Exam. Code: 0942
Sub. Code: 7059

2010

B. Engg. (Mechanical Engg.)-6th Semester

MEC-602: Finite Element Methods

Time allowed: 3 Hours | Max. Marks: 50

NOTE: *Attempt **five** questions in all, including Q. No. 1 which is compulsory and selecting two questions from each Section-I & II. Make suitable assumptions wherever applicable.*

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Q1: Briefly answer the following questions. (1 x 10 =10)

a. With the help of a figure, briefly explain Saint Venant's principle.
b. A bar element with two nodes is placed in 3D. How many and what kind of dofs are present there?
c. State the principle of minimum potential energy.
d. What are major disadvantages of finite element methods?
e. What are important rules for placing nodes in a finite element model?
f. With the help of a figure show the characteristics of a constant strain triangle (CST)?
g. Show the characteristics of a two dimensional frame element with the help of a figure.
h. What do you understand by toplogy optimization?
i. What are the advantages of Galerkin approach in FEM?
j. What is Guyen's reduction?

Section-I

Q2: (a) A system of springs is shown in the figure 1. Find out the extension at its nodes using either the direct approach or the potential energy approach. (5)

(b) A bar is fixed from two ends as shown in the figure 2. Using an approximate displacement function $u = a_1 + a_2.x + a_3.x^2$, find out the displacement and stress along the x-axis. (5)

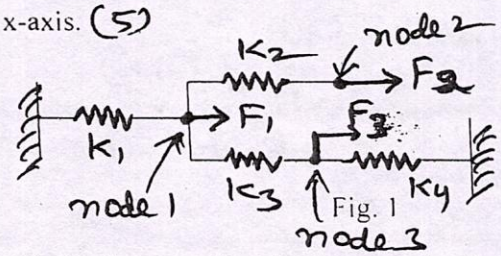

Fig. 1

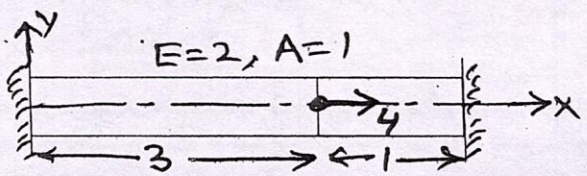

Fig. 2

Q3: (a) A stepped bar is shown in the figure 3. Using a suitable finite element method, find the displacement, element stresses and reaction at its nodes. (8)

(b) Briefly explain quadratic shape functions. (2)

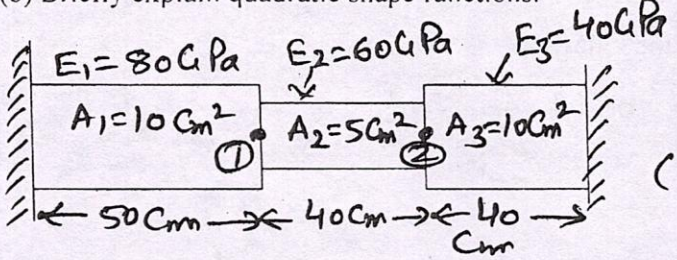

Fig. 3

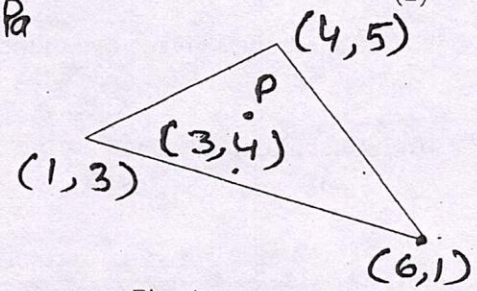

Fig. 4

Force at node 1 = 100KN(+x)
node 2 = 60 KN (+x)

P.T.O.

Q4: (a) A point P lying within the triangular element shown in the figure 4. Find out its shape functions. Also find out the displacement at the point P given that the displacement at node 1, 2 and 3 is (0.1, 0.2), (0.1, 0.1) and (0.2, 0.1) respectively. (5)

(b) Draw an axisymmetric element having triangular sweeping area and indicate degrees of freedom on it. (2)

(c) A hexagonal plate lying in x-y plane is subjected to internal stresses as shown in the fig. 5. Simplify the model and also apply suitable boundary conditions on it. (3)

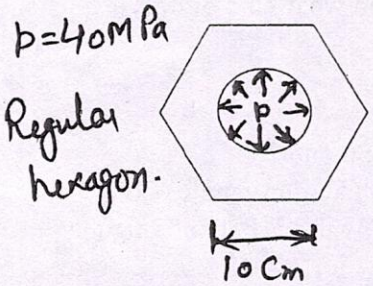

Fig. 5

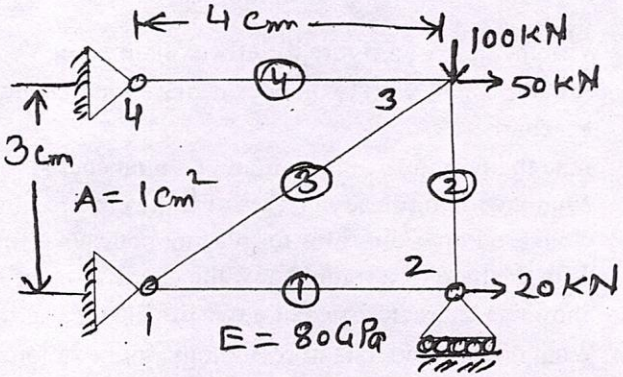

Fig. 6

Section II

Q5: A two dimensional truss as shown in the fig. 6. Find out the nodal displacements. Also find out the element stresses in element 2 and 3. Also find out the reactions at node 1. (10)

Q6. A problem shown in the figure 7, find out the eigen values and eigen vectors. (10)

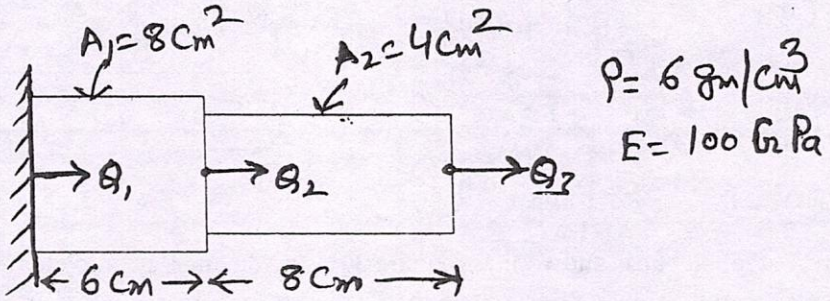

Fig. 7

Q7: Write short notes on any two of the following 5x2 = 10

(a) Rigid body modes

(b) Structural optimization

(c) Finite element in design

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