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

Question Paper Code: 31772

B.E. / B.Tech. DEGREE EXAMINATION, NOV 2016

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. Distinguish between essential boundary condition and natural boundary condition.
6. Give the salient feature of isoparametric element.
7. What is meant by path line?
8. Define inviscid flow.
9. Mention two natural boundary conditions as applied to thermal problems.
10. Define heat transfer.

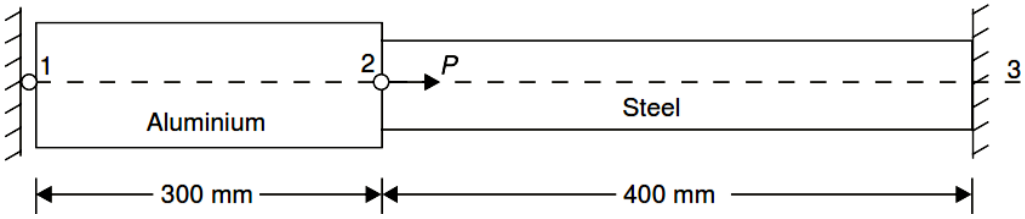
PART - B (5 x 16 = 80 Marks)

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

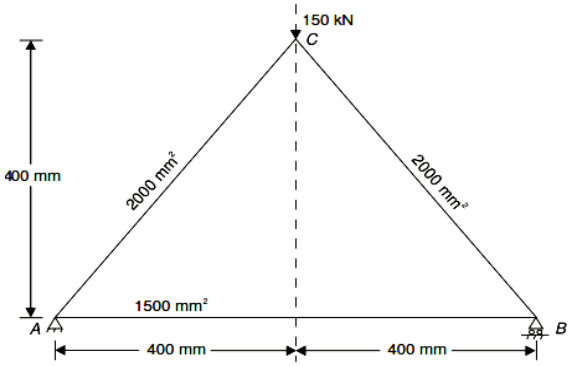
(b) A simply supported beam is subjected to uniformly distributed load over entire span and it is subjected to a point load at the center of the span. Calculate the deflection at midspan by using RayleighRitz method. (16)

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)

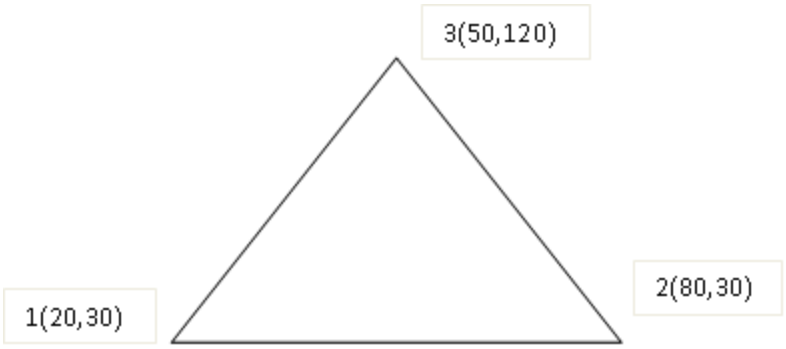


Or

(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)



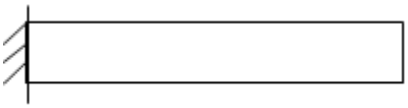
13. (a) For the element shown in figure, the nodal displacements are given as $u_1 = 2\ mm$, $v_1 = 1\ mm$, $u_2 = 0.5\ mm$, $v_2 = 1.5\ mm$, $u_3 = 3\ mm$ and $v_3 = 1\ mm$. The coordinates are given in *mm*. Assume plane stress condition. Let $E = 210\ GPa$, $\mu = 0.3$ and thickness = 10 *mm*. Determine the element stresses. (16)



Or

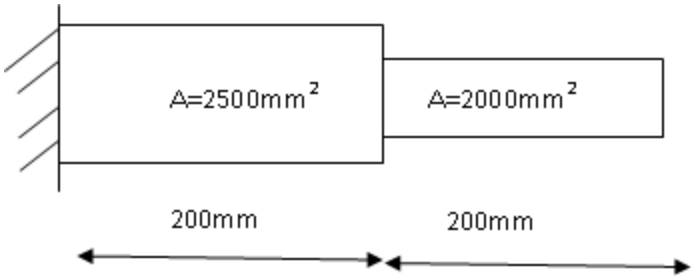
(b) Derive the shape function and stiffness matrix for a CST element in general coordinate system under plane strain condition. (16)

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)

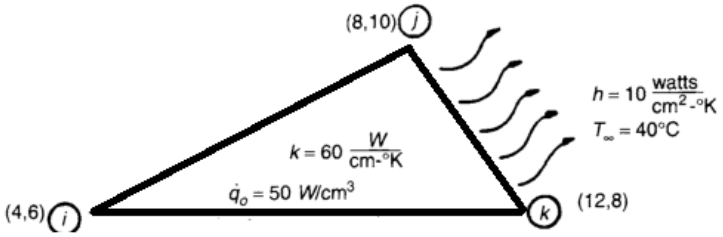


Or

(b) 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)



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)