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Question Paper Code : 71565

B.E./B.Tech. DEGREE EXAMINATION, APRIL/MAY 2017.

Third Semester

Aeronautical Engineering

CE 6452 — SOLID MECHANICS

(Regulations 2013)

Time : Three hours Maximum : 100 marks

(Answer ALL the questions and missing data may be appropriately assumed, if any. Use of arithmetic graph sheet is permitted)

PART A — (10 × 2 = 20 marks)

1. Define stress at a section.

2. Sketch a three-dimensional-truss.

3. How 'force-couple' is different from 'moment-couple' in their actions on beams?

4. What do you mean by 'modular ratio' of materials?

5. Specify the location of maximum slope and deflection in a simply-supported beam carrying an udl of w kN/m throughout its span of length L.

6. Appropriately state the Maxwell's reciprocal theorem.

7. Give a mathematical expression for power transmission by a solid-shaft.

8. Mention one application of open- and closed-coil helical springs.

9. Write the sketch of a 'pure-shear' state of stress.

10. Write a mathematical expression for Hoop-stress in a thin cylinder.

PART B — (5 × 13 = 65 marks)

11. (a) A prismatic brass-bar shown in Fig. 11 (a) is subjected to axial forces as indicated. Find the magnitude and nature of the deformation of the entire bar. Take Young's modulus of elasticity of the bar as 105 GPa. (10 + 3)

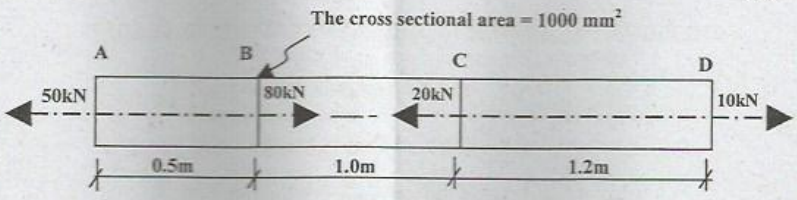

Fig. 11 (a)

Or

(b) Analyze the plane-truss shown in Fig. 11 (b) by method of joints. Also, appropriately tabulate the results. (10 + 3)

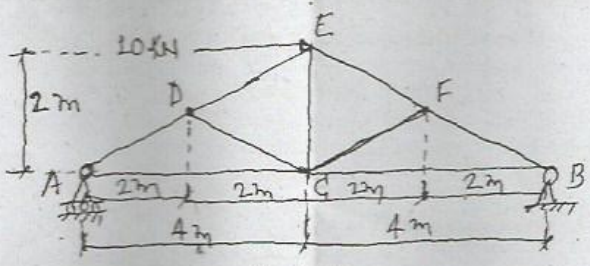

Fig. 11 (b)

12. (a) Analyze the beam shown in Fig. 12 (a) and draw the SFD with salient values in it. Also, specify the points of 'zero-SF' and 'SF-crossings' in it (if any). (6 + 4 + 3)

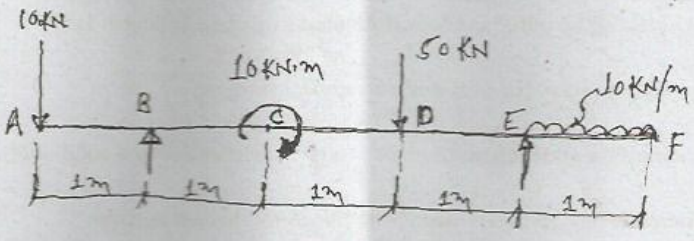

Fig. 12 (a)

Or

(b) Analyze the beam shown in Fig. 12 (b) and Draw the BMD with salient values in it. Also, specify the points of "contraflexure" and "BM crossings" in it (if any). (6 + 4 + 3)

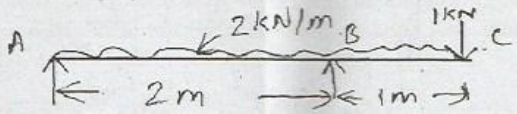

Fig. 12 (b)

13. (a) (i) Appropriately define the following theorems : two theorems of moment area method; principle of superposition; and Maxwell's reciprocal theorem. (4 × 2)

(ii) A cantilever beam carries a load of 10 kN which is 1 m from the support. Find the slope at that point. Take EI as constant. (5)

Or

(b) (i) Appropriately state the concepts behind: Macaulay's method; moment-area method and conjugate beam method for deflection of beams. (3 + 2 + 2)

(ii) A cantilever beam carries a load of 10 kN which is 1 m from the support. Find the deflection at that point. Take EI as constant. (6)

14. (a) (i) Write the simple torsion equation along with the nomenclature of each term in it. (3 + 4)

(ii) Find the critical load of a mild-steel scale of size 300 × 30 × 2 mm^3 which is properly built-in such a way that both the ends are highly rigid. Assume it is a long column and its modulus of elasticity is 200 GPa. (6)

Or

(b) (i) Appropriately analyze an open-coiled helical spring for its shear stress produced in it. (7)

(ii) With a neat sketch, explain the phenomenon of 'buckling' of long column. (6)

15. (a) A machine element is subjected to the various stresses as shown in Fig. 15 (a). Using Mohr's circle method, find the principal stresses, maximum shear stress, and their appropriate inclinations. (8 + 5)

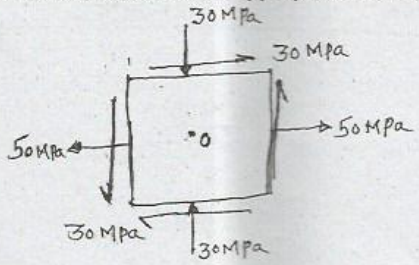

Fig. 15 (a)

Or

(b) With appropriate sketch, analyze a thin cylinder for critical stresses. (7 + 6)

PART C — (1 × 15 = 15 marks)

16. (a) Find the size and length of the middle piece BC of the tie-bar shown in Fig. 16 (a), if the stress in it is 140 MPa, total elongation of the entire bar is 0.14 mm, and Young's modulus of the bar is 200 GPa. (10 + 5)

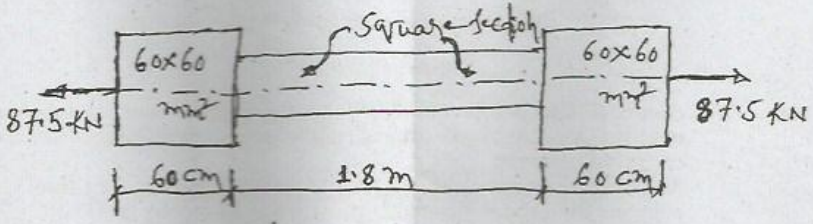

Fig. 16 (a)

Or

(b) A compound bar shown in Fig. 16 (b) is fixed between the rigid supports at 40° C. At this condition, what are the stresses in the bar, when the temperature is reduced by 20° C, if (i) its supports does not yield, and (ii) supports come near to each other by 0.1 mm. Take the respective moduli of elasticities of steel and aluminium as 210 GPa and 74 GPa; and the respective coefficients of linear expansions are 11.7×10^{-4} per ° C and 23.4×10^{-4} per °C. (3 + 7)

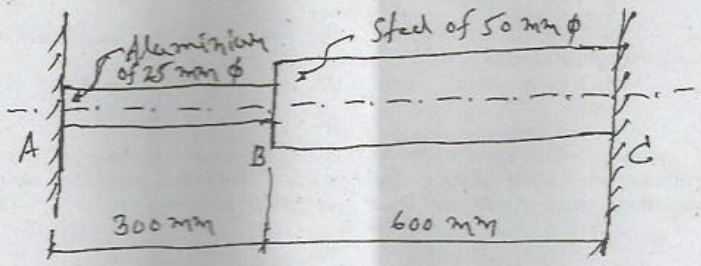

Fig. 16 (b)