Seat No.	

SL - 1002

Total No. of Pages : 3

B.E. (Mechanical) (Semester - VII) (Revised) Examination, May - 2017

FINITE ELEMENT ANALYSIS

Sub. Code : 67503

Day and Date : Wednesday, 17 - 05 - 2017 **Total Marks : 100**

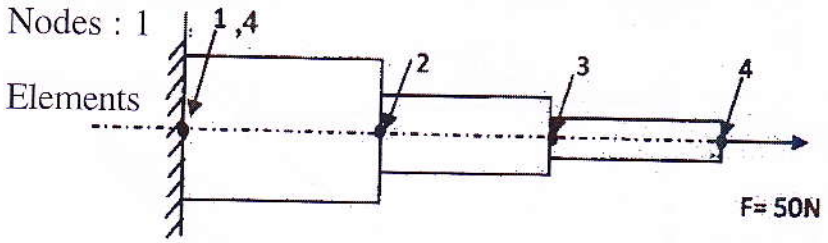
Time : 02.00 p.m. to 05.00 p.m.

Instructions :

1) **Answer any three questions from each section.**
2) **Figures to right indicate full marks.**
3) **Assume if necessary suitable data and state them clearly.**
4) **Draw neat labelled sketch wherever necessary.**
5) **Use of non-programmable calculators is permissible.**

SECTION - I

Q1) Analyse the axially loaded stepped bar shown in figure below. Use the finite element method (element and global matrix) to predict the nodal displacements u_2, u_3 and u_4 at the nodes 2, 3 and 4, and the support reaction R at the fixed node 1 ($u_1 = 0$). The cross sectional areas are 50 mm^2, 20mm^2 and 10mm^2, the lengths of steps are 15mm each and the modulus of elasticity is 210GPa. **[16]**



Q2) a) Define bandwidth of a stiffness matrix. Explain with an example how node numbering affects the bandwidth and hence computer memory, computational efforts and time. **[8]**

P.T.O.

b) What are higher order (quadratic, cubic, etc.) elements? Sketch their shape functions (interpolation polynomials). [8]

Q3) a) Explain general steps of FEM using a simple 1-D element for thermal analysis of heat conduction through a composite wall. [8]

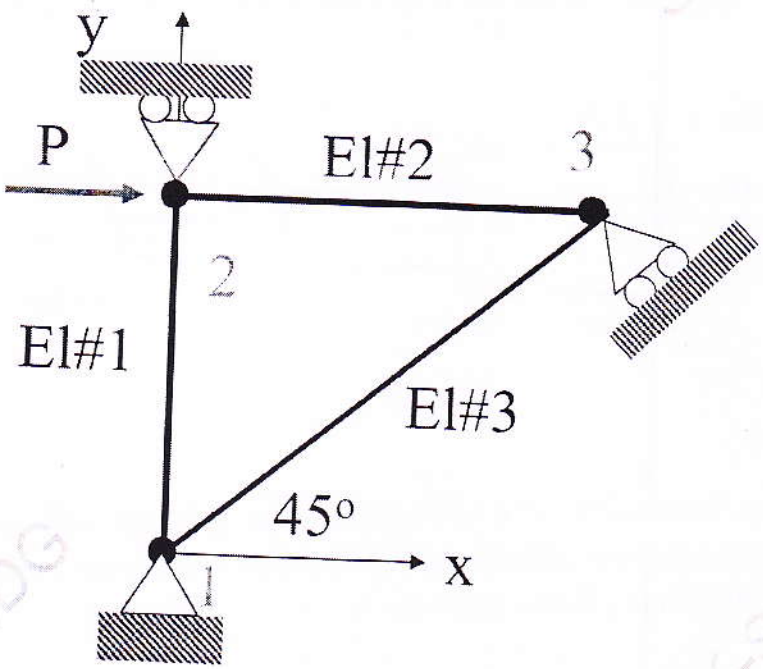
b) State different weighted residual methods used in FEA formulation. [8]

Q4) Write short notes on: (any three) : [18]

a) Higher order elements
b) Isoparametric elements
c) Galerkin's Method
d) Mesh refinement and convergence
e) Axisymmetric elements

SECTION - II

Q5) a) For the plane truss shown in figure below determine the unknown displacements, reaction forces, strains and stresses in the members of the truss. P = 1000kN (horizontal force at node 2), Modulus of elasticity E= 210 GPa, length of the two members (element 1 and 2) is 1 m each and cross-sectional area is 6×10^{-4} m^2. The cross-sectional area of element 3 is $6 \times \sqrt{2} \times 10^{-4}$ m^2. [8]



b) Explain the importance of element shape and distortion in relation to quality of the finite element mesh. [8]

Q6) a) Explain plane stress and plane strain conditions with example and stress-strain relationship matrix? [8]

b) Explain higher order 1D, 2D and 3D elements. [8]

Q7) a) Explain with suitable examples simplification of a model using symmetry.[8]

b) State the steps involved to model a mechanical element (e.g., a bracket), perform a static analysis and view results using commercial FEA software.[8]

Q8) Write short notes on: (any three) : [8]

a) Triangular element

b) FE model of 2-D steady state heat conduction

c) Features of a commercial FEA package

d) What are natural coordinates? What are their benefits?

e) Numerical integration