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Total No. of Questions : 09] [Total No. of Pages : 03

Paper ID [ME201]

MAY-08

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B.Tech. (Sem. - 3rd)

STRENGTH OF MATERIALS -I (ME - 201)

Time : 03 Hours **Maximum Marks : 60**

Instruction to Candidates:

1) Section - A is **Compulsory**.
2) Attempt any **Four** questions from Section - B.
3) Attempt any **Two** questions from Section - C.

Section - A

(10 × 2 = 20)

Q1)

a) A torsion member is fabricated from two concentric thin tubes. At the ends, the two tubes are welded to rigid discs so that both the tubes are twisted as a unit. The radius of the outer tube is 2r and that of the inner tube is r. Find the ratio of the shear stress produced in the two tubes.

b) If an element is subjected to pure shearing stress of 20MPa, then find the value of maximum principal stress.

c) A steel cable of 20mm diameter is used to lift a load of 15kN. Find the elongation of the cable if E = 200GPa and the length of the cable is 10m.

d) Find the deflection at the centre of a simply supported beam of length 3 m, loaded with a udl of intensity 5kN/m through out. Take E = 200GPa and I = 3×10^6 mm^4.

e) Find the ratio of the torsional moments of resistance of a solid circular shaft of diameter 'D' and a hollow circular shaft having external diameter 'D' and internal diameter 'd'.

f) A steel bar of 2m length is fixed at both ends at 20°C.If the coefficient of thermal expansion is 11×10^{-6}/°C and the modulus of elasticity is 200GPa, find the stress experienced by the bar if the temperature is reduced to 18°C.

g) Briefly explain the concept of the point of contra-flexure.

h) An elastic bar of length 'L', cross-sectional area 'A', Young's modulus of elasticity 'E' and self weight 'w' is hanging vertically. It is subjected to a load 'P' applied axially at the bottom end. Find the total elongation of the bar.

i) The Euler load for a column is 1000kN and the crushing load is 1500kN. Find the 'Rankine' load?

j) Briefly discuss the parallel axis theorem for finding the second moment of area of a cross-section.

Section - B

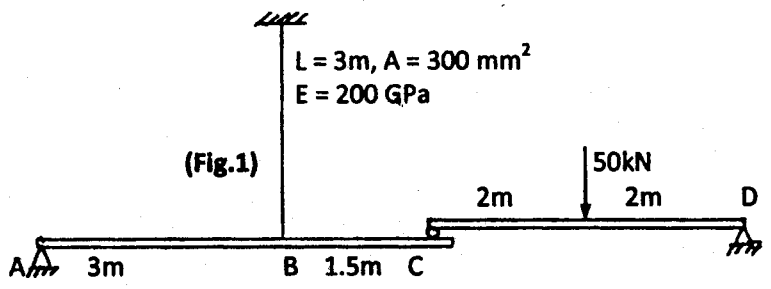
(4 × 5 = 20)

Q2) An overhanging beam of circular cross-section diameter, d = 101.6 mm,length L = 4.88 m is simply supported symmetrically. The distance between the two supports is 3.05 m. A load P = 18.15 kN act vertically at each end. Assuming E = 210 GPa, determine the deflection under each load.

Q3) A hollow steel shaft 4 m long is to transmit 150 kW power at 150 rpm. The total angle of twist in this length is not to exceed 2.5° and the allowable shear stress is 60 MPa. Determine the inside and outside diameters if G = 82 GPa

Q4) A steel tubular column of outer and inner diameters 40 mm and 30 mm respectively, is 2 m long. Compare the crippling loads given by Rankine's and Euler's Formula. They are loaded through pin joints at each end. Take yield stress = 330 N/mm^2, the Rankine's constant = 1/7500 and E = 200 GPa. Also determine the length at which the Euler's formula ceases to apply (in the same cross section)

Q5) The rigid bars ABC and CD are supported by pin supports at A and D and by a steel rod at B, as shown in Fig. 1. There is a roller connection between the bars at C. Compute the vertical deflection of point C caused by the 50kN load



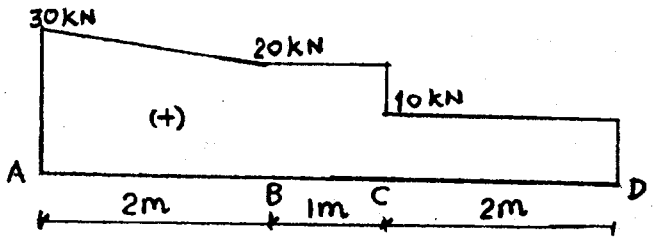
(Fig.1)

Q6) A spherical weather balloon is made of 0.2 mm thick fabric that has a tensile strength of 10 MPa. The balloon has to reach an altitude where the interior pressure is 1500MPa above the atmospheric pressure. Find the largest allowable diameter of balloon, using 1.2 as a factor of safety

Section - C

(2 × 10 = 20)

Q7) From the shear force diagram for a cantilever beam as shown in Fig. 2 develop the loading diagram and subsequently the bending moment diagram



(Fig-2)

Q8) The strains on an element are:

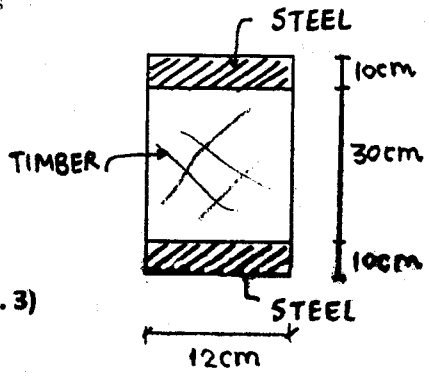
$\varepsilon_x = -8 \times 10^{-4}$ $\varepsilon_y = -2 \times 10^{-4}$ $\gamma_{xy} = -8 \times 10^{-4}$

Determine analytically as well as graphically the principal strains and their directions. What are the corresponding principal stresses and in which direction do these act (E = 200 GPa and $v = 0.3$)

Q9) A flitched beam consists of a timber beam 12 cm wide and 30 cm deep with two steel plates, one at the top while other at the bottom, each 12 cm wide and 10 cm thick firmly secured to the timber beam (Fig. 3). If the maximum permissible stress for timber is 8 N/mm^2, find the following for the flitched beam.

(a) Moment of resistance
(b) Bending stress distribution
(c) Bending strain distribution.

Take $E_s/E_t = n_s = 20$



(Fig. 3)