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Question Paper Code: 37702

B.E. / B.Tech. DEGREE EXAMINATION, APRIL 2019

Seventh Semester

Mechanical Engineering

01UME702 - FINITE ELEMENT ANALYSIS

(Regulation 2013)

Duration: Three hours Maximum: 100 Marks

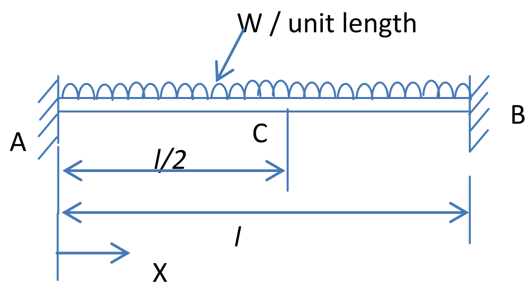
Answer ALL Questions

PART A - (10 x 2 = 20 Marks)

1. What is meant by discretization of domain?
2. Distinguish between local and global coordinate system.
3. State the principle of minimum potential energy.
4. List the properties of shape function.
5. What meant by plane stress analysis?
6. What are the conditions for a problem to be axisymmetric?
7. What is the difference between lumped mass and consistent mass?
8. What is the difference between lumped mass and consistent mass?
9. Mention two natural boundary conditions as applied to thermal problems.
10. Define heat transfer.

PART - B (5 x 16 = 80 Marks)

11. (a) Find the deflection at the centre of a clamped beam subjected to uniformly load through its length as shown in fig. (i) Use collocation method and Glaerkin's method. (16)



Or

(b) Consider the differential equation for a problem as $(d^2y / dx^2) + 300\, x^2 = 0,\ 0 \leq x \leq 1$ with the boundary conditions $y(0) = 0$, $y(1) = 0$. Illustrate the solution of the problem using one coefficient trail function as $y = a_1 x\,(1-x^3)$. Use (i) Point collocation method, (ii) Sub-domain collocation method. (iii) Least square method and (iv) Galerkin's method. (16)

12. (a) A rod of diameter 10 mm, length 200 mm and has nodal displacements due to axial loads as 1.2 mm and 2.8 mm. The position of the rod is shown in fig.2. Predict (i) the displacement at a point Q on the rod (ii) strain (iii) stress and (iv) the strain energy for the rod. Take E =210 Gpa. (16)

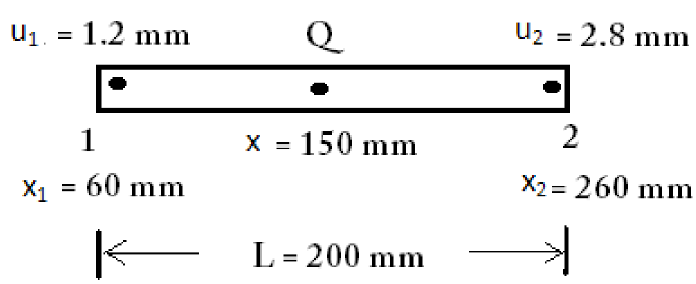
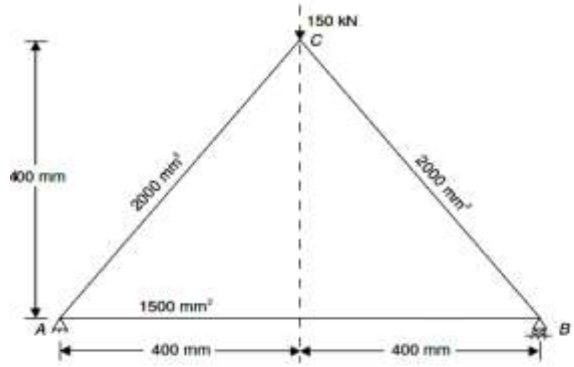


fig.2.

Or

(b) For the three bar truss as shown in figure, determine the nodal displacements and the stress in each member and find the support reaction also. The coordinates are (0,0), (800,0) and (400,400). Take modulus of elasticity as 200 *GPa*. (16)



13. (a) Derive the shape function and stiffness matrix for a CST element in general coordinate system under plane strain condition. (16)

Or

(b) Examine the Cartesian coordinates of the point P which has local coordinates $\varepsilon = 0.8$ and $\eta = 0.6$ shown in the fig.5. (16)

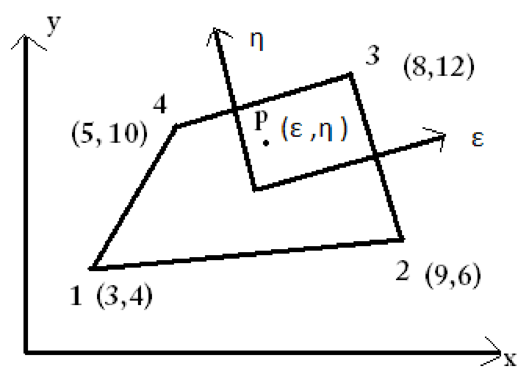
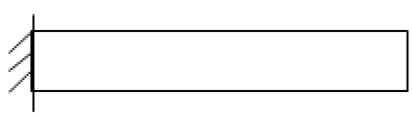


fig.5.

14. (a) For the one dimensional bar as shown in figure, determine the natural frequencies of longitudinal vibration using two elements of equal length. Take $A = 600\ mm^2$, $E = 2 \times 10^5\ N/mm^2$, $\rho = 0.8 \times 10^{-4}\ N/mm^3$ and $L = 400\ mm$. (16)



Or

(b) Determine the natural frequencies of transverse vibration for a beam fixed at both ends. The beam may be modeled by two elements each of length L and cross sectional area A. The use of symmetry boundary condition is optional. (16)

15. (a) A furnace wall is made up of three layers inside with K = 8.5 W/mK, middle layer with K = 0.25 W/mK, outer layer with K = 0.08 W/mK. The respective thickness of the inner, middle and outer layers is 25 *cm*, 5 *cm* and 3*cm* respectively. Inside temperature is 600° *C*, outside temperature of the wall is exposed to air of 30° *C* with h = 45 W/m^2K. Determine the nodal temperature. (16)

Or

(b) A wall of 0.9 m thickness having thermal conductivity of 1.2 W/mK. The wall is to be insulated with a material of thickness 0.09 m having an average thermal conductivity 0.3 W/mK. The surface temperature is 1100° C and outside of the insulation is exposed to atmospheric air at 40° with heat transfer coefficient 35 W/m^2K. Calculate the nodal temperature. (16)

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