ECEn 560
Electromagnetic Wave Theory

Homework #3
Due Jan. 14, 2016 in class (may be turned in late for half credit)

1. (a) Review the derivation of the eigenvalues and eigenvectors of the governing matrix for a uniaxial material. (b) What do the eigenvectors mean physically? (c) The eigenvalues?

2. (a) A beam strikes a uniaxial slab and splits into two beams. Derive an expression for the distance between the ordinary and extraordinary beams at the exit face of the slab in terms of the slab width and the angle between the direction of propagation and the z axis of the material. (b) Use your observation of the distance between double images and the theory of wave propagation in an anisotropic material to estimate the material parameters of a calcite crystal.

3. A uniaxial medium has relative permittivity values $\epsilon_{xr} = \epsilon_{yr} = 2$ and $\epsilon_{zr} = 2.4$. The dispersion relation for an extraordinary wave traveling at an angle θ with respect to the z axis is $\omega^2/k^2 = \cos^2\theta/(\epsilon\mu) + \sin^2\theta/(\epsilon_z\mu)$. (a) For a plane wave traveling at an angle of $30°$ with respect to the z axis, what are the possible values of the phase velocity? (b) Give directions of the electric flux density corresponding to your answers to part a. (c) Give directions of the electric field intensity corresponding to your answers to part a.