

2021-22
SOLID MECHANICS
MEC – 301

Full Marks: 30

Time: 75 Mins

Section - B

All are of equal marks. Answer any **THREE** questions.

- Q1.** (i) Derive Euler's crippling load for a long column with both ends fixed.
(ii) Explain the limitations of Euler's column theory.
(iii) The steel pipe has an outer diameter of 50mm. It is held in place by a guy wire as shown in Figure 1. Find out the inner diameter of the pipe so that it can support a maximum horizontal load of $P = 4\text{ kN}$ without causing the pipe to buckle. Take $E = 210\text{ GPa}$. Yield point stress in compression = 250 MPa .

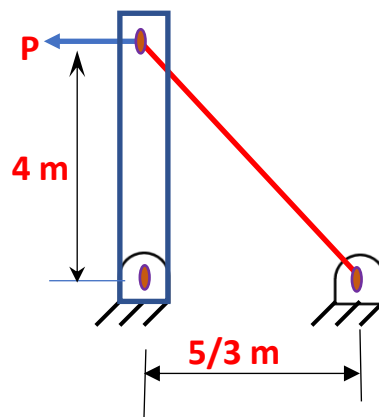


Figure 1: Problem 1.

- Q2.** Calculate the slope of elastic line at B and the deflection at point D of the beam shown in Figure 2. Consider $E = 200\text{ GPa}$ and $I = 2.5 \times 10^9\text{ mm}^4$.

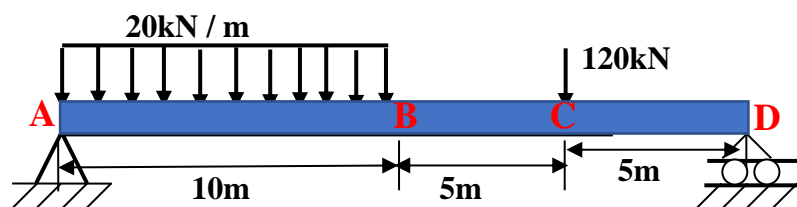


Figure 2: A simply supported beam.

- Q3.** (a) State Castigliano's Theorem.
(b) Define Modulus of Resilience and Modulus of Toughness.
(c) Calculate the horizontal and vertical displacement of joint B of the truss for which each member has cross-sectional area 1250 mm^2 (Figure 3). Assume $E = 200\text{ GPa}$.

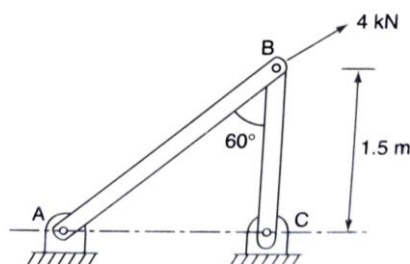


Figure 3: Problem 3.

- Q4.** (i) At a given point in a machine element, the following stresses were evaluated: 100 MPa (tensile) and a zero shear on a horizontal plane and 50 MPa (compressive) on a plane perpendicular to this plane as shown in Figure 4. Determine the stresses at this point on a plane having a slope of 3 vertical to 4 horizontal.
- (ii) Derive the relationship between modulus of elasticity (E), modulus of rigidity (G) and bulk modulus of elasticity (K).
- (iii) Derive the theoretical limits of Poisson's ratio (μ).

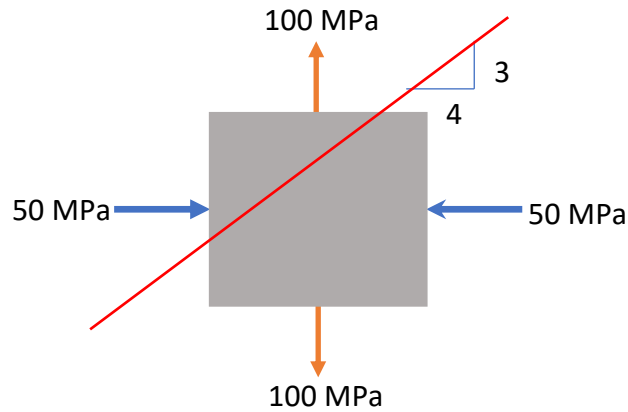


Figure 4: Problem 4.