Electric Circuits II – Laboratory 03

Step response of first order circuits

#	Student ID	Student Name	Grade (10)	Instructor signature
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Delivery Date	

Objective

In this exercise, the DC step response of simple RC/RL circuits is examined. The complete response behavior of RC/RL circuits is also tested.

Theory Overview

When the dc source of an RC circuit is suddenly applied, the voltage or current source can be modeled as a step function, and the response is known as a step response

The complete response of such circuit consists of two parts, the steady state response and the transient response.

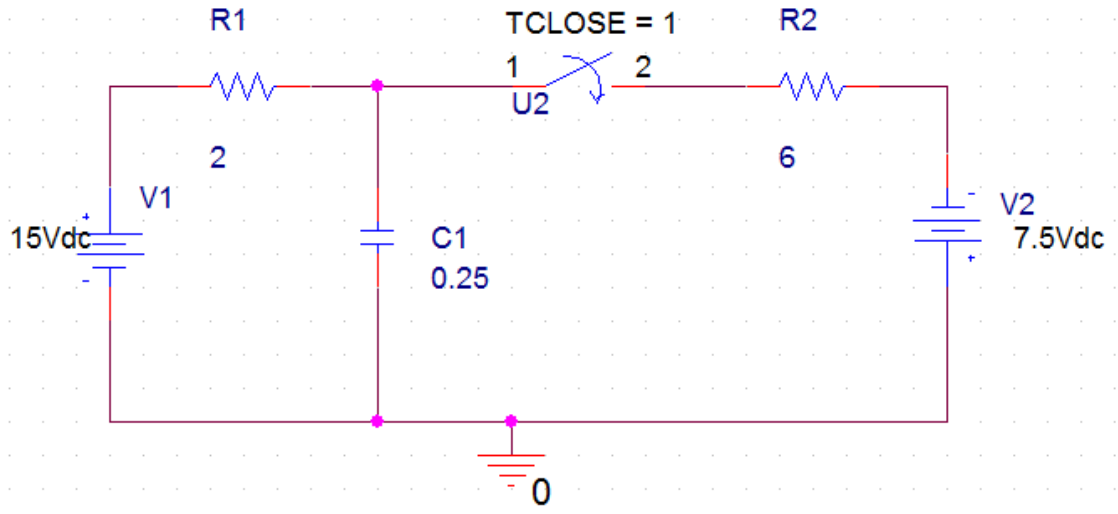
$$v(t) = v(\infty) + [v(0) - v(\infty)]e^{-t/\tau}$$

$$i(t) = i(\infty) + [i(0) - i(\infty)]e^{-t/\tau}$$

Procedure

Part 1

1. Build the following schematic using orcad pspice



2. You can find switch on EVAL library named SW_tClose
3. Use time domain transient in simulation profile, set the runtime to 6 seconds

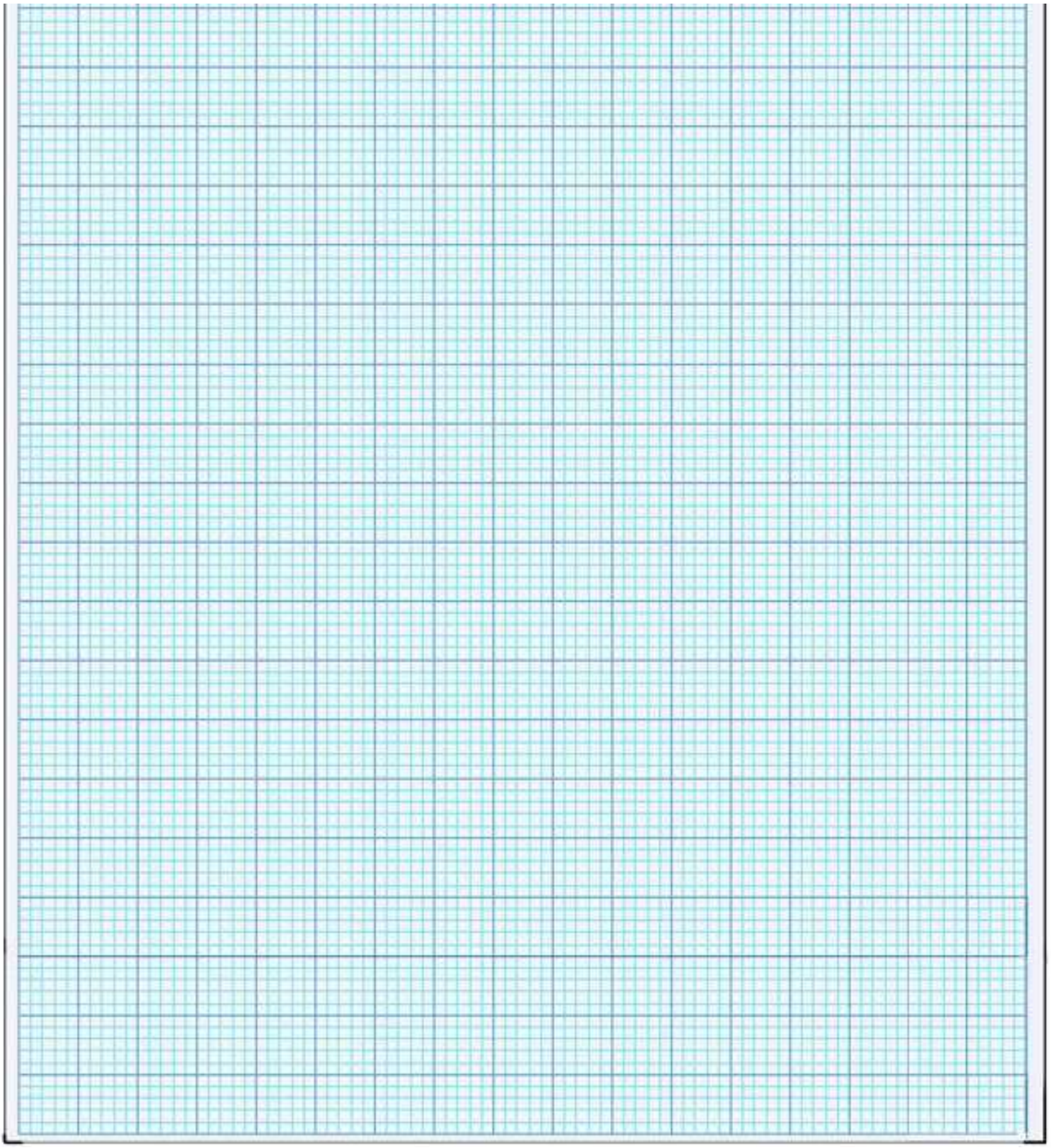
4. Run simulation then plot the relation between V(C1:2)-V(C1:1) and time

Results and data analysis

τ	

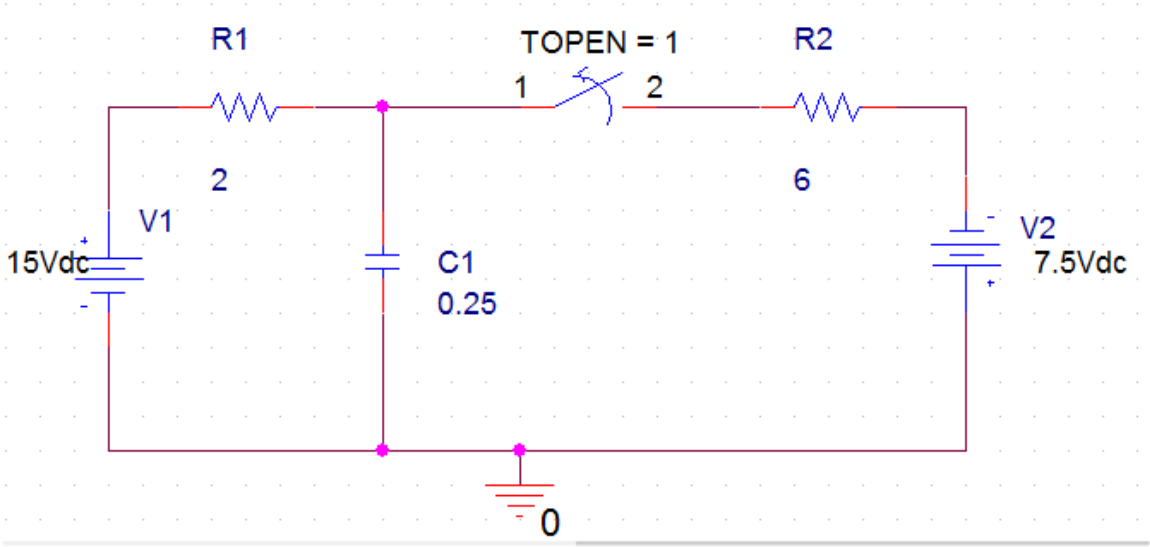
$VC(\tau)$ simulated	
$VC(\tau)$ calculated	
Deviation	

Time (sec)	Vc
0.0	
0.5	
1.0	
1.2	
1.4	
1.6	
1.8	
2.0	
2.2	
2.4	
2.6	
2.8	
3.0	
3.2	
3.4	
3.6	
3.8	
4.0	



Part 2

1. Build the following schematic using orcad pspice



2. You can find switch on EVAL library named SW_tOpen
3. Use time domain transient in simulation profile, set the runtime to 6 seconds
4. Run simulation then plot the relation between V(C1:2)-V(C1:1) and time

Results and data analysis

τ	

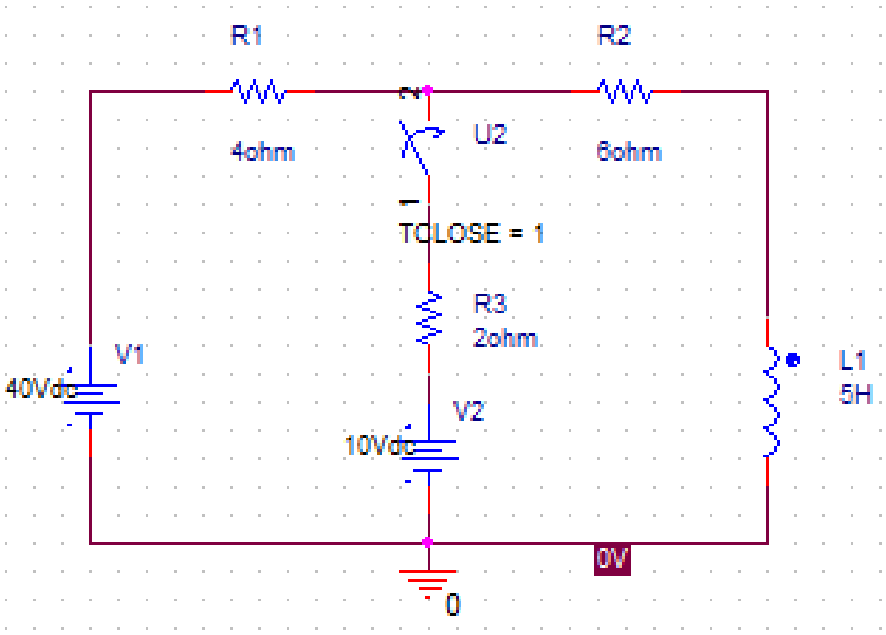
$VC(\tau)$ simulated	
$VC(\tau)$ calculated	
Deviation	

Time (sec)	Vc
0.0	
0.5	
1.0	
1.2	
1.4	

1.6	
1.8	
2.0	
2.2	
2.4	
2.6	
2.8	
3.0	
3.2	
3.4	
3.6	
3.8	
4.0	

Part 03

1. Build the following schematic using orcad pspice



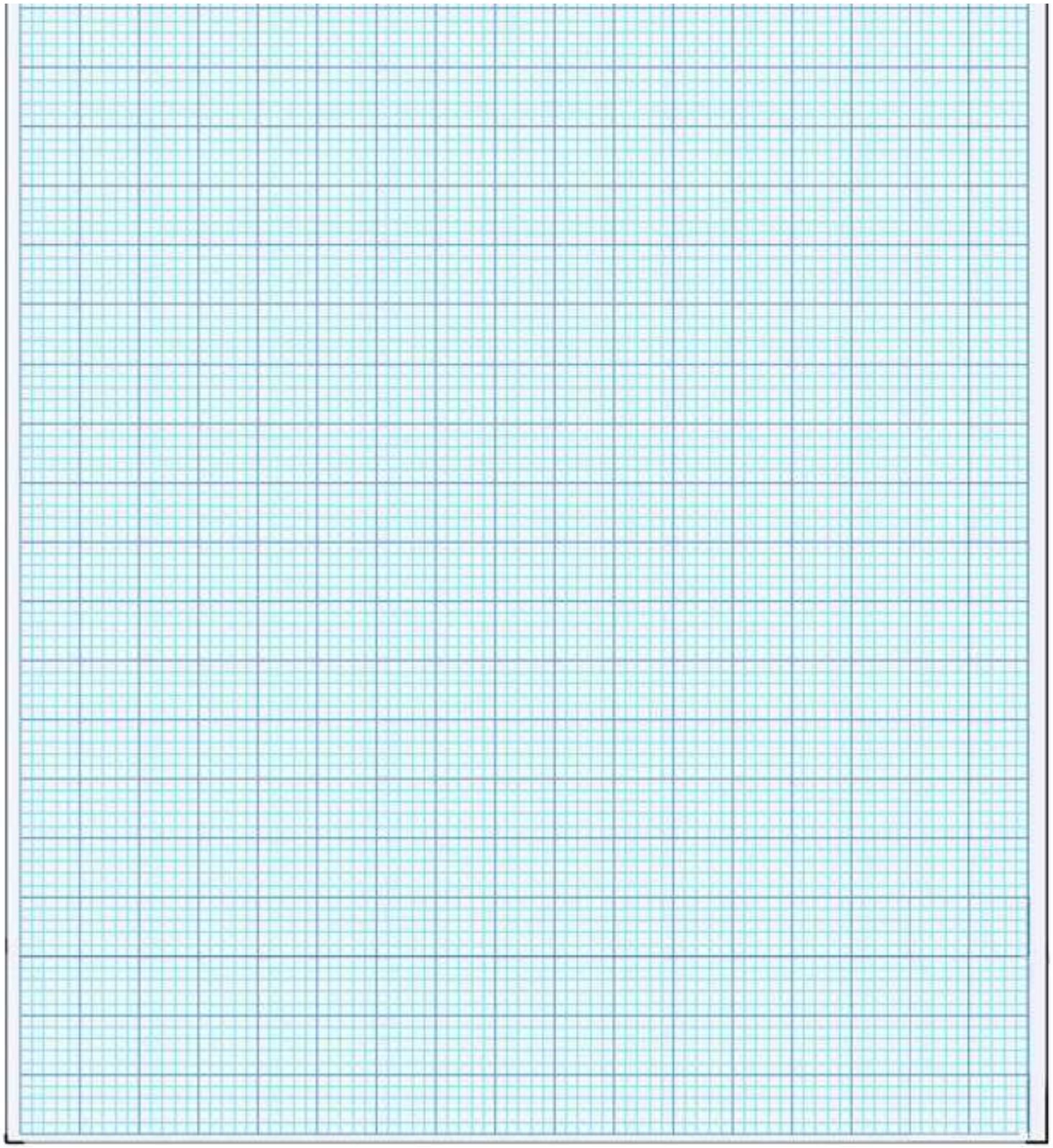
2. You can find switch on EVAL library named SW_tClose
3. Use time domain transient in simulation profile, set the runtime to 6 seconds
4. Run simulation then plot the relation between I(L1) and time

Results and data analysis

τ	

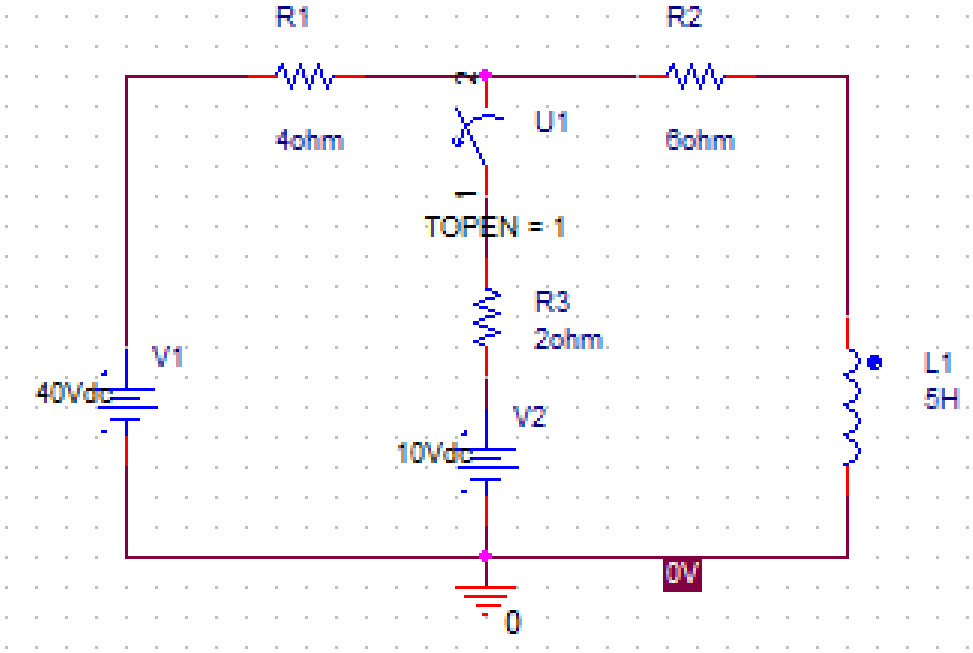
$Il(\tau)$ simulated	
$Il(\tau)$ calculated	
Deviation	

Time (sec)	I_L
0.0	
0.5	
1.0	
1.2	
1.4	
1.6	
1.8	
2.0	
2.2	
2.4	
2.6	
2.8	
3.0	
3.2	
3.4	
3.6	
3.8	
4.0	
4.2	
4.4	
4.6	
4.8	
5.0	
5.5	
6.0	



Part 04

1. Build the following schematic using orcad pspice



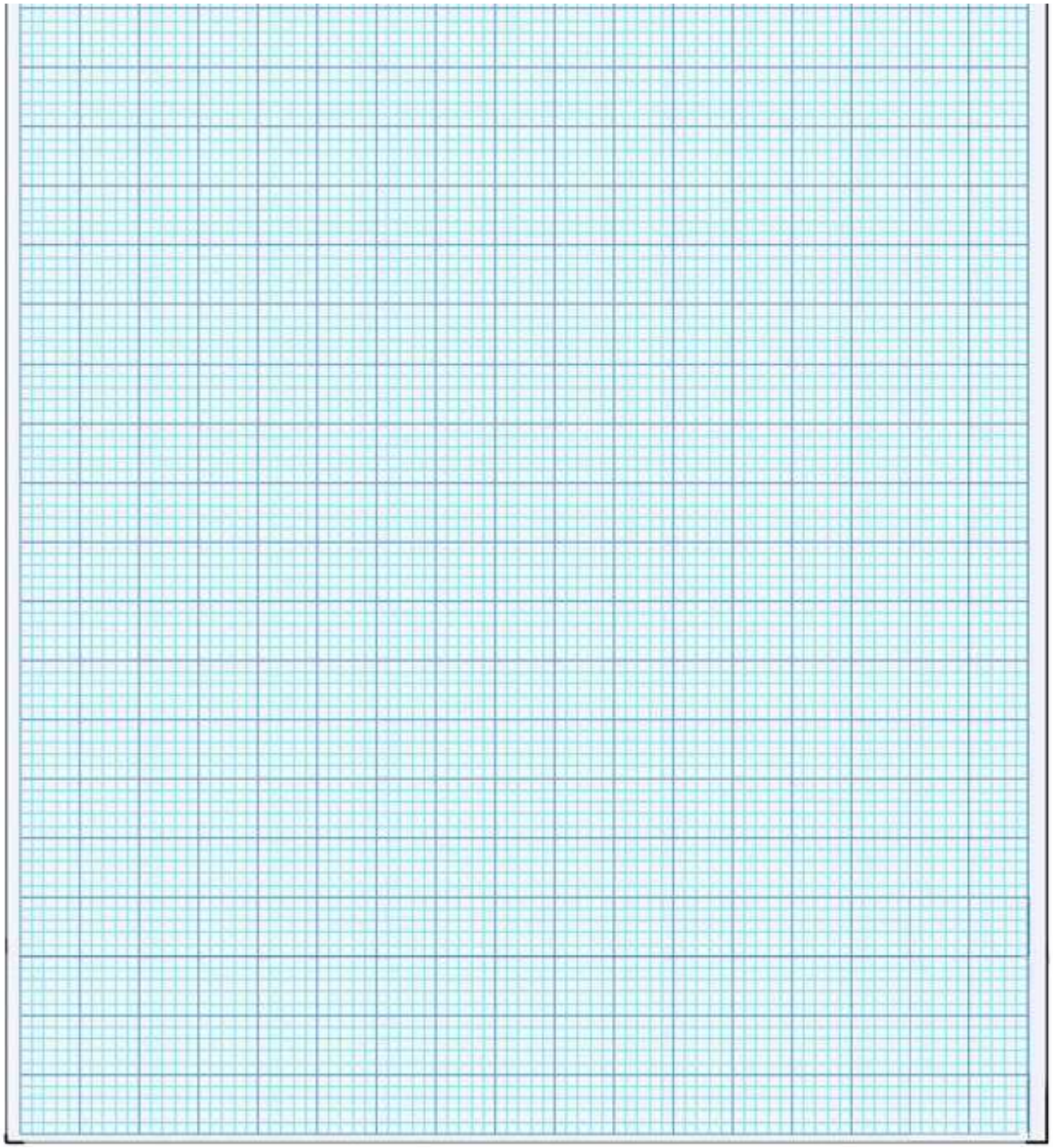
2. You can find switch on EVAL library named SW_tOpen
3. Use time domain transient in simulation profile, set the runtime to 6 seconds
4. Run simulation then plot the relation between I(L1) and time

Results and data analysis

τ	

$Il(\tau)$ simulated	
$Il(\tau)$ calculated	
Deviation	

Time (sec)	I_L
0.0	
0.5	
1.0	
1.2	
1.4	
1.6	
1.8	
2.0	
2.2	
2.4	
2.6	
2.8	
3.0	
3.2	
3.4	
3.6	
3.8	
4.0	
4.2	
4.4	
4.6	
4.8	
5.0	
5.5	
6.0	



Questions and Conclusions

1. What is a reasonable approximation for a capacitor in DC steady state?

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2. What is a reasonable approximation for a coil at in steady state?

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3. In general, what sorts of shapes do the step up/down voltages of DC RC circuits follow?

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4. In general, what sorts of shapes do the step up/down current of DC RL circuits follow?

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