Homework 5 due 29 Sept. 2005 in class
PH462 EM Waves and Optical Physics posted: 22 September 2005

Reading: Heald and Marion (HM) chapter 6 and posted notes.

1) HM problem 6-12.

2) HM problem 6-13. Note that in this problem they define yet another representation of the complex refractive index: $\tilde{n} = n(1 + i\kappa) = n_R + i\,n_I$.

3) Consider reflection from a gold surface placed **in vacuum**. The real and imaginary parts of the complex refractive index ($\tilde{n} = n_R + i\,n_I$) for gold are n_R = 1.4, n_I = 1.88 at 450nm, and n_R = 0.36, n_I = 10.4 at 1500nm.. In Mathematica, use the Fresnel equation notebook posted on the course website (or your own) with these values of the complex refractive index to:

a. plot the power reflection coefficient **vs. incident angle** for both orientations and both wavelengths of the electric field, $E_{\parallel}$ and $E_{\perp}$,

b. plot the corresponding phase shifts for reflected light **vs. incident angle** for each case.

c. Defining the z direction to be along the surface normal, plot the (real) electric fields along the z-axis for the 450nm case for normal incidence and S-polarized ($E_{\perp}$) light at and incidence angle of 60degrees. On the incident side of the boundary, show the incident, reflected and the sum of the two. Check visually to make sure that the boundary conditions are satisfied.

4) Consider the waveguide of HM section 7.2. Suppose that between the two conducting planes is a gas. The refractive index of the gas varies with pressure P, so that $n(P) = 1 + \eta P$.
   a. Calculate the propagation constant k_g (in the notation of HM).
   b. Calculate the components of the magnetic field.
   c. Evaluate the Poynting vector for an arbitrary, single mode.
   d. Evaluate the phase and group velocities.

5) HM problem 7-9