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Question Paper Code : 91062

B.E./B.Tech. DEGREE EXAMINATIONS, NOVEMBER/DECEMBER 2019
Fourth Semester
Aeronautical Engineering
AE 6403 – AIRCRAFT STRUCTURES – I
(Regulations 2013)

Time : Three Hours | Maximum : 100 Marks

Answer ALL questions

PART – A **(10×2=20 Marks)**

1. Explain the method of joints.
2. Explain the method of superposition with example.
3. State Castigliano's energy theorems.
4. Explain the need for dummy load method.
5. Explain the difference between long column and short column.
6. Write down the expressions for buckling loads of column with
   i) hinged ends,
   ii) fixed ends,
   iii) one end fixed and the other end free and
   iv) one end fixed and the other end hinged.
7. State the maximum stress theory and maximum strain theory.
8. State the maximum shear stress theory and distortion energy theory.
9. A bar of length L m is fixed at its ends and its temperature is raised. Write down the expression for thermal stress developed. What is the nature of stress ?
10. A bar of uniform section is fixed at its top end and a collar is attached at its bottom end. A block of weight W is allowed to slide along its length from height h and strike the collar. Write down the expression for stress developed in the bar.

PART – B (5×13=65 Marks)

11. a) Determine the forces in the members of the truss shown in the Fig. 1.

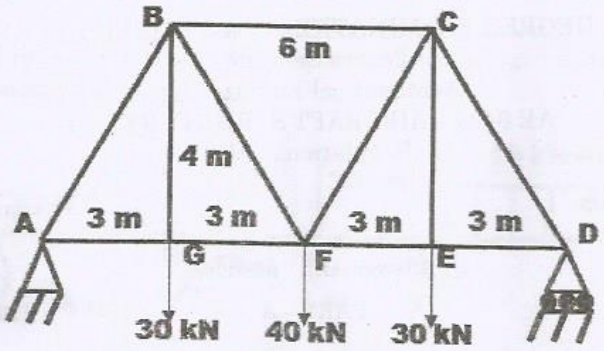

Fig. 1.

(OR)

b) A beam of uniform section and length L is fixed at one end and hinged at the other end. It is subjected to uniformly distributed load of intensity q_0 throughout its length. It is also subjected to a load P, acting downward at its midpoint. Using method of superposition determine the support reactions.

12. a) A Cantilever beam of length L and uniform section is subjected to uniformly distributed load of intensity q_0 over the entire length of the beam. Determine the slope and deflection at the free end using dummy load method.

(OR)

b) A simply supported beam of length L and uniform section is subjected to uniformly distributed load of intensity q_0 over the entire length of the beam. Determine the deflection at the midpoint using unit load method.

13. a) i) Derive the expression for critical buckling load of a column of length L, uniform section and with fixed ends. (7)

ii) A column of length 3 m has its cross section in the form rectangle of width 240 mm and depth 80 mm. Its modulus of elasticity is 210 GPa. Determine its slenderness ratio. Also determine the critical buckling load for the column with :

a) both ends hinged
b) both ends fixed
c) one end fixed and the other free and
d) one end fixed and the other end hinged. (6)

(OR)

b) A beam of length L and of uniform section is simply supported at its ends and subjected to shear force Q at its midpoint. Also it is subjected to axial compressive load P at its ends. Derive the expressions for beam-column displacement and its maximum stress.

14. a) A thin walled circular cylindrical tube is subjected to an internal pressure of 5 MPa and its mean radius is 400 mm. The yield stress of the tube material is 300 MPa and Poisson's ratio is 0.3. Determine the required wall thickness using maximum stress theory, maximum shear stress theory and strain energy theory. Consider factor of safety as 3.

(OR)

b) A shaft of diameter 80 mm is subjected to a torque of 6 kN-m and a bending moment. The yield stress of the material is 250 MPa and Poisson's ratio is 0.3. Determine the allowable bending moment using

i) maximum shear stress theory (4)

ii) maximum strain energy theory and (4)

iii) maximum shear strain energy/distortion energy theory. (5)

15. a) A stepped bar ABC is fixed at its ends and subjected to an axial load of 150 kN acting at B and directed towards C. Segments AB and BC are made of steel and copper respectively. Cross sectional area of AB is 25 cm^2 and its length is 50 cm. Cross sectional area and length of BC are 15 cm^2 and 30 cm respectively. The modulus of elasticity and coefficient of thermal expansion of steel and copper are respectively : $E_s = 210$ GPa, $\alpha_s = 12 \times 10^{-6}/°C$ and $E_c = 120$ GPa, $\alpha_c = 17 \times 10^{-6}/°C$. Determine the stress developed in steel and copper.

(OR)

b) Derive the expression for stress induced due to free fall of weight W on to a bar of length L and uniform section. A bar of length 3 m is fixed at its top end and a collar is attached at its bottom end. The cross section of the bar is circle of diameter 3 cm and modulus of elasticity is 210 GPa. A weight 500 N is allowed to fall from a height of 7.5 cm and strike the collar. Determine the stress induced, elongation of the bar and velocity of weight at the instant of striking the collar.

PART – C (1×15=15 Marks)

16. a) A continuous beam is subjected to loads as shown in Fig. 2 Determine the support reactions by applying Clapeyron's three moment theorem.

(OR)

b) Determine the support reactions of the beam shown in Fig. 2 using moment distribution method.

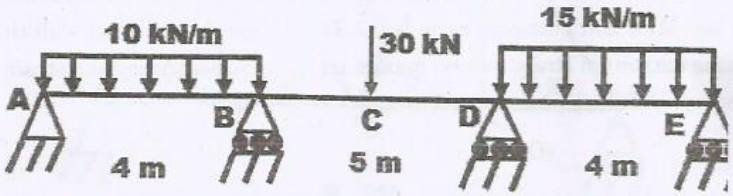

Fig. 2.