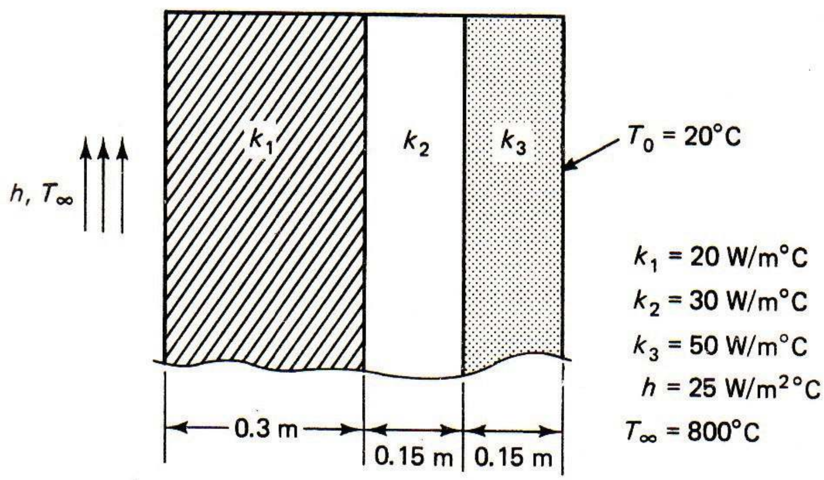
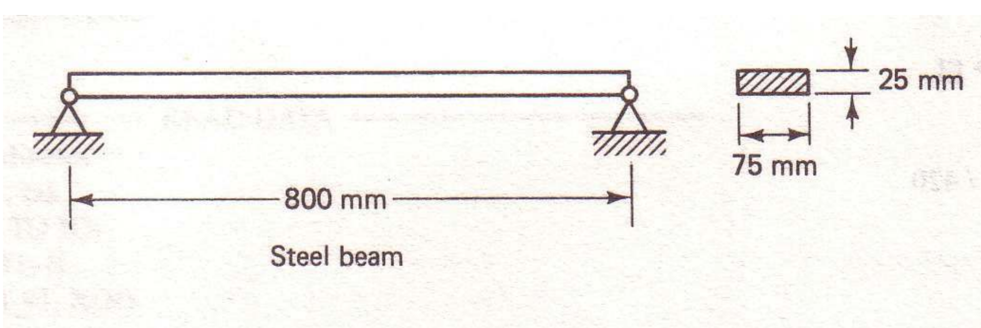


Fig.2

8. Determine all natural frequencies of the simply supported beam shown in Fig. 3.



E = 200 GPa Density = 7840kg/m^3

Fig.3

Code No: M0322/R07 **Set No. 3**

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FINITE ELEMENT METHODS

(Mechanical Engineering)

Time: 3 Hours **Max Marks: 80**

Answer any FIVE Questions

All Questions carry equal marks

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1. (a) Define Geometric Variance.
   (b) What is meant by displacement function?

2. Derive stiffness equations for a bar element from the one dimensional second order equation by variational approach.

3. Determine the vertical deflection at the midpoint of the distributed load for the beam shown in Fig.1.

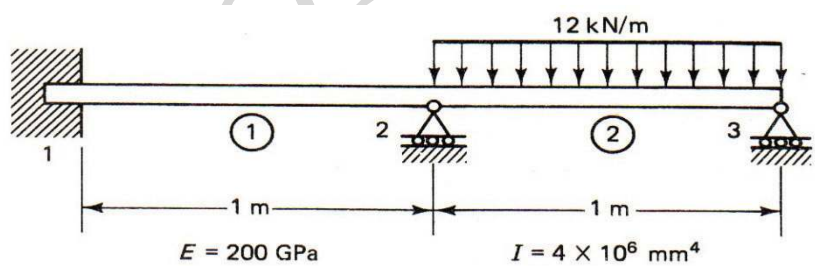

Fig.1

4. Derive the shape functions for a triangular linear element in global Co-ordinate system.

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5. The coordinates of the nodes of a triangular element are 1(-1,4), 2(5,2) and 3(3,6) of thickness 0.2 cm. The convection takes place over all surfaces with a heat transfer coefficient of 150 W/m^2K and T/= 30^0C. Determine the conductivity matrix and load vector if the internal heat generation is 200 W/cm^3. Assume thermal conductivity the element is 100 W/m K.

6. Discuss the importance of Isoparametric concept used in FEM. Name the Isoparametric elements. How is 'assembly' done in Isoparametric formulation?

7. Determine the natural frequencies of a simply supported beam of length 800 mm with the cross sectional area of 75 cm X 25 cm as shown in the Fig.2.
   Take E= 200 Gpa and density of 7850 kg/m^3.

1 of 2

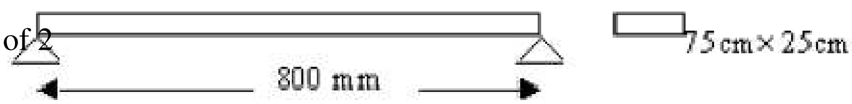

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Fig.2

8. Fig.3 shows an isoparametric axisymmetric two-dimensional finite element.
   (a) construct the Jacobian Matrix J.
   (b) Give an analytical expression of the column in the strain-displacement matrix B (r, s) that corresponds to the displacement u1.

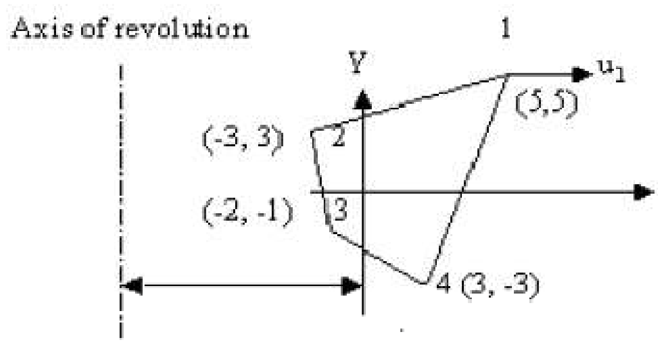

Fig.3

Code No: M0322/R07 **Set No.4**

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FINITE ELEMENT METHODS

(Mechanical Engineering)

Time: 3 Hours **Max Marks: 80**

Answer any FIVE Questions

All Questions carry equal marks

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1. a) With the help of a neat diagram, describe the various components of stress and strains.
   b) Derive the stress-strain relationship and strain displacement elevation.

2. With a suitable example explain the formulation of finite element equations by total potential energy approach. Assume suitable data for the example. Use I-D analysis.

3. Calculate the deflection at the center of the beam as shown in Fig1.
   Take E = 220 GPa; A = 40 mm × 40 mm.

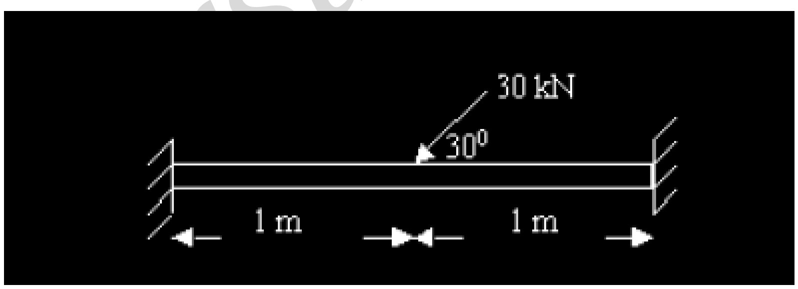

Fig1

4. Heat generated in a large plate (0.8 W/m K) at the rate of 4000 W/m^3. The plate is of thickness 25 cm. The outer surface is exposed to an ambient air with a heat transfer coefficient of 20 W/m2K at 30^0C. If the inside surface temperature is 500^0C, calculate the temperature at a distance of 10 cm from the inner wall. Assume cross sectional area is 62.5 mm^2.

Code No: M0322/R07

Set No.4

5. Consider the axial vibrations of a steel bar shown in the Fig.2:
   a) Develop global stiffness and mass matrices,
   b) Determine the natural frequencies?

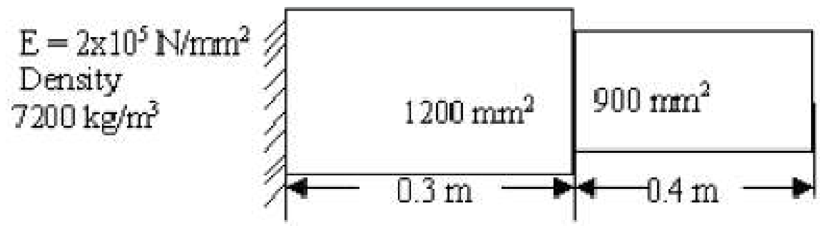

Fig.2

6. Explain Gauss quadrature approach for evaluating one-dimensional and two-dimensional integrals with an example.

7. a) Discuss the importance of Isoparametric concept used in FEM.
   b) Derive the element stiffness matrix of a CST element for plane stress condition.

8. Triangular elements are used for stress analysis of a plate subjected to in-plane load. The components of displacement parallel to (x, y) axes at the nodes i, j and k of an element are found to be (- 0.001, 0.01), (-0.002, 0.01) and (- 0.002, 0.02) cm respectively. If the (x, y) coordinates of the nodes i, j and j are (20, 20), (40, 20) and (40, 40) in cm respectively, find (a) the distribution of the (x, y) displacement components inside the element and (b) the components of displacement of the point (xp,yp) = (30, 25) cm.