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Question Paper Code : 70347

B.E./B.Tech. DEGREE EXAMINATIONS, NOVEMBER/DECEMBER 2023.

Third / Fourth Semester

Aeronautical Engineering

CE 8395 – STRENGTH OF MATERIALS FOR MECHANICAL ENGINEERS

(Common to: Aerospace Engineering/ Automobile Engineering/ Industrial Engineering/ Industrial Engineering and Management/ Manufacturing Engineering/ Marine Engineering/ Material Science and Engineering/ Mechanical Engineering/ Mechanical Engineering (Sandwich)/ Mechanical and Automation Engineering/ Mechatronics Engineering/ Production Engineering/ Robotics and Automation/ Safety and Fire Engineering)

(Regulations 2017)

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — ($10 \times 2 = 20$ marks)

1. Define thermal stress.

2. Write the relationship between E, G and K.

3. Differentiate hogging and sagging bending moment.

4. Draw the bending stress and shear stress distribution for an 'I' section.

5. Write the uses of helical springs.

6. Why hollow circular shafts are preferred when compared to solid circular shafts?

7. A simply supported beam of span 'L' subjected to a couple 'M' at a distance 'a' from the left end. Write the expression for bending moment using Macaulay's method.

8. How to find the slope and deflection at a point in a loaded beam using moment area method?

9. Differentiate between a thin cylinder and a thick cylinder.

10. Draw the failure pattern of thin cylinder when it is subjected to internal fluid pressure.

PART B — ($5 \times 13 = 65$ marks)

11. (a) A copper rod 36 mm diameter is enclosed with steel tube of 40 mm inner diameter. The ends being rigidly connected together. Assembly is heated to 30°C. Find the stress in each metal, coefficient of thermal expansion of steel = 12×10^{-6}/°C, for copper = 16×10^{-6}/°C. Modulus of elasticity Es = 200 GPa and Ecu = 110 GPa.

Or

(b) For the plane stress system shown in Figure. 11(b), find the major and minor principal stresses and the planes on which they act. Also find the maximum shear stresses and the planes on which they act. Show the planes and stress in a neat sketch.

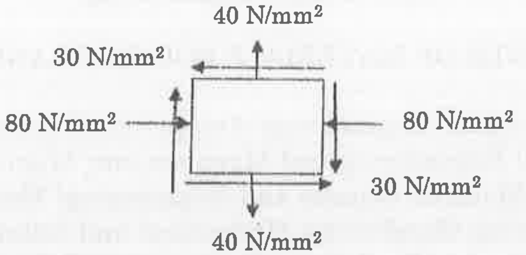

Figure. 11(b)

12. (a) Draw the Shear force and Bending moment diagrams for the loaded beam of length 9 m carrying uniformly distributed load as shown in Figure. Q. 12 (a)

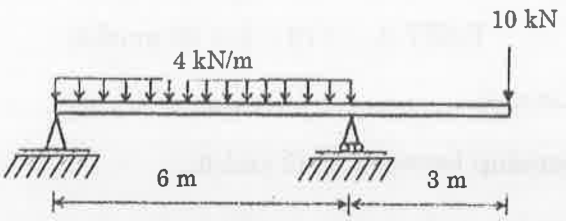

Figure Q. 12 (a)

Or

(b) The I section shown in figure Q.12 (b) is subjected to shear force of 120 kN. Find the maximum shear stress and draw the shear stress diagram.

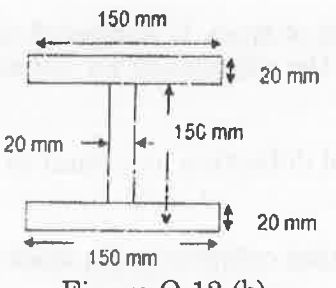

Figure Q.12 (b)

13. (a) A hollow shaft, having an internal diameter 50% of its external transmits 540 kW power at 120 rpm. The maximum torque being 20% greater than the mean. The shear stress is not to exceed 60 N/mm^2 and twist in a length of 3m not to exceed 1.2°. Calculate its external and internal diameters which would satisfy both the above conditions. Assume modulus of rigidity, $C = 1 \times 10^5$ N/mm^2.

Or

(b) A closely coiled helical spring of mean diameter 20 cm is made of 3 cm diameter rod and has 16 turns. A weight of 3 kN is dropped on this spring. Find the height by which the weight should be dropped before striking so that the spring may be compressed by 18 cm. Take $C = 8 \times 10^4$ N/mm^2.

14. (a) Determine the deflection at the mid span and slope at the ends for the beam shown in Fig.Q.14 (a) Take $EI = 8.6 \times 10^{10}$ kN/mm^2. Use Macaulay's Method.

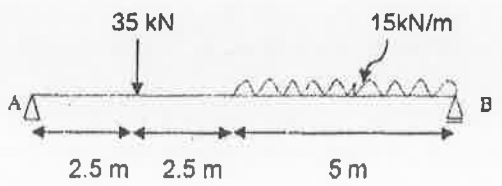

Fig.Q.14 (a)

Or

(b) A simply supported beam AB of span 4m carries a point load of 100 kN at its centre C. The value of I for the left half is 1×10^8 mm^4 and for the right portion I is 3×10^8 mm^4. Find the slopes at the two supports and deflection under the load. Take E = 200 GPa.

15. (a) A cylindrical vessel, whose ends are closed by means of rigid flange plates, is made of steel plate 3 mm thick. The length and the internal diameter of the vessel are 50 cm and 25 cm respectively. Determine the longitudinal and hoop stresses in the cylindrical shell due to an internal fluid pressure of 3 N/mm^2. Also calculate the increase in length, diameter and volume of the vessel.

Or

(b) Find the thickness of metal necessary for a cylindrical shell of internal diameter 150 mm to withstand an internal pressure of 7 N/mm^2. The maximum hoop stress in the section is not to exceed 35 N/mm^2.

PART C — (1 × 15 = 15 marks)

16. (a) Calculate the modulus of rigidity and bulk modulus of a cylindrical bar of diameter of 25 mm and of length 1.6 m, if the longitudinal strain in a bar during a tensile test is four times the lateral strain. Find the change in volume, when the bar is subjected to a hydrostatic pressure of 100 N/mm^2. Take E = 1 × 10^5 N/mm^2.

Or

(b) A cantilever beam AB of length L having uniform cross section fixed at the point A and free at the pin B and carries a gradually varying load from 0 at B to 'w' per unit run at the fixed end A. Calculate the slope and deflection at the free end.
