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Question Paper Code : 90069

B.E./B.Tech. DEGREE EXAMINATIONS, NOVEMBER/DECEMBER 2022.

Fourth Semester

Aeronautical Engineering

AE 8403 – AIRCRAFT STRUCTURES – I

(Regulations 2017)

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Why do zero-force members are present in trusses?
2. Write down the compatibility condition used in the derivation of three moment equation.
3. Write the expression for strain energy due to torsion.
4. State Castigliano's theorems and mention their applications
5. State the significance of Southwell's plot.
6. What are the limitations of Euler's theory of buckling?
7. List down the theories that are commonly used to predict the failure of brittle materials.
8. Differentiate volumetric strain and distortion strain.
9. What causes stress relaxation?
10. What are the different types of thermal stresses?

PART B — (5 × 13 = 65 marks)

11. (a) Determine the end moments and support reactions at the supports of the beam shown in Fig. 11 a. Assume EI = constant.

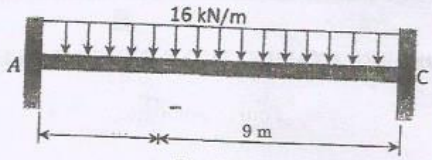

Fig.11a.

Or

(b) Using method of sections, determine the forces in the members DF, DE and CE of the truss shown in Fig. 11 b.

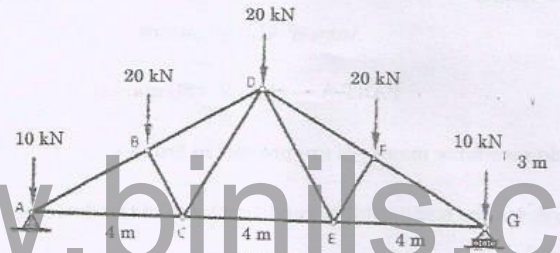

Fig.11b.

12. (a) A cantilever beam is subjected to an UDL of intensity 'w' (per unit length) throughout its span 'l'. Assume El is constant. Find the deflection and slope at the free end by energy methods.

Or

(b) A bar of uniform cross section is bent into a of quadrant of a circle of radius 'R'. One end of the bar is fixed and the other end is free. At the free end it carries a vertical load W'. Determine the vertical deflection at the free end using energy methods.

13. (a) A column of circular section is subjected to a load of 120kN. The load is parallel to the axis but eccentric by 2.5mm. The external and internal diameters of the column are 60mm and 50mm respectively. The column is 2.1m long with both of its ends hinged. Determine the maximum stress in the column. Take E=200GPa.

Or

(b) Determine the required ratio of buckling load of two columns one hollow and the other solid. Both are made up of same material and have the same length, cross sectional area and end conditions. The internal diameter of hollow column is half of its external diameter.

14. (a) Determine the required diameter of a bolt that is subject to an axial pull of 9kN together with a transverse shear force of 4.5kN using (i) Maximum Principal Stress failure theory and (ii) Maximum Principal Strain failure theory. Take the elastic limit in tension as 225N/mm², FOS as 3 and Poisson's ratio as 0.3.

Or

(b) At a section of a mild steel shaft, the maximum torque is 8437.5N-m and maximum bending moment is 5062.5N-m. The diameter of the shaft is 90mm and elastic limit in simple tension is 220N/mm². Determine whether the failure of the material will occur or not according to Maximum Shear Stress failure theory. If not then find the FOS.

15. (a) Steel railroad reels 10m long are laid with a clearance of 3mm at a temperature of 15°C. At what temperature will the rails just touch? What stress would be induced in the rails at that temperature if there were no initial clearance? Assume α =11.7 $\mu m/(m°C)$ and E=200GPa.

Or

(b) (i) Discuss about prediction of fatigue life.

(ii) Write notes on creep and stress relaxation.

PART C — (1 × 15 = 15 marks)

16. (a) Find the moment at the middle support 'B' using three-moment equation and sketch the BMD of the beam shown in Fig.16a

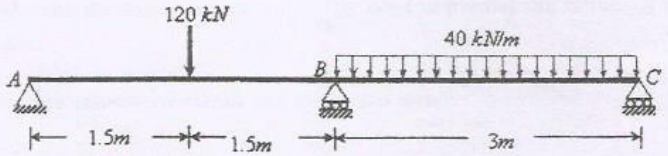

Fig.16a.

Or

(b) Find the deflection at the mid-span of the beam shown in Fig. 16b. Take $E = 200$ GPa and $I = 400 \times 10^6 mm^4$.

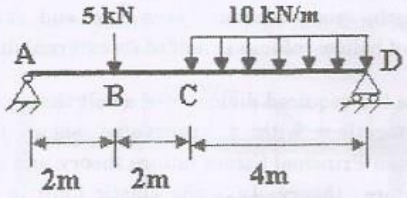

Fig.16b.