Fields and Waves I

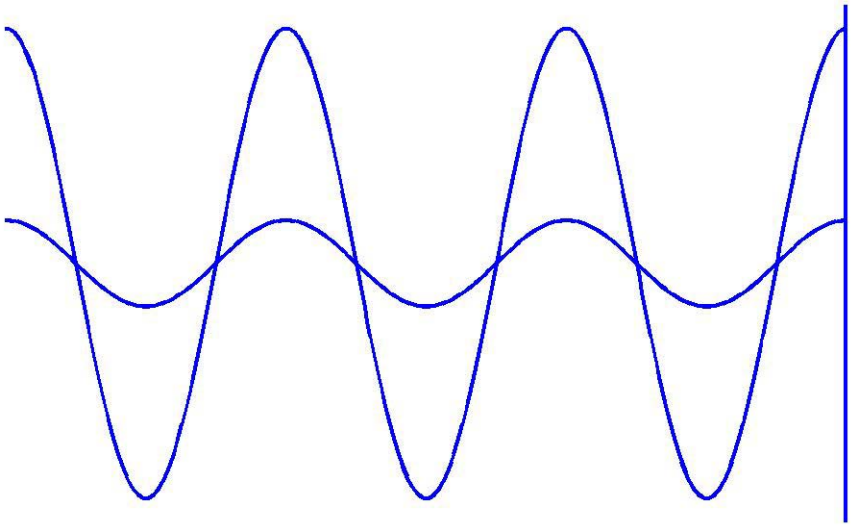
Name _____ **ECSE-2100 Spring 2002** **Section** _____

Homework 7

Due Thursday April 25, 2002

In this assignment, you may find it useful to run sing_bnd.m

1) Plane Wave Parameters



Region 1 $z = 0$

The figure shows an incident and a reflected electric field wave at some time, $t = t_1$. The amplitude of the incident wave is 4 V/m and it is +z-directed. The amplitude of the reflected wave is 0.73 V/m. Propagation is in the $+x$-direction at 15kHz. The boundary line represents an air/dielectric border, not necessarily in that order.

What is the reflection coefficient?

What is the transmission coefficient?

Which region is dielectric and which region is air?

What is the relative permittivity of the dielectric material?

In both materials, what are $\omega, \beta, \eta, \lambda$ in each region?

2) Plane Wave Representation

For both electric and magnetic fields, what are the expressions for the incident, reflected and transmitted waves in phasor form?

Sketch the standing wave pattern in Region 1 (the region to the left of the boundary line). What is the standing wave ratio?

What are the incident power density, the reflected power density and the transmitted power density?

3) Lossy and Lossless Materials

Now we replace region 2 (the region to the right of the boundary line) with distilled water.

At this frequency, would we consider the distilled water a good conductor, an insulator, or neither?

What are the new reflection and transmission coefficients? (They should be complex, but you can use any reasonable approximations).

In phasor notation, what is the electric field in the water?

How far will the transmitted wave penetrate before it loses 90% of its power?

What percentage of the incident power is delivered to the water?

4) Multiple Boundaries

Now assume that a lossless dielectric window is placed between the first region and water. Also the frequency is raised to 3GHz ($3x10^9$Hz). If our goal is to have no reflected wave in Region 1, what should the dielectric constant and thickness be for the window?