Reg. No. : | | | | | | | | | | |

Question Paper Code: 37702

B.E. / B.Tech. DEGREE EXAMINATION, MAY 2022

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. Discuss the concept of potential energy
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. Name the conditions to be satisfied in order to use axisymmetric element.
7. What is meant by path line?
8. What is the difference between lumped mass and consistent mass?
9. Explain temperature gradient.
10. Define steady state heat transfer.

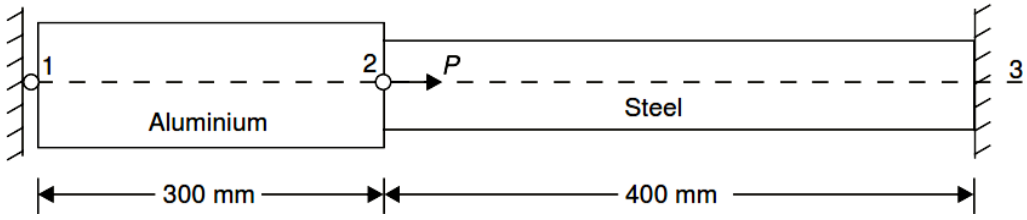
PART - B (5 x 16 = 80 Marks)

11. (a) The differential equation of the physical phenomenon is given by $d^2y/dx^2 + 500x^2 = 0;\ 0 \le x \le 1$, by using the trail function, $y = a_1(x - x^3) + a_2(x - x^5)$ solve using weighted residual methods. (16)

Or

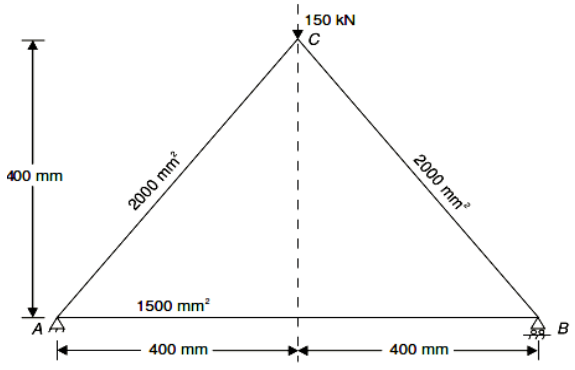
(b) Consider the differential equation for a problem as $(d^2y / dx^2) + 300\ x^2 = 0$, $0 \le x \le 1$ with the boundary conditions $y(0) = 0$, $y(1) = 0$. Illustrate the solution of the problem using one coefficient trail function as $y = a_1x\ (1-x^3)$. Use (i) Point collocation method, (ii) Sub-domain collocation method. (iii) Least square method and (iv) Galerkin's method. (16)

12. (a) Determine the nodal displacement at node 2, stresses in each material and support reactions in the bar as shown in figure. Due to the applied force of 400 *KN* and temperature rise of 30°*C*. Take $A_1 = 2400\ mm^2$, $A_2 = 1200\ mm^2$, $E_1 = 0.7 \times 10^5\ N/mm^2$, $E_2 = 2 \times 10^5\ N/mm^2$, $\alpha_1 = 22 \times 10^{-6\circ}\ C$ and $\alpha_2 = 12 \times 10^{-6\circ}\ C$. (16)

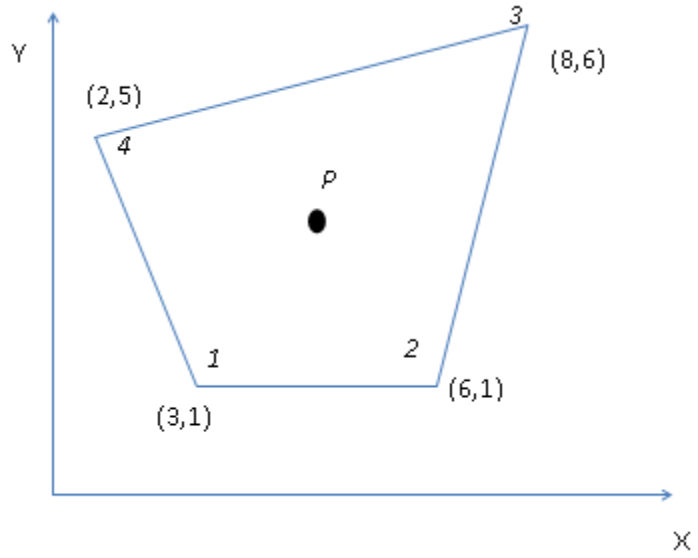


Or

(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) For the isoperametric quadrilateral element shown in fig. Determine the local coordinates of the point p which has Cartesian coordinates(7, 4). (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)

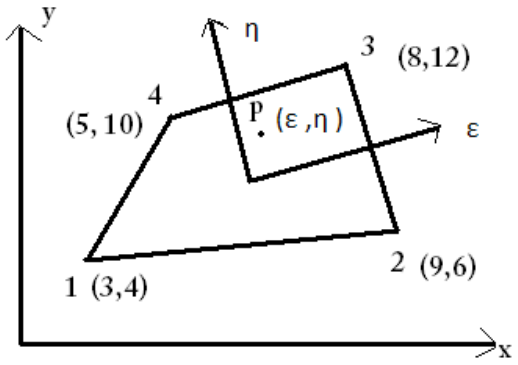
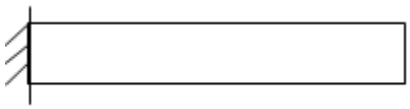


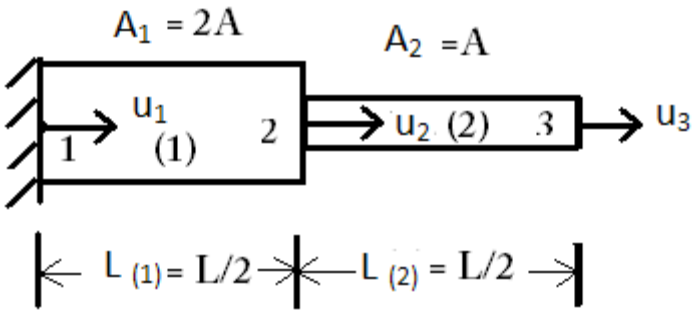
fig.5.

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) Identify the natural frequencies of longitudinal vibration of the constrained stepped bar shown in fig.6 Also find the mode shapes.



(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 3cm 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) Summarize the element equations for the element shown in fiq.9. Which experiences convection on the side j k and its upper face: Take k = 7.5W/mm°C, h = 0.15W/mm^2 ° C, T_∞= 20°C and t = 1mm. (16)

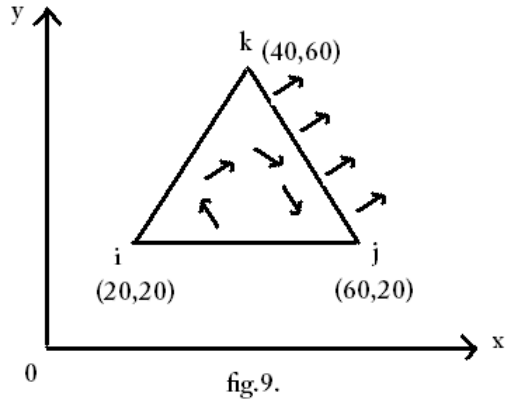


fig.9.