Reg. No. : | E | N | G | G | T | R | E | E | . | C | O | M |

Question Paper Code : 50028

B.E./B.Tech. DEGREE EXAMINATIONS, APRIL/MAY 2024.

Fourth Semester

Aeronautical Engineering

AE 3403 – AIRCRAFT STRUCTURES – I

(Regulations 2021)

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. State the "principle of superposition".
2. Define plane truss and space truss with example.
3. What are Castigliano's theorems?
4. Differentiate statically determinate and indeterminate beams.
5. Draw the Euler's curve of a beam column for different eccentric ratio's.
6. Brief how inelastic bucking differ from elastic buckling.
7. What is octahedral shear stress theory and list its significances.
8. What is factor of safety? How it plays important role in design of aircraft structures?
9. In design of aircraft structures, how to conduct failure analysis impact loading?
10. What is stress relaxation?

PART B — (5 × 13 = 65 marks)

11. (a) Derive the Clapeyron's theorem of three moments for continous beam with constant flexural rigidity.

Or

(b) A truss of span 10 meters is loaded as shown in fig 1. Find the forces in all the members of the truss.

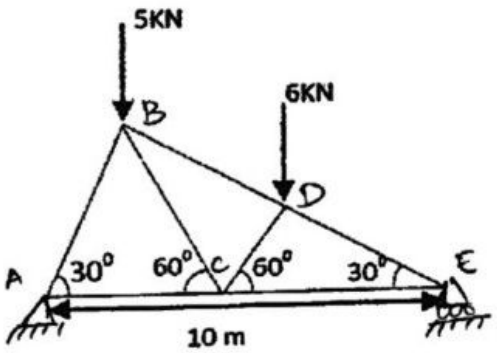

Fig. 1

12. (a) A slightly tapered bar AB of rectangular cross section and length L is acted upon by axial force P. The width of the bar varies uniformly from b_2 end at A to b_1 end at B as shown in fig.2. The thickness t is constant. Find the strain energy of the bar.

Fig. 2

Or

(b) A cantilever beam supports a concentrated load P and M_o as shown in the fig 3.

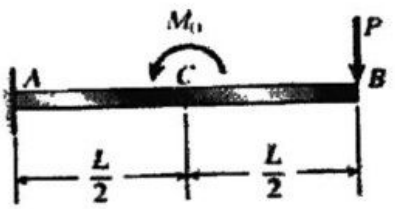

Fig. 3

Calculate the deflection and angle of rotation at point B using dummy load method.

13. (a) Draw and explain South-Well Plot.

Or

(b) Find the Euler's Crippling Load for a hollow cylindrical steel column of 38 mm external diameter and 2.5 mm thick. Take length of the column as 2.3 m and hinged at its both ends. Take E = 205 GPa. Also, determine crippling load by Rankine's formula using constants as σ_c = 335 MPa and a = 1/7500.

14. (a) Explain distortion energy theory. Discuss its significance and derive the failure envelope according to it.

Or

(b) The state of stress at critical point of a prismatic circular bar in rectangular coordinate system is given below. $\begin{pmatrix} 30 & 10 & 0 \\ 10 & 20 & 0 \\ 0 & 0 & 10 \end{pmatrix}$

Material properties are,

Yield stress in tension = 200MPa.

Ultimate stress in tension = 310MPa and

Poison's ratio = 0.3

Find principal stresses, factor of safety according to maximum shear stress criterion, factor of safety according to maximum distortion energy theory.

15. (a) A plastic bar ACB having two different solid circular cross sections is held between rigid supports as shown in the fig 4. The diameters in the left- and right-hand parts are 50 mm and 75 mm, respectively. The corresponding lengths are 225 mm and 300 mm. The modulus of elasticity (E) is 6.0 GPa, and the coefficient of thermal expansion is 100×10^{-6}/°C. The bar is subjected to a uniform temperature increase of 30°C.

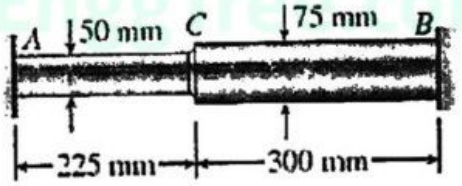

Fig. 4

Calculate

(i) Maximum compressive stress (7)

(ii) Displacement at point C. (6)

Or

(b) A block weighing W = 5.0 N drops inside a cylinder from a height h = 200 mm onto a spring having stiffness k = 90 N/m. Determine the impact factor and maximum shortening of the spring due to impact.

PART C — (1 × 15 = 15 marks)

16. (a) A prismatic circular bar is subjected to eccentric axial load of 10KN with eccentricity e = 10 mm from the axis of the bar. Find the diameter of the bar using maximum principal stress theory. Given yield stress in tension = 235 MPa, Ultimate tensile strength = 300 MPa and Factor of safety = 3.5.

Or

(b) The frame ABC supports a concentrated load P at point C. Members AB and BC have lengths h and b, respectively (as shown in fig. 5). Determine the vertical deflection and angle of rotation of the frame. (Use base form or modified form as convenient).

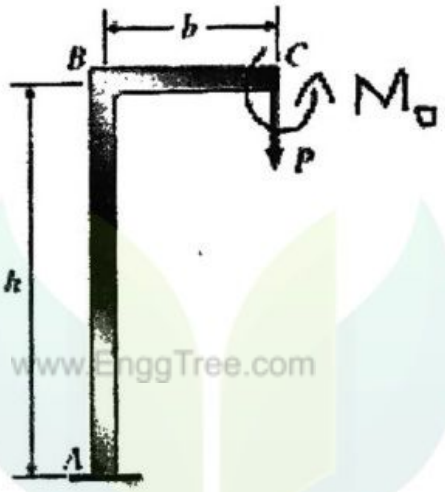

Fig. 5