ECE 541: Electric Circuits

Laboratory Exercise #6
RL Circuit

Week of 12/5 (Groups A and B)

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1. Introduction

In this lab, we will experimentally validate the natural and step responses of the RL circuit.

2. Procedure

2.1. Resistor-Inductor (RL) Circuit

- Set up the circuit shown in Figure 1.

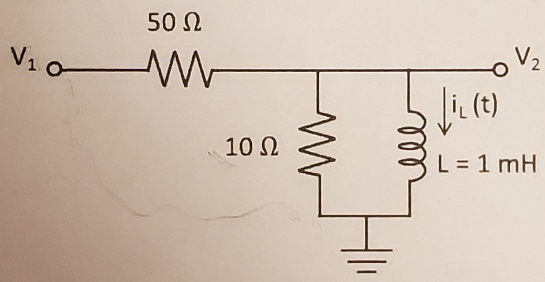
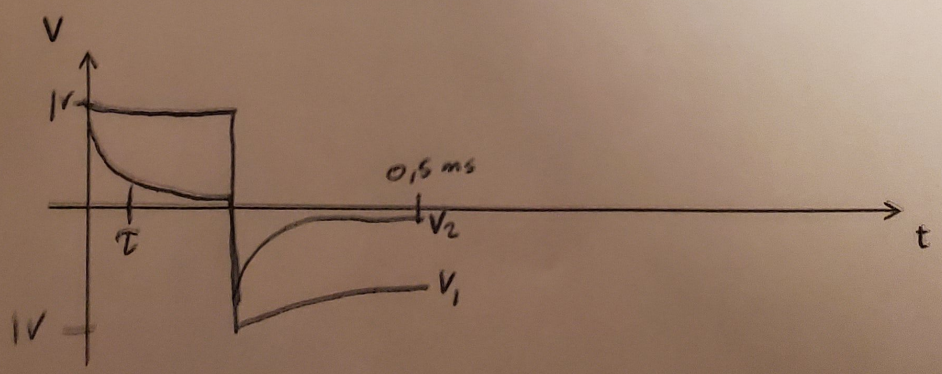


Figure 1: An RL Circuit

- Adjust the signal generator to produce a square wave of 0 V to 1 V at 1 kHz. Connect the output of the signal generator to V_1.
- Connect the channel 1 and 2 probes of the oscilloscope to the input (V_1) and output (V_2), respectively.
- Based on the oscilloscope, sketch at least 1 period of the waveforms of V_1 and V_2 on the same graph below. Label each graph.



- What is the calculated time constant (τ)? Indicate τ and V(τ) on the graph above. Does τ match the graphical interpretation of the time constant?

$\Delta V = 0.554\,V$

$\frac{L}{R} = \frac{0.001}{8.33} = 0.00012 = 120\,\mu s$

$V(\tau) = 0.20498\,V$

- Based on the oscilloscope waveforms, formulate the equation for $V_2(t)$ describing the Natural Response of the RL circuit. Assume $t_0 = 0$ s.

$V_s = 0.288V$

$V_0 = -0.256\,V$

$Req = 8.33\Omega$

$I_0 = -0.0307$

$V_2(t) = -0.256\,e^{-t/0.00012}$

- Based on the oscilloscope waveforms, formulate the equation for $V_2(t)$ describing the Step Response of the RL circuit. Assume $t_0 = 0$ s.

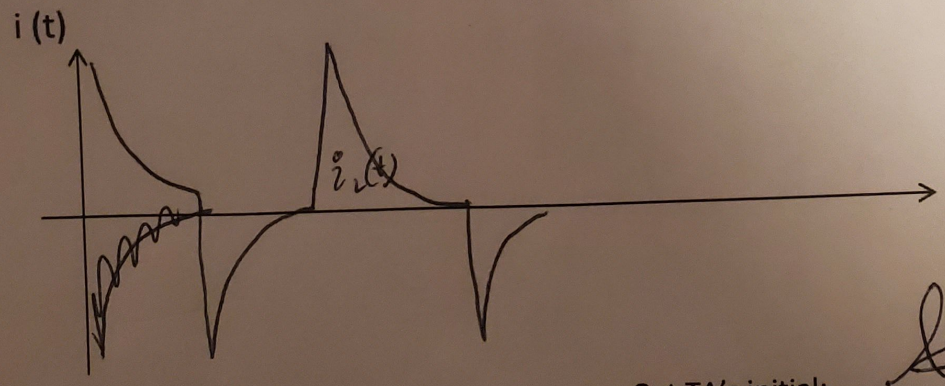
$V_2(t) = 0.288 - 0.288\,e^{-t/0.00012}$

- Write the expression for $i_L(t)$ in both the Natural Response and Step Response of the RL circuit.

$i_L(t) = -0.0307\,e^{-t/0.00012}$

$i_L(t) = 0.03457 - 0.03457\,e^{-t/0.00012}$

- Based on the equation derived above, sketch the expected waveform of $i_L(t)$ that corresponds to the $V_2(t)$ waveform sketched previously.



Get TA's initial: _____