Supplemental #1
ECE357 /ECE320
University of Toronto

1) Answer the following questions:

a) What is the defining equation for a lossy transmission line (TL) characteristic impedance.

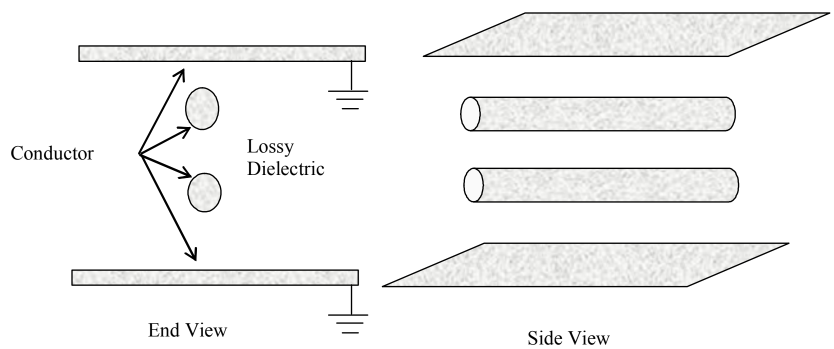
b) Give an expression for a lossy transmission line characteristic impedance in terms of the line capacitance, inductance, etc.

c) Write the voltage wave equation for a lossy transmission line. (Make sure you define your variables)

d) Write the solution to the equation you found in part (c).

e) Define the voltage reflection coefficient at the load, and explain what do we mean by a matched line?

f) Figures below show a shielded two-wire transmission line. On the figure to the right



draw a distributed parameter model for this two wire transmission line. (Make sure you indicated what each element of your modal represents)

2) A voltage source of $V_g = 10\angle 0\,[V]$ is connected to a $50\,[\Omega]$ lossless transmission line of length 5 [m]. The source operates at frequency $\omega = 2\pi \times 10^8\,[Hz]$ and its internal impedance is $Z_g = 25\,[\Omega]$. The line is connected to a $50\,[\Omega]$ load and the phase velocity on the line is measured to be $1\times 10^8\,[m/s]$. Answer the following questions.

a) What are the instantaneous voltage and current at any point on the line?

b) What are the instantaneous voltage and current at the load?

c) What is the average power transferred to the load.

3) The solution to the voltage and current wave equations were given by

$$V(z) = V_0^+ \, e^{-j\beta z} + V_0^- \, e^{+j\beta z}$$

$$I(z) = I_0^+ \, e^{-j\beta z} + I_0^- \, e^{+j\beta z}$$

Express the $V(z)$ and $I(z)$ in terms of the input ($z = 0$) voltage (V_i) and input current (I_i) to the line.

a) In exponential form.

b) In terms of sine and cosine functions.

4) What are the effective reactive elements simulated by a 50 cm long, short-circuited section of a $50\,[\Omega]$, $3\times10^8\ [m/s]$ lossless transmission line

a) At 100 MHz.

b) At 200 MHz.

5) The EMF of a $50\,[\Omega]$ generator is a single pulse of 12 [volt] amplitude and 8 [μs] duration. The generator drives a $100\,[\Omega]$ resistive load through a 600 [m] long section of a $50\,[\Omega]$, $2\times10^8\ [m/s]$ transmission line. Plot the generator terminal voltage in a 20 μs long time interval starting at the time of launching of the leading edge of the pulse on the line.

6) Consider 2 meter of a lossless transmission line, $Z_0 = 300\,[\Omega]$, $v_p = 2.5\times10^8$ [m/s]. It is terminated with a $300\,[\Omega]$ load, and the source is a $60\angle0^0$ [V], 100 [MHz] generator with a $300\,[\Omega]$ equivalent internal resistance.

a) What is the voltage at the input to the line (phasor form)?

b) Write the voltage at the load (phasor form)?

c) What is the standing wave ratio?

d) What is the time average power delivered to the load

e) A second load with input resistance of $300\,[\Omega]$ is connected in parallel to the existing load. What is the standing wave ratio on the line?

f) What is the total average power delivered to the load in this case?