ECE 3065

MIDTERM 1 (60') - 3.October 2005 - Max 110%

1. The amplitude of a satellite Radio Wave is described by the function:

$$z(y,t) = 0.16sin(24 \times 10^9 \pi t + 160\pi y - \frac{\pi}{3})\ e^{0.0003y} \quad (Volts/m) \tag{1}$$

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

(b) Assuming that the propagation path is nonmagnetic, what is the value of the phase velocity v_p, the dielectric constant ϵ_r and the conductivity σ?? **(5 %)**

(c)The above wave propagates at a $75 - \Omega$ lossless coaxial line which is terminated in a 40-room motel. Each room's transceiver is equivalent to a series combination of a resistor $R = 3000$ i t $L = 39.8nH(= 1000/(8\pi))$. Assuming that the operating frequency is 12 GHz,what is the reflection Coefficient Γ and the Standing Wave Ratio S at the load? If a value of SWR smaller than 5 is considered to be satisfactory matching, how could you characterize this matching? **(15 %)**

(d) Could you match this load with a quarter-wavelength transformer assuming that the only parameter you can modify is the position of the transformer along the feeding line? **BONUS (10 %)**

(f th l t i al l th of th t a i io li i $l = 20.25\lambda$, what is the input impedance Z_{in} for the load of (c)? Does the load behave as an inductor or as a capacitor? **(10 %)**

2. The electric field of a remote-sensing uniform plane wave propagating in nonmagnetic lossless cosmic powder (assume that the intrinsic impedance is equal to the free space one) is given by: $\tilde{E}$=($\hat{x}$-$\hat{y}$) 15 $e^{-j160\pi z}$ (μV/m) for a remote sensing satellite operating at 18GHz.

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

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

(c) What would be the polarization if the magnetic field was given by: $\tilde{H} = (\hat{x}+j\hat{y})5e^{-j160\pi z}$ (μA/m)? **(10 %)**

3. A lossless 50Ω microstrip transmission line, that is used in collision avoidance radars, is to be mtached to a horn antenna with Z_L=(100+j25) Ω using a series short-circuited stub. Use the Smith chart to find:

(a) the reflection coefficient Γ and the standing-wave ratio without the stub, **(5 %)**

(b) the input impedance at 0.25 λ from the load, **(5 %)**

(c) the shortest line length for which the input impedance is purely resistive, **(5 %)**

(d) the stub length and the distance between the antenna and the stub (2 solutions).(a) Find the direction of wave propagation. **(15 %)**

GOOD LUCK !!!