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Question Paper Code : S 4558

B.E./B.Tech. DEGREE EXAMINATION, NOVEMBER/DECEMBER 2009.

Fourth Semester

Mechanical Engineering

(Common to Second Semester Mechatronics Engineering)

CE 251 — STRENGTH OF MATERIALS

(Regulation 2001)

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Derive a relation for change in length of a bar hanging freely under its own weight.

2. A brass rod 2 m long is fixed at both its ends. If the thermal stress is not to exceed 76.5 N/mm². Calculate the temperature through which the rod should be heated. Take the values of α and E as 17×10^{-6}/K and 90 GPa respectively.

3. Draw shear force diagram for a simply supported beam of 5 m span is subjected to a clockwise moment of 15 kN.m at a distance of 2 m from the left end.

4. Sketch the bending and shear stress distribution for a 'T' section.

5. Show that the shear stress distribution over a rectangular section is parabolic.

6. Calculate the maximum torque that a shaft of 125 mm diameter can transmit, if the maximum angle of twist is 1° in a length of 1.5 m. Take $C = 70 \times 10^3$ N/mm².

7. A cylindrical shell of 500 mm diameter is required to withstand an internal pressure of 4 MPa. Find the minimum thickness of the shell, if maximum tensile strength in the plate material is 400 N/mm² and efficiency of joint is 65%. Take factor of safety as 5.

8. A rectangular R.C simply supported beam of span 3 m and cross section 200 mm × 350 mm carries a point load of 100 kN at its mid span. Find the maximum slope and deflection of the beam if $E = 0.2 \times 10^5$ N/mm².

9. Draw conjugate beam for a cantilever carrying uniformly distributed load over the entire span.

10. Define strain energy density.

PART B — (5 × 16 = 80 marks)

11. (a) (i) State Moment – Area Mohr's theorems. (4)

(ii) A simply supported beam AB of uniform section, 4 m span is subjected to a clockwise moment of 10 KN.m applied at the right hinge B. Derive the equation to the deflected shape of the beam. Locate the point of maximum deflection and find the maximum deflection. (12)

Or

(b) (i) Derive a relation for change in length of a bar of uniformly tapering circular section subjected to an axial tensile load 'W'. (8)

(ii) A reinforced concrete column 500 mm × 500 mm in section is reinforced with 4 steel bars of 25 mm diameter, one in each corner, the column is carrying a load of 1000 KN. Find the stresses in the concrete and steel bars. Take E for steel = 210×10^3 N/mm² and E for concrete = 14×10^3 N/mm². (8)

12. (a) Draw the shear force and bending moment diagram for the beam shown in Figure 12 (a) and also locate the point of contraflexure.

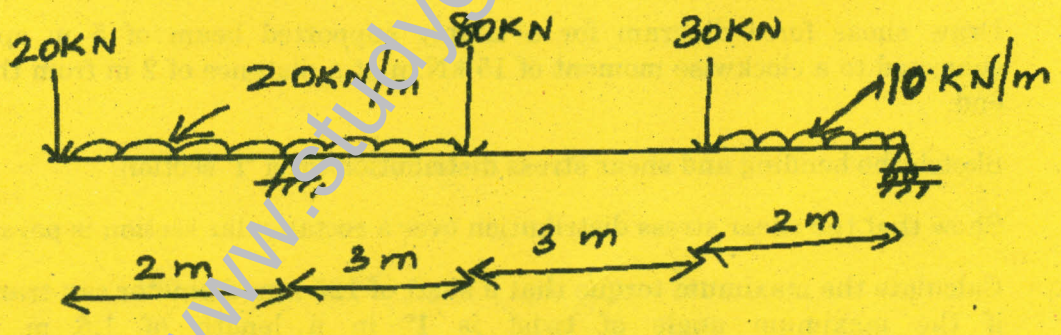

Figure 12 (a)

Or

(b) A simply supported beam AB of span 5 m carries a UDL of 25 KN/m throughout its entire span. Calculate the deflection at its mid span using any method. Assume EI = 2×10^4 KNm².

13. (a) A solid shaft is subjected to a torque of 100 Nm. Find the necessary shaft diameter if the allowable shear stress is 100 N/mm^2 and the allowable twist is 3° per 10 diameter length of the shaft. Take C = 1×10^5 N/mm^2.

Or

(b) (i) State any four assumptions made in the theory of simple bending. (4)

(ii) Derive the bending formula (12)

$$\frac{M}{I} = \frac{f}{y} = \frac{E}{R}$$

14. (a) A thin cylindrical shell 1.5 m long, internal diameter 300 mm and wall thickness 10 mm is filled up with a fluid at atmospheric pressure. If the additional fluid of 300×10^3 mm^3 is pumped in the shell, find the pressure exerted by the fluid on the shell. Take E = 2×10^5 N/mm^2 and 1/m = 0.3. Also find the hoop stress induced.

Or

(b) (i) Derive a relation for deflection of a closely coiled helical spring subjected to an axial downward load W. (8)

(ii) A quarter elliptic leaf spring 80 cm long is made of steel plates of width 10 times the thickness. The spring is to carry a load of 3 KN and the end deflection is limited to 5 cm. The bending stress of the plates must not exceed 300 N/mm^2. Find suitable values of the size and number of plates to be used. Take E = 2×10^5 N/mm^2. (8)

15. (a) A cantilever of length 2 a is carrying a load of W at the free end, and another load of W at its centre. Determine by moment area method, the slope and deflection of the cantilever at the free end.

Or

(b) (i) Derive a relation for strain energy stored in a body due to shear stress. (6)

(ii) A rectangular body 500 mm long, 100 mm wide and 50 mm thick is subjected to a shear stress of 80 Mpa. Determine the strain energy stored in the body. Take N = 85×10^3 N/mm^2. (10)
