No. of Printed Pages : **3**

BIMEE-013

B.Tech. MECHANICAL ENGINEERING (BTMEVI)

Term-End Examination
June, 2013

BIMEE-013 : FINITE ELEMENT ANALYSIS

Time : 3 hours *Maximum Marks : 70*

*Note : Answer **any five** questions. Scientific calculator is allowed. All questions carry **equal** marks.*

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1. (a) Explain the basic steps of Rayleigh-Ritz method. **6**

   (b) Why polynomial terms preferred for shape functions in FEM ? **6**

   (c) Define the term 'Stiffness Matrix'. **2**

2. A beam AB of span 'l' simply supported at the ends and carrying a concentrated load 'W' at the centre 'C' as shown in Figure 1. Determine the deflection at the mid span using Rayleigh-Ritz method and compare it with exact solution. Use a suitable one term trigonometric trial function. **14**

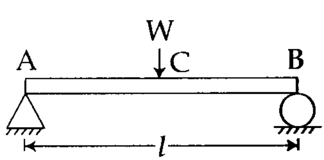


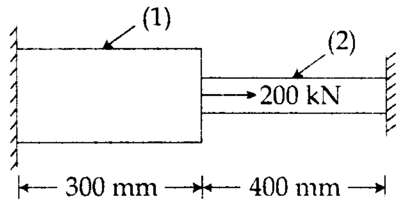
Figure - 1

3. A stepped bar, fixed both ends, is subjected to an axial load of 200 kN at the place of change of cross section as shown in figure 2. Find : **14**

(a) The nodal displacements

(b) The reaction forces

(c) The induced stresses in each material.



(1) - Aluminium bar (2) - Steel bar

$A_1 = 2400 \text{ mm}^2$ $E_1 = 70 \times 10^3 \text{ N/mm}^2$

$A_2 = 600 \text{ mm}^2$ $E_2 = 200 \times 10^3 \text{ N/mm}^2$

Figure - 2

4. Consider a 4- bar truss as shown in figure 3. It is given that E =200 Gpa and A=500mm^2 for all the elements. Determine : **14**

(a) Nodal displacements

(b) Support reaction

(c) Element stresses

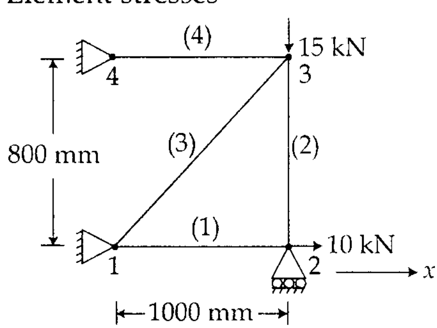


Figure - 3

5. Determine the deflection and stresses in three different sections of a composite stepped bar loaded as shown in the figure 4. **14**

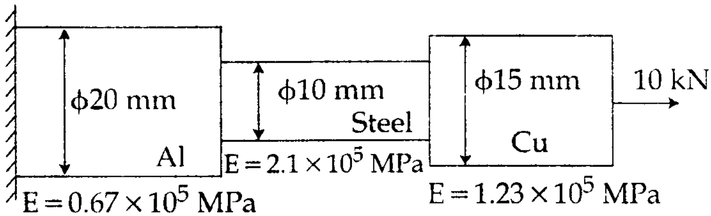


Figure - 4

6. (a) Use Hermite's interpolation formula to derive cubic shape functions for the transverse deflection of beams. **7**

(b) Derive the local finite element stiffness matrix for a beam with combined transverse loading and axial force. **7**

7. Derive the shape functions for a beam finite element of length 'L' assuming a cubic polynomial in the form **14**

$\nu(x) = a_0 + a_1 x + a_2 x^2 + a_3 x^3$ by satisfying the boundary conditions :

$\nu(0) = (0)\ \upsilon(L) = 0,$

$\nu(0) = 0$ and $\upsilon(L) = 0.$