ECE 3025 Homework 6: Lossy Transmission Lines

Solutions

1. Assuming the rest of the cables are lossless, there was a 5 dB drop for 12m of cable length. Thus, the attenuation constant of the line is α =(0.417 dB/m)/(8.7 dB/Neper) or 0.048 Nepers per meter.

2. We can use the following relationship to calculate velocity of propagation:

$$v_p = \frac{\omega}{\beta} = \frac{2\pi f}{\text{Im}\left\{\sqrt{(R + j2\pi fL)(G + j2\pi fC)}\right\}}$$

   Once v_p is known, we can calculate the transit time, T:

$$T = \frac{D}{v_p} = \frac{3 \text{ miles}}{v_p}$$

   To get total total loss in dB, we use the following relationship

$$\text{Loss} = 8.7D\alpha = 8.7 \times (3 \text{ miles}) \times \text{Re}\left\{\sqrt{(R + j2\pi fL)(G + j2\pi fC)}\right\}$$

   Now we just need to plug in the corresponding values of $R = 50$ Ω/mile, $L = 1$ mH/mile, $C = 66$ nF/mile, and $G = 0$ milliSiemens/mile for dry wires and 0.01 milliSiemens/mile for wet wires.

   (a) For dry wires at 100 kHz: Loss = 5.3 dB, T = 4.9 μs

   (b) For dry wires at 1 MHz: Loss = 5.3 dB, T = 1.6 μs

   (c) For wet wires at 100 kHz: Loss = 21.3 dB, T = 4.3 μs

   (d) For wet wires at 1 MHz: Loss = 21.4 dB, T = 1.6 μs