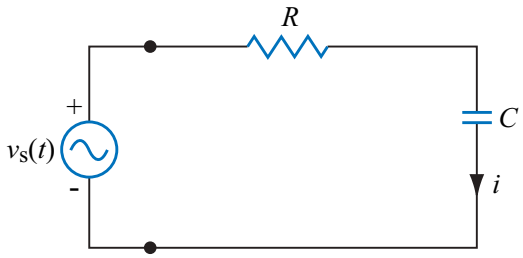
CMPE 330 Spring 2015 First Midterm Examination

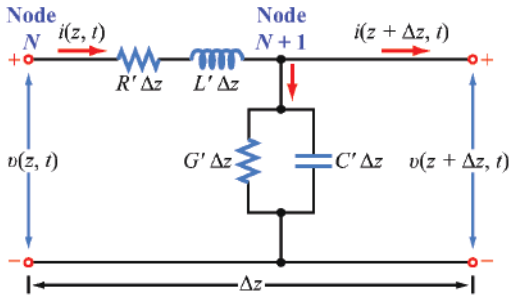
(Each problem is worth 10 points)

1. A wave in a lossy transmission line has a frequency of $f = 5$ GHz and $\epsilon_r = 2.25$.
   a. What are ω, λ, β, and u_p?
   b. The wave has an initial amplitude of 125 V. After propagating 300 m, its amplitude is 1 V. What is its amplitude at 100 m and 200 m?

2. For a simple RC circuit like the one shown on the right [Ulaby et al., Fig. 1-20], operating at a frequency f with a source voltage whose phasor is expressed $\tilde{V}_s$, give expressions for the phasors of the voltage and the current across the resistor and the capacitor as a function of $\tilde{V}_s$, R, C, and f. What fraction of the power is dissipated in the resistor and what fraction is dissipated in the capacitor?



3. Show how to obtain the telegrapher's equations for a transmission line using the equivalent circuit shown to the right [Ulaby et al., Fig. 2-8] in the limit where Δz becomes small. Write the corresponding phasor domain equations.



4. In a parallel plate transmission line, we have $Z_0 = 100\ \Omega$ and $u_p = 2 \times 10^8$ m/s. What are L' and C'? Recall that in a parallel plate transmission line, we have $L' = \mu h/w$ and $C' = \epsilon w/h$, where w is the width of the plates and h is the separation between the plates. Estimate w/h to two significant figures.

5. Consider a 50-Ω transmission line with a load impedance of 100 Ω and a generator impedance of 50 Ω. At $t = 0$, we turn on a generator voltage of 100 V, and at $t = 1$ ns, the transient voltage reaches the load. Give the voltage and current as a function of time at both the generator and the load.