Exam. Code: 0942
Sub. Code: 33873

2055

B.E. (Mechanical Engineering)-6th 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. Make assumptions in case of missing data or wherever you feel it is needed.***

x-x-x

Section A

1. Provide brief answers to the following short questions. (marks 2 x 5 =10)
   (a) With the help of an example explain the concept of plain stress condition.
   (b) Explain the properties of a two-node bar element and also comment on its degrees of freedom when used in 1-D, 2-D and 3-D.
   (c) With the help of a neat sketch, draw a beam element and show various degrees of freedom on it. Briefly discuss the applications of the element.
   (d) What is post-processing in context of FEM? Briefly explain using a suitable example.
   (e) Explain 2D and 3D element with an example for each?

Section B

2. (a) Find out the natural coordinates and shape functions for point P on the bar element shown in the figure A. What will be the displacement of this point if the displacement of its endpoints are u1=1 and u2=2. (5 marks)
   (b) Find out the shape functions and natural coordinates for a point P shown inside a triangular element shown in figure B. Find out the displacements (for x and y directions) of the point P given that u1=0.2, u2 =0.1, u3 = 0.1, u4 = 0.3, u5=0.2 and u6=0.1. (5 marks)

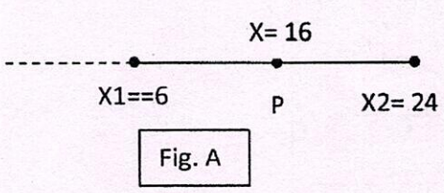

Fig. A

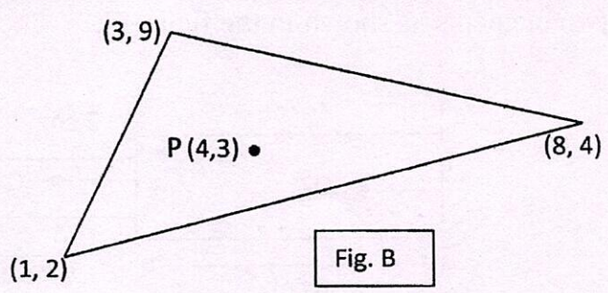

Fig. B

3. A bar shown in figure C is loaded with a horizontal force. Find out approximate solution for displacement and stress, using Rayleigh's Ritz method and potential energy approach. (10)

OR

Find out displacement of the three nodes for the spring system shown in figure D using potential energy approach. Stiffness of the springs are given in the figure. Consider F1=2 and F2=1

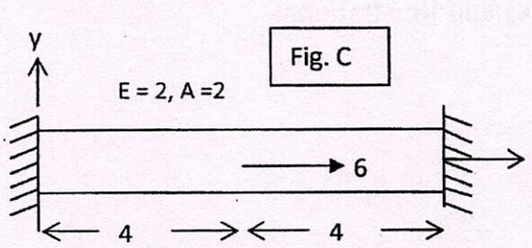

Fig. C

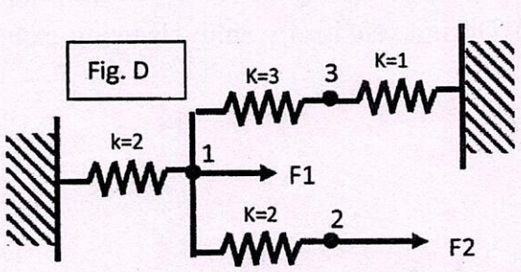

Fig. D

4. Solve the problem shown in the figure E for nodal displacement, element stress and reaction at the support. Take E = 100 GPa

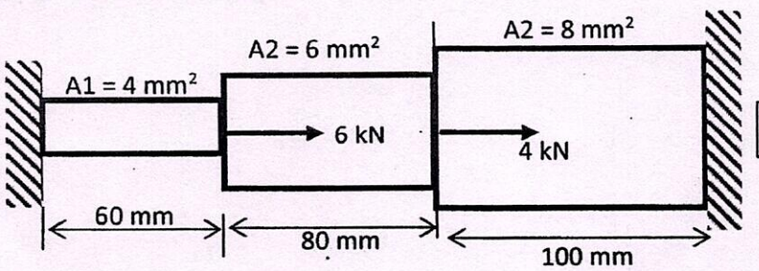

Fig. E

P.T.O.

Section C

5. The four bar truss shown in the figure F. Find the following using FEM approach. (10)
   a. Combined stiffness matrix
   b. Displacement vector
   c. Reaction forces
   d. Elemental stress of elements

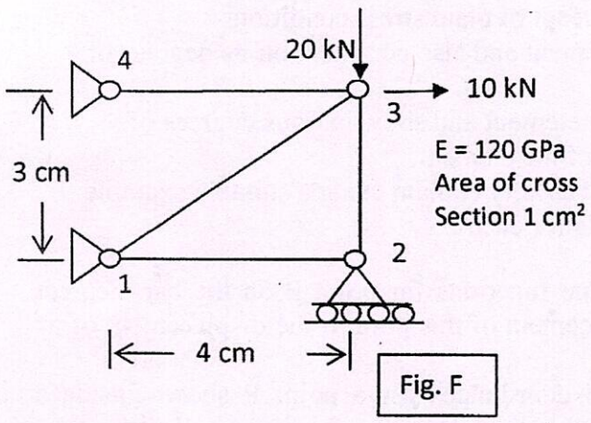

Fig. F

6. Determine the Eigen values and Eigenvectors for the stepped bar having three nodes and two elements as shown in the figure G. (10)

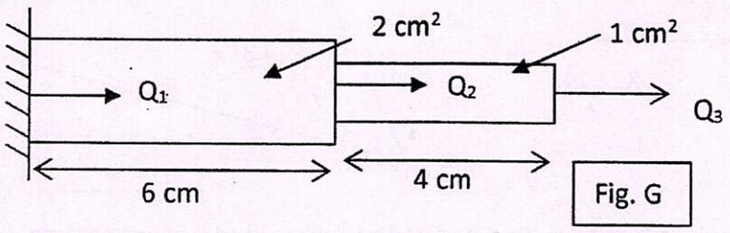

Fig. G

7. Write short notes on any two of the following. (5 x 2 =10)
   (a) Topology optimization using examples and illustrations
   (b) Post processing methods using examples and illustrations
   (c) Design sensitivity analysis using examples and illustrations

x-x-x