Exam. Code: 0942
Sub. Code: 33873

2015

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 any five of the following short questions. Each question has 2 marks.
   (a) With the help of a neat sketch explain the concept of plane strain and the conditions in which it is applicable.
   (b) With the help of a neat sketch, explain quadratic shape function.
   (c) Draw a neat sketch of the beam element and notate applicable degrees of freedom on it.
   (d) Briefly explain the concept of convergence with respect to the FEM analysis.
   (e) Draw a triangular axisymmetric element and show applicable degrees of freedom on it.
   (f) With the help of a neat sketch explain the concept of Saint Venant's principle and its applicability in FEM.

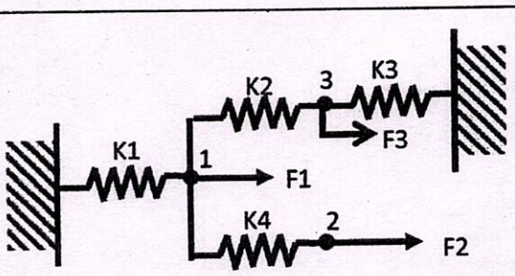

Figure A

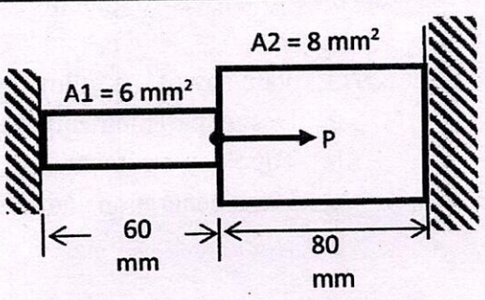

Figure B

Section B

Q2: Solve the spring problem given in figure A using potential energy approach. (10)

Q3: Solve the two-bar element shown in figure B using the finite element method approach for displacement, element stresses and reactions. The modulus of elasticity for the material is 120 GPa and the applicable force P = 40 kN. (10)

Q4: (a) Find out shape functions for the bar element shown in figure C at point P. What will be the displacement at point P if the nodal displacements are given as 0.2 mm and 0.3 mm respectively. (5)

(b) Find out Jacobian of the triangular matrix shown in figure D. Also find its strain displacement matrix (B matrix). (5)

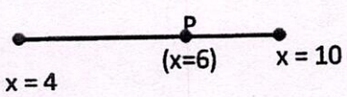

Fig. C

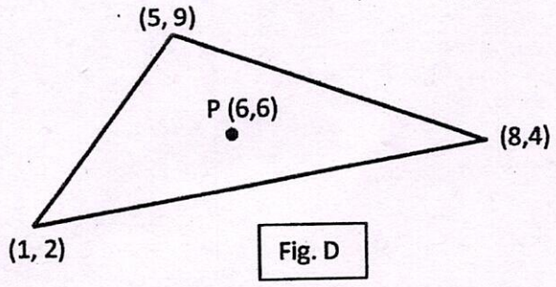

Fig. D

P.T.O.

Section C

Q5: Solve the truss problem shown in figure E for displacement, elemental stresses, and reactions at the supports. (10)

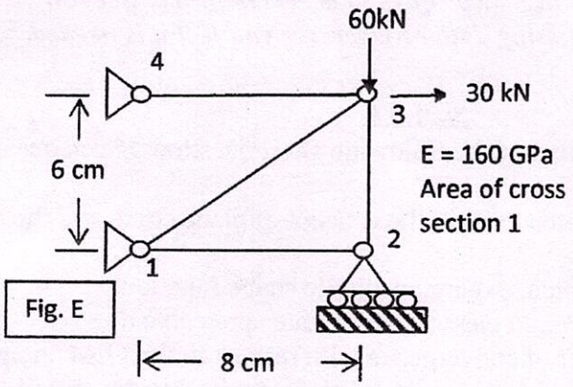

Fig. E

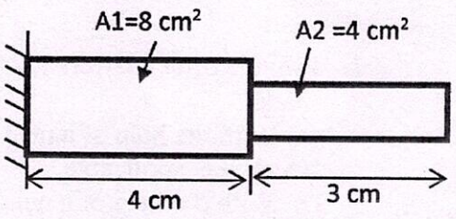

Fig. F

Q6: Determine the Eigen values and Eigenvectors for the stepped bar having three nodes and two elements as shown in figure F. The modulus of elasticity for the material is 160 GPa and the specific gravity is 10 gm/cm^3 . (10)

Q7: Explain any of the following two in context to FEM (5x2=10)

a. Design parametrization and structural optimization.
b. Topology optimization.
c. Mesh generation and refinement.

x-x-x