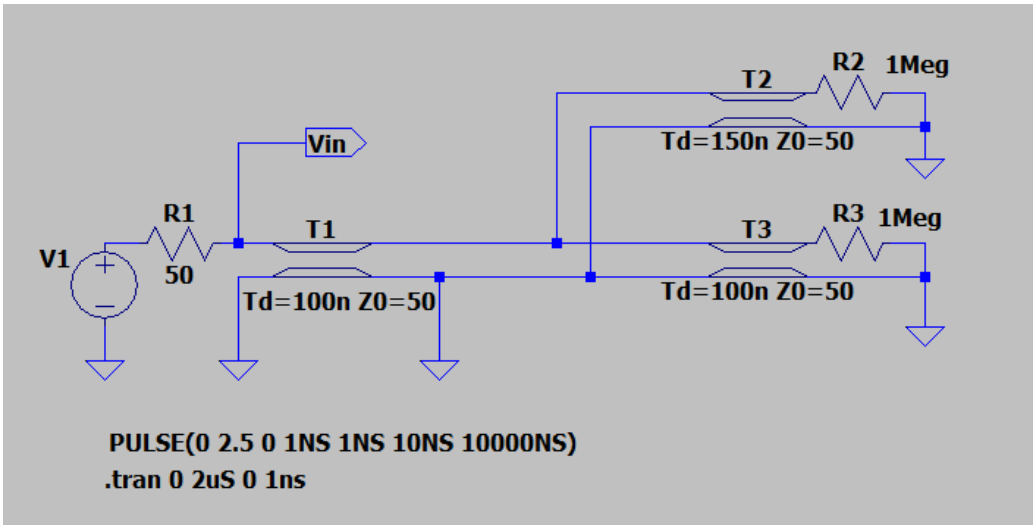
Physics 53600 – Assignment #3 – Due February 20, 2020

1. Lossless transmission lines can be simulated in SPICE using the **tline** component, which is described in terms of its characteristic impedance and its length, specified in terms of a propagation delay.

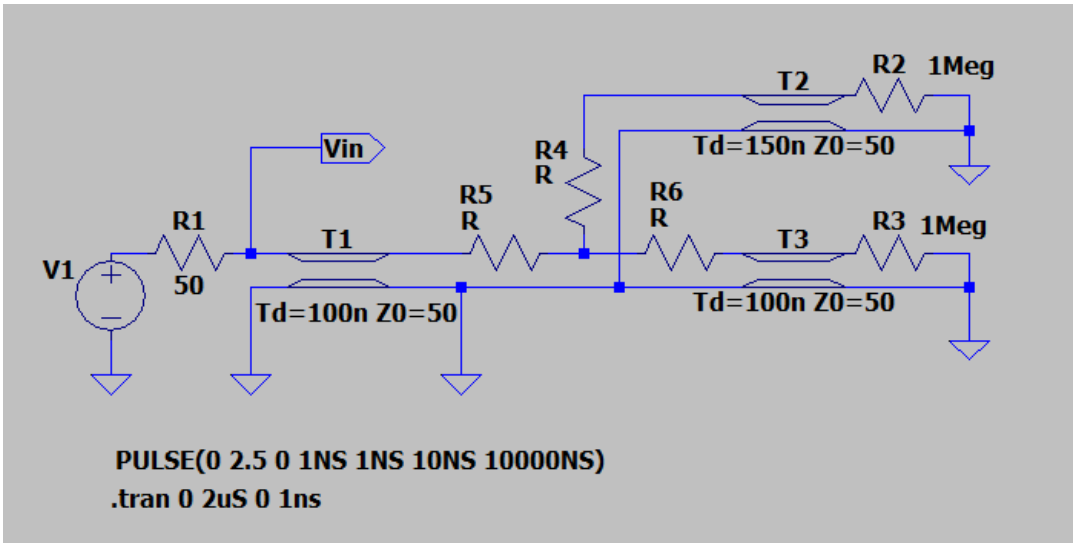
   (a) Simulate the following circuit in LTspice:



   and show a plot of the waveform measured at Vin, the input to the transmission line network.

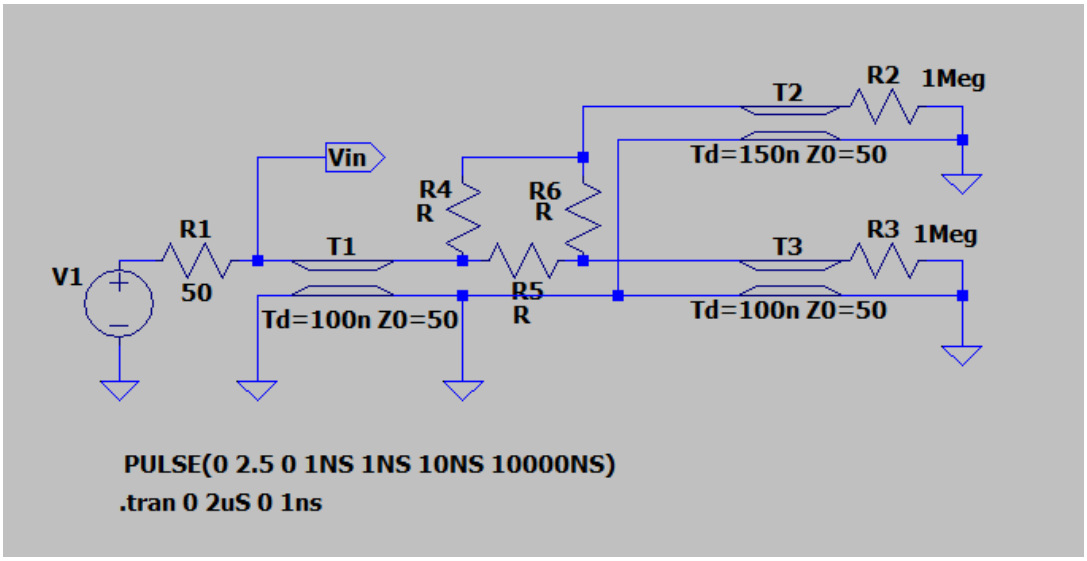
   (b) Describe the signal paths in the network that produce at least the first 6 reflected pulses observed at **Vin**. For example, the first reflected pulse can be described as "Propagates 100 ns to the junction of the three transmission lines, is then reflected from the impedance mismatch at the junction, and propagates back to the source arriving at 200 ns."

(c) Now consider a network that has series resistors at the junction:



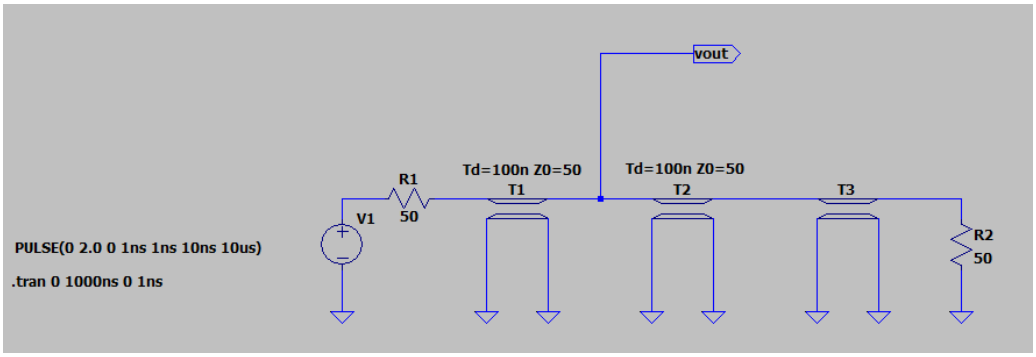
What value of R4, R5, and R6 will eliminate reflections of any signal arriving at the junction of the three transmission lines?

(d) Next, consider a network that has an alternative configuration of resistors at the junction:



What value of R4, R5, and R6 in this configuration will eliminate reflections of any signal arriving at the junction of the three transmission lines?

2. Time-domain reflectometry is a technique used to analyze the integrity of a transmission line by looking at the signals reflected from impedance mismatches within the system. Consider the following circuit in which the electrical length and impedance of transmission line T3 are unknown:



The signal observed at **vout** that is produced by the voltage source looks like this:

Calculate the electrical length and the impedance of transmission line T3 and explain your reasoning.