ECE 3065

SAMPLE MIDTERM 1

1. The amplitude of an AM Radio Wave is described by the function:

$$y(x,t) = 4.5cos(2 \times 10^7 \pi t - \frac{1}{3}\pi x + \frac{\pi}{6}) \ , e^{-0.0008x} \quad (Volts) \tag{1}$$

(a) What is the amplitude A, the period T, the frequency f, the wavelength λ, the reference phase ϕ_o and the attenuation factor α? The velocity of light in the air is $c = 3 \times 10^8 m/sec$. **5 %**

(b) What is the value of the propagation constant β and the angular frequency ω? DO NOT FORGET THE UNITS AT (a), (b) **5 %**

(c)The above wave propagates at a $50-\Omega$ lossless transmission line which is terminated in a parabola with impedance Z_L=(40-j50)Ω. What is the reflection Coefficient Γ and the Standing Wave Ratio S at the load? **10 %**

(d) If the electrical length of the transmission line is $l = 0.30\lambda$, what is the input impedance Z_{in}? Does the load behave as an inductor or as a capacitor? Use the Smith chart to verify your results.**15 %**

2. The electric field of a uniform plane wave propagating in free space is given by: $\tilde{E} = (\hat{x} - j\hat{y})30e^{-j\pi z/3}$ (V/m) for a remote sensing satellite.

(a) Specify the polarization of the wave. **10 %**

(b) Calculate the magnetic field in phasor form. **10 %**

(c) What would be the difference if the electric field was given by: $\tilde{E} = (\hat{x} + j\hat{y})30e^{-j\pi z/3}$ (V/m)? **10 %**

3. The electric field of a wireless communication wave propagating through a nonmagnetic lossless material is given by: $\mathbf{E} = \hat{z}30cos(10^9 t - 6y)$ (mV/m)

(a) Find the direction of wave propagation. **10 %**

(b) Find the phase velocity and the wavelength in the material. **10 %**

(c) Assuming that an electric signal with this amplitude propagates on a transmission line with $Z_o = 50\Omega$ and has to be tranfered completely to a Radar antenna with $Z_L = 200\Omega$, a quarter-wave tranformer has to be used. What will be its electrical length and its characteristic impedance value? **15 %**

GOOD LUCK !!!