ECEn 560
Electromagnetic Wave Theory

Homework #2
Due January 12, 2016 in class (may be turned in late for half credit)

1. Convert the phasor electric field $\overline{E}(\overline{r}) = \hat{y}e^{-ikz}$ to the time domain. Which direction is the wave propagating?

2. Review (a) the derivation of the wave equation from Maxwell's equations, (b) the separation of variables solution for a plane wave, and (c) the derivation of the dispersion relation $k_x^2 + k_y^2 + k_z^2 = k^2$. (d) What does the dispersion relation mean physically?

3. Consider the uniaxial material with

$$\overline{\overline{\epsilon}}_r = \begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1.15 \end{bmatrix}$$

   (a) What are the possible phase velocities of a plane wave with frequency 1 GHz propagating in the z direction? (b) What are the possible phase velocities if the wave is propagating in the x direction?

4. Study the derivation that transforms Maxwell's equations for a plane wave into an eigenvalue/eigenvector problem. What do (a) the eigenvectors and (b) the eigenvalues represent physically? (c) How does the eigenvalue/eigenvector problem relate to the plane wave dispersion relation? (d) What are the "inputs" and "outputs" of the eigenvalue/eigenvector problem?