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C193

B. Tech. EXAMINATION, 2020

(Third Semester)

(B Scheme) (Re-appear Only)

(AE)

AE205B

MECHANICS OF SOLIDS

Time : 2½ *Hours*] [*Maximum Marks :* 75

Before answering the question-paper candidates should ensure that they have been supplied to correct and complete question-paper. No complaint, in this regard, will be entertained after the examination.

Note : Attempt *Four* questions in all. All questions carry equal marks. Candidate may use only non-programmable scientific calculator. Assume suitably missing data, if any.

1. (a) From the basic principles, derive the relationship between Young's Modulus of Elasticity and Bulk Modulus of Elasticity.

(b) A copper rod of 40 mm diameter is surrounded tightly by a cast-iron tube of 80 mm external diameter; its ends are firmly fastened together. When put to a compressive load of 30 kN, what load will be shared by each material ? Also determine the amount by which the compound bar is shortened if it is 2 m long. Assume E_{CI} = 175 GPa and E_{Cu} = 75 GPa.

2. A vertical steel rod, 1.3 m long, is rigidly secured at its upper end. A weight of 80 N is allowed to slide freely on the rod through a distance of 100 mm on to the stop mounted at the lower end. The upper 700 mm length of

rod has a diameter of 20 mm while the lower 600 mm length is 16 mm in diameter. Calculate the maximum stress induced in the bar ignoring the extension of the bar in determining the potential energy given up by the weight. Assume E = 200 GPa.

3. A beam ABCD 10 m long is supported at points B and C. The overhangs AB and CD are 2 m and 3 m respectively. The overhang AB carries UDL of 1 kN/m and CD carries a UDL of 0.5 kN/m. In addition to this, there are point loads of 1 kN, 2 kN and 1 kN at distance of 1.5 m, 3 m and 8 m from point A respectively. Find the reactions at the support points and draw shear force and bending moment diagrams stating thereon all the important values of the SF and BM. State the position of the points of inflexion on the beam, if any.

4. Three beams have the same length, the same allowable stress and the same bending moment. The cross-sections of the beams are a square, a rectangular with depth twice the width and a circle. Determine the ratios of the weight of the circular and rectangular beams with respect to the square beam.

5. A hollow shaft of diameter ratio 3/5 is required to transmit 800 kW at 110 rpm. The maximum torque being 20% greater than the mean. The shear stress is not to exceed 63 MPa and the twist in length of 3 m is not to exceed 1.4 degree. Calculate the minimum external diameter satisfying these conditions. Assume G = 84 GPa.

6. Derive shear stress and axial deflection equations for a closed coiled helical spring subjected to an axial load in its usual symbols.

7. Compare the crippling loads given by Rankine's and Euler's formulae for tubular strut of 2.25 m long having outer and inner diameters of 37.5 mm and 32.5 mm respectively and loaded through pin-join at both ends. Assume, yield stress as 315 MPa, a = 1/7500 and E = 200 GPa. If elastic limit for the material is taken as 200 MPa, then for what length of the strut, does the Euler formula cease to apply ?

8. A thin cylinder 50 mm internal diameter and 1 mm thick is subjected to an internal pressure of 1 MPa and also a torque of 50 Nm about the axis of the cylinder. Determine the principle stresses and maximum shear stress on the outer surface of the cylinder.