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Question Paper Code : 23856

B.E./B.Tech. DEGREE EXAMINATION, NOVEMBER/DECEMBER 2018.

Sixth Semester

Mechanical Engineering

ME 2353 – FINITE ELEMENT ANALYSIS

(Common to Automobile Engineering, Industrial Engineering and Management, Mechanical and Automation Engineering and Mechanical Engineering (sandwich))

(Regulations 2008)

Time : Three hours | Maximum : 100 marks

Any missing data may be suitably assumed.

Answer ALL questions.

PART A — ($10 \times 2 = 20$ marks)

1. Distinguish between the Rayleigh-Ritz method and finite element method.

2. What do you understand by the term "Piecewise continuous function"?

3. Differentiate global and local coordinates.

4. What are the types of problems treated as one dimensional problems?

5. Write down the shape functions associated with the three noded linear triangular element and plot the variation of the same.

6. Give at least one example each for plane stress and plane strain analysis.

7. Consistent mass matrix gives accurate results than lumped mass matrix in dynamic analysis of bar element – Justify.

8. What types of analysis preferred in FEA when the structural member subjected to transient vibrations?

9. What are the boundary conditions in FEA heat transfer problem?

10. State Darcy's law of fluid flow for finite element analysis.

PART B — (5 × 16 = 80 marks)

11. (a) Solve the differential equation for a physical problem expressed as $\frac{d^2y}{dx^2}+100=0,\ 0\leq x\leq 10$ with boundary conditions as $y(0)=0$ and $y(10)=0$ using.

(i) point collocation method (4)

(ii) sub domain collocation method (4)

(iii) least squares method and (4)

(iv) Galarkin's method. (4)

Or

(b) A simply supported beam subjected to uniformly distributed load over entire span and it is subjected to a point load at the centre of the span. Calculate the deflection using Rayleigh-Ritz method and compare with exact solutions.

12. (a) A steel bar of length 800 mm is subjected to an axial load of 3 kN as shown in fig. Q. 12 (a). Find the elongation of the bar, neglecting self weight. (16)

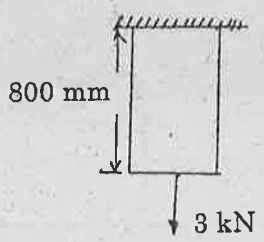

Fig. Q12 (a)

Or

(b) Derive the stiffness matrix for 2D truss element. (16)

13. (a) For the plane strain elements shown in Figure 13(a), the nodal displacements are given as $u_1 = 0.005\ mm, v_1 = 0.002\,mm$, $u_2 = 0.0\,mm$, $v_2 = 0.0\,mm$, $u_3 = 0.005\ mm, v_3 = 0.30\,mm$. Determine the element stresses and the principle angle. Take $E = 70\,GPa$ and Poisson's ratio = 0.3 and use unit thickness for plane strain. All coordinates are in mm.

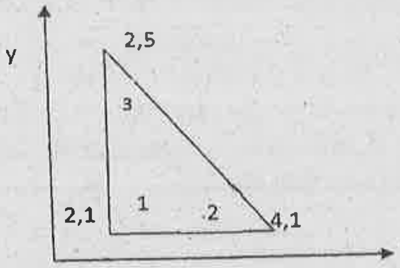

Fig. Q. 13 (a)

Or

(b) Derive the element characteristics of a nine node quadrilateral element.

14. (a) Determine the first two natural frequencies of transverse vibration of the cantilever beam shown in Fig. 14 (a) and plot the mode shapes.

Fig. 14 (a)

Or

(b) Determine the first two natural frequencies of longitudinal vibration of the bar shown in Fig. 14(b) assuming that the bar is discretised into two elements as shown, E and ρ represent the Youngs Modulus and mass density of the material of the bar.

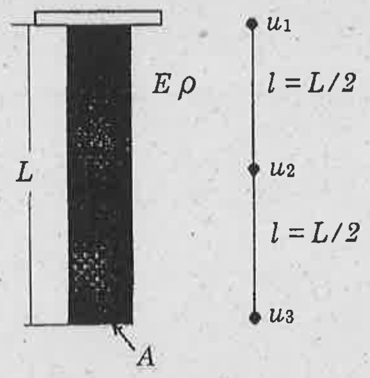

Fig. 14 (b)

15. (a) Consider a brick wall of thickness 0.3 m, $K = 0.7 W/m\,^\circ C$. The inner surface is at 28°C and the outer surface is exposed to cold air at –15°C. The heat transfer coefficient associated with the outside surface is $40 W/m^2\,^\circ C$. Determine the steady state temperature distribution within the wall and also the heat flux through the wall. Use two 1D elements and obtain the solution.

Or

(b) Establish the finite element equations including force matrices for the analysis of two dimensional steady-state fluid flow through a porous medium using triangular element.

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