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10MAR12

First Semester M.Tech. Degree Examination, January 2011
Finite Element Method

Time: 3 hrs. Max. Marks:100

Note: ***Answer any FIVE full questions.***

1 a. Explain the steps involved in FEM, with suitable examples. **(10 Marks)**
b. Write a note on iso, sub and super parametric elements. **(05 Marks)**
c. List the various applications of FEM. **(05 Marks)**

2 a. What are the shape functions? Derive the shape function for 1 D linear element. **(10 Marks)**
b. Explain the convergence criterion. **(04 Marks)**
c. Write a note on simple, complex and multiplex elements. **(06 Marks)**

3 a. Determine the nodal displacement, stress in each element and the reaction forces at the support for the bar shown in Fig.Q.3(a) due to applied force P = 100 kN.
Take E_{steel} = 200 GPa, E_{copper} = 100 GPa. **(12 Marks)**

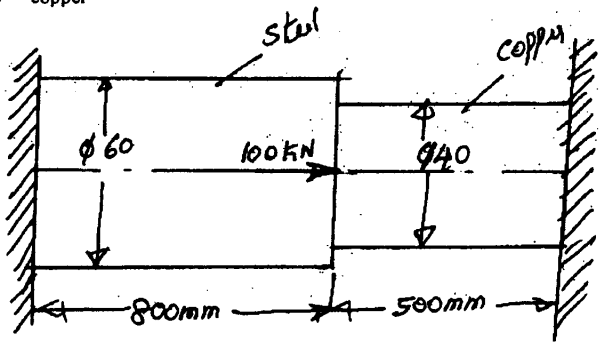

Fig.Q.3(a).

b. Write a short note on stiffness matrix for the plane truss element. **(08 Marks)**

4 Consider the four – bar truss shown in Fig.Q.4. It is given that E = 2 x 10^6 N/mm^2 and A_e = 100 mm^2 for all elements.
i) Determine the element stiffness matrix for each element.
ii) Assemble the elemental stiffness matrix K for the entire truss.
iii) Using elimination approach solve for the nodal displacement.
iv) Calculate stress in each element.
v) Calculate the reaction forces. **(20 Marks)**

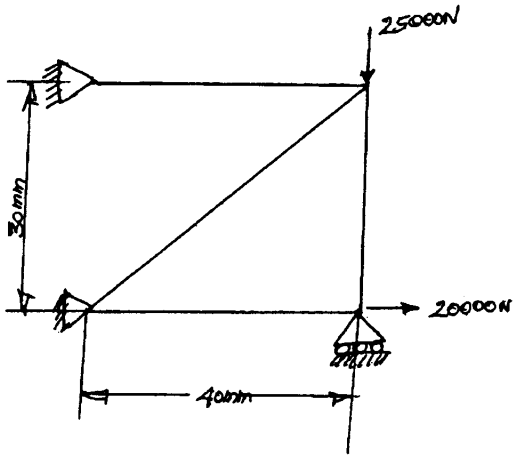

Fig.Q.4.

5 a. Determine the nodal displacement using principle of minimum potential energy for the springs shown in Fig.Q.5(a). Take $F_1 = 75$ N and $F_2 = 100$N. **(10 Marks)**

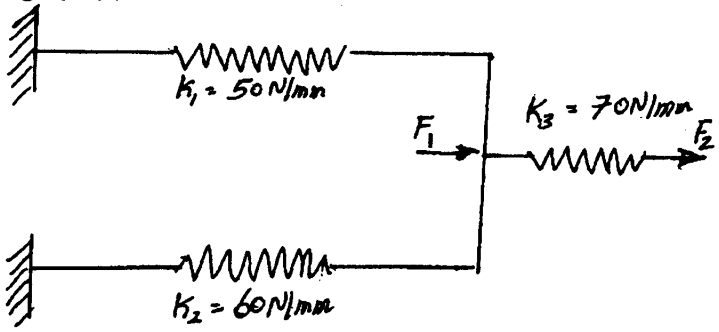

Fig.Q.5(a).

b. Find the displacement of the system shown in Fig.Q.5(b), using Galerkin method. **(10 Marks)**

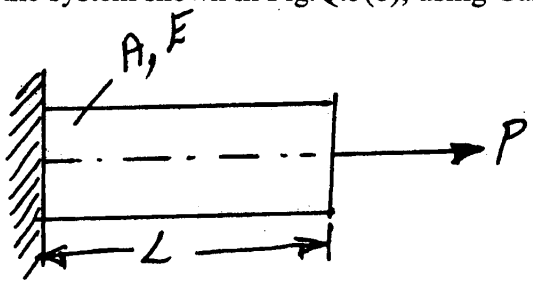

Fig.Q.5(b).

6 a. Explain in brief the parametric and the variational design in CAE. **(06 Marks)**

b. Write the 3D homogenized transformation matrices. **(08 Marks)**

c. Write a note on simulation based design. **(06 Marks)**

7 a. Explain 3D transformation and 3D rotation of objects. **(10 Marks)**

b. For the polygon shown in Fig.Q.7(b) compute the following transformation and determine the new position of polygon :

i) Translate the polygon by 3 units in the x-direction and 2 units in y direction.

ii) Scale the polygon by factor = 2.

iii) Rotate the polygon about the origin in the CCW by 45°. **(10 Marks)**

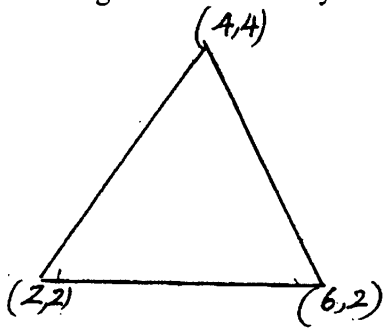

Fig.Q.7(b).

8 a. Explain the various construction techniques and representation scheme used in solid modeling. **(10 Marks)**

b. Write short notes on :

i) Properties of Bezier curves.

ii) Plane and ruled surface creation. **(10 Marks)**

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