

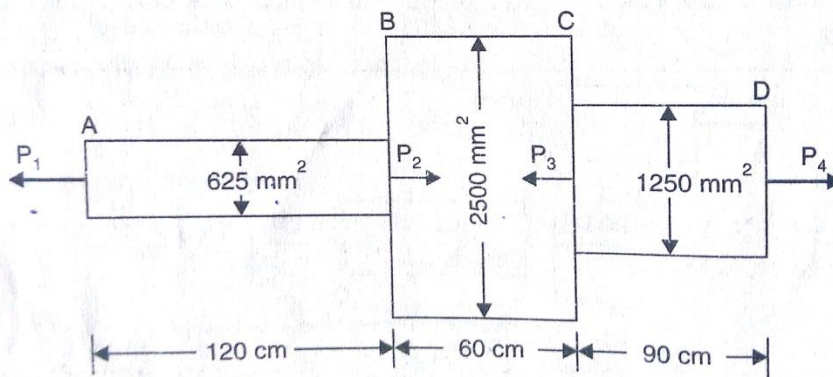
IMPORTANT QUESTIONS OF MECHANICS OF MATERIALS

PART – A

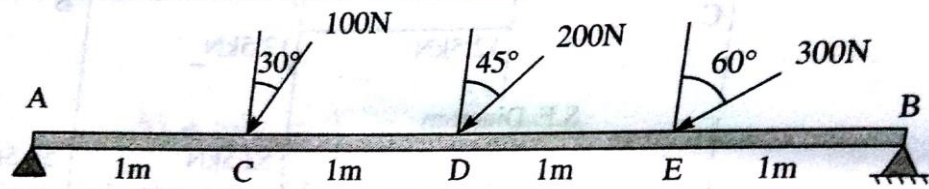
1. Define stress and strain and What are the various types of stresses and strains.
2. Define Elasticity ,ductility and Plasticity.
3. Define Poisson's ratio ,Youngs modulus,Bulk Modulus, Modulus of Rigidity & Factor of safety and what is the Relationship between elastic constants (E, G & K)? .
4. A rod 200cm long and of diameter 3cm is subjected to an axial pull of 30KN if the youngs modulus of the material is $2 \times 10^5 \text{ N/mm}^2$. Determine stress,strain and elongation of the rod.
5. The safe stress for a hollow steel column which carries an axial load of 2.2MN is 0.12 GN/m^2 . If the external diameter of the column is 25cm, determine the internal diameter.
6. Define Beam and what are the various types of beams explain clearly with the help of neat sketch?
7. What are the various loads acting on a beam?
8. Define point of contraflexure?
9. Define Shear force and Bending moment.
10. Draw the Shear force and bending moment for cantilever of length 'L' carrying a point load 'W' at the free end.
11. What is flitched beam?
12. What do you mean by simple bending and pure bending?
13. What is section modulus? Write the equation for circular section?
14. What are the assumptions made in the theory of simple bending?
15. Find an expression for section modulus for a rectangular section?
16. What do you mean by slope and deflection.
17. Calculate instantaneous stress produced in a bar 10 cm^2 in area and 4m long by the sudden application of tensile load of unknown magnitude, if the extension of the bar due to suddenly applied load. Take $E = 2 \times 10^5 \text{ N/mm}^2$.
18. A tensile load of 60KN is gradually applied to a circular bar of 4cm diameter and 5m long. If young's modulus is $2 \times 10^5 \text{ N/mm}^2$. Determine strain energy absorbed by the rod.
19. What do you mean by slope and deflection.
20. A wooden beam of 4 m long, simply supported at its ends, is carrying a point load of 7.25 KN at its centre. If E for the beam is $2 \times 10^5 \text{ N/mm}^2$ and $I = 1 \times 10^8 \text{ mm}^4$ then find maximum slope and deflection.
21. The shearing stress of a solid shaft is not to exceed 40 N/mm^2 . When the torque transmitted is 20000 N-m. Determine the minimum diameter of the shaft.
22. Define Resilience, Proof Resilience and Modulus of Resilience.
23. Define the following terms a)Torsion b) proof Resilience c) Polar Moment of inertia?
24. A solid shaft of 150mm diameter is used to transmit torques transmitted by the shaft if the maximum shear stress induced to the shaft is 45 N/mm^2 .
25. Define spring what are the various types of springs.

PART – B

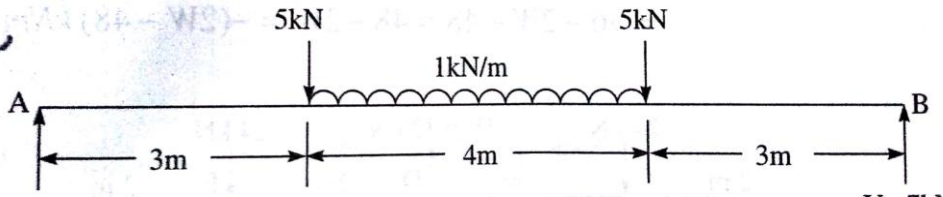
1. Three bars made of copper, zinc and aluminum are equal of length and have cross-section 500,750 and 1000 mm² respectively. They are rigidly connected at their ends. If this compound member is subjected to a longitudinal pull of 250KN, estimate the proportion of the load carried on each rod and the induced stresses. Take the value of E for copper = 1.3×10^5 N/mm², for zinc = 1.0×10^5 N/mm² and for aluminum = 0.8×10^5 N/mm².
2. A gun metal rod 22 mm diameter screwed at the ends passes through a steel tube 25mm internal diameter and 30mm external diameter. The temperature of the whole assembly is raised to 126°C and the nuts on the rod are then screwed lightly home on the ends of the tube. Find the intensity of stress in the rod and the tube when the common temperature has fallen to 16°C.
Coefficient of linear expansion for steel = 12×10^{-6} per °C
Coefficient of linear expansion for gun metal = 20×10^{-6} per °C
Modulus of elasticity for steel = 2.1×10^5 N/mm²
Modulus of elasticity for gun metal = 0.94×10^5 N/mm².
3. A steel tube of 30mm external diameter and 20mm internal diameter encloses a copper rod of 15mm diameter to which it is rigidly joined at each end. If at a temperature of 10°C there is no longitudinal stress, calculate the stresses in the rod and tube when the temperature is raised to 200°C. take E for steel and copper as 2.1×10^5 N/mm² and 1×10^5 N/mm² respectively. The value of co-efficient of linear expansion for steel and copper is given as 11×10^{-6} per °C and 18×10^{-6} per °C respectively
4. A bar of 30 mm diameter is subjected to a pull of 60 KN. The measured extension on a gauge length of 200 mm is 0.09 mm and the change in diameter is 0.0039 mm.
Calculate a)Poisson's ratio b)Modulus of Elasticity
c)Modulus of Rigidity d)Bulk Modulus.
5. A member ABCD is subjected to point loads P₁,P₂,P₃ and P₄ as shown in below figureCalculate the force P₂ necessary for equilibrium, if P₁ = 45KN, P₃ = 450KN and P₄ = 130KN. Determine the total elongation of the member, Take E= 2.1×10^5 N/mm².



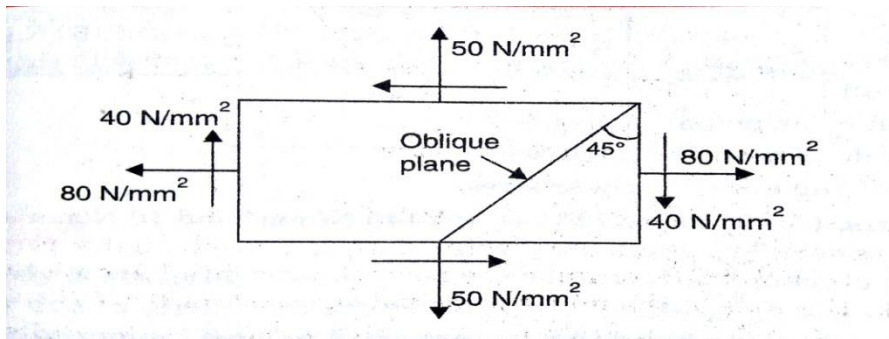
6. Draw Shear force and Bending Moment diagrams of given Simply supported beam



7. Draw Shear force and Bending Moment diagrams for the loaded beam as shown in below figure.

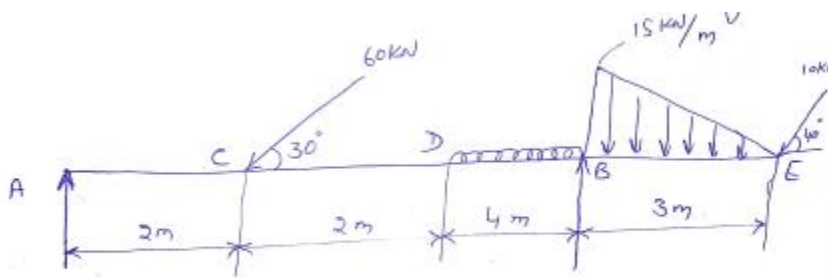


8. A point in a strained material is subjected to stresses as shown in below figure. Using Mohr's circle method, determine the normal, tangential and resultant stresses across the oblique plane.



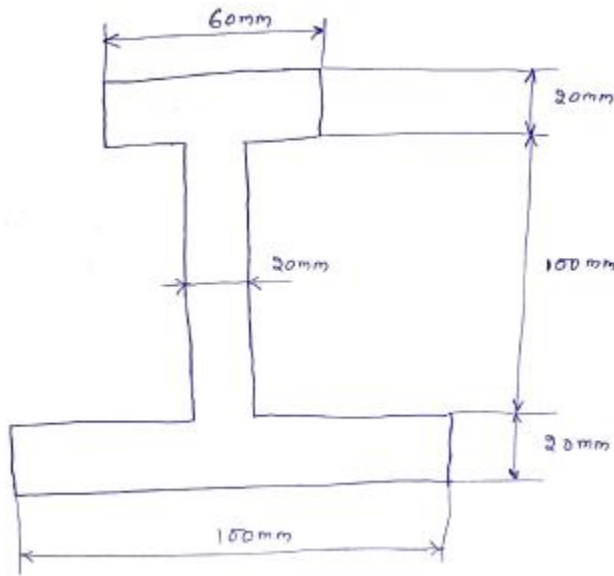
9. A simply supported beam of span 10 m carry as UDL of 10 KN/m over a length of 3 m from left support and also from right support. Draw SF and BM diagram.

10. Draw the shear force and bending moment diagram for the beam as shown in below figure.



11. Prove the relation $\frac{M}{I} = \frac{\sigma}{y} = \frac{E}{R}$ for simple bending.

12. A beam of I - section 500 mm deep and 190mm wide has flanges 25mm thick and web 15mm thick. It carries a shearing force of 400KN at a section assuming the moment of inertia to be $6.45 \times 10^8 \text{ mm}^4$. Sketch the shear stress distribution across the section.
13. A beam of I-section as shown in below figure. Is simply supported over a span of 4m. Determine the load that the beam can carry per metre length, if the allowable stress in the beam is 30.82N/mm^2 .



14. A rectangular beam 100mm wide and 250mm deep is subjected to a maximum shear force of 50KN. Determine a) Average shear stress b) maximum shear stress c) shear stress at a distance of 25mm above the neutral axis. And also draw shear stress distribution diagram.
15. A flitched beam consists of a wooden joist 150mm wide and 300mm deep strengthened by a steel plate 12mm thick and 300mm deep on either side of the joist. If the maximum stress in the wooden joist is 7 N/mm^2 . Find the corresponding maximum stress attained in the steel. Also find the moment of resistance of the composite section. Take E for steel = $2 \times 10^5 \text{ N/mm}^2$ and for wood $1 \times 10^4 \text{ N/mm}^2$
16. A cantilever of length (l) carries a point load (W) at a distance 'a' from the fixed end find the slope and deflection at the free end.
17. Prove that the deflection at the centre of a simply supported beam carrying a point load at the centre it is given by

$$y_c = \frac{WL^3}{3EI}$$

18. A beam 4m long, simply supported at its ends carries a point load W at its centre if the slope at the ends of the beam is not to exceed 1° find the deflection at the centre of the beam.

19. A load of 100N falls to a height of 2cm collar rigidly attached to the lower end of the vertical rod 1.5m long and of 1.5 cm^2 cross-sectional area. The upper end of the vertical bar is fixed. Determine a) stress b)Elongation c) strain energy stored in the vertical rod. Take $E = 2 \times 10^5 \text{ N/mm}^2$.
20. A cantilever of length 3m is carrying a point load of 25KN at the free end. If the moment of inertia of the beam is $1 \times 10^8 \text{ mm}^4$ and the value of $E = 2 \times 10^5 \text{ N/mm}^2$. Find the slope and deflection at the free end.
21. Find the diameter of the shaft required to transmit 60KW at 150 r.p.m. if the maximum torque is likely to exceed the mean torque by 25% for a maximum permissible shear stress of 60 N/mm^2 . Find also the angle of twist in degrees for a length of 2.5 meters. Take modulus of Rigidity = $8 \times 10^4 \text{ MN/ m}^2$.
22. A leaf spring 750 mm long is required to carry a central point load of 8KN. If the central deflection is not to exceed 20 mm and the bending stress is not to exceed 200N/mm^2 . Determine the thickness, width and number of plates. And also compute the radius to which the plates should be curved. Assume width of plates = 12 times the thickness and $E = 2 \times 10^5 \text{ N/mm}^2$.
23. A hollow shaft, having an internal diameter 50% of its external diameter transmits 600KW at 150 r.p.m. Determine the external and internal diameter of the shaft if the shear stress is not to exceed 65N/mm^2 and the twist in a length of 3m should not exceed 1.4 degrees. Assume maximum torque is 1.2 times of the mean torque and modulus of rigidity = $1 \times 10^5 \text{ N/mm}^2$.
24. A hollow shaft is to transmit 300KW power at 80r.p.m if the shear stress is not to exceed 60 N/mm^2 and the internal diameter is 0.6 of the external diameter, find the external and internal diameters assuming that the maximum torque is 1.4 times of the mean torque.
25. A closely coiled helical spring of round steel wire 10mm in diameter having 10 complete turns with a mean diameter of 12cm is subjected to an axial load of 200N. determine a) deflection of the spring. B) maximum shear stress C) stiffness of the spring. Take $G= 8 \times 10^4$.