Code No: 8113

VASAVI COLLEGE OF ENGINEERING *(Autonomous)*, HYDERABAD
M.E. I Year (Mechanical) I-Semester (Make Up) Examinations, May-2015
(Advanced Design and Manufacturing)

Finite Element Techniques

Time: **3** hours Max. Marks: **70**

*Note: Answer **ALL** questions in **Part-A** and any **FIVE** questions from **Part-B***

Part-A (10 X 2=20 Marks)

1. Explain the basic concept of FEM and name some engineering applications.
2. The displacement in an element is described by $u = x^3 - 2x^2 + 5x$. Determine the strain at a point $x = 5.2$ in the element.
3. For the uniformly varying load acting on the beam element shown in fig.1 estimate the equivalent nodal load vector.

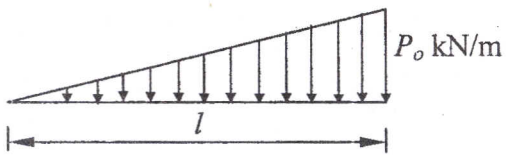

Fig. 1

4. State the transformation matrix for a truss element.
5. Formulate the material property matrix [D] for a triangular element with E = 100 GPa and ν = 0.35 using plane strain conditions.
6. Write the material matrix for an axisymmetric element.
7. Write the essential and natural boundary conditions in heat transfer problem.
8. List the advantages and disadvantages of using lumped mass matrices over consistent mass matrix.
9. Write the three-dimensional stress-strain relation for an isotropic material.
10. State the difference in formulation of fluid flow using stream function and velocity potential.

Part-B (5 X 10=50 Marks)

11. a).Explain the various steps involved in solving a problem using finite element method. (4)
    b.) Derive the stiffness matrix for a truss element with two degrees of freedom at each node from basics. (6)

Contd..2..

12. The plane truss shown in Fig. 2. is composed of members having a square 15mm × 15mm cross section and modulus of elasticity E = 70 GPa.. Compute the nodal displacements in the global coordinate system for the loads shown. Also, compute the axial stress in each element. **Consider elements 2 and 3 only and 1 and 4 are for dimensional reference.** (10)

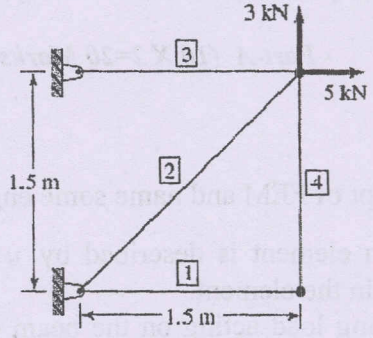

Fig. 2

13. For the two element plate shown in fig.3, determine the strain displacement matrices for the two elements. (10)

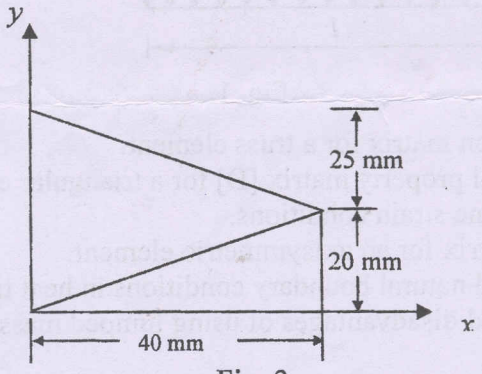

Fig. 3

14. a). State the properties of eigen vectors. (3)

b). Calculate the conductance matrix $[K^{(e)}]$ and load vector $\{F^{(e)}\}$ for the triangle element shown in fig.4 . The thermal conductivities are $k_x = k_y = 4$ W/cm-°C and h = 0.3 W/cm^2 °C. Thickness of the element is 1cm. All coordinates are given in cms. Convection occurs on the side joining modes *i* and *j*. (7)

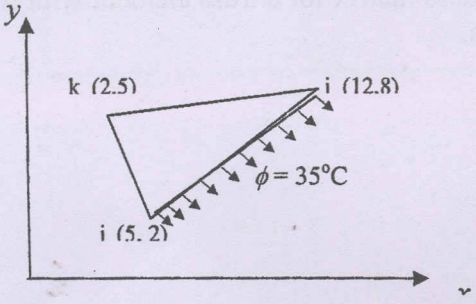

Fig. 4

Contd..2..

15. Derive the strain displacement matrix for an axisymmetric triangular element. (10)

16. The stream function corresponding to a fluid flow is given by $\psi(x, y) = 12(2x^2 - y^3)$.

(i) determine whether the flow is irrotational.

(ii) Find the velocity potential of the flow.

(iii) Find the velocity components of the flow. (10)

17. a). Explain the difference between isoparametric, subparametric and superparametric elements. (5)

b). Evaluate the Integration $I = \int_0^{10} (3x^2 + 5x + x^3)dx$ using two point approximation. (5)

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