

ELEC 353 – Assignment #9

1.1 Google “signal integrity” and find some web sites that define this term. Give a definition of “signal integrity” in your own words, and give references to the web sites you used.

1.2 Similarly, Google “knee frequency” and give a definition in your own words, and the associated web sites that you used.

1.3 What is “intersymbol interference”?

2. A plane wave travels in the z direction in a material at 850 MHz. The relative permittivity of the material is $\epsilon_r = 9$ and the loss tangent is 0.15. The electric field is oriented parallel to the x axis. The amplitude of the electric field at $z = 0$ is 5 volts/meter.

- (i) What is the value of the conductivity?
- (ii) What is the value of the propagation constant? What is the attenuation constant? What is the phase constant?
- (iii) What is the penetration depth?
- (iv) What is the intrinsic impedance?
- (v) Write the vector-phasor for the electric field.
- (vi) Write the vector-phasor for the magnetic field.
- (vii) Write the electric field vector and the magnetic field vector in the time domain.
- (viii) What is the amplitude of the electric field at $z = 2$ m?
- (ix) What is the power density at $z = 0$ m? At $z = 2$? (Hint: evaluate the \bar{E} and the \bar{H} phasors at $z = 0$ and then evaluate the Poynting Vector using $\bar{S} = \frac{1}{2} \text{Re}(\bar{E} \times \bar{H}^*)$. Then repeat with the \bar{E} and \bar{H} phasors evaluated at $z = 2$.)

3. A plane wave traveling in a lossless material at 2450 MHz can be written as

$$\bar{E} = \hat{a}_x A e^{-j\beta z}$$

where A is a complex-valued constant. The relative permittivity is $\epsilon_r = 2.45$. The amplitude of the wave at $z = 15$ cm is 2 mV/m and the phase angle is -26 degrees. The material is non-magnetic.

- (i) What is the value of the phase constant β ?
- (ii) What is the value of the constant A ?
- (iii) What is the value of the intrinsic impedance?
- (iv) Use Maxwell's Equations to find the vector-phasor for the magnetic field. Give numerical values for all the constants.
- (v) What is the amplitude and phase of the magnetic field at $z = 1.12$ m?