Exam.Code:0942
Sub. Code: 6731

2053

B.E. (Mechanical Engineering)

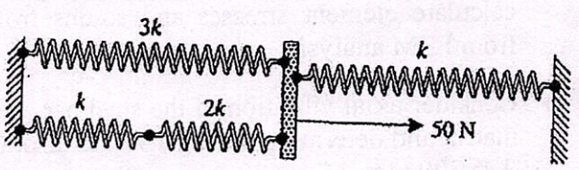
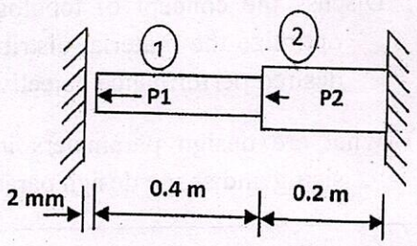
Sixth Semester

MEC-602: Finite Element Methods

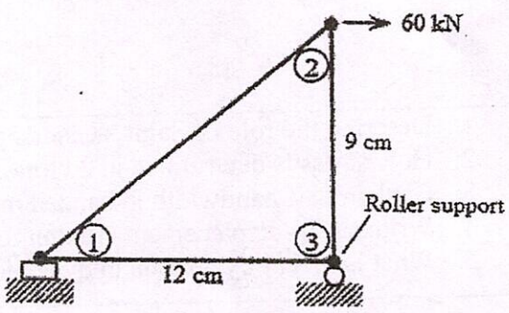
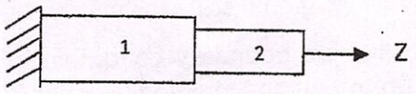
Time allowed: 3 Hours **Max. Marks: 50**

NOTE: Attempt <u>five</u> questions in all, including Question No. I which is compulsory and selecting two questions from each Part.

x-x-x

I	1. Describe the role of Saint Venant's principle in FEM. 2. How stress is determined in 2d truss element. 3. Explain half bandwidth in banded matrix with suitable example? 4. Write strain-displacement relation for two dimensional 3-noded element. 5. What is meant by a mode in dynamic analysis?	(2x 5 = 10)
	Part A	
2	a) What are shape functions? Explain how these shape functions are used in the FEM analysis. Differentiate between shape function of any 1d and 2d element. b) For the spring system given in diagram, Determine: (i) Number the elements and nodes; (ii) Assemble the individual stiffness matrices to get global stiffness matrix.  c) What are boundary conditions? How are boundary conditions treated in handling finite element equation?	(4) (3) (3)
3	Consider the bar loaded as shown in the diagram. Determine : a) displacements at Nodes, b) Element stresses c) Support reactions. Given: E1=E2 = 200 GPa. $P_1=3x10^5$ N, $P_2 = 6 x10^5$ N, $A_1=100$ mm^2, $A_2= 200$ mm^2 	(10)
4	a) Mention element load vector as a result of temperature change in 1d linear element? Discuss how temperature load can be assembled with body force taking suitable example. b) What are the ways in which a three dimensional problem can be reduced to a two dimensional approach? Give any three applications where this approach can be used. c) Explain stress and strain fields of a triangular element.	(4) (3) (3)

P.T.O.

	Part B	
5	a) For the plane truss structure as shown in the diagram, determine the nodal displacement and stresses in each element. Take E=200GPa, A=0.05 cm^2 	(8)
	b) Differentiate among bar element, truss element and beam element indicating D.O.F.	(2)
6	a) Discuss the concept of "post-processing" in FEM analysis. Explain how to calculate element stresses and strains from the nodal displacements obtained from FEM analysis.	(3)
	b) Consider axial vibration of the steel bar, determine the global stiffness and mass matrix and determine the eigenvalues also. Given : L1=300 mm, L2 = 400 mm. A1=1200 mm^2, A2=900 mm^2, E = 200 GPa, specific weight = 7850 kg/m^3. 	(7)
7	a) Discuss the concept of topology optimization using FEM, including how to optimize the material distribution within a given design domain to achieve desired performance objectives.	(5)
	b) What are design parameters in finite element based optimization. Describe sizing and shape design parameters.	(5)

x-x-x