MAE 444 Flight Structures  
Homework #2  Due Wed. 9/12

1. The state of hydrostatic stress is defined as:

\[
\begin{bmatrix}
\sigma_x & \tau_{xy} & \tau_{xz} \\
\tau_{yx} & \sigma_y & \tau_{yz} \\
\tau_{zx} & \tau_{zy} & \sigma_z
\end{bmatrix}
= \begin{bmatrix}
\sigma_o & 0 & 0 \\
0 & \sigma_o & 0 \\
0 & 0 & \sigma_o
\end{bmatrix}
\]

For this state of stress, show that, on any inclined surface, the stress vector is directed normal to the surface and has a magnitude equal to \( \sigma_o \).

2. Consider the displacement field in a body given by

\[
\begin{align*}
    u &= 0.02x + 0.02y - 0.01z \text{ cm} \\
    v &= 0.01y - 0.02z \text{ cm} \\
    w &= -0.01x + 0.01z \text{ cm}
\end{align*}
\]

What are the strains in the body?
What is the distance after deformation between the two points that are located at (0,0,0) and (5,0,0) cm before deformation?

3. The simply supported beam with rectangular cross-section discussed in class has a weight density \( \rho \) (force per unit volume), and is loaded only by its own weight in the negative y-direction.

   a. Determine \( \sigma_x \) and \( \tau_{xy} \) as functions of \( x \) and \( y \) using the bending stress and shear stress formulas from elementary solid mechanics.
   
   b. Verify that the equilibrium equation in the x-direction is satisfied.
   
   c. Using the equilibrium equation in the y-direction, and the boundary conditions on the top and bottom surfaces, determine \( \sigma_y \) as a function of \( x \) and \( y \).