STRENGTH OF MATERIALS-I

Unit-1

Simple stresses and strains

Short Questions:

1. What is the Principle of surveying
2. Define Magnetic, True & Arbitrary Meridians.
3. Mention different types of chains
4. Differentiate between direct and indirect ranging.
5. What is the Principle of chain surveying
6. What are the Obstacles in chain surveying
7. Write down the conditions for closed traverse
8. Mention the Errors in chain surveying

Long Questions:

1. A tensile test was conducted on a mild steel bar. The following data was obtained from the test:
   Diameter of steel bar = 2.5 cm; Gauge length of the bar = 24 cm;
   Diameter of the bar at rupture = 2.35 cm; Gauge length at rupture = 24.92mm
   Determine (a) percentage elongation (b) percentage decrease in area.
2. A tensile test was conducted on a mild steel bar. The following data was obtained from the test:
   Diameter of steel bar = 3cm; Gauge length of the bar = 20cm
   Load at elastic limit = 250kN; Extension at load of 150kN = 0.21mm
   Maximum load = 380kN; Determine: (a) Young's modulus (b) Yield strength (c) Ultimate Strength (d) Strain at the elastic limit.
3. Design a steel rod to sustain a load of 80 kN with a safety factor 2.5. What is the maximum permissible length of the rod, if the allowable deformation is 0.5 mm? Assume a yield stress of 230 MPa and Young's modulus of 195 GPa.
4. A compound tube consists of a steel tube 140mm internal diameter and 160mm external diameter and an outer brass tube 160mm internal diameter and 180mm external diameter. The two tubes are of the same length. The compound tube carries an axial load of 900kN. Find the stresses and the load carried by each tube and the amount it shortens. Length of each tube is 140mm. Take E for steel as 2x105 N/mm2 and for brass as 1x105 N/mm2.
5. Determine the Poisson's ratio and bulk modulus of a material, for which Young's modulus is 1.2x105 N/mm2 and modulus of rigidity is 4.5x104 N/mm2.

Objectives Questions:

1. Poisson's ratio of aluminum is
   a) 0.3
   b) 0.33
   c) 0.35
   d) none of these

2. In stress strain curve the area upto the elastic limit

   a) Ductility
   b) Strength
   c) Resilience
   d) None of these

3. A 2 m long bar of uniform section 50mm^2 extends 2mm under a limiting axile stresses of 200 N/mm^2. What is the modulus of resilience of the bar.

   a) 0.1 units
   b) 0.2 units
   c) 10000units
   d) 20000units
4. Proof resilience is the maximum energy stored at

   a) Elastic limit
   b) Limit of proportionality
   c) Ultimate point
   d) None of these

5. 1MPa=

   a) 1 N/m^2
   b) 1 N/mm^2
   c) 1KN/mm^2
   d) 1 KN/m^2

6. The SI unit for strain is

   a) Pa
   b) MPa
   c) GPa

d) None of these

UNIT-II

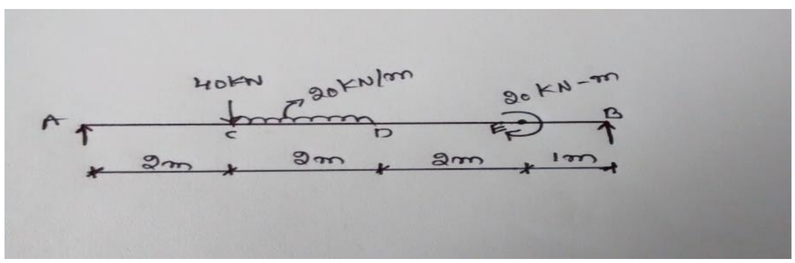
Shear force and bending moment

Short Questions:

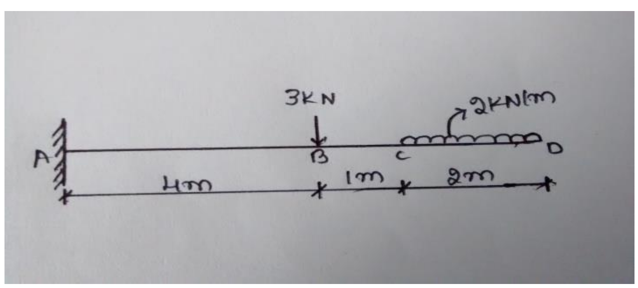
1. What are the different types of beams?
2. Differentiate between a simply supported beam and a cantilever.
3. Differentiate between a fixed beam and a cantilever.
4. Draw shear force diagrams for a cantilever of length L carrying a point load W at the free end.
5. Draw shear force diagrams for a cantilever of length L carrying a point load W at the mid-span.

Long Questions:

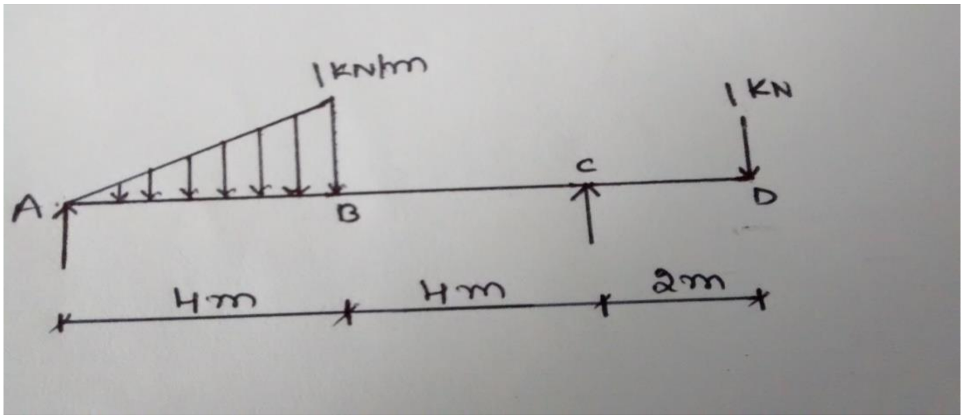
1. Draw SFD and BMD for the following beam. And also find the point of contraflexure.



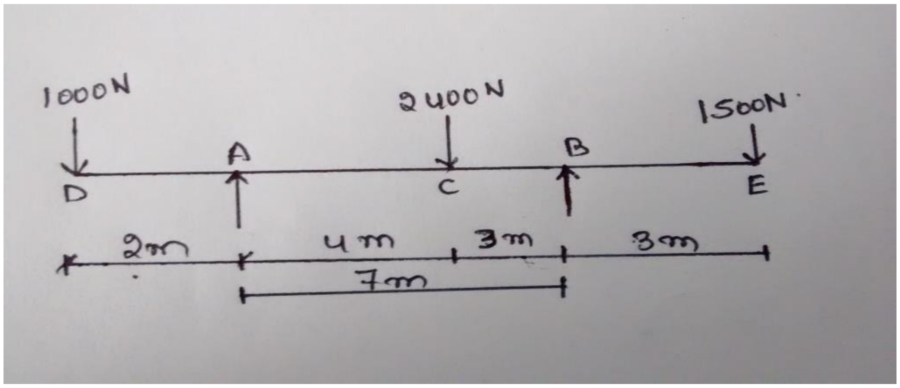
2. Draw SFD and BMD for the following beam.



3. Draw SFD and BMD for the following beam.



4. Write down the relation for shear force and bending moment for the simply supported beam subjected to uniformly distributed load.
5. Draw SFD and BMD for the following beam. Also find the point of contraflexture.



Objective Questions:

1. In a beam the point of contra flexture is a point where
   a) Shear force is maximum
   b) Shear force is zero
   c) Bending moment changes its sign
   d) Bending moment is maximum

2. The shape of SFD for a cantilever subjected to a couple at its end is
   a) No shear force in any part of the beam
   b) Rectangular
   c) Constant
   d) Parabolic
3. The point of contra flexure is a point of zero
   a) Load
   b) Shear force
   c) Bending moment

d) None of the above

4. Sagging bending moment is considered as
   a) Positive
   b) Negative
   c) Zero
   d) None of the above

5. Hogging bending moment is considered as
   a) Positive
   b) Negative
   c) Zero
   d) None of the above

UNIT-III
Flexural stresses and shear stresses

Short Questions:

1. Define bending stress in a beam with a diagram.
2. Define neutral axis and where is it located in a beam.
3. What are the assumptions made in theory of simple bending?
4. Explain the role of section modulus in defining the strength of a section.
5. Draw the bending stress and shear stress profiles for a rectangular beam section.

Long Questions:

1. Derive the bending equation for a beam.
2. A rectangular beam 60 mm wide and 150 mm deep is simply supported over a span of 6 m. If the beam is subjected to central point load of 12 kN, find the maximum bending stress induced in the beam section.
3. A rectangular beam 300 mm deep is simply supported over a span of 4 m. What uniformly distributed load the beam may carry, if the bending stress is not to exceed 120 MPa. Take I = 225 x 106 mm4 .
4. A hollow square section with outer and inner dimensions of 50 mm and 40 mm respectively, is used as a cantilever of span 1 m. How much concentrated load can be applied at the free end, if the maximum bending stress is not exceed 35 MPa?
5. A square beam 20mm x 20mm in section and 2m long is supported at the ends. The beam fails when a point load of 400N is applied at the centre of the beam. What uniformly distributed load per meter length will break a cantilever of same material 40mm wide, 60mm deep and 3m long?

Objective Questions:

1. A beam of rectangular section of breadth 100mm and depth 200mm is subjected to a bending moment of 20KN-m. Stress developed at a distance of 100 mm from top face is
   a) 30MPa
   b) 15MPa
   c) 7.5MPa
   d) None of these
2. Curvature of a beam is equal to
   a) EI/M
   b) M/EI
   c) ME/I
   d) MI/I
3. The bending stress along the neutral axis
   a) Maximum
   b) Minimum
   c) Zero
   d) None of them
4. In simple theory of bending it is assumed that the material is
   a) Homogeneous
   b) Isotropic
   c) Obeys hooks law
   d) All of the above
5. The variation of bending stress with distance from NA is
   a) Linear
   b) Parabolic
   c) Cubic
   d) None of the above

UNIT-IV
DEFLECTION OF BEAMS

Short Questions:

1. Define deflection and slope of a beam.
2. Write the differential equation for the beam
3. List the different methods for finding slope and deflection of a beam.
4. What is Macaulay’s method? How is it different from the general double integration method?
5. State and explain the first theorem of Mohr.

Long Questions:

1. Derive the differential equation for the deflection of beam.
2. Prove that the deflection at centre of a simply supported beam, carrying a point load at centre, is given by $y = (wl\hat{}3)/48EI$
3. Use Moment-Area method to find the slope and deflection of a simply supported beam carrying a point load at the centre.
4. A simply supported beam 5 m long carries concentrated loads of 10 kN each at a distance 1m from the ends. Calculate:
   (a) Maximum slope and deflection for the beam, and
   (b) Slope and deflection under each load.
   Take: EI = 1.2 × 104 kN.m2.
5. A cantilever of length L is loaded with uniformly varying load of intensity zero at the free end and w/unit length at the fixed end. Derive an expression for the deflection at any point. Find also the slope and deflection of the free end.

Objective Questions:

1. The slope is always zero at
   a) Roller
   b) Hinge
   c) Fixed
   d) All the above
2. The deflection is zero at
   a) Roller
   b) Hinge
   c) Fixed
   d) All the above
3. At roller support the slope is always
   a) Zero
   b) Maximum
   c) Minimum
   d) None of the above
4. At the hinged support the slope is always
   a) Zero
   b) Maximum
   c) Minimum
   d) None of the above
5. At fixed support the slope is always
   a) Zero

b) Maximum
c) Minimum
d) None of the above

UNIT-IV

PRINCIPAL STRESSES AND STRAINS, THEORIES OF FAILURE

Short Questions:

1. Define principal planes and principal stresses
2. Draw the representation of biaxial state of stress at a point in a material.
3. Draw the representation of the state of pure shear stress at a point in a material.
4. Explain the condition of plane stress.
5. List the various theories of failure of materials.

Long Questions:

1. Define and explain he theories of failure:
   (i) Maximum principal stress theory
   (ii) Maximum principal strain theory
2. Derive an expression for the major and minor principal stresses on an oblique plane, when the body is subjected to direct stresses in two mutually perpendicular directions accompanied by a shear stress.
3. A body is subjected to direct stresses in two mutually perpendicular principal tensile stresses accompanied by a simple shear stress. Draw the Mohr's circle of stresses and explain how you will obtain the principal stresses and strains.
4. A body is subjected to direct stresses in two mutually perpendicular directions.
   How will you determine graphically the resultant stresses on an oblique plane when (i) the stresses are unequal and unlike; (ii) the stresses are unequal and like.
5. In a two dimensional stress system, the direct stresses on two mutually perpendicular planes are 100 MN/mm2. These planes also carry a shear stress of 25 MN/mm2. If the factor of safety on elastic limit is 2.5, then find: (i) the value of stress when shear strain energy is minimum; (ii) elastic limit of material in simple tension.

Objective Questions:

1. Principal stresses are the
   a) Maximum normal stresses

b) Minimum normal stresses
c) Maximum and minimum normal stresses
d) Maximum and minimum shear stresses

2. Shear stress on principal plane is

a) Maximum
b) Minimum
c) Either maximum or minimum
d) Zero

3. Normal stress on principal plane is
a) Maximum
b) Minimum
c) Either maximum or minimum
d) Zero

4. The normal stresses or equal on
a) Principal plane
b) Planes of maximum shear stress
c) All planes
d) None of the above

5. The shear stresses are equal in magnitude on
a) Principal plane
b) Plane of maximum shear stress
c) All mutually perpendicular planes
d) None of the above