Fields and Waves I - Fall 2000

Preparation Assignment - Due Oct. 30, 2000

An FM radio signal is traveling in free space. It has a form

$$H(y) = 3 \times 10^{-3} e^{-j0.68\pi y} \hat{a}_x \ A/m$$

Find the frequency
Find the time domain expression

Preparation Assignment - Due Nov.1, 2000

An electric field in free space is given by

$$E = 50 \cos(10^3 t + \beta x) \hat{a}_y$$

Find the direction of propagation.
Find the β and the time to travel a distance λ
Sketch the wave at $t = 0,\ T/4,\ T/2$.

Homework - Due November 2, 2000

1. A lossless transmission line in air has a characteristic impedance of $Z_0 = 70\ \Omega$ and phase constant of $\beta = 3$ radians/meter at 100 Mhz. Find the inductance and capacitance per meter.

2. The one dimensional wave equation is

$$\frac{\partial^2 E}{\partial x^2} = \frac{1}{U^2}\frac{\partial^2 E}{\partial t^2}$$

where U is the velocity. Show that any function of (x-Ut) is a solution. Suggestion - plug in $E = f(x - Ut)$. Be careful about evaluating the derivatives.

3. A telephone line has $R = 30\ \Omega/km$ $L = 100\ mH/km$, $G = 0$, and $C = 20\ \mu F/km$. At 1 kHz find the characteristic impedance, the propagation constant and the phase velocity.

4. A transmission line has $\omega = 10^6$, $\alpha = 0.921\ Np/m$, $\beta = 1\ rad/m$, and $Z_0 = 60 + j40\ \Omega$. The source end is connected to a voltage of $10\angle 0^\circ$ and $Z_g = 40\ \Omega$. The line is 2m long and the load end is terminated by $Z_l = 20 + j50\ \Omega$. Find the input impedance, the sending end current and the current at the middle of the line.