**Reading assignment**
Ulaby, 8-2, 8-4, 8-5
Connor and Salon, Unit X (On Waves & Materials)

**Problem 1 - oblique incidence**
A plane wave described by $E_i = 100 \cos(\omega t - \pi x - 1.73\pi z)a_y \text{ V/m}$ is incident upon a dielectric material with $\varepsilon_r = 4$.

a. Write $E$ in phasor form.
b. What are $\gamma_i$ and $\theta_i$?
c. What are $\theta_t$ and $\gamma_t$?
d. What are the reflection and transmission coefficients?
e. Write the total electric field phasors in both regions.
f. Confirm your results by running polariz.m

![Diagram](image)

**Problem 2 - Snell’s law, critical angle**
For visible light, the index of refraction for water is $n = 1.33$. If we put a light source 1 meter under water and observe it from above the surface of the water, what is the largest $\theta_i$ for which light will be transmitted?
How large will the circle of illumination be?

![Diagram](image)

**Problem 3 - polarization**
Consider the same material properties and incident angle as Problem 1, but assume the opposite polarization.

a. What are the reflection and transmission coefficients?
   Which polarization has a lower reflection coefficient (magnitude)?
b. Now allow $\theta_i$ to vary. At what value of $\theta_i$ is the wave completely transmitted? (i.e. What's the Brewster angle?)