



Code No. : 5205/S

**FACULTY OF ENGINEERING**  
**B.E. 4/4 (Mech./Prod.) I Semester (Suppl.) Examination, July 2012**  
**FINITE ELEMENT ANALYSIS**

Time : 3 Hours]

[Max. Marks : 75

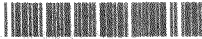
*Note : Answer all questions from Part A. Answer any five questions from Part B.*

**PART – A**

**(25 Marks)**

1. Write the compatibility conditions. 2
2. What are quadratic shape functions ? 3
3. Write the stiffness matrix for a frame element. 3
4. Write the Jacobian for 3-noded triangular and 4-noded quadrilateral elements. 3
5. Write the 'D' matrix for a axisymmetric element. 2
6. What are thermal boundary conditions ? 2
7. What is eigen value and eigen vector ? Explain their significance. 3
8. Write the stiffness matrix of circular shaft subjected to torsion. 3
9. Determine heat capacitance matrix for 1D conduction element. 2
10. Sketch 3D elements tetrahedron and brick elements. 2

(This paper contains 3 pages)



## PART - B

(50 Marks)

11. For tapered bar shown in Fig. 1, at '1-1' and '2-2' the area of cross section is  $10^{-6}\text{m}^2$  and  $10^{-4}\text{m}^2$ . Find the deflection at node 2 and element stresses if  $E = 200\text{ GPa}$ .

10

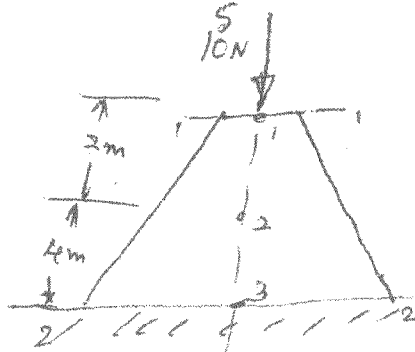


Fig. 1

12. For the truss shown in Fig. 2 find the
- The deflection at node 2
  - The strains and stresses in each member.
- if  $E = 200\text{ GPa}$ ,  $A = 10^{-6}\text{m}^2$ .

10

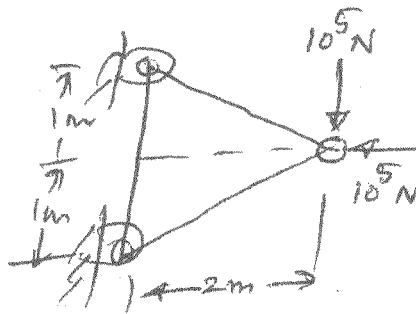


Fig. 2

13. Write the shape functions for
- 2-noded beam element
    - 3-noded triangular element
  - Derive the stiffness matrix for 2 noded bar Element.

4

6



14. a) Write the Jacobian Matrix for  
i) 3-noded axisymmetric element 4  
ii) 4-noded quadrilateral element
- b) Derive the stiffness matrix for truss element. 6
15. For the composite wall shown in Fig. 3, determine the temperature variation if  
 $K_1 = 2K_2 = \frac{K_3}{2} = 50 \text{ W/m}^\circ\text{C}$  10

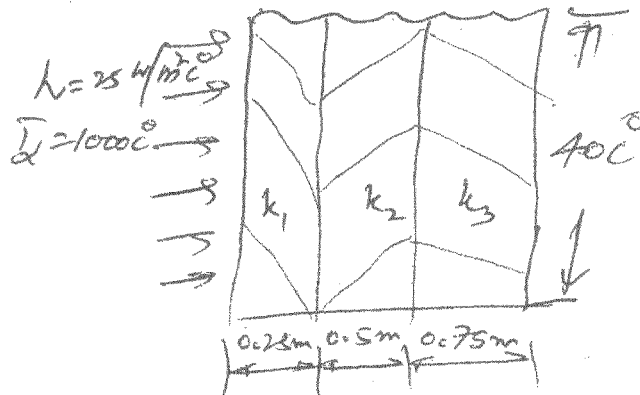


Fig. 3

16. For the cantilever beam shown in Fig. 4, Determine the natural frequencies and corresponding mode shapes if  $E = 200 \text{ GPa}$ ,  $\rho = 7800 \text{ kg/m}^3$ . 10



Fig. 4

17. Write the following 10
- a) Integrate numerically  $I_z = \int_{-1}^1 (3z^2 - 6z + 5) dz$  and compare the solution with Gaussian quadrature ( $n = 1, w_1 = 2, z_1 = z_2 = 0, n = 2, w_1 = w_2 = 1, z_1 = z_2 = \mp 0.577$ ).
- b) Write conduction and connection matrices for plate with triangular elements.