Lab 8: Transients using LTSPICE

Getting started with LTspice

Dear students, hello!! I hope you are healthy and safe! :)
LTspice is a very cool and simple software to use for simulating circuits. Please download the software from:
https://www.analog.com/en/design-center/design-tools-and-calculators/ltspice-simulator.html?gclid=EAIaIQobChMIsqGC6r-h4AIVSbjACh0y5QOmEAAYASAAEgLz4_D_BwE

LTspice could be slightly different for Mac and Windows users. Therefore, we provide two video links, the first one for Mac users and the second one for Windows users. They are very similar though.

1. https://www.youtube.com/watch?v=6AA4YBtqhwE (Mac users)
2. https://www.youtube.com/watch?v=JRcyHuyb1V0&t=19s (Windows users)

And a small written tutorial could be found here:
https://eecs.oregonstate.edu/education/docs/tutorials/LTSpiceIntro.pdf

Please create a report and include all the steps explained in each experiment.
Note: the values used in the experiments below, might be different from what have been used in lab8 handout in the website. The frequencies of function generators are fixed, and you DO NOT need to change frequency values.

Lab 8: Transients

Experiment 1, RC transient:
1. Open ltspice, load the lab8_Ex1_RC.asc file.
2. Make a plot of VC (with respect to ground) and VR (the voltage across the resistor, the instruction on how to do this is found on the written tutorial above). Attach the plots to your reports.
Explanation: when you run the simulator file, you may not see the desired waveforms at the first place. After the empty plot window pops up, you need to click on desired spots on the simulator's circuit so that the waveforms show up on the plotting window.

3. Does the transient looks like an exponential curve?
4. Does the capacitor voltage changes instantly?
5. Measure the time constant (τ) based on the plots. To do so, **FIRST, enlarge (maximize) the plotting window.** Then, calculate 63% of the maximum voltage, which in here is 8V, and find that value on the curve. By moving the cursor on a waveform in a plot, two values of x(time) and y(voltage) appears at the top of window. By finding y = 63% of the total voltage on the rising part of VC waveform, x should represent roughly your time constant, τ. More explanation on how to measure a time constant, τ, could be found on lab 8 hand out.
6. Calculate the time constant, τ.
7. Are the calculated and measured time constants close?

Experiment 2, RL transient:

1. Open ltspice, load the lab8_Ex2_RL.asc file.
2. Make a plot of VL and attach it to your report.
3. Does the transient look like an exponential curve?
4. Does the inductor voltage change instantly?
5. Measure the time constant, τ, based on the plots. To do so, **FIRST, enlarge (maximize) the plotting window.** Then, calculate 37% of the maximum voltage, which in here is 8V, and find that value on the curve. By moving the cursor on a waveform in a plot, two values of x(time) and y(voltage) appears at the top of window. By finding y = 37% of the total voltage on the falling part of VL waveform, x should represent roughly your time constant, τ. More explanation on how to measure a time constant, τ, could be found on lab 8 hand out.

6. Calculate the time constant, τ.
7. Are the calculated and measured time constants close?

Experiment 3, Series RLC transient:

1. Open ltspice, load the lab8_Ex3_Series_RLC.asc file.
2. Make a plot of VR and attach it to your report.
3. What is the shape of the transient?
4. Measure the time constant, τ, based on the plot (Please refer to the lab8 handout and the picture at the bottom of the page 3). Please do not forget to maximize your plotting window before measuring the time constant.
5. What is the calculated time constant, τ, (provided in the lab appendix)?
6. Are the calculated and measured time constants, τ, close?
7. Change the Resistor_Sub_Box resistance until you get a critically damped VR.
8. At what resistance did the oscillation become critically damped?

Experiment 4, Parallel RLC transient:

1. Open ltspice, load the lab8_Ex4_Parallel_RLC.asc file.
2. Make a plot of VC and attach it to your report.
3. What is the shape of the transient?
4. Measure the time constants, τ, based on the plot (Please refer to the lab8 handout and the picture at the bottom of the page 3). Please do not forget to maximize your plotting window, before measuring the time constant.
5. What is the calculated time constants, τ, in the lab appendix?
6. Are the calculated and time constants, τ, close?

Great job!:)