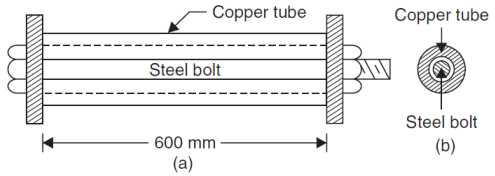
Jaipur Engineering College and Research Centre
Department of Mechanical Engineering
Subject: Mechanics of Solids [3ME4-07]
ASSIGNMENT-1 [Unit-1]

Q1. What is the difference between nominal stress and true stress? Explain.
Q2. What is factor of safety? Explain.
Q3. Discuss the meaning of stress and also explain Hooke's law.
Q4. How shear stress is different from simple stress? Discuss in detail.
Q5. A Surveyor's steel tape 30 m long has a cross-section of 15 mm × 0.75 mm. With this, line AB is measure as 150 m. If the force applied during measurement is 120 N more than the force applied at the time of calibration, what is the actual length of the line? Take modulus of elasticity for steel as 200 kN/mm^2.
Q6. A hollow steel tube is to be used to carry an axial compressive load of 160 kN. The yield stress for steel is 250 N/mm2. A factor of safety of 1.75 is to be used in the design. The following three class of tubes of external diameter 101.6 mm are available. Which section do you recommend?

Class:	Light	Medium	Heavy
Thickness:	3.65 mm	4.05 mm	4.85 mm

Q7. A specimen of steel 20 mm diameter with a gauge length of 200 mm is tested to destruction. It has an extension of 0.25 mm under a load of 80 kN and the load at elastic limit is 102 kN. The maximum load is 130 kN.
The total extension at fracture is 56 mm and diameter at neck is 15 mm. Find
(i) The stress at elastic limit (ii) Young's modulus (iii) Percentage elongation
(iv) Percentage reduction in area. (v) Ultimate tensile stress.
Q8. A bar of 25 mm diameter is tested in tension. It is observed that when a load of 60 kN is applied, the extension measured over a guage length of 200 mm is 0.12 mm and contraction in diameter is 0.0045 mm. Find Poisson's ratio and elastic constants E, G, K.
Q9. A steel bolt of 20 mm diameter passes centrally through a copper tube of internal diameter 28 mm and external diameter 40 mm. The length of whole assembly is 600 mm. After tight fitting of the assembly, the nut is over tightened by quarter of a turn. What are the stresses introduced in the bolt and tube, if pitch of nut is 2 mm? Take $E_s = 2 \times 10^5$ N/mm^2 and $E_c = 1.2 \times 10^5$ N/mm^2.



Q10. A steel rail is 12 m long and is laid at a temperature of 18°C. The maximum temperature expected is 40°C.

i. Estimate the minimum gap between two rails to be left so that the temperature stresses do not develop.
ii. Calculate the temperature stresses developed in the rails, if:
    a. No expansion joint is provided.
    b. If a 1.5 mm gap is provided for expansion.
iii. If the stress developed is 20 N/mm^2, what is the gap provided between the rails?

Take $E = 2 \times 10^5$ N/mm^2 and $\alpha = 12 \times 10^{-6}$/°C.

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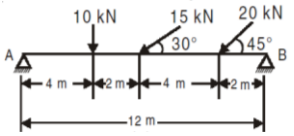
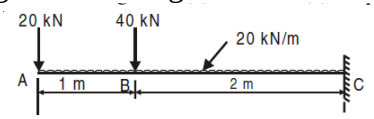
ASSIGNMENT-2 [Unit-2]

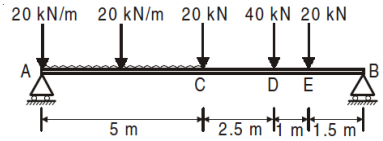
Q1. Discuss the different types of supports.
Q2. Discuss the different types of beams.
Q3. Discuss the different types of loading.
Q4. What do you mean with theory of simple bending? Explain.
Q5. The beam AB of span 12 m shown in figure is hinged at A and is on rollers at B. Determine the reactions at A and B for the loading shown in the figure.



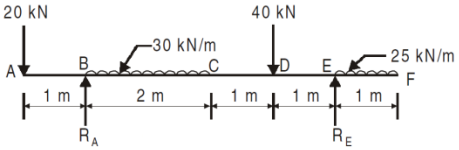
Q6. Draw shear force and bending moment diagram for the cantilever beam shown in figure.



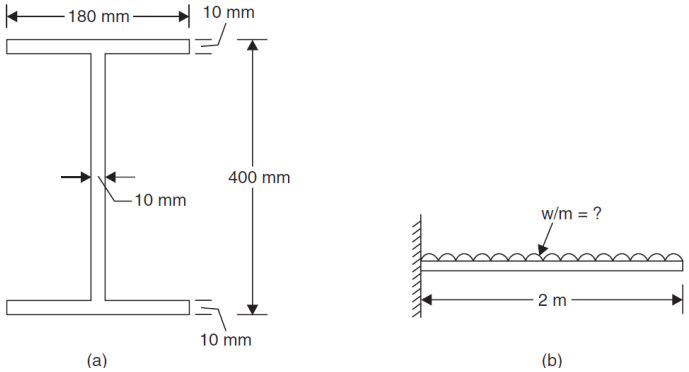
Q7. Draw the SF and BM diagrams for the beam shown in figure and find out the position and the magnitude of maximum moment.



Q8. Draw BM and SF diagrams for the beam shown in figure, indicating the values at all salient points.



Q9. Figure shows the cross-section of a cantilever beam of 2.5 m span. Material used is steel for which maximum permissible stress is 150 N/mm^2. What is the maximum uniformly distributed load this beam can carry?



Q10. Compare the moment carrying capacity of the section given in Q.9 with equivalent section of the same area but (i) square section, (ii) rectangular section with depth twice the width and (iii) a circular section.

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Assignment 3 [Unit-3]

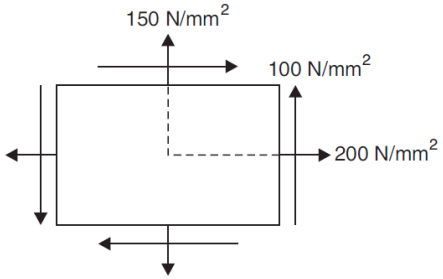
Q1. Show that sum of normal stresses in any two mutually perpendicular directions is constant in case of a general two dimensional stress.

Q2. A material has strength in tension, compression and shear as 30N/mm^2, 90 N/mm^2 and 25 N/mm^2, respectively. If a specimen of diameter 25 mm is tested in tension and compression identity the failure surfaces and loads.

Q3. The state of stress at a point in a strained material is as shown in figure. Determine

i. the direction of principal planes,
ii. the magnitude of principal stresses and
iii. the magnitude of maximum shear stress.

Indicate the direction of all the above by a sketch.



Q4. Write short notes on followings:

i. Maximum shear stress theory
ii. Maximum principle strain theory
iii. Maximum principle stress theory
iv. Total strain energy per unit volume theory
v. Maximum shear strain energy per unit volume theory

Q5. Why failure theories are needed? Name the important theories of failure. Discuss the use of different theories.

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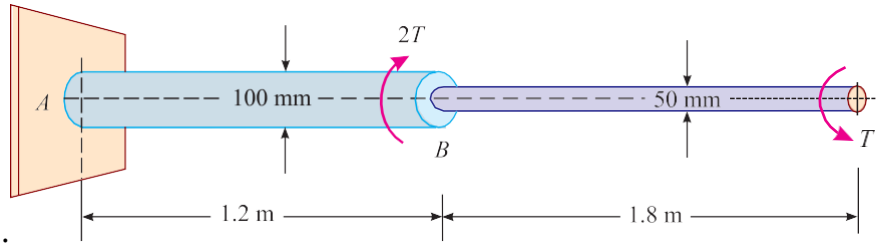
Assignment 4 [Unit-4]

Q1. Define the term torque. Prove $\frac{\tau}{R} = \frac{C\theta}{l}$ in case of torsion of a circular shaft.

Q2. A solid steel shaft of 60 mm diameter is to be replaced by a hollow steel shaft of the same material with internal diameter equal to half of the external diameter. Find the diameters of the hollow shaft and saving in material, if the maximum allowable shear stress is same for both shafts.

Q3. The stepped steel shaft shown in Fig. 27.4 is subjected to a torque (T) at the free end, and a torque (2T) in the opposite direction at the junction of the two sizes



What is the total angle of twist at the free end, if maximum shear stress in the shaft is limited to 70 MPa? Assume the modulus of rigidity to be 84 GPa.

Q4. What do you understand by the terms column and strut? Distinguish clearly between long columns and short columns. Also explain the failure of long columns and short columns.

Q5. A T-section 150 mm × 120 mm × 20 mm is used as a strut of 4 m long with hinged at its both ends. Calculate the crippling load, if Young's modulus for the material be 200 GPa.

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Assignment 5 [Unit-5]

Q1. What is the relation between slope, deflection and radius of curvature of a simply supported beam?

Q2. What is moment area method for the slope and deflection of a simply supported beam?

Q3. A simply supported beam of span 4 m is carrying a uniformly distributed load of 2 kN/m over the entire span. Find the maximum slope and deflection of the beam. Take EI for the beam as 80 $\times 10^9$ N-mm^2.

Q4. Distinguish between circumferential stress and longitudinal stress in a cylindrical shell, when subjected to an internal pressure.

Q5. A cylindrical thin drum 800 mm in diameter and 4 m long is made of 10 mm thick plates. If the drum is subjected to an internal pressure of 2.5 MPa, determine its changes in diameter and length. Take E as 200 GPa and Poisson's ratio as 0.25.