Exam.Code:0942
Sub. Code: 7059 (29)

1059

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. I which is compulsory and selecting two questions from each Part.*

x-x-x

1 (2x5=10)

i. What is the behavior of stress in quadratic element? Justify the answer.
ii. Whether solution obtained through FEM is exact solution? Comment.
iii. State the properties of stiffness matrix.
iv. Draw a two noded beam element with degree of freedom indicated on it
v. Write the significance of Guyan reduction

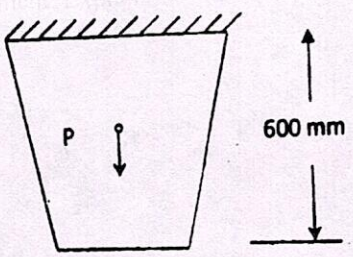
Part A

2 a) What is Finite Element Modeling? How the elements for meshing are selected? (4)

b) If displacement at node 1 is 2 units and at node 2 is 5 units for 1d linear element of length 500 cm. Find the displacement and strain at a point 100 cm away from node 1. (3)

c) How plane strain condition is different from plane stress condition. Briefly explain with the help of suitable figure. (3)

3 A thin plate having a uniform thickness t=10 mm and modulus of elasticity $E=2\times10^5$ N/mm^2 and density ρ= 7.85g/cm^3. In addition to its self weight, it is subjected to a point load P = 500 N at its midpoint. The plate has a taper with 37.5 mm at free end and 187.5 mm at fixed end. Model the plate with two finite elements. Determine global stiffness matrix and global force vector. Find nodal displacements, elemental stresses and reaction force also. (10)



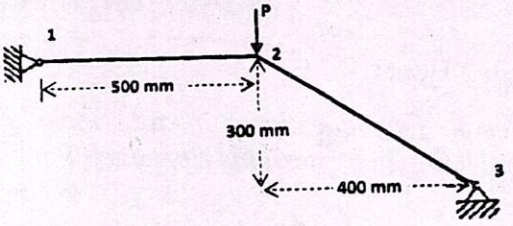
4. a) A constant strain triangular element has the nodal coordinates (1, 2), (4, 0.5) and (3, 4) for i, j and k nodes respectively. The element is 1 mm thick having uniform material properties with E=100 GPa and Poisson ratio = 0.3. Upon loading, the nodal displacements are: u_i= 100μm, u_j= 75μm, u_k= 80μm, v_i= -50μm, v_j= -40μm, v_k= -45μm. Determine strain displacement matrix, jacobian matrix and strain in the triangular element. (5)

b) What are the characteristics of axisymmetric element. Explain the strain displacement relationship for axisymmetric problems. (5)

P.T.O.

Part B

5. For the 2 bar truss structure as shown in the diagram, determine the nodal displacements, elemental stresses and support reactions. (10)



Given:

Area=200 mm^2, E= 70 GPa for both members. Load, P = 24 kN.

6. a) A cantilever beam of span 2m is subjected to udl of 10kN/m and a point load of 5kN at the free end. Given E= 200 GPa and I = 4 x 10^{-6} m^4. Determine the global load vector. (4)

   b) Briefly describe the condition where mass matrix is used for FEM analysis. Differentiate between consistent and lumped mass matrix for bar element. (3)

   c) Describe a technique to reduce the computation efforts by reducing matrices size in FEM dynamic analysis. (3)

7 Write short notes on the followings: (2 x 5 = 10)

   a) Mesh convergence and Mesh refinement techniques

   b) Structural optimization in FEM

x-x-x