HW#2

7-1. (a) Obtain the wave equations governing the **E** and **H** fields in a source-free conducting medium with constitutive parameters ϵ, μ, and σ. (b) Obtain the corresponding Helmholtz's equations for time-harmonic fields.

7-3. Obtain a general formula that expresses the phasor $\mathbf{E}(\mathbf{R})$ in terms of the phasor $\mathbf{H}(\mathbf{R})$ of a TEM wave and the intrinsic impedance of the medium, where **R** is the radius vector.

7-5. The **E**-field of a uniform plane wave propagating in a dielectric medium is given by

$$\mathbf{E}(t,z) = \boldsymbol{a_x} 2\cos\left(10^8 t - z/\sqrt{3}\right) - \boldsymbol{a_y}\sin\left(10^8 t - z/\sqrt{3}\right) \quad (V/m)$$

a) Determine the frequency and wavelength of the wave.
b) What is the dielectric constant of the medium?
c) Describe the polarization of the wave.
d) Find the corresponding **H**-field.

7-7. A 3-(GHz), y-polarized uniform plane wave propagates in the $+x$-direction in a nonmagnetic medium having a dielectric constant 2.5 and a loss tangent 0.05

a) Determine the distance over which the amplitude of the propagating wave will be cut in half.
b) Determine the intrinsic impedance, the wavelength, the phase velocity, and the group velocity of the wave in the medium.
c) Assuming $\mathbf{E} = \boldsymbol{a_y} 50\sin(6\pi 10^9 t + \pi/3)\ (V/m)$ at $x = 0$, write the instantaneous expression for **H** for all t and x.

7-10. There is a continuing discussion on radiation hazards to human health. The following calculations provide a rough comparison.

a) The U.S. standard for personal safety in a microwave environment is that the power density be less than 10(mW/cm^2). Calculate the corresponding standard in terms of electric field intensity. In terms of magnetic field intensity.
b) It is estimated that the earth receives radiant energy from the sun at a rate of about 1.3(kW/m^2) on a sunny day. Assuming a monochromatic plane wave(which it is not), calculate the equivalent amplitudes of the electric and magnetic field intensity vectors.

7-11. Show that the instantaneous Poynting vector of a circularly polarized plane wave propagating in a lossless medium is a constant that is independent of time and distance.