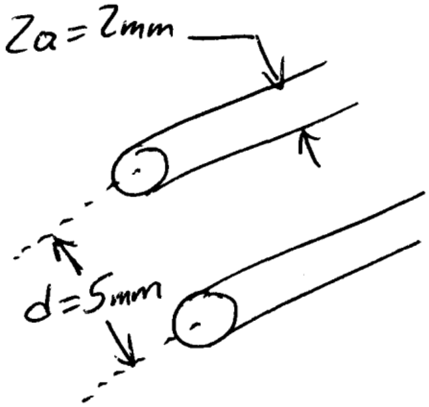
1) A two-wire transmission line consists of two perfectly-conducting wires of diameter 2 mm with a center-to-center spacing of 5 mm. If the insulation had an effective dielectric permittivity of $2.2\varepsilon_0$, find L, C, Z_0, and the phase velocity. At a frequency of 890 MHz, what are the phase constant and wavelength?



From Table 11.1,

$$L = \frac{\mu}{\pi}\cosh^{-1}\left(\frac{d}{2a}\right)$$

$$C = \frac{\pi\epsilon}{\cosh^{-1}(d/2a)}$$

$$L = \frac{\mu_0}{\pi}\cosh^{-1}\left(\frac{5mm}{2mm}\right) = \frac{4\pi\times10^{-7}}{\pi}\cosh^{-1}(2.5)$$

$$L = 6.267\times10^{-7}\ H/m = 626.7\ nH/m$$

$$C = \frac{\pi(2.2)8.854\times10^{-12}}{\cosh^{-1}(2.5)}$$

$$C = 3.906\times10^{-11}\ F/m = 39.057\ pF/m$$

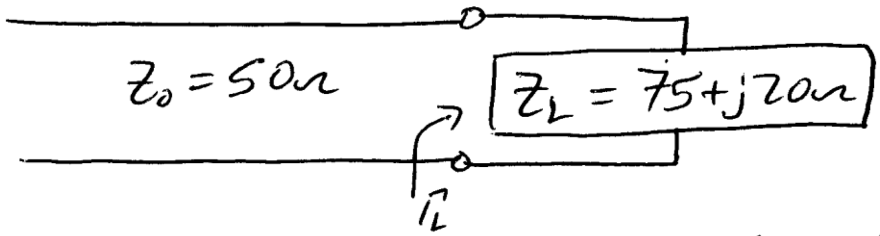
(11.21c) $Z_0 = \sqrt{L/C} = \sqrt{\frac{6.267\times10^{-7}}{3.906\times10^{-11}}} = 126.67\ \Omega$

(11.21b) $u = \frac{1}{\sqrt{LC}} = \frac{1}{\sqrt{6.267\times10^{-7}(3.906\times10^{-11})}} = 2.021\times10^{8}\ m/s$

(11.21b) $\beta = \omega/u = \frac{2\pi(890\times10^{6})}{2.021\times10^{8}} = 27.67\ rad/m$

(11.13) or (11.14) $\lambda = u/f = 2\pi/\beta = \frac{2\pi}{27.67} = 0.2271\ m$

11.14 A 50Ω coaxial cable feeds a 75+j20Ω dipole antenna. Find Γ and S.



Assume coaxial cable is lossless (SWR or VSWR doesn't make much sense for lossy trans. lines)

$$(11.36)\quad \Gamma_L = \Gamma = \frac{Z_L - Z_0}{Z_L + Z_0} = \frac{(75+j20)-50}{(75+j20)+50}$$

$$\Gamma_L = 0.2529\angle 29.57^\circ$$

$$|\Gamma| = |\Gamma_L| = 0.2529$$

$$(11.38)\quad S = \frac{1+|\Gamma_L|}{1-|\Gamma_L|} = \frac{1+0.2529}{1-0.2529}$$

$$S = 1.677$$