EELE 461/561 – Digital System Design   **Name:** _____
Homework #4   **Grade (EELE461):** _____ / 10
   **Grade (EELE561):** _____ / 15

NOTE: Print this sheet and use as a cover for your homework set.

**EELE 461 & EELE 561**

A) Reflections on a T-line (1)
    (3 POINTS)

    For the following circuit (R_S=25, R_L=75), draw the bounce diagram for the first 5 wave propagations in the
    transmission line.   Then simulate this circuit in DxDesigner and plot Va and Vb. Place markers at all major
    events on the waveform. Use your ideal voltage step source.
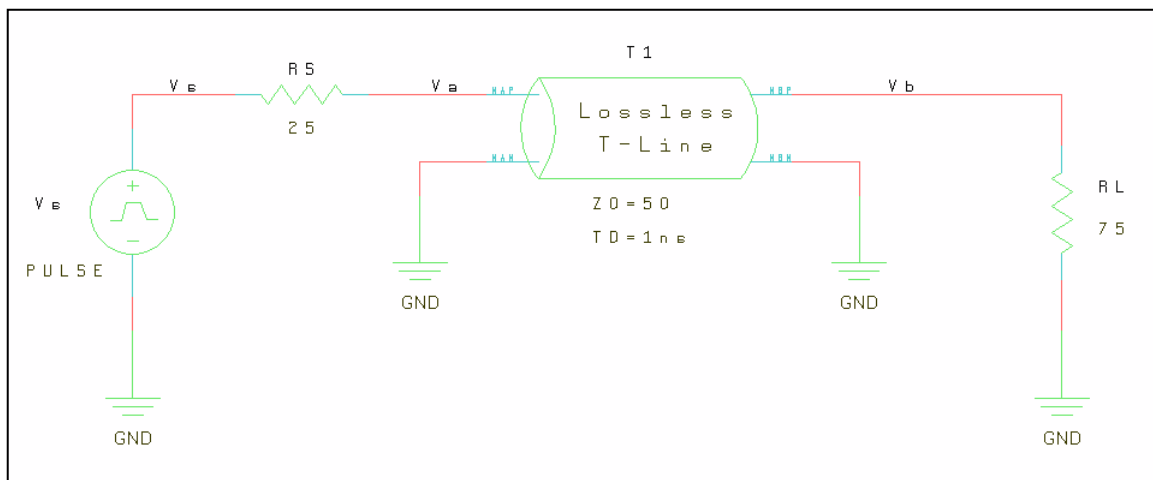
B) Reflections on a T-line (2)
    (3 POINTS)

    For the following circuit (R_S=75, R_L=25), draw the bounce diagram for the first 5 wave propagations down the
    transmission line.   Then simulate this circuit in DxDesigner and plot Va and Vb. Place markers at all major
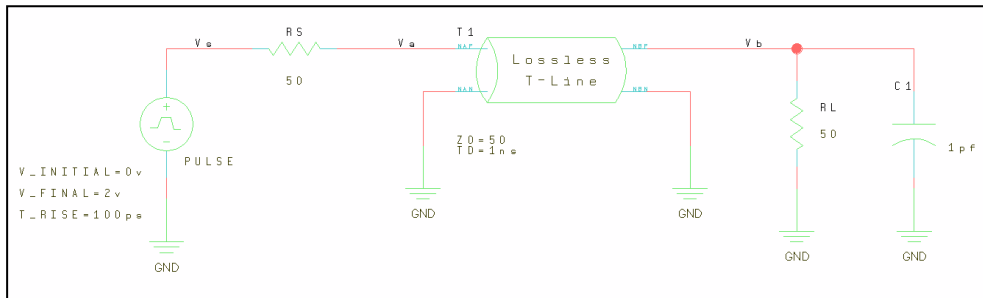   events on the waveform. Use your ideal voltage step source.
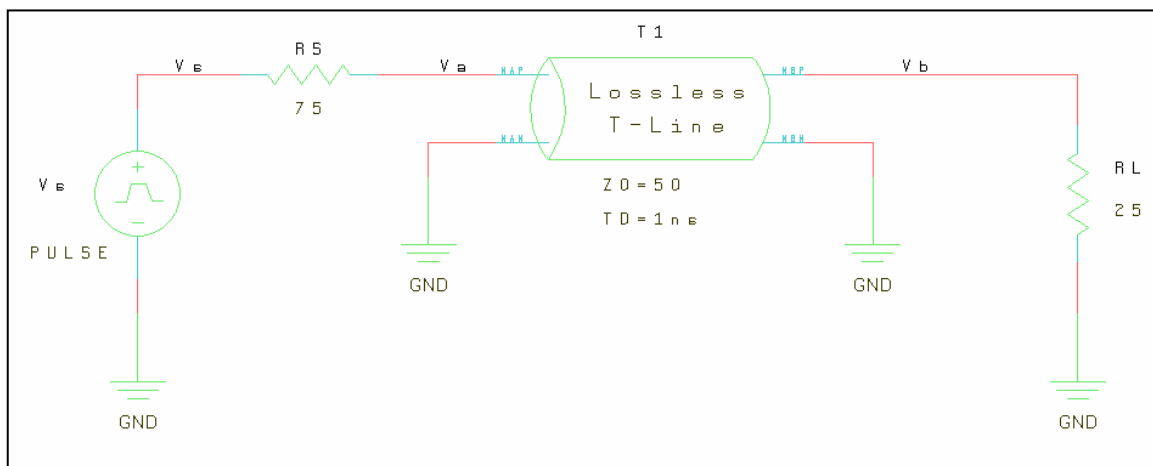
C) Reflections From a Capacitor
   (2 POINTS)

   Calculate the reflection that will occur due to the capacitor in the following circuit if the source risetime is a 100ps step. Then simulate this circuit in DxDesigner. Place markers on the reflection at Va to check the accuracy of your hand calculation.

D) Reflections From an Inductor
   (2 POINTS)

   Calculate the reflection that will occur due to the inductor in the following circuit if the source risetime is a 100ps step. Then simulate this circuit in DxDesigner. Place markers on the reflection at Va to check the accuracy of your hand calculation.
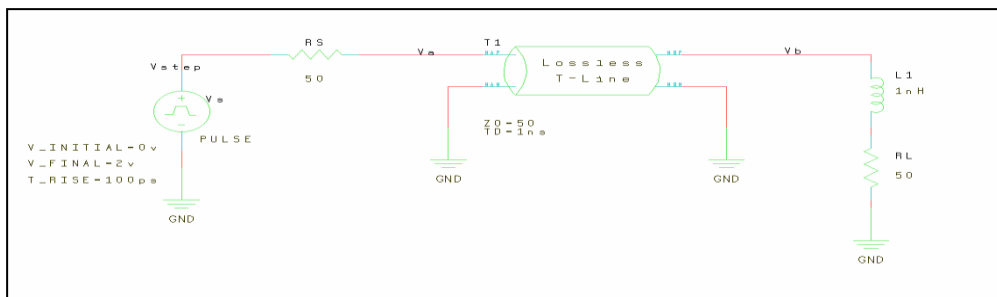
EELE 561 Only

E) You are designing a USB link and want to evaluate the severity of reflections that may occur. Your link consists of:
   - A transmitter with a 100ps risetime and 30ohm output impedance
   - A 3" PCB trace (Dk=4) with 60ohm impedance
   - A USB connector that can be modeled with a 10nH inductor
   - A 2" USB cable with 90ohms (Dk=2.8)
   - Another USB connector that can be modeled with an 8nH inductor
   - Another 3" PCB trace (Dk=4") with 55ohm impedance
   - An receiver with a 5pF equivalent load capacitance.
   - A load termination resistor of 90ohms to ground.

   Enter your model in DxDesigner and observe the reflections at Va (i.e., the far side of the 30ohm source resistor). Identify which impedance discontinuity causes the largest reflection in the system. For the largest discontinuity, apply the appropriate math to see if you can calculate by-hand what the reflection magnitude should be in order to check the simulation results. Suggest a solution to reducing the worst reflection in this link.
   (5 POINTS)