HW#1
EE699 – Fall 2007
Due 9/4/07

1. Starting with Maxwell's equations, derive the vector wave equation <u>for the magnetic field</u> assuming an *inhomogeneous, anisotropic* media.

2. Starting with the magnetic field wave equation in problem 1, derive the weak form of the wave equation using a reaction integral.

3. Given a TM_z-polarized propagating in a source-free, inhomogeneous material media. The axial electric field satisfies the scalar wave equation:

$$\nabla \cdot \mu(x,y)^{-1} \nabla E_z(x,y) + \omega^2 \varepsilon(x,y) E_z(x,y) = 0$$

For simplicity, assume that the material is a layered media, with a one-dimensional profile $\varepsilon(y)$, $\mu(y)$, which is assumed to be piece-wise homogeneous. Show that the wave equation can be written as

$$\left[\frac{\partial^2}{\partial x^2} + \mu(y) \frac{\partial}{\partial y} \mu(y)^{-1} \frac{\partial}{\partial y} + \omega^2 \mu(y) \varepsilon(y) \right] E_z(x,y) = 0$$

From the wave equation, derive the boundary conditions satisfied by E_z at a boundary $y = y_s$ at which $\mu(y)$ and $\varepsilon(y)$ is discontinuous. [Hint: the derivatives must be finite. That is, the derivative of a function that is discontinuous will result in a delta function, which could not cancel to give zero on the right-hand-side of the source-free wave equation.]