

Question bank Strength of material

UNIT I

SIMPLE STRESS AND STRAIN

1. A rod of 150 cm long and diameter 2.0cm is subjected to an axial pull of 20 KN. If the modulus of elasticity of the material of the rod is 2×10^5 N/mm²
Determine 1. Stress 2. Strain 3. the elongation of the rod
2. The extension in a rectangular steel bar of length 400mm and thickness 10mm is found to 0.21mm .The bar tapers uniformly in width from 100mm to 50mm. If E for the bar is 2×10^5 N/mm² ,Determine the axial load on the bar
3. A rod of 250 cm long and diameter 3.0cm is subjected to an axial pull of 30 KN. If the modulus of elasticity of the material of the rod is 2×10^5 N/mm²
Determine 1. Stress 2. Strain 3. the elongation of the rod
4. Find the young's modulus of a rod of diameter 30mm and of length 300mm which is subjected to a tensile load of 60 KN and the extension of the rod is equal to 0.4 mm
5. The extension in a rectangular steel bar of length 400mm and thickness 3mm is found be 0.21mm .The bar tapers uniformly in width from 20mm to 60mm E for the bar is 2×10^5 N/mm² Determine the axial load on the bar.
6. The ultimate stress for a hollow steel column which carries an axial load of 2Mn is 500 N/mm² .If the external diameter of the column is 250mm, determine the internal diameter
Take the factor of safety as 4.0
7. A steel rod having a cross-sectional area of 300 mm² and a length of 150 m is suspended vertically from one end. It supports a tensile load of 20 kN at the lower end. If the unit mass of steel is 7850 kg/m³ and $E = 200 \times 10^3$ MN/m², find the total elongation of the rod.
8. Define elastic limit.
9. Define volumetric strain.
10. Define tensile stress and compressive stress.

UNIT II

STRESS IN BEAMS

1. Three planks of each 50 x200 mm timber are built up to a symmetrical I section for a beam. The maximum shear force over the beam is 4KN. Propose an alternate rectangular section of the same material so that the maximum shear stress developed is same in both sections. Assume then width of the section to be 2/3 of the depth.
2. A beam of uniform section 10 m long carries a udl of KN/m for the entire length and a concentrated load of 10 KN at right end. The beam is freely supported at the left end. Find the position of the second support so that the maximum bending moment in the beam is as minimum as possible. Also compute the maximum bending moment (
3. A beam of size 150 mm wide, 250 mm deep carries a uniformly distributed load of w kN/m

over entire span of 4 m. A concentrated load 1 kN is acting at a distance of 1.2 m from the left support. If the bending stress at a section 1.8 m from the left support is not to exceed 3.25 N/mm^2 find the load w .

4. A cantilever of 2m length carries a point load of 20 KN at 0.8 m from the fixed end and another point of 5 KN at the free end. In addition, a u.d.l. of 15 KN/m is spread over the entire length of the cantilever. Draw the S.F.D, and B.M.D.

5. A Simply supported beam of effective span 6 m carries three point loads of 30 KN, 25 KN and 40 KN at 1m, 3m and 4.5m respectively from the left support. Draw the SFD and BMD. Indicating values at salient points.

6. A Simply supported beam of length 6 metres carries a udl of 20KN/m throughout its length and a point of 30 KN at 2 metres from the right support. Draw the shear force and bending moment diagram. Also find the position and magnitude of maximum Bending moment.

7. A Simply supported beam 6 metre span carries udl of 20 KN/m for left half of span and two point loads of 25 KN and 35 KN at 4 m and 5 m from left support. Find maximum SF and BM and their location drawing SF and BM diagrams.

8. A beam of length of 10 m is simply supported at its ends and carries two point loads of 100 KN and 60 KN at a distance of 2 m and 5 m respectively from the left support. Calculate the deflections under each load. Find also the maximum deflection. Take $I = 18 \times 10^8 \text{ mm}^4$ and $E = 2 \times 10^5$.

9. A beam of length of 6 m is simply supported at its ends. It carries a uniformly distributed load of 10 KN/m as shown in figure. Determine the deflection of the beam at its mid-point and also the position and the maximum deflection. Take $EI=4.5 \times 10^8 \text{ N/mm}^2$.

10. A beam of length of 6 m is simply supported at its ends. It carries a uniformly distributed load of 10 KN/m as shown in figure. Determine the deflection of the beam at its mid-point and also the position and the maximum deflection. Take $EI=4.5 \times 10^8 \text{ N/mm}^2$.

UNIT III TORSION

1. Determine the diameter of a solid shaft which will transmit 300 KN at 250 rpm. The maximum shear stress should not exceed 30 N/mm^2 and twist should not be more than 10 in a shaft length 2m. Take modulus of rigidity = $1 \times 10^5 \text{ N/mm}^2$.

2. The stiffness of the closed coil helical spring at mean diameter 20 cm is made of 3 cm diameter rod and has 16 turns. A weight of 3 KN is dropped on this spring. Find the height by which the weight should be dropped before striking the spring so that the spring may be compressed by 18 cm. Take $C=8 \times 10^4 \text{ N/mm}^2$.

3. It is required to design a closed coiled helical spring which shall deflect 1mm under an axial load of 100 N at a shear stress of 90 Mpa. The spring is to be made of round wire having shear modulus of $0.8 \times 10^5 \text{ Mpa}$. The mean diameter of the coil is 10 times that of the coil wire. Find the diameter and length of the wire.

4. A steel shaft ABCD having a total length of 2400 mm is contributed by three different sections as follows. The portion AB is hollow having outside and inside diameters 80 mm

and 50 mm respectively, BC is solid and 80 mm diameter. CD is also solid and 70 mm diameter. If the angle of twist is same for each section, determine the length of each portion and the total angle of twist. Maximum permissible shear stress is 50 Mpa and shear modulus 0.82×10^5 MPa

5. The stiffness of close coiled helical spring is 1.5 N/mm of compression under a maximum load of 60 N. The maximum shear stress in the wire of the spring is 125 N/mm². The solid length of the spring (when the coils are touching) is 50 mm. Find the diameter of coil, diameter of wire and number of coils. $C = 4.5$

6. Define: Torsional rigidity of a shaft.

7. What do mean by strength of a shaft?

8. Write down the equation for Wahl factor.

9. Define: Torsional stiffness.

10. What are springs? Name the two important types.

UNIT IV

THIN CYLINDERS & SPHERE:

1. A Thin cylindrical shell 3 m long has 1m internal diameter and 15 mm metal thickness. Calculate the circumferential and longitudinal stresses induced and also the change in the dimensions of the shell, if it is subjected to an internal pressure of 1.5 N/mm² Take $E = 2 \times 10^5$ N/mm² and poisson's ratio $\nu = 0.3$. Also calculate change in volume.

2. A closed cylindrical vessel made of steel plates 4 mm thick with plane ends, carries fluid under pressure of 3 N/mm² The diameter of the cylinder is 25cm and length is 75 cm. Calculate the longitudinal and hoop stresses in the cylinder wall and determine the change in diameter, length and Volume of the cylinder. Take $E = 2.1 \times 10^5$ N/mm² and $\nu = 0.286$.

4. A thick cylinder shell of 100 mm internal diameter is to withstand an internal pressure of 20N/mm². Taking maximum permissible tensile stress 60 N/mm² and maximum shear stress as 50 N/mm² .Determine the metal thickness necessary for the shell

5. A rectangular block of material is subjected to a tensile stress of 110 N/mm² on one plane and a tensile stress of 47 N/mm² on the plane at right angle to the former plane and a tensile stress of 47 N/mm² on the plane at right angle to the former. Each of the above stress is accompanied by a shear stress of 63 N/mm² Find (i) The direction and magnitude of each of the principal stress (ii) Magnitude of greatest shear stress

6. At a point in a strained material, the principal stresses are 100 N/mm² (T) and 40 N/mm² (C). Determine the resultant stress in magnitude and direction in a plane inclined at 60° to the axis of major principal stress. What is the maximum intensity of shear stress in the material at the point?

7. A rectangular block of material is subjected to a tensile stress of 210 N/mm² on one plane and a tensile stress of 28 N/mm² on the plane at right angle to the former plane and a tensile stress of 28 N/mm² on the plane at right angle to the former. Each of the above stress is accompanied by a shear stress of 53 N/mm² Find (i) The direction and magnitude of each of the principal stress (ii) Magnitude of greatest shear stress

8 A closed cylindrical vessel made of steel plates 5 mm thick with plane ends, carries fluid under pressure of 6 N/mm². The diameter of the cylinder is 35 cm and length is 85 cm. Calculate the longitudinal and hoop stresses in the cylinder wall and determine the change in diameter, length and Volume of the cylinder. Take $E = 2.1 \times 10^5$ N/mm² and $\nu = 0.286$.

9. At a point in a strained material, the principal stresses are 200 N/mm² (T) and 60 N/mm² (C). Determine the direction and magnitude in a plane inclined at 60° to the axis of major principal stress. What is the maximum intensity of shear stress in the material at the point?

10. A cylindrical vessel made of aluminium plates 8 mm thick with plane ends, carries fluid under pressure of 6 N/mm². The diameter of the cylinder is 65 cm and length is 95 cm. Calculate the longitudinal and hoop stresses in the cylinder wall and determine the change in diameter, length and Volume of the cylinder. Take $E = 2 \times 10^5$ N/mm² and $\nu = 0.486$.

UNIT V

CURVED BEAMS AND UNSYMMETRICAL BENDING

1. show the distribution of shear stress

2. show that the shear stress distribution over rectangular section

3. show that the shear stress distribution over trapezoidal section

4. show that the shear stress distribution over circular cross section

5. find the stress in crane hooks

6. At a point in a strained material, the principal stresses are 200 N/mm² (T) and 60 N/mm² (C). Determine the direction and magnitude in a plane inclined at 60° to the axis of major principal stress. What is the maximum intensity of shear stress in the material at the point?

7. At a point in a strained material, the principal stresses are 200 N/mm² (T) and 60 N/mm² (C). Determine the direction and magnitude in a plane inclined at 60° to the axis of major principal stress. What is the maximum intensity of shear stress in the material at the point?

8. At a point in a strained material, the principal stresses are 100 N/mm² (T) and 40 N/mm² (C). Determine the direction and magnitude in a plane inclined at 60° to the axis of major principal stress. What is the maximum intensity of shear stress in the material at the point?

9. show that tension and the compression lies below and above the neutral axis in case of shear stress distribution

10. show that in case of square beam shear stress intensity at the neutral axis is the mean intensity