Benha University
Faculty of Engineering at Shoubra
Electrical Engineering Department

Sheet 01

ECE 344: Microwave Fundamentals
Third Year Communications
2017

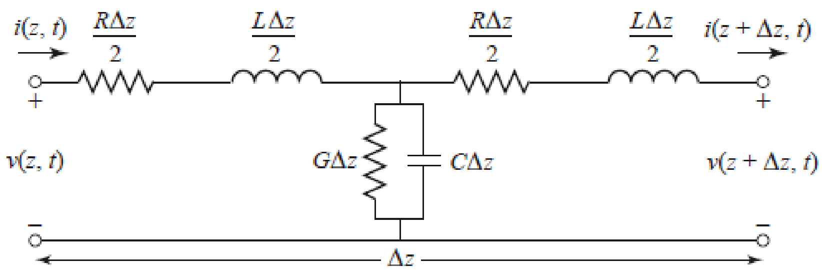
[1] A 75 Ω coaxial line has a current $i(t, z) = 1.8\cos(3.77 \times 10^9 t - 18.13z)$ mA. Determine (a) the frequency, (b) the phase velocity, (c) the wavelength, (d) the relative permittivity of the line, (e) the phasor form of the current, and (f) the time domain voltage on the line.

[2] A transmission line has the following per-unit-length parameters: L = 0.5 μH/m, C = 200 pF/m, R = 4.0 Ω/m, and G = 0.02 S/m. Calculate the propagation constant and characteristic impedance of this line at 800 MHz. If the line is 30 cm long, what is the attenuation in dB? Recalculate these quantities in the absence of loss (R = G = 0).

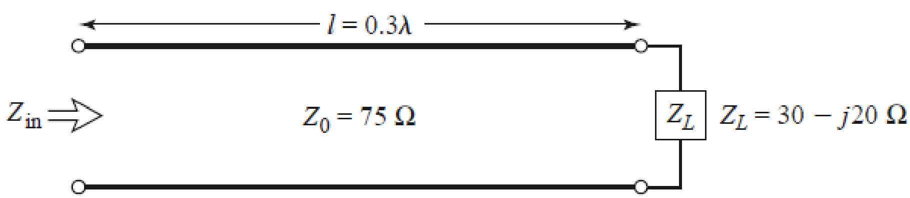
[3] Show that the T -model of a transmission line shown in the accompanying figure also yields the telegrapher equations derived in Section 2.1.

$$\frac{\partial v}{\partial z} = -Ri - L\frac{\partial i}{\partial t}$$

$$\frac{\partial i}{\partial z} = -Gv - C\frac{\partial v}{\partial t}$$



[4] A lossless transmission line of electrical length l = 0.3λ is terminated with a complex load impedance as shown in the accompanying figure. Find the reflection coefficient at the load, the SWR on the line, the reflection coefficient at the input of the line, and the input impedance to the line.



[5] A terminated transmission line with Z_0 = 60 Ω has a reflection coefficient at the load of $\Gamma = 0.4\angle 60^\circ$. (a) What is the load impedance? (b) What is the reflection coefficient 0.3 λ away from the load? (c) What is the input impedance at this point?

[6] A 100 Ω transmission line has an effective dielectric constant of 1.65. Find the shortest open-circuited length of this line that appears at its input as a capacitor of 5 pF at 2.5 GHz. Repeat for an inductance of 5 nH.

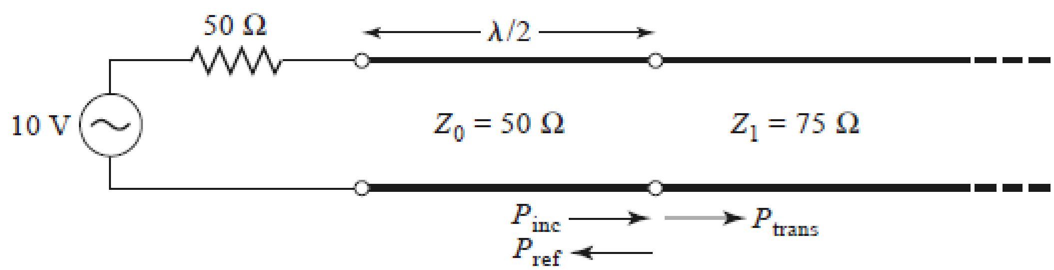
[7] A lossless transmission line is terminated with a 100 Ω load. If the SWR on the line is 1.5, find the two possible values for the characteristic impedance of the line.

[8] Let Zsc be the input impedance of a length of coaxial line when one end is short-circuited, and let Zoc be the input impedance of the line when one end is open-circuited. Derive an expression for the characteristic impedance of the cable in terms of Zsc and Zoc.

[9] A radio transmitter is connected to an antenna having an impedance 80 + j40 Ω with a 50 Ω coaxial cable. If the 50 Ω transmitter can deliver 30 W when connected to a 50 Ω load, how much power is delivered to the antenna?

[10] For a purely reactive load impedance of the form $Z_L = jX$, show that the reflection coefficient magnitude $|\Gamma|$ is always unity. Assume that the characteristic impedance Z_0 is real.

[11] Consider the transmission line circuit shown in the accompanying figure. Compute the incident power, the reflected power, and the power transmitted into the infinite 75 Ω line. Show that power conservation is satisfied.



Good Luck

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