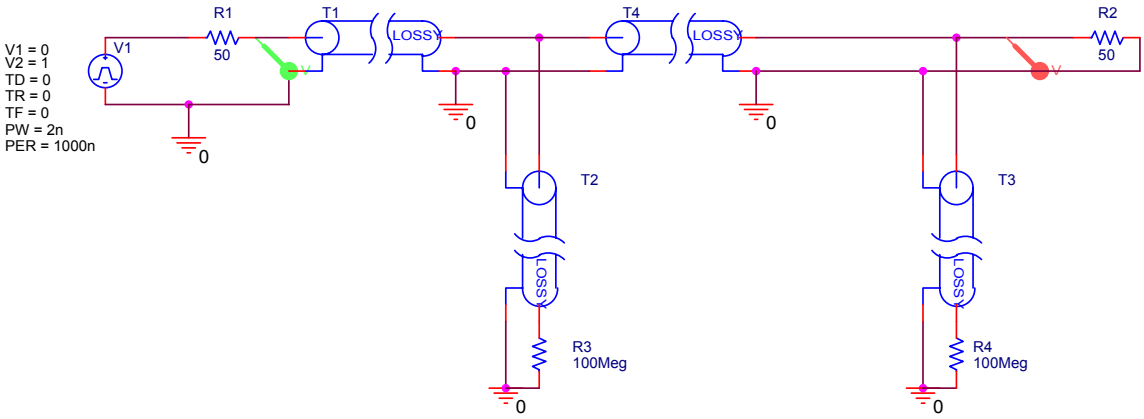
**Fields and Waves I**

**Name** _____ **ECSE-2100 Spring 2002** **Section** _____

**Extra Credit Assignment**
**28 February 2002**

The questions in this assignment can be used for extra credit points. There are two questions on transmission lines. If both are done correctly, an extra 10 points will be added to the score on Quiz 1. There is also one question on electric fields. If it is answered correctly, 5 extra points will be added to the overall course grade.

1. (5 points) – Pulses on transmission lines. A transmission line like the one we have just considered as an RF filter is driven by a pulsed voltage source. The pulses have a magnitude of 1V and a duration of 2ns. The pulses repeat every 1000ns. The following questions refer to the time $0 < t < 800ns$. For all four transmission lines, the capacitance per unit length $C' = 1.020 \times 10^{-10} F/m$, the inductance per unit length $L' = 2.451 \times 10^{-7} H/m$, and the resistance per unit length is $R' = 0.500\Omega / m$. Note that these numbers are a little different than we measured for the RG58A/U cable we use in class. They are, in fact, somewhat faked, to make the line characteristics come out simply. The conductance per unit length is too small to be of concern. The lengths of the lines are *T1:40m, T2:5m, T3:3.333m, T4:5m.*




a. How many pulses are observed at the load end with a voltage greater than 100mV? At what times do they occur? Use the following table, which has more cells than necessary. The pulses can be positive or negative.

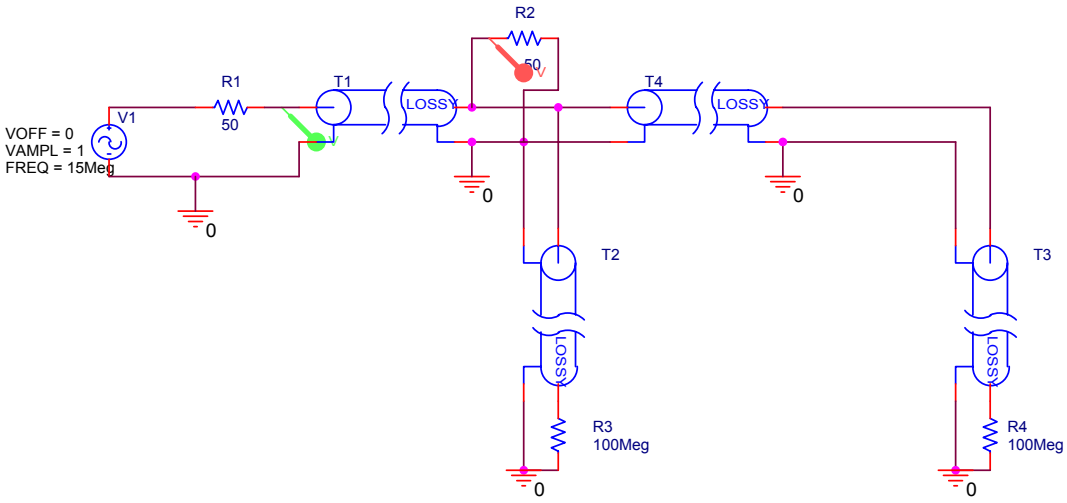
| | | | | | |
|---|---|---|---|---|---|
| Voltage Magnitude | | | | | |
| Time of Pulse | | | | | |

b. Counting the original pulse, how many pulses are observed at the source end with a voltage greater than 100mV? At what times to they occur? Use the following table, which has more cells than necessary. The pulses can be positive or negative.

| | | | | | |
|---|---|---|---|---|---|
| Voltage Magnitude | | | | | |
| Time of Pulse | | | | | |

Note – It is a good idea to generate the bounce diagram.

2. (5 points) Sinusoidal Waves on Transmission Lines Now, consider both a 10MHz and a 15MHz source driving the transmission line configuration below. Assume that the lines are identical to the one's in the previous problem, except that the loss term *R'* is zero and thus the line is lossless.




a. Find the standing wave pattern on T1 when the source frequency is 10MHz.

b. Find the standing wave pattern on T1 when the source frequency is 15MHz.

3. (5 points) A coaxial cable has a center conductor with radius $r = a$, an outer conductor with inner radius $r = b$, and an insulator with $\varepsilon = \varepsilon_r \varepsilon_o$. Assume that the inner conductor is at a voltage $V_o$ and that the outer conductor is grounded. For a closed cylindrical surface of length $l$ with radius $r = c$, where $a < c < b$, (see arrow in figure), determine the value of $\oint \vec{D} \cdot d\vec{S} = ?$ in terms of the given quantities.