ME 202 Strength of Materials Spring 2023 Quiz 1 (10 points) 18 Jan 2023

Closed books closed notes. Only one self-handwritten A4 cheat sheet allowed. No extra sheets. Figures not to scale. Exam rules are in full force and effect.

1. (5 points) An industrial power transmission shaft of length $L = 1$ m carries a maximum bending moment of 4000 Nm and a maximum axial torque of 2000 Nm. The shaft has a solid cylindrical cross-section with diameter d. The shaft material steel has elastic modulus $E = 200$ GPa, shear modulus $G = 75$ GPa, and tensile yield strength $\sigma_Y = 500$ MPa. Calculate the minimum safe diameter (in mm) of the shaft as per (a) the maximum normal stress theory of failure (b) the maximum shear stress theory of failure.

2. (5 points) Consider the shaft AB in the following figure with axial torques applied at C and D as shown. The shaft ends A and B are fixed into the wall to prevent rotation. Find (a) the reaction torques at the ends A and B (b) the angles of twist at points C and D. The cross-section and material of the shaft is uniform along its length