Roll No. ..... Total Pages : 04

BT-3/D-19 33104

MECHANICS OF SOLIDS-I

ME-203N

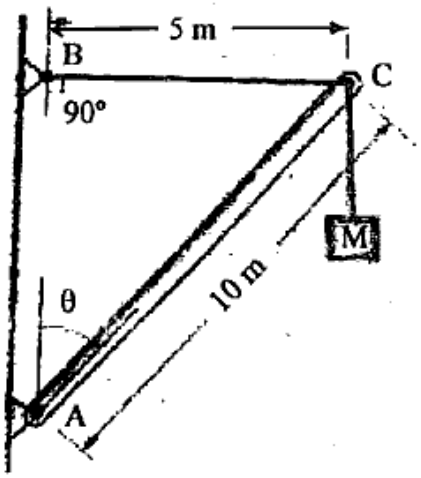
Time : Three Hours] [Maximum Marks : 75

Note : Attempt *Five* questions in all, selecting at least *one* question from each Unit. All questions carry equal marks. Assume any missing data.

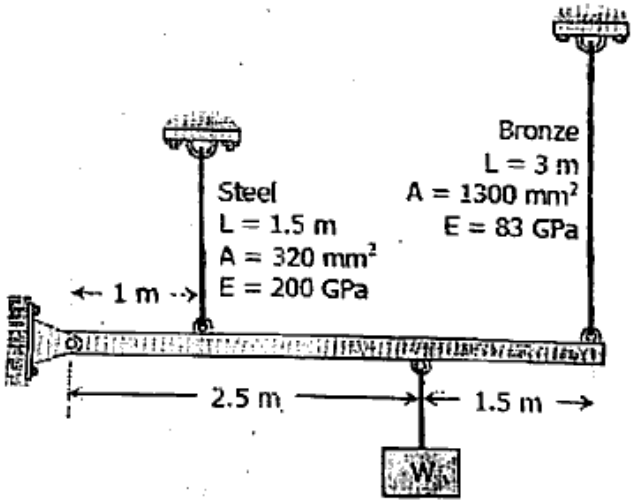
Unit I

1. (a) State and prove Lami's theorem. **5**

   (b) A 10 m boom supports a load of 600 kg. as shown in Fig. given below. The cable BC is horizontal and 5 m long. Find the forces in boom and the cable. **10**



2. A rigid bar of negligible weight is supported as shown in Fig. If W = 80 kN, compute the temperature change that will cause the stress in the steel rod to be 55 MPa. Assume the coefficients of linear expansion are 11.7 μm/(m.°C) for steel and 18.9 μm/(m.°C) for bronze. **15**



Unit II

3. At a point in a piece of material there is a tensile stress of 8650 N/cm² upon a horizontal plane and a compressive stress of 3950 N/cm² upon a vertical plane. There is also a shear stress of 4720 N/cm² upon each of these planes. Find the planes of maximum shear stress at the point. Determine also the resultant stress on the planes of maximum shear stress. **9**

Draw the Mohr's circle diagram when a piece of material is subjected to shear stress only. Assume any suitable value of stress for the diagram. 6

4. A beam AB 10 m long carries a uniformly distributed load of 2 kN/m over its entire length together with concentrated load of 5 kN at the left end A and 8 kN at right end B. The beam is to be supported at two props at the same level, 6 m apart so that the reaction is the same at each. Find the positions of the supports and S.F. and B.M. diameters. Mark the value of maximum B.M. Locate the points of inflexion, if any. 15

Unit III

5. A solid alloy shaft 50 mm diameter is to be coupled in series with a hollow steel shaft of the same external diameter. Find the internal diameter of the steel shaft if the angle of twist per unit length is to be 75% of that of the alloy shaft. http://www.kuonline.in

Determine the speed at which the shafts are to be driven to transmit 200 kW if the limits of shearing stresses are to be 55 and 80 MN/m^2 in the alloy and steel respectively. $G_{steel} = 2.2\ G_{alloy}$. 15

6. A timber beam 150 mm wide and 100 mm deep is to be reinforced by two steel flitches each 150 mm × 10 mm in section. Calculate the ratio of the moments of resistance in the two mentioned cases : (i) Flitches attached symmetrically on the sides (ii) Flitches attached at top and bottom. 15

Unit IV

7. Derive the expression for Euler critical load in case the column with both ends hinged. 5

A CI cylindrical column 3 m in length and with ends hinged has a critical buckling load of P kN. When the column is fixed at both ends, its critical buckling load rises by 300 kN more. If the ratio of external diameter to internal diameter is 1.25 and E = 100 GPa, determine the external diameter of column. 10

8. A simply supported beam of 5 m length is subjected to concentrated point load of 16 kN at 1 m from left support and 24 kN at 1 m from right support. The beam carries a uniformly distributed load of 8 kN/m over a span of 2 m at a distance of 1 m from left support. Using Macaulay's method, make calculations for deflections at all important points. The flexural rigidity for the given beam EI = 12000 × 10^6 kN mm^2. 15