Homework #4: Due Monday 28 June

1. A uniform plane wave is propagating in free space. The frequency is 100GHz and the power density is 1kW per square meter. Write both the electric and magnetic field phasors for this wave. That is find the parameters for $\vec{E}_i(z) = \hat{x}E_{mi}e^{-jk_o z}$ and $\vec{H}_i(z) = \hat{y}H_{mi}e^{-jk_o z}$ and then write the fields in phasor form.
2. Now assume that this wave is incident normally on a perfect conductor located at $z = 0$. Find the reflected wave phasors for both the electric and magnetic fields. That is find the parameters for $\vec{E}_r(z) = \hat{x}E_{mr}e^{+jk_o z}$ and $\vec{H}_r(z) = \hat{y}H_{mr}e^{+jk_o z}$ and then write the fields in phasor form. Once you have the incident and reflected waves, plot the standing wave pattern for both the electric and magnetic fields.
3. Now replace the perfect conductor with a lossless dielectric that fills the entire region from $z = 0$ to infinity. The dielectric has a permittivity of $\varepsilon = 3.55\varepsilon_o$. Again, find the reflected fields. Also find the transmitted fields in phasor form. That is find $\vec{E}_t(z) = \hat{x}E_{mt}e^{-jkz}$ and $\vec{H}_i(z) = \hat{y}H_{mt}e^{-jkz}$. Once you have the incident and reflected waves, plot the standing wave pattern for both the electric and magnetic fields. Also, determine the transmitted power density.
4. Now for the dielectric half space, assume that the original wave is propagating at an angle of 50 degrees with respect to normal incidence. Assume that the wave propagates only in the y and z directions and remains polarized in the x direction. Is this wave perpendicular or parallel polarized? Find the transmitted electric and magnetic field phasors. The general forms for the electric and magnetic fields are $\vec{E}_t(z) = \hat{x}E_{mx}e^{-jk_z z - jk_y y}$ and $\vec{H}_t(z) = \hat{y}H_{my}e^{-jkz_z z - jk_y y} + \hat{z}H_{mz}e^{-jk_z z - jk_y y}$. Also, determine the transmitted power density.
5. Describe in as much detail as you can manage, what will happen in question 4 for angle of 75 degrees. Only a basic description is necessary, but you will receive extra points if you have a more complete answer.