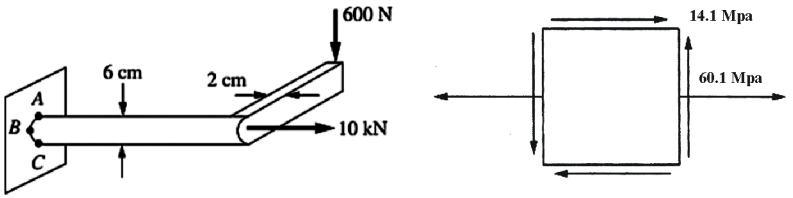
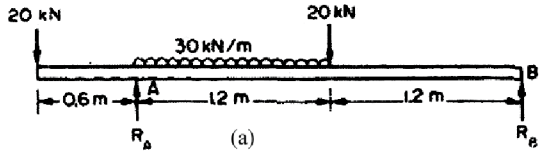
and angle of twist, will each lead to different values for the required diameter. The larger shaft must then be chosen as the one for which neither condition is exceeded. For the shaft material G = 80 GN/m^2. **15**

Section C

5. A 1-m-long rectangular beam is attached to a 2 m long circular shaft and loaded as shown in figure. Calculate the maximum normal and shearing stresses at points A, B and C. **15**



6. Determine the slope and deflection under the 50 kN load for the beam loading system E = 200 GN/m^2; I = 80 × 10^{-6} m^4 shown in figure. Find also the position and magnitude of the maximum deflection. **15**



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B. Tech. EXAMINATION, 2021

Semester III (CBCS)

STRENGTH OF MATERIALS–I (ME, AE)

ME-301

Time : 2 Hours *Maximum Marks : 60*

The candidates shall limit their answers precisely within 20 pages only (A4 size sheets/assignment sheets), no extra sheet allowed. The candidates should write only on one side of the page and the back side of the page should remain blank. Only blue ball pen is admissible.

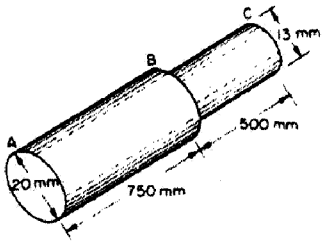
Note : Attempt *Four* questions in all, selecting *one* question from any of the Sections A, B, C and D. Q. No. **9** is compulsory.

Section A

1. (a) A 25 mm diameter bar is subjected to an axial tensile load of 100 kN. Under the action of this load a 200 mm gauge length is found to extend 0.19 × 10^{-3} mm. Determine the modulus of elasticity for the

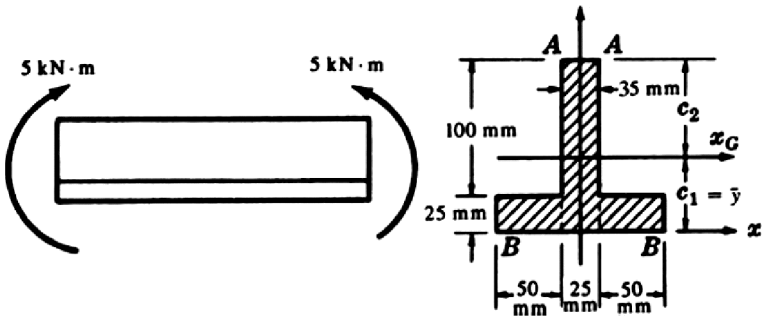
bar material. (b) If, in order to reduce weight whilst keeping the external diameter constant, the bar is bored axially to produce a cylinder of uniform thickness, what is the maximum diameter of bore possible given that the maximum allowable stress is 240 MN/m^2 ? The load can be assumed to remain constant at 100 kN. (c) What will be the change in the outside diameter of the bar under the limiting stress quoted in (b) ? (E = 210 GN/m^2 and v = 0.3). **15**

2. A steel bar ABC is of circular cross-section and transmits an axial tensile force such that the total change in length is 0.6 mm. The total length of the bar is 1.25 m. AB being 750 mm and 20 mm diameter and BC being 500 mm long and 13 mm diameter shown in figure. Determine for the parts AB and BC the changes in (a) length and (b) diameter. Assume Poisson's ratio v for the steel to be 0.3 and Young's modulus E to be 200 GN/m^2. **15**



Section B

3. A beam is loaded by one couple at each of its ends, the magnitude of each couple being 5 kNm. The beam is steel and of T-type cross-section with the dimensions indicated in figure. Determine the maximum tensile stress in the beam and its location and the maximum compressive stress and its location. **15**



4. Determine the dimensions of a hollow shaft with a diameter ratio of 3 : 4 which is to transmit 60 kW at 200 rev/min. The maximum shear stress in the shaft is limited to 70 MN/m^2 and the angle of twist to 3.8° in a length of 4 m. The two limiting conditions stated in the question, namely maximum shear stress

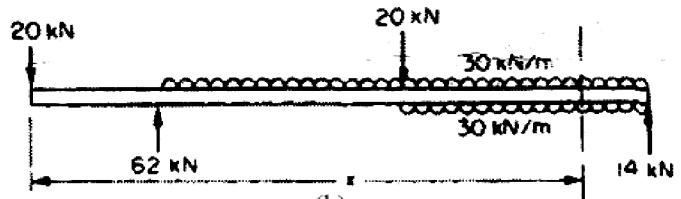
(Compulsory Question)

9. (a) Draw stress-strain diagram for Mild steel, cast iron and highly ductile material. Explain how Poisson's ratio is determined during stress-strain testing and also show what happens in the area where stress becomes constant but strain increases ? **4**

(b) Draw neat sketch and explain ductile and brittle failure of circular shaft. **4**

(c) Show relationship between bending moment, slope and deflection. **4**

(d) Draw all static theories failure envelope at one place and compare all theories of failure in terms of yield stress. **3**



(b)

Section D

7. A structure is composed of circular members of diameter *d*. At a certain position along one member the loading is found to consist of a shear force of 10 kN together with an axial tensile load of 20 kN. If the elastic limit in tension of the material of the members is 270 MN/m^2 and there is a factor of safety of 4, estimate the magnitude of *d* required according to (a) the maximum principal stress theory and (b) the maximum shear strain energy per unit volume theory. Poisson's ratio $v = 0.283$. **15**

8. Using Castigliano's first theorem, obtain the expression for (a) the deflection under a single concentrated load applied to a simply supported beam as shown in figure (b) the deflection at the centre of a simply supported beam carrying a uniformly distributed load. **15**