Reg. No. :

Question Paper Code : 50031

B.E./B.Tech. DEGREE EXAMINATION, NOVEMBER/DECEMBER 2017

Sixth Semester

Aeronautical Engineering

AE6601 – FINITE ELEMENT METHODS

(Regulations 2013)

Time : Three Hours | Maximum : 100 Marks

Answer ALL questions

PART – A (10×2=20 Marks)

1. What is weighted residual approach ?
2. Derive the finite difference approximation for second order derivative using central difference scheme.
3. Write down the shape function expressions for a bar element with two nodes.
4. Write down the stiffness matrix for a beam element. Also define its consistent load vector due to uniformly distributed load.
5. Mention the difference between constant strain triangular element and linear strain triangular element.
6. Define area coordinates and mark the area coordinate values at the six nodes of a triangular element.
7. Define isoparametric element.
8. State the principle of Gaussian numerical integration scheme.
9. Define band width.
10. Mention the principle of factorization method used for solving simultaneous linear algebraic equations.

PART – B (5×16=80 Marks)

11. a) A beam of length L and uniform section is simply supported at its ends and subjected to uniformly distributed load over its entire length. Using Rayleigh-Ritz method with two term approximation for displacement in the form of trigonometric function obtain the expressions for maximum deflection and maximum bending moment.

(OR)

b) A beam is simply supported at its ends and subjected to uniformly distributed load over entire span of the beam. The length of the beam is L and its flexural rigidity is constant. Using Galerkin method with two term approximation for displacement in the form of trigonometric function, obtain the expressions for maximum deflection and maximum bending moment.

12. a) A bar ABCDE is fixed at its ends and is subjected to an increase in temperature of 75° C. The modulus of elasticity is 200 GPa and coefficient of linear expansion is 12×10^{-6}/°C. Length of AC is 0.3 m and its area is 400 mm^2. B is its midpoint. Length of CE is 0.3 m and its area is 800 mm^2. D is its midpoint. A load of 40 kN is applied at B, acting towards C and a load of 20 kN is applied at D acting towards C. Determine stresses developed in AB, BC, CD and DE.

(OR)

b) A beam of length 8 m and of uniform section is fixed at its ends. The cross section of the beam is rectangle of width 300 mm and depth 200 mm. The beam is subjected to a load of 60 kN at the midpoint and uniformly distributed load of intensity 10 kN/m over its entire length. E = 200 GPa. Determine the slope and deflection at the midpoint of beam using two elements.

13. a) Derive the shape function expressions for a constant strain triangular element and obtain the strain-displacement matrix.

(OR)

b) Derive the shape function expressions for a linear strain triangular element in terms of area coordinates and obtain the strain-displacement matrix.

14. a) Derive the shape function expressions for a quadrilateral element with four nodes in terms of natural coordinates. Derive the strain-displacement matrix for the element.

(OR)

b) Derive the shape function expressions for any one corner node and one midpoint node of a quadrilateral element with eight nodes in terms of natural coordinates. Derive the consistent load vector for the element with eight nodes subjected to uniform traction along the edge 2-6-3. Corner nodes are 1, 2, 3 and 4 and 5, 6, 7 and 8 are mid side nodes.

15. a) A composite wall consists of four materials. The first material, left most has its thermal conductivity 1 W/m° C and its thickness is 220 mm. The second material thickness is 150 mm and its thermal conductivity is 0.8 W/m° C. The third material thickness is 50 mm and its thermal conductivity is 0.08 W/m° C. Thickness and thermal conductivity of right most material are respectively 3 mm and 70 W/m° C. The left most wall is subjected to convection with the surrounding temperature at 1500° C and the convection heat transfer coefficient is 75 W/m^2 °C. Consider area of conduction and convection as 1 m^2 and determine the temperature distribution across the composite wall.

(OR)

b) A fin of length 12 cm has its cross section as rectangle of width 5 cm and depth 2 cm. The thermal conductivity of the fin material is 300 W/m° C. The temperature at the left end of the fin is 200° C. The fin is subjected to convection with the surrounding temperature as 25° C and convective heat transfer coefficient is 2000 W/m^2 °C. Determine the temperature distribution along the length of the fin considering only convection over lateral surface fin. Use three elements.
