Exam.Code:0942
Sub. Code: 7059

1058

B.E. (Mechanical Engineering)
Sixth Semester
MEC-602: Finite Element Methods

Time allowed: 3 Hours

Max. Marks: 50

NOTE: Attempt five questions in all, including Question No. 1 (Section-A) which is compulsory and selecting two questions each from Section B-C.

x-x-x

Section A

Q1: Write short answers of the following questions. (1 x 10 = 10)

a) Briefly state with the help of a figure, the plane stress condition
b) Refer to figure 1 (b), let δ be the extension of the point P after a force of F is applied on it. Write potential energy equation of the system.
c) Write down stiffness matrix for the problem shown in figure 1(c)
d) State the important rules for placing the nodes in a FEM model.
e) State Saint Venant's principle with the help of a neat sketch.
f) What is the purpose of shape function in FEM modelling?
g) What is the difference between a FE modelling of a problem with dynamic consideration with one without dynamic considerations?
h) A problem shown in the figure 1 (h) is to be presented as a simplified finite element model with appropriate boundary conditions. Draw figure of the simplified model.
i) The temperature of the bar shown in the figure 1 (i) is increased. How this is going to affect the stresses of the bar?
j) Draw a 2 noded beam element with the degrees of freedom indicated on it.

Section B

Q2: (a) For a plane triangular element shown in the figure 2, find out the shape functions at the point P lying inside it. (5)

(b) A spring cart system is shown in the figure. Find out the combined stiffness matrix and displacement of the carts using finite element method approach. (5)

Q3: (a) Use the Ralyleigh Ritz method to find the displacement field of the rod shown in the figure 3. Element 1 is made of Aluminium and element 2 is made of Steel. The properties of the material are E_{al} = 80 GPa, A_1 = 800 mm^2, L_1 = 200 mm, E_{st} = 200 Gpa, A_2 = 1000 mm^2, L_2 = 400 mm. Load P is 20 kN. Assume a piece-wise displacement field $u = a_1 + a_2.x$ for element 1 and $u = a_3 + a_4.x$ for element 2. (7)

(b) Compare the Ralyelighs method with the analytical solution obtained from mechanics of materials. (3)

Q4: Consider the bar loaded as shown in the figure 4. Determine the nodal displacements, element stresses, and support reactions. Solve this problem by hand calculations, adopting the elimination approach method for handing boundary conditions. (10)

Section C

Q5: A truss shown in the figure 5 is loaded with a force of 1000 kN at node 2 in the x direction. Write down (i) Element stiffness matrix (ii) Combined stiffness matrix (iii) Nodal displacements (iv) Element stresses for element no. 2 and 3 (v) Reaction force at node 2. (10)

Q6 Determine the Eigen-values and eigenvector for the stepped bar shown in the figure 6. (10)

Q7: Write short note on any two of the following (5x2 = 10)

a. Node numbering scheme
b. Post-processing
c. Mesh generation

P.T.O.

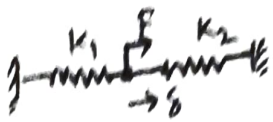


Fig 1(b).

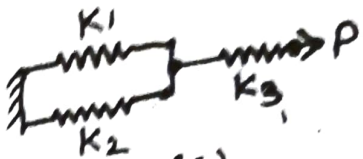
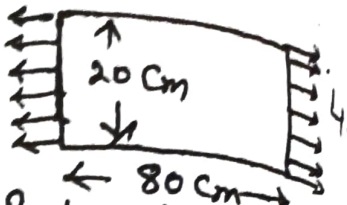


Fig 1(c)



Rectangular plate width 40 Cm thickness 1 Cm

Fig 1(d)

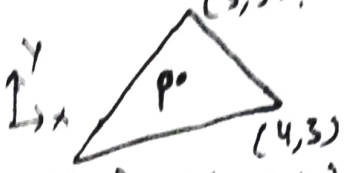


Fig 2(a)

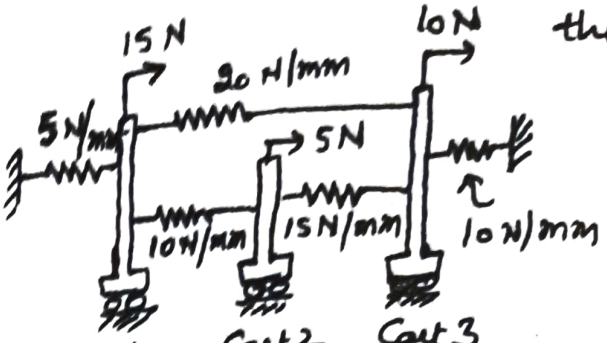
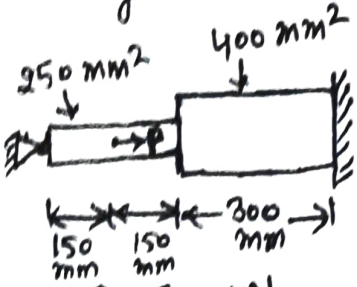


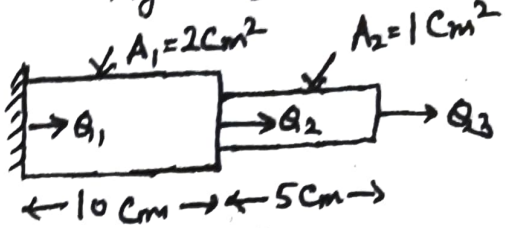
Fig 2(b)



P = 300 kN

E = 200 GPa

Fig 4.



E = 200 GPa

Sp. Density ρ = 6 gm/Cm³ Fig 6

Fig 3(a)

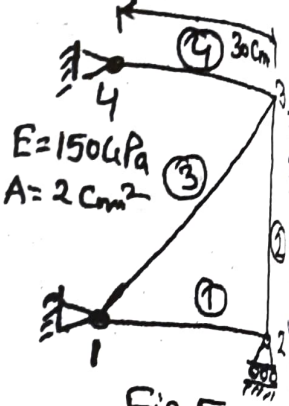


Fig 5

x-x-x