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Question Paper Code : 31030

B.E./B.Tech. DEGREE EXAMINATION, NOVEMBER/DECEMBER 2013.

Sixth/Seventh Semester

Aeronautical Engineering

AE 2351/AE 1007/AE 61/10122 AE 602 – FINITE ELEMENT METHOD

(Regulation 2008/2010)

Time : Three hours   Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. What is meant by approximation?

2. Define natural boundary condition.

3. How dynamic analysis vary with static analysis?

4. State stability of analysis?

5. What are the types of 2D elements?

6. Define plane strain.

7. What is isoparametric representation?

8. Write a shape function for 9 node quadrilateral elements.

9. State the significant of heat transfer analysis.

10. What are the boundary conditions considered for the fluid flow?

PART B — (5 × 16 = 80 marks)

11. (a) The differential equation of a physical phenomenon is given by $\frac{d^2y}{dx^2} + 500x^2 = 0,\ 0 \le x \le 1.$ The approximation function is $y = a_1(x - x^4) + a_2(x - x^5)$, when y(0) = 0 and y(1) = 0. Determine the value of the parameter a_1 and a_2 by the method of variational formulation.

Or

(b) Discuss the relationship of stress-stain? Derive the stiffness matrix.

12. (a) Consider a beam having cross-sectional area 6000 mm², depth 300 mm, moment of inertia 120 × 10^{-6} mm⁴ and length 7.5 m. The beam is subjected to uniformly distributed load of 20,000 N/m. Divide the beam into two elements with three nodes. Node 2 is 5 m from left end and 2.5 m from right end. Calculate (i) rotations at node 2 and 3 and (ii) displacement at node 3. Take $E = 2 \times 10^{11}$ N/m².

Or

(b) Use the Rayleigh-Ritz method to find the displacement at the mid-point of the vertical rod fixed at both ends having 2m height. Assume the relevant parameter.

13. (a) (i) Evaluate the element stiffness matrix for the triangular elemen shown in fig 1 under plane stress condition. Assume the followin values. $E = 2x10^5\,\text{N/mm}^2, v = 0.3\,\text{and}\,t = 10\,\text{mm}$.

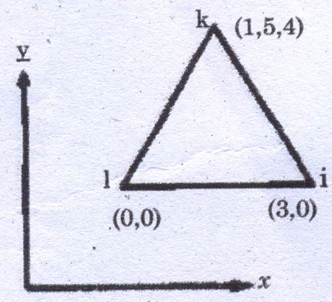

Fig 1

(ii) Determine the x and y coordinates of point P for the triangular element shown in fig 2. The function N_1 and N_2 are 0.2 and 0.3 respectively.

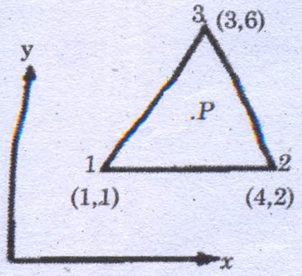

Fig 2

Or

(b) An axisymmetric body with a linearly distributed load on the conical surface is shown in fig 3. Determine the equivalent point loads at nodes 2,4, and 6.

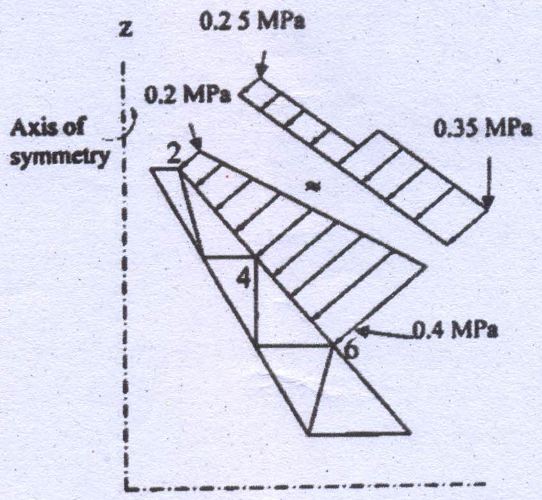

Fig 3

14. (a) Consider two dimensional steady state heat transfers by conduction to discuss the temperature distribution in a slab with finite element method in detail.

Or

(b) How three dimensional problem is treated as two dimensional? Discuss the application.

15. (a) For a fully developed laminar flow between two long parallel plate separated by a distance 2L, The governing equation is $\mu \frac{d^2u}{dy^2} = \frac{dP}{dx}$, where μ is the fluid viscosity and 'P' is the pressure. Derive the finite element form and hence determine the velocity distribution for a given constant pressure gradient $\frac{dP}{dx}$. The boundary conditions are that the fluid velocity is zero at the surface of the plates is $u(-L) = 0$ and $u(L) = 0$.

Or

(b) Consider an iron rod L = 10 cm long of diameter, D = 1 cm with thermal conductivity, k = 50 w/m°C. One end of the rod is maintained at T_0 = 200°C and other end at T_L = 0°C. While it is exposed to convection from its lateral surfaces into ambient air at 0°C with a heat transfer coefficient h = 200 w/m²°C. Assume 1D Steady state heat flow, the mathematical formulation of this problem is given by $\frac{d^2T(x)}{dx^2} - N^2T(x) = 0$ in $0 \le x \le L$, $T(x)$ = 200°C at $x = 0$, and $T(x)$ = 0°C at $x = L$. Where $N^2 = \frac{ph}{kh} = \frac{4h}{kD}$. By dividing the region into 5 equal parts. Calculate temperature distribution along the rod using finite element method.
