Please check that this question paper contains__09__ questions and _03_ printed pages within first ten minutes.

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

Uni. Roll No. …….

Program: **B.Tech.**
Semester: **3rd**
Name of Subject: **Strength of Materials**
Subject Code: **PCME-102**
Paper ID: **16073**

12-01-2022(M)

Time Allowed: 02 Hours **Max. Marks: 60**

NOTE:

1) Each question is of 10 marks.
2) Attempt any six questions out of nine
3) Any missing data may be assumed appropriately

Q1. A steel rod of 20 mm diameter passes centrally through a tight-fitting copper tube of external diameter 40 mm. The tube is closed with the help of rigid washers of negligible thickness and nuts threaded on the rod. The nuts are tightened until the tube's compressive load is 50 kN, as shown in Figure 1.

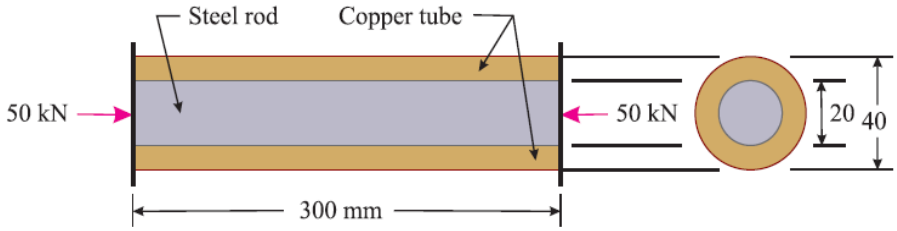

Figure 1.

Determine the stresses in the rod and the tube when the assembly temperature falls by 50 K. Take E for steel and copper as 200 GPa and 100 GPa, respectively. Take coefficient of expansion for steel and copper as 12×10^{-6} K and $18x\ 10^{-6}$ K, respectively.

Q2. Figure 2 shows three direct stresses in three coplanar directions, p, q and r, at a particular point. Determine the magnitude and the direction of the principal stresses.

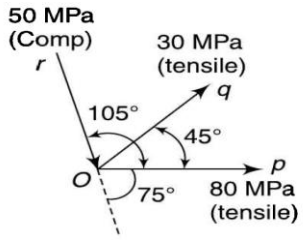

Figure 2.

P.T.O.

Q3. A horizontal bean AB 6 m long is hinged at A and freely supported at B. The beam is loaded, as shown in Figure 3. Draw the shear force and bending moment diagrams.

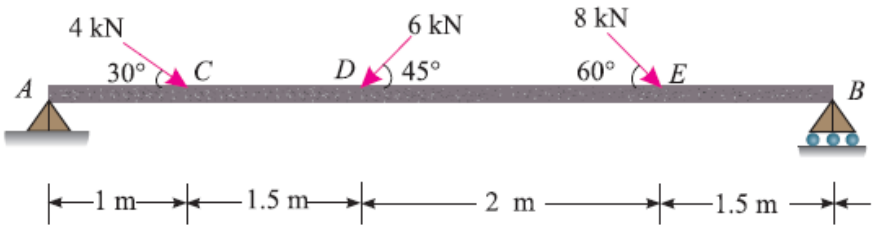

Figure 3.

Q4. A cast-iron water pipe of 500 mm inside diameter and 20 mm thick is supported over a span of 10 meters. Find the maximum stress in the pipe metal when the pipe is running full. Take the density of cast iron as 70.6 kN/m³ and that of water as 9.8 kN/m³. Refer to Figure 4.

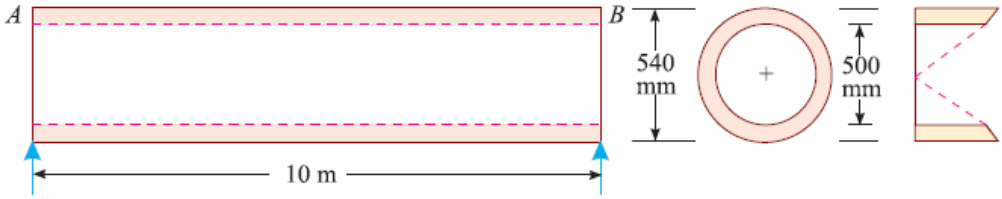

Figure 4.

Q5. The cross-section of a beam is shown in Figure 5. The beam is made of material with permissible stress in compression and tension equal to 100 MPa and 140 MPa, respectively. Calculate the moment of resistance of the cross-section when subjected to a moment causing compression at the top and tension at the bottom.

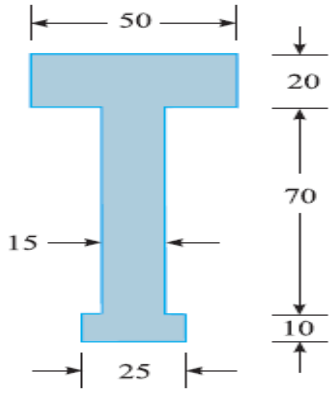

Figure 5.

Q6. A composite shaft consists of a steel rod of 60 mm diameter surrounded by a closely fitting tube of brass. Find the outside diameter of the brass tube when a torque of 1 kN-m is applied on the composite shaft and shared equally by the two materials. Take C for steel as 84 GPa and C for brass as 42 GPa. Also, determine the common angle of twist in a length of 4 metres.

Q7. A boiler shell of 2 m diameter comprises mild steel plates of 20 mm thick. The efficiency of the longitudinal and circumferential joints is 70% and 60%, respectively. First, determine the safe pressure in the boiler if the permissible tensile stress in the plate section through the rivets is 100 MPa. Also, determine the circumferential stress in the plate and longitudinal stress through the rivets.

Q8. At a section of a mild steel shaft, the maximum torque is 8437.5 Nm and maximum bending moment is 5062.5 Nm. The diameter of shaft is 90 mm and the stress at the elastic limit in simple tension for the material of the shaft is 220 N/mm^2. Determine whether the failure of the material will occur or not according to maximum shear stress theory. If not, then find the factor of safety.

Q9. A beam of length 6 m is simply supported at its ends and carries two-point loads of 48 kN and 40 kN at a distance of 1 m and 3 m respectively from the left support. Find:
(i) deflection under each load,
(ii) maximum deflection, and
(iii) the point at which maximum deflection occurs.

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