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

Question Paper Code: 37072

B.E. / B.Tech. DEGREE EXAMINATION, NOV 2017

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. Distinguish between local and global coordinate system.
2. Summarize the meaning of weak formulation.
3. List the properties of shape function.
4. Define truss element.
5. Give the salient feature of isoparametric element.
6. What is meant by path line?
7. Classify the types of mass matrix.
8. Illustrate the phenomenon of damping.
9. Mention two natural boundary conditions as applied to thermal problems.
10. Define 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 $y = a_1 x\ (1-x^3)$. 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)

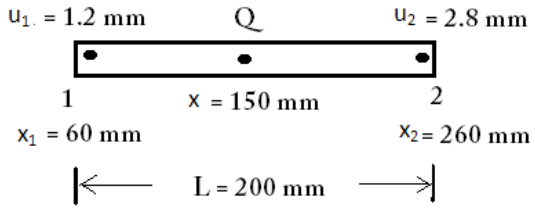
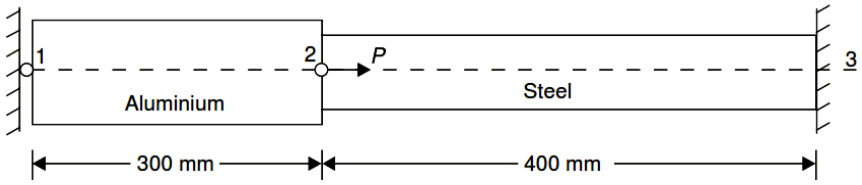


fig.2.

Or

(b) 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)



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)

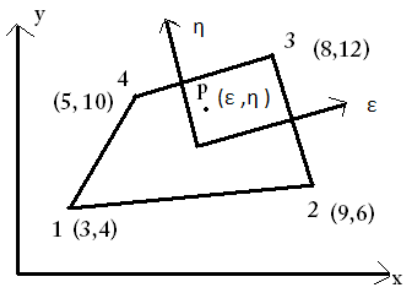
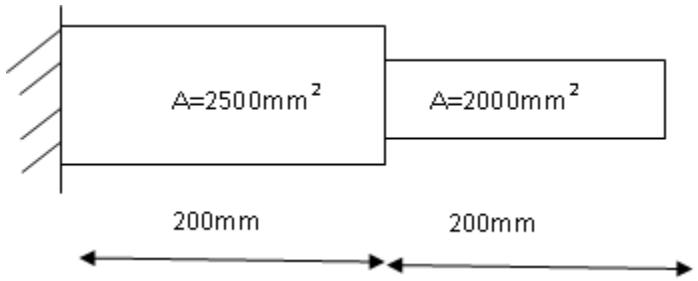


fig.5.

14. (a) Determine the eigen values and frequencies for the stepped bar as shown in figure. Take $E = 2 \times 10^5\ N/mm^2$, $\rho = 0.8 \times 10^{-4}\ N/mm^3$. (16)



Or

(b) Evaluate the eigen values and frequencies for the stepped bar shown in fig.7. (16)

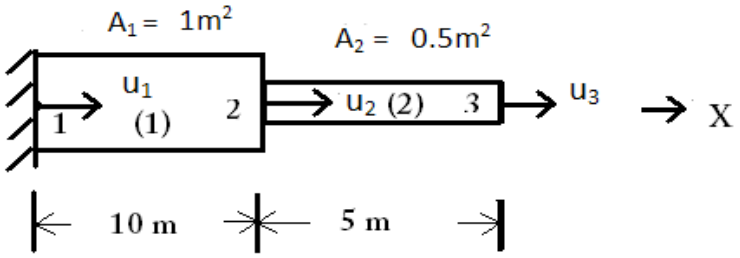


fig.7.

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) 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)

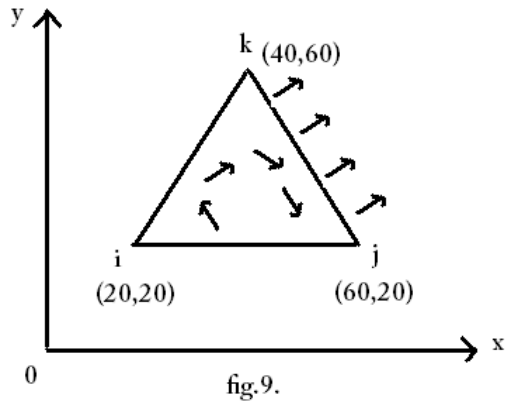


fig.9.

(All dimensions are in mm)