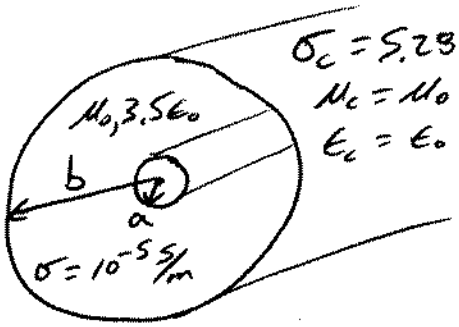
11.2 A coaxial cable has an inner conductor of radius $a = 0.8$ mm and an outer conductor of radius $b = 2.6$ mm. The conductors have $\sigma_c = 5.28 \times 10^7$ S/m, $\mu_c = \mu_o$, and $\varepsilon_c = \varepsilon_o$; they are separated by a dielectric material having $\sigma = 10^{-5}$ S/m, $\mu = \mu_o$, $\varepsilon = 3.5\ \varepsilon_o$. At 80 MHz, calculate the line parameters L, C, G, and R.



$a = 0.8$ mm

$b = 2.6$ mm

$f = 80$ MHz

From Table 11.1, get equations for R, L, G, & C

$$L = \frac{\mu}{2\pi} \ln \frac{b}{a} = \frac{4\pi \times 10^{-7}}{2\pi} \ln\left(\frac{2.6}{0.8}\right) = 235.731 \text{ nH/m}$$

$$C = \frac{2\pi\epsilon}{\ln(b/a)} = \frac{2\pi (8.854 \times 10^{-12})(3.5)}{\ln(2.6/0.8)} = 165.196 \text{ pF/m}$$

$$G = \frac{2\pi\sigma}{\ln(b/a)} = \frac{2\pi (10^{-5})}{\ln(2.6/0.8)} = 53.308 \ \mu\text{S/m}$$

$$R = \frac{1}{2\pi\delta\sigma_c}\left[\frac{1}{a} + \frac{1}{b}\right]$$ ↘ Calculate skin depth

$$\delta = \frac{1}{\sqrt{\pi f \mu \sigma_c}} = \frac{1}{\sqrt{\pi (80 \times 10^6) 4\pi \times 10^{-7} (5.28 \times 10^7)}} = 7.7439 \times 10^{-6} \text{ m}$$

$$R = \frac{1}{2\pi (7.7439 \times 10^{-6}) 5.28 \times 10^7}\left[\frac{1}{0.8 \times 10^{-3}} + \frac{1}{2.6 \times 10^{-3}}\right]$$

$$R = 0.6363 \ \Omega/\text{m}$$