ME 323: Mechanics of Materials **Homework 1**

Spring 2026 **Due: January 23, 2026**

Problem 1 (10 points):

While walking through the streets of Osaka, you come across a unique design of a streetlamp (*figure 1*). In this design, a streetlamp of weight W is suspended from the post OABC. A load 4P is also applied at point C in the X direction.

(a) Calculate the reaction forces and moments developed at points O and D of the structure.
(b) In words, suggest how the reaction forces vary as you move along the length of the post i.e. from O to C.

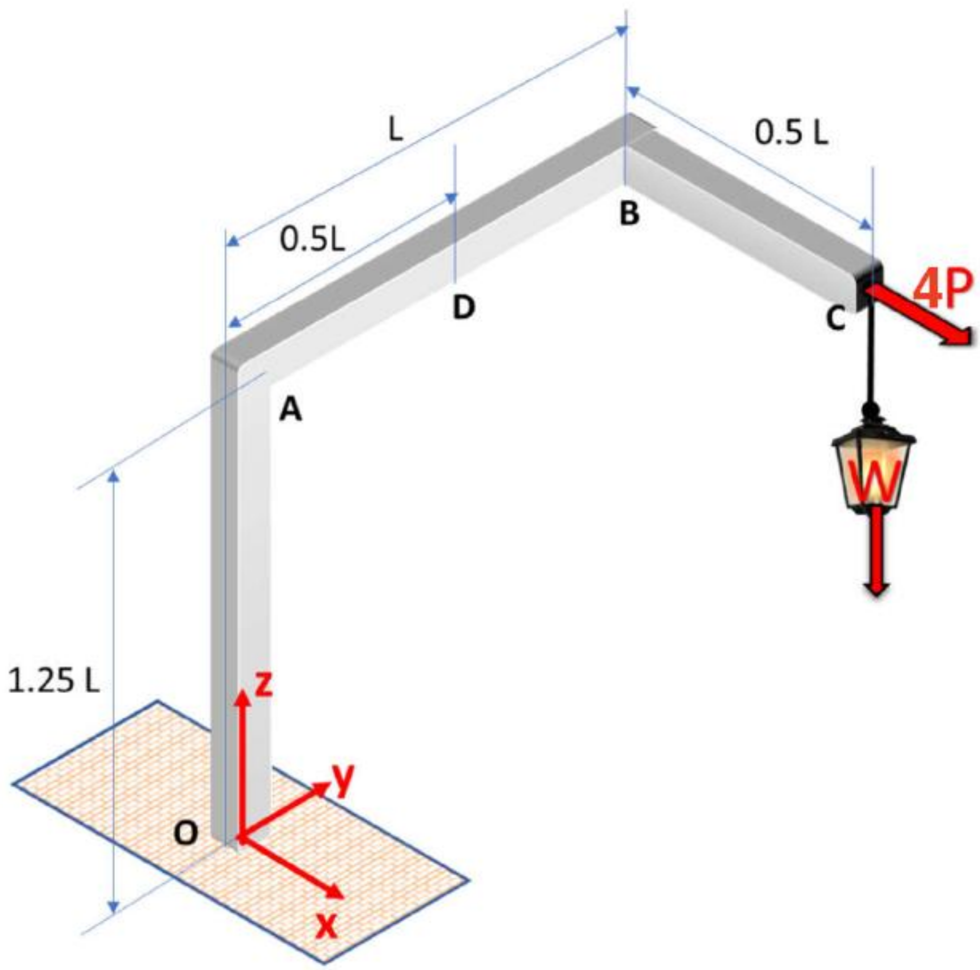

Figure 1: Streetlamp design for Problem 1

Problem 2 (10 points):

Your toddler nephew glues together two wooden blocks of identical square cross section (10 mm x 10 mm) along the plane AC as shown in *figure 2*. The dimension of the entire setup is 10 mm x 10 mm x 100 mm.

a) If the glue can withstand a maximum shear stress of 10 kPa, calculate the maximum force P that can be applied at the end of the wooden blocks so that the blocks stay together (or the minimum force to take them apart).
b) If the glue can withstand a maximum normal stress of 5 kPa and shear stress of 3.5 kPa. What is the maximum load that can be applied?

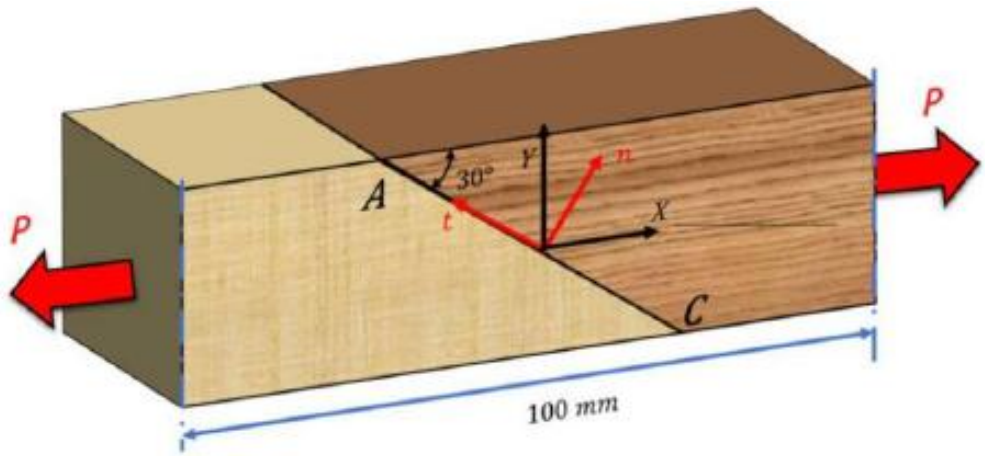

Figure 2: Structure for Problem 2

Problem 3 (10 points):

The truss shown below (*figure 3*) is supported by pin joints at B and D. Each member of the truss is made of the same material but has different cross-sectional areas: Member (1) - A, Member (2) - 2A, Member (3) - 2A, and Member (4) - A. If a force P acts downward at H,

(a) Determine the load carried by each member of the truss.

(b) Determine the stress developed in each member of the truss. State whether it is in tension or compression.

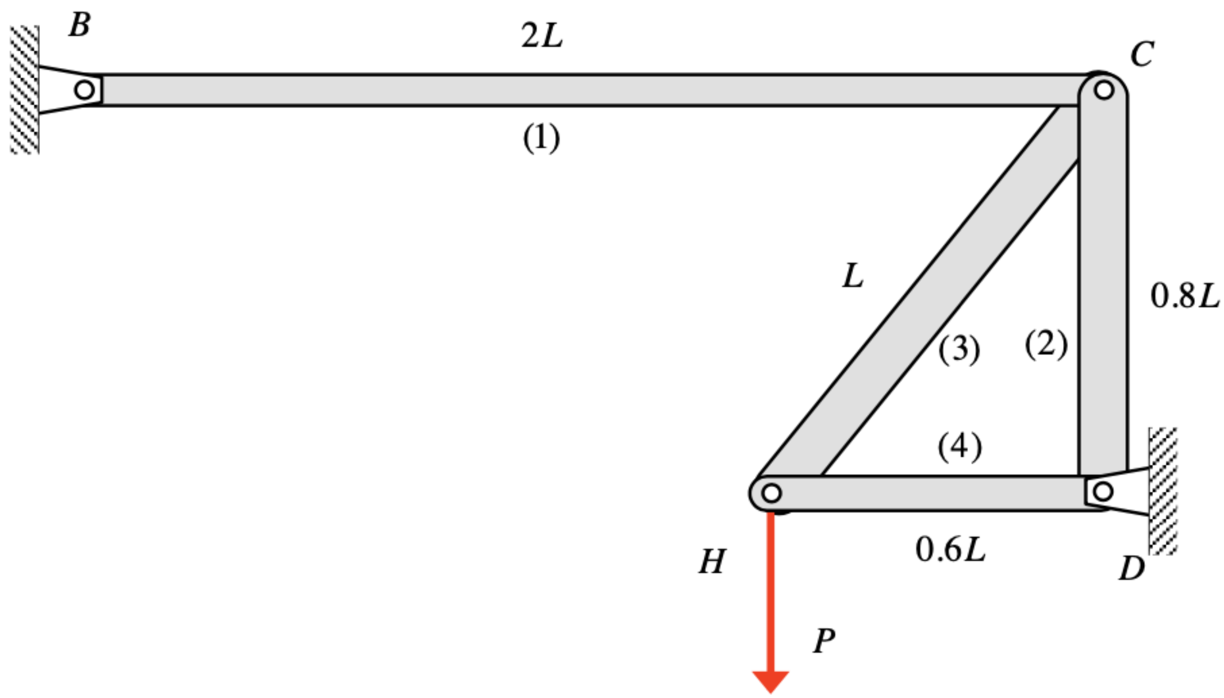

Figure 3: Truss for Problem 3

Problem 4 (2.5 points + 2.5 points):

A component is known to be in a state of plane stress ($\sigma_z = 0$). The folowing values are also known for stresses and strains:

$\sigma_x = 20 \times 10^6$ N/m^2

$\sigma_y = 120 \times 10^6$ N/m^2

$\varepsilon_x = -1 \times 10^{-3}$

$\varepsilon_y = 6 \times 10^{-3}$

4.1 The numerical value for Poisson's ratio of the material is:

(a) $\nu = -0.2956$

(b) $\nu = 0.1853$

(c) $\nu = 0.5722$

(d) $\nu = 0.3243$

4.2 The numerical value for Young's Modulus of the material is:

(a) $E = 1.89 \times 10^{10}$ Pa

(b) $E = 2.39 \times 10^{15}$ Pa

(c) $E = 5.45 \times 10^{8}$ Pa

(d) $E = 6.07 \times 10^{5}$ Pa