MACHAKOS UNIVERSITY

MECHANICAL ENGINEERING DEPARTMENT

DIPLOMA MECHANICAL ENGINEERING (production & automotive)

STRENGTH OF MATERIALS III

Time 2 hours

INSTRUCTIONS:

- **This Examination contains two sections A and B**
- **Section A is compulsory**
- **Attempt any other two questions from section B**

SECTION A: COMPULSORY

1. (a) state the assumptions made in simple torsion theory (5 marks)

   (b) Derive the expression for section modulus for a hollow circular shaft. (5 marks)

   (c) Show that resilience due to shear loading is given by (10 marks)

$$\frac{\tau^2}{2G}$$

   (d) Derive the expressions for maximum stress and deflection for a close-coiled helical spring subjected to axial torque T. (10 marks)

SECTION B: SELECT ANY TWO QUESTIONS

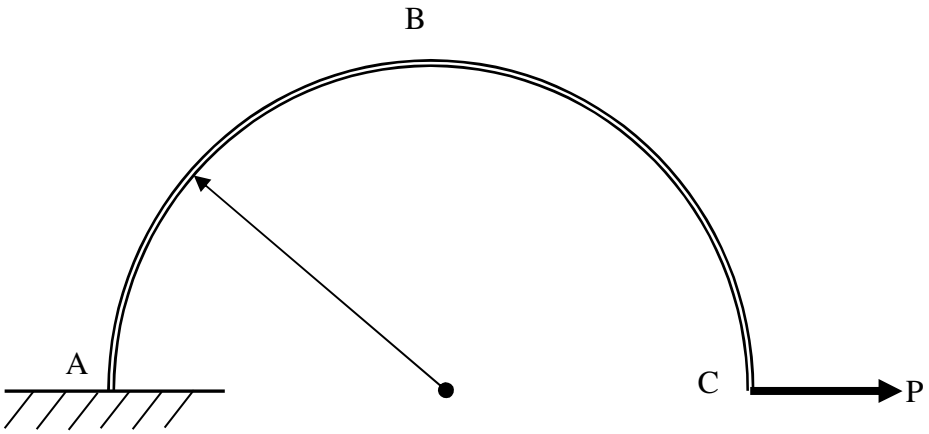
2. (a). derive the expressions for deflection and maximum bending stress for a cantilever leaf spring (quarter-elliptic type). (15 marks)

(b). A leaf spring spans 1m and is simply supported at each end. It is made from 50 mm wide and 6.5 thick. Determine the maximum load that can be placed at the centre such that the maximum stress in the material shall not exceed 280N/mm^2. (5 marks)

3. (a) A steel shaft AB of length 1.5 m long has a twisting moment of T = 1100Nm applied to end B. this shaft diameter is 50mm. the other end A of the shaft is built into the wall. Determine the maximum shear stress developed in the shaft and the angle of twist at end B. assume G = 80GPa. Ignore the weight of the shaft. (8 marks)

   (b) If the maximum allowable shear stress of the shaft in (a) is 70MPa, what is the value of maximum twisting moment that can be applied to the shaft? If the diameter of the shaft is doubled, what is the maximum value of the twisting moment? (12 marks)

4. A circular rod is bent into the shape of half ring and supported in a vertical plane as shown below. Using castigliano's theorem, determine horizontal movement of point C. EI is constant. (20 marks)



5. A concrete column of 600mm diameter and length 1.5m contains six 25mm diameter steel reinforcing rods. If the column supports a load of 1500kN, determine the strain energy in the column. E_{steel} 200GPa, $E_{concrete}$ = 25GPa (20 marks)