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Question Paper Code : 40528

B.E./B.Tech. DEGREE EXAMINATION, APRIL/MAY 2018
Sixth Semester
Aeronautical Engineering
AE 6601 – FINITE ELEMENT METHODS
(Regulations 2013)

Time : Three Hours | Maximum : 100 Marks

Answer ALL questions

PART – A (10×2=20 Marks)

1. Enumerate the phases of finite element analysis.
2. What is finite difference method ?
3. Why polynomials are generally used as shape function ?
4. Write the advantages of natural coordinates over global coordinates.
5. Give one example each for plane stress and plane strain problems.
6. Give four applications where axisymmetric elements can be used.
7. Draw the eight-node quadrilateral in x, y space.
8. Formulate an equation to evaluate an integral 'I' considering n-point approximation using Gauss-Legendre quadrature.
9. State any two reasons for preferring hollow shafts over solid shafts.
10. List any four Finite Element Analysis (FEA) software packages.

PART – B (5×13=65 Marks)

11. a) Determine the deflection under the point load of a simply supported beam of length 5 m which is carrying a point load of 5 kN, acting 3 m from the left end. Take $E = 2\times10^5$ N/mm^2 and $I = 1\times10^8$ mm^4, use Rayleigh-Ritz method and compare with exact.

(OR)

b) A simply supported beam of span length 'l' subjected to uniformly distributed load of w/unit length, throughout its length. Find the deflection at the centre of the beam using

i) Sub-domain collocation method

ii) Least squares method and

iii) Galerkin's method.

12. a) Find the nodal displacements developed in the planar truss shown in Figure 1 when a vertically downward load of 1000 N is applied at node 4. The applicable data are given in Table 1.

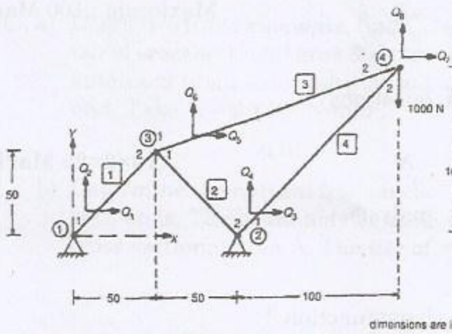

Figure 1

Member number "e"	Cross-sectional area $A^{(e)}$ cm^2	Length $l^{(e)}$ cm	Young's modulus $E^{(e)}$ N/cm^2
1	2.0	$\sqrt{2}$ 50	2×10^6
2	2.0	$\sqrt{2}$ 50	2×10^6
3	1.0	$\sqrt{2.5}$ 100	2×10^6
4	1.0	$\sqrt{2}$ 100	2×10^6

Table 1

(OR)

b) The beam is loaded as shown in Figure 2, determine (1) the slopes at 2 and 3 and (2) the vertical deflection at the midpoint of the distributed load.

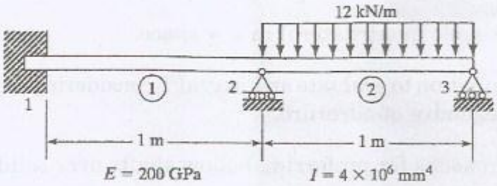

Figure 2

13. a) Evaluate the element stiffness matrix for the triangular element with coordinates (1 (0, 0), 2(6, 0) and 3(3,5)) under plane strain condition. Assume the following values : E = 200 GPA, $\mu = 0.25$, t = 1 mm.

(OR)

b) A long cylinder (Figure 3) of inside diameter 80 mm and outside diameter 120 mm tightly fits in a hole over its full length. The cylinder is then subjected to an internal pressure of 2 MPa. Using two elements on the 10 mm length, find the displacements at the inner radius.

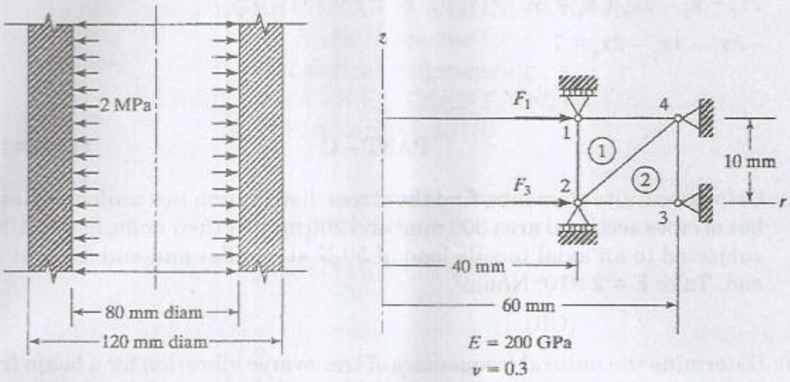

Figure 3

14. a) Derive the shape function for the four-node quadrilateral element. Also write the equation in matrix form to get the displacement at any point inside the element.

(OR)

b) Evaluate the integral $I = \int_{-1}^{1}\left[a_1 + a_2x + a_3x^2 + a_4x^3\right] dx$ using three point Gauss quadrature and compare it with exact solution.

15. a) A composite wall consists of three materials, as shown in figure 4. The outer temperature is 20°C. Convection heat transfer takes place on the inner surface of the wall with 800°C. Determine the temperature distribution in the wall.

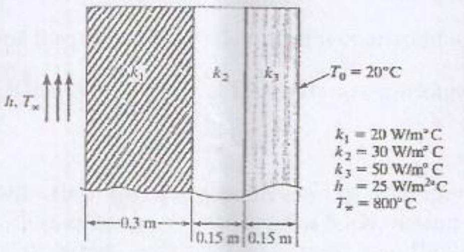

Figure 4

(OR)

b) Solve the simultaneous algebraic equations using elimination method.

$4x_1 - 2x_2 + x_3 - 3x_4 = 5$

$x_1 + 5x_2 + 2x_3 = 9$

$2x_1 + x_2 - 4x_3 + x_4 = 6$

$-3x_1 - 4x_2 - 2x_4 = 7$

PART – C (1×15=15 Marks)

16. a) Using two finite elements, find the stress distribution in a uniformly tapering bar of cross sectional area 300 mm^2 and 200 mm^2 at their ends, length 100 mm, subjected to an axial tensile load of 50 N at smaller end and fixed at larger end. Take $E = 2 \times 10^5$ N/mm^2.

(OR)

b) Determine the natural frequencies of transverse vibration for a beam fixed at both ends. The beam may be modeled by two elements, each of length L and cross sectional area A. The use of symmetry boundary condition is optional.