ECE424F MICROWAVE CIRCUITS

Homework #1

1. A plane-wave at 1GHz is propagating through a non-magnetic dielectric with a relative permittivity $\varepsilon_r = 4.0$. The loss tangent of the material is tanδ=0.001. Calculate the power loss in dB when the wave travels a distance of 1.5m. Repeat for tanδ=0.01 and tanδ=0.1.

2. A 100m long copper wire has a radius of a=1mm. Calculate the corresponding D.C. resistance. Compute the skin depth at 3GHz and the associated A.C. resistance. How do the two resistance values compare to each other ?

3. A transmission line is filled with a non-magnetic dielectric of $\varepsilon_r = 2.5$. The line has a capacitance per unit length of $C = 200\text{pF/m}$ and a resistance per unit length of $R = 2\ \Omega/\text{m}$. Calculate the corresponding phase velocity, characteristic impedance and attenuation constant α (assume G=0).

4. Problem 2.3 in textbook.

Hint: Assume $\overline{E} = \hat{y}E_o e^{-\gamma z}$

Note:

A very nice CAD tool for analyzing microwave circuits is Puff. Puff was designed at CalTech and runs on PC's under MS-DOS. You can really have a lot of fun with this software while still learning! Therefore, it is highly recommended that you purchase it. The price is about 15 USD and it can be ordered through the Internet at http://www.systems.caltech.edu/EE/Faculty/rutledge/Pufform.html. Have fun!!