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

Question Paper Code: 37702

B.E. / B.Tech. DEGREE EXAMINATION, NOV 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 Rayleigh Ritz method?
2. Distinguish between local and global coordinate system.
3. How do you calculate the size of the global stiffness matrix?
4. List the properties of shape function.
5. What meant by plane stress analysis?
6. Give the salient feature of isoparametric element.
7. What is the difference between lumped mass and consistent mass?
8. What is the difference between lumped mass and consistent mass?
9. Explain temperature gradient.
10. Define steady state heat transfer.

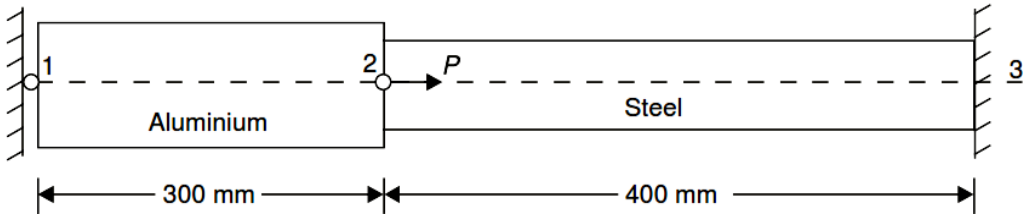
PART - B (5 x 16 = 80 Marks)

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

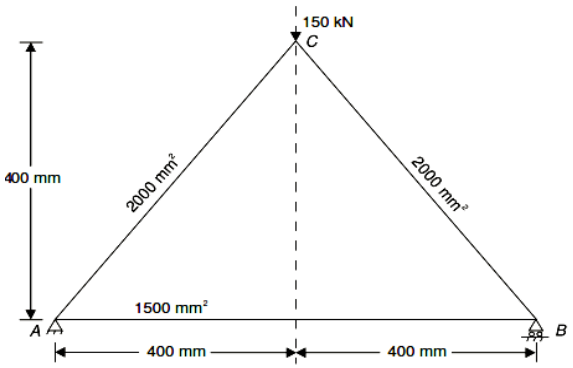
(b) Consider the differential equation for a problem as $(d^2y / dx^2) + 300\ x^2 = 0$, $0 \le x \le 1$ with the boundary conditions $y(0) = 0$, $y(1) = 0$. Illustrate the solution of the problem using one coefficient trail function as $y = a_1x\ (1-x^3)$. Use (i) Point collocation method, (ii) Sub-domain 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 $A_1 = 2400\ mm^2$, $A_2 = 1200\ mm^2$, $E_1 = 0.7 \times 10^5\ N/mm^2$, $E_2 = 2 \times 10^5\ N/mm^2$, $\alpha_1 = 22 \times 10^{-6}$° C and $\alpha_2 = 12 \times 10^{-6}$° C. (16)

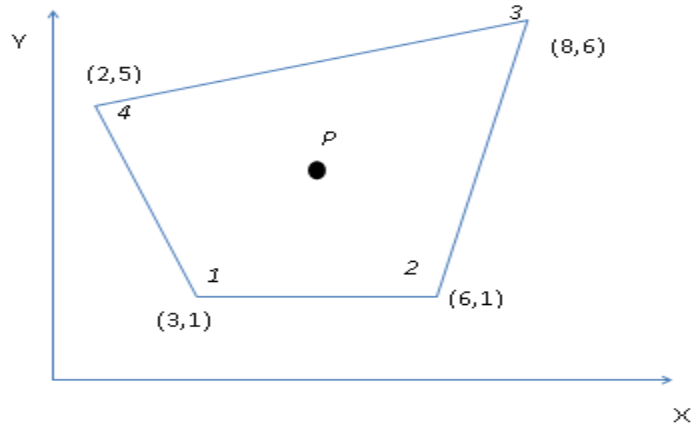


Or

(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)



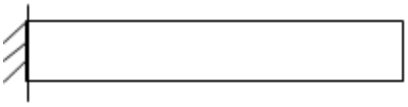
13. (a) For the isoperametric quadrilateral element shown in fig. Determine the local coordinates of the point p which has Cartesian coordinates(7, 4). (16)



Or

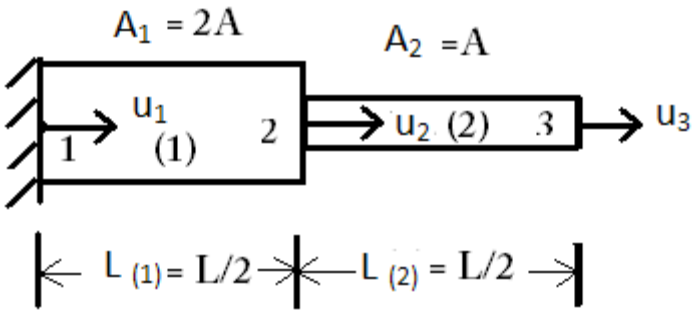
(b) Derive the shape function and stiffness matrix for a CST element in general coordinate system under plane strain condition. (16)

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)



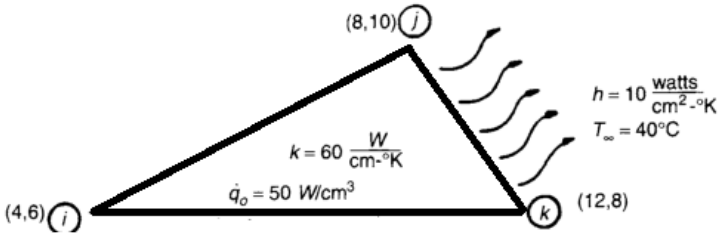
Or

(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) Compute element matrices and vectors for the element shown in figure when the edge jk experiences convection loss. (16)



Or

(b) 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)