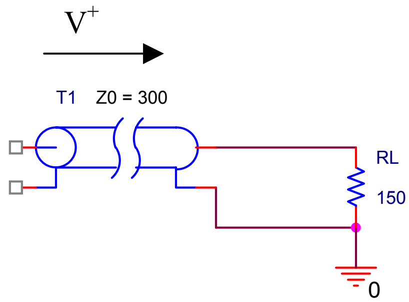
Fields and Waves I

Name _______________ ECSE-2100 Fall 2002 Section ____________

Homework 3

Due Thursday 19, September, 2002

1) Power



A semi-infinite lossless transmission line is shown in the above circuit. Semi-infinite implies that the transmission line continues to the left. As such, we only need information about the incident (forward propagating) wave. The source voltage and input impedance are not important for our problem. The amplitude of the forward propagating wave is 5V.

1) Determine the power of the incident wave.

2) Determine the power of the reflected wave.

3) What is the amplitude of the load voltage?

4) Using the load voltage, determine the power delivered to the load?

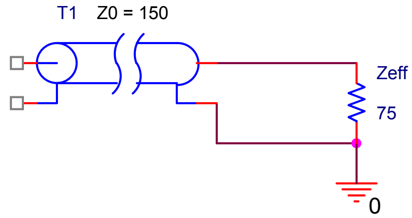
5) What relationship exists between the answer in part 4 and the answers in parts 1 and 2?

6) Are there any other resistive loads that would have an identical load power?

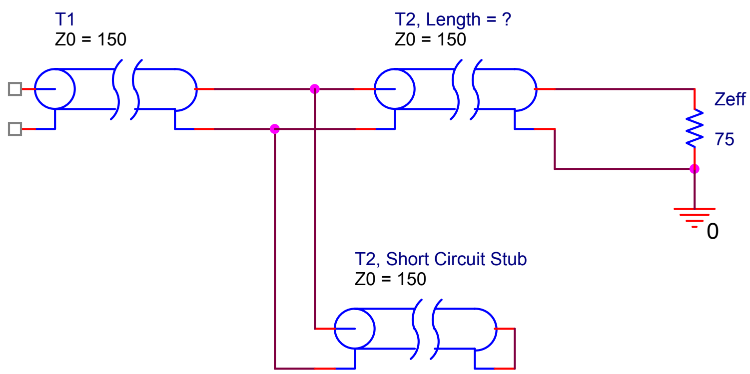
7) If we replace the load with an open circuit, what will the amplitude of the load voltage be? Why would there be zero power at the load?

2) Stubs-Matching

Your neighbors are management majors and somehow they figured out how to pirate cable by splicing into your cable. However, they didn't quite do a perfect job since they didn't have any electrical engineering consultants.



As a result, the transmission line and effective load appear above. The circuit is semi-infinite and lossless. Once you find out what they did, you are concerned that reflections will warn the BigBad Cable Company. So you set out to fix the problem and still allow the poor management majors to watch repeat episodes of The Antique Road Show. Assume all transmission lines have a propagation velocity of 2.4E8 [m/s] and a test frequency of 500MHz is used to check for mismatches.



1) In order to avoid reflections, what is the effective load at the end of T1?

2) Is the input <u>admittance</u> to the short circuit stub real or imaginary?

3) What is the real part of the input <u>admittance</u> of T2?

4) How long is T2?

5) For that length, what is the input <u>admittance</u> of T2?

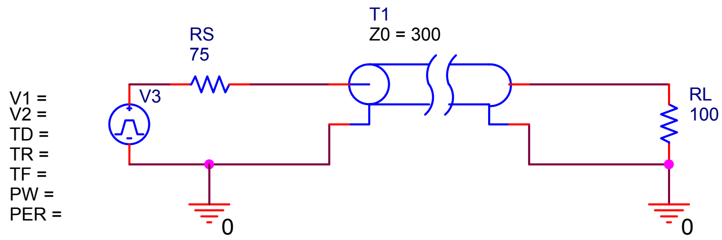
6) What is the input <u>admittance</u> of T3?

7) How long is T3?

Extra Credit:

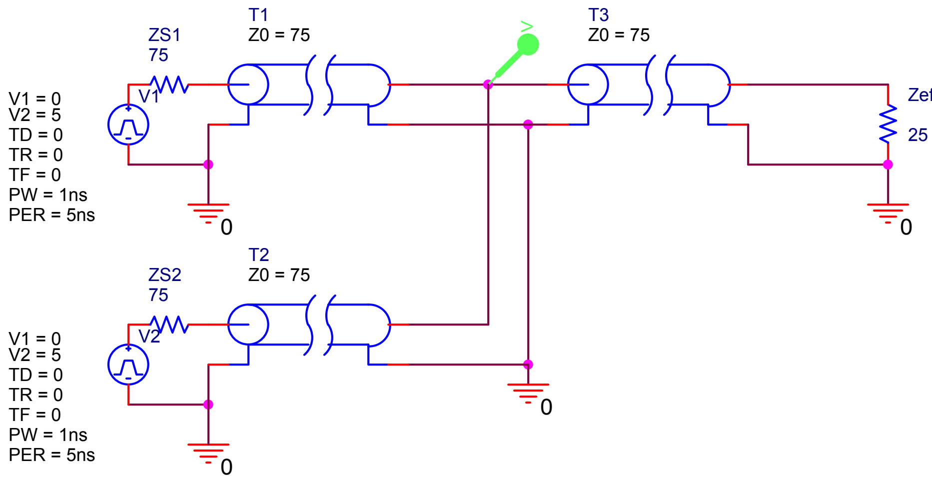
Solve this problem using Smith Charts. (Section 2.9 of the book)

3) Transients-Lattice Diagram



For the above circuit, the transmission line has a velocity of propagation of 3E8 [m/s] and is 10 [m] long. A single, 10V, 1[ns] pulse occurs at t=0. Draw the lattice diagram, labeling all pertinent values.

4) Transients-Measurements



For the above circuit, plot (prior to using SPICE) the voltage at the node indicated for the range $t \in [0, 40ns]$. Assume a velocity of propagation of 2E8 [m/s] and the lossless lines have length T1:1[m], T2:2[m], and T3:1[m]. Both sources send a 5V, 1[ns], pulse every 5[ns].

Simulate the circuit with SPICE to verify your results.

5) Integrals

Do not use Maple except to check your solutions. You must show your work

1) Integrate $f(r,\theta,\phi) = r\sin(\phi)$ over the volume $r < a$.
2) Integrate $f(r,\theta,\phi) = r\sin(\phi)$ over the surface $r = a$, $0 < \varphi < \pi$.
3) Integrate $f(r,\theta,\phi) = r[\cos(\phi)]^2$ over the volume $r < a$, $0 < z < l$.