

**B.Tech. MECHANICAL ENGINEERING  
(BTMEVI)**

**00946**

**Term-End Examination**

**June, 2015**

**BIMEE-013 : FINITE ELEMENT ANALYSIS**

*Time : 3 hours*

*Maximum Marks : 70*

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**Note :** *Attempt any five questions. All questions carry equal marks. Standard notations and symbols have their usual meaning.*

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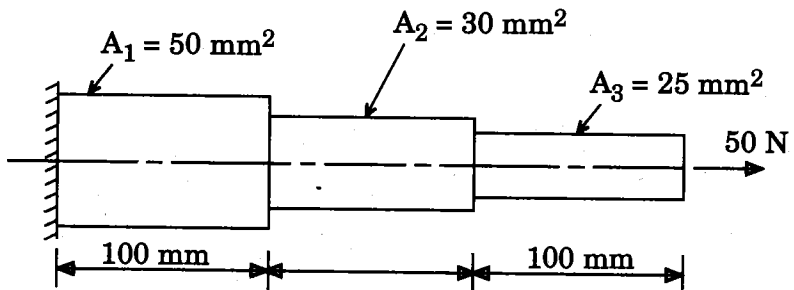
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1. Discuss in detail about the concepts of FEM formulation. How is it that the FEM emerged as a powerful tool ? Discuss the major applications of FEM. 14
  
2. (a) Define shape function. Write the shape function of a four-noded quadrilateral element. 7  
(b) Derive one-dimensional steady state heat conduction equation. 7
  
3. (a) Using Galerkin approach, derive the element stiffness matrix for a 1-D bar problem. 7  
(b) The elements of a row or a column of the stiffness matrix of a bar element sum up to zero, but this is not so for a beam element. Explain why. 7

4. (a) Distinguish between the following : 7
- (i) Cartesian co-ordinate and Natural co-ordinate system
  - (ii) Bar and Beam element
- (b) Determine the matrix relating strain and nodal displacement for an axisymmetric triangular element. 7

5. A fixed beam of 5 m span carries a point load of 20 kN at a distance of 2 m from one of its ends. Determine the slope and deflection under the load [ $EI = 10 \times 10^3 \text{ kN-m}^2$ ]. 14

6. Use finite element method to calculate the displacement and stresses of a bar shown in the figure below : 14



Take  $E = 200 \text{ GPa}$ .

7. Answer any *two* of the following questions : 7+7

- (a) Determine the constant load vector for the CST element under the action of gravity acting in the plane of the element.
  - (b) Explain the steps involved in the analysis of beams.
  - (c) Derive the constitutive relation matrices for plane stress and plane strain situations.
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