

Code No: 56017

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

B. Tech III Year II Semester Examinations, December - 2017

FINITE ELEMENT METHODS

(Common to AE, ME)

Time: 3 hours

Max. Marks: 75

Answer any five questions
All questions carry equal marks

- - -

- 1.a) Describe in short a procedure to solve an engineering problem with the help of Finite Element Analysis.
- b) The governing equation for a fully developed steady laminar flow of a Newton as shown in figure 1.

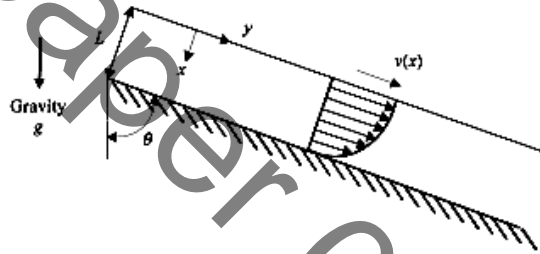


Figure 1

$$\mu \frac{d^2 v}{dx^2} + \rho g \cos \theta = 0$$

Where

μ = coefficient of viscosity,

v = fluid velocity,

ρ = density,

g = acceleration due to gravity,

θ = angle between the inclined surface and the vertical,

The boundary conditions are given by

$$\left. \frac{dv}{dx} \right|_{x=0} = 0 \quad (\text{zero shear stress})$$

$$v(L) = 0 \quad (\text{no slip})$$

Let us find the velocity distribution $v(x)$ using the weighted residual method. Assume a trial solution

$$v(x) = \hat{v}(x) = c_0 + c_1 x + c_2 x^2 \quad [5+10]$$

- 2.a) What do you understand by quadratic shape functions?
- b) Rod under distributed and concentrated forces and subjected to forces as shown in figure 2. [5+10]

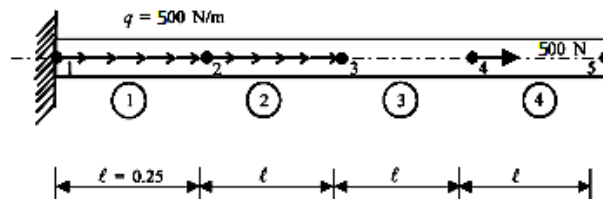


Figure 2

3. For the three-bar truss shown in figure 3, determine the displacements of node 1 and the stress in element 3. [15]

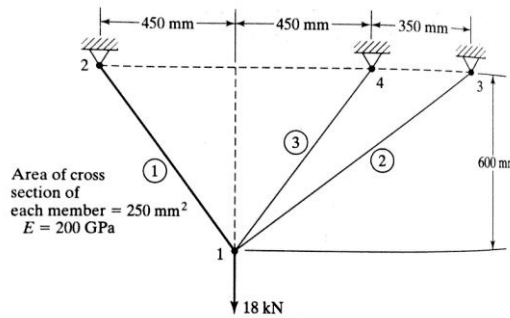


Figure 3

4. For the beam problem shown in figure 4, determine the tip deflection and slope at the roller support. [15]

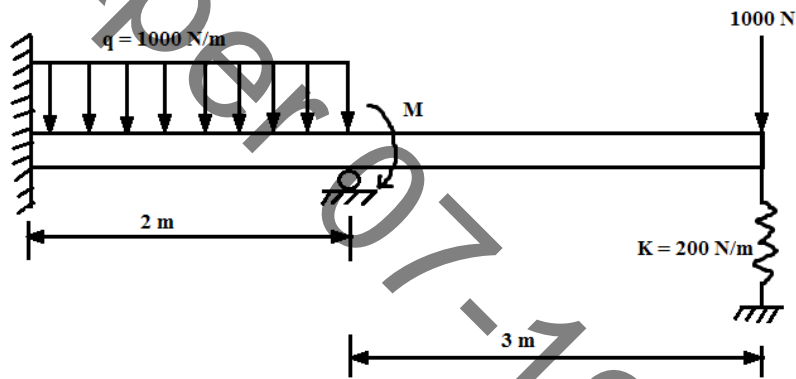


Figure 4

5. Determine the deflection of a thin plate subjected to extensional loads as shown in figure 5. [15]

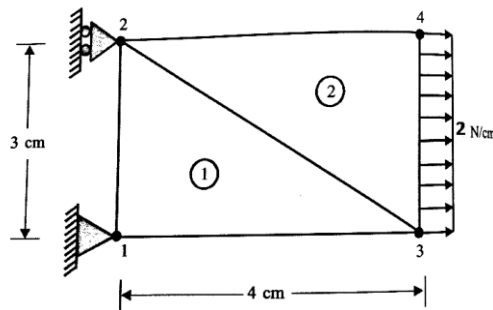


Figure 5

6. Determine the Jacobian of the transformation J for the triangular element shown in figure 6. [15]

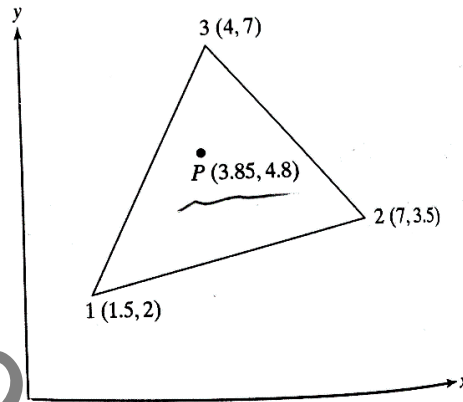


Figure 6

7. The plane wall shown in figure 7. Is 0.5 m thick? The left surface of wall is maintained at a constant temperature of 200°C , and the right surface is insulated. The thermal conductivity $k=25\text{W/m}^{\circ}\text{C}$, and there is uniform heat generation inside the wall of $Q = 400 \text{ W/m}^3$. Determine the temperature distribution through the wall thickness using linear elements. [15]

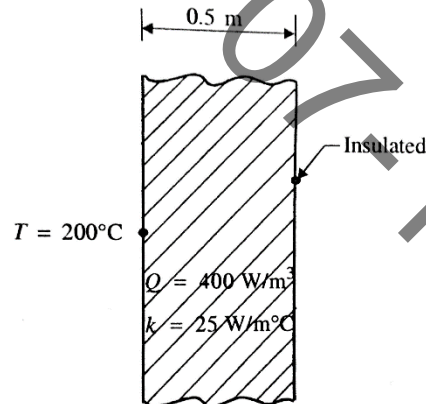


Figure 7

- 8.a) Differentiate between consistent and lumped mass matrices.
 b) Consider a uniform cross-section (in figure 8) bar of length L made up of a material whose Young's modulus and density are given by E and ρ . Estimate the natural frequencies of axial vibration of the bar using consistent mass matrices. [5+10]

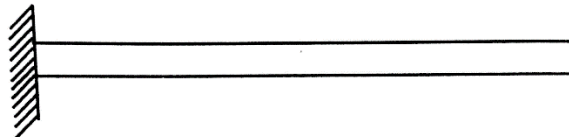


Figure 8