جامعة بيرزيت

BIRZEIT UNIVERSITY

Department of Electrical and Computer Engineering

Circuit Analysis – ENEE2304

PSpice Assignment

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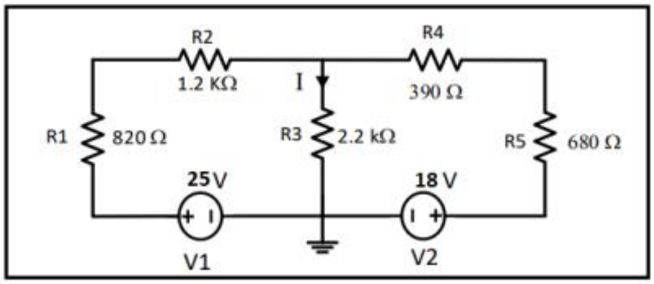
Section: 1

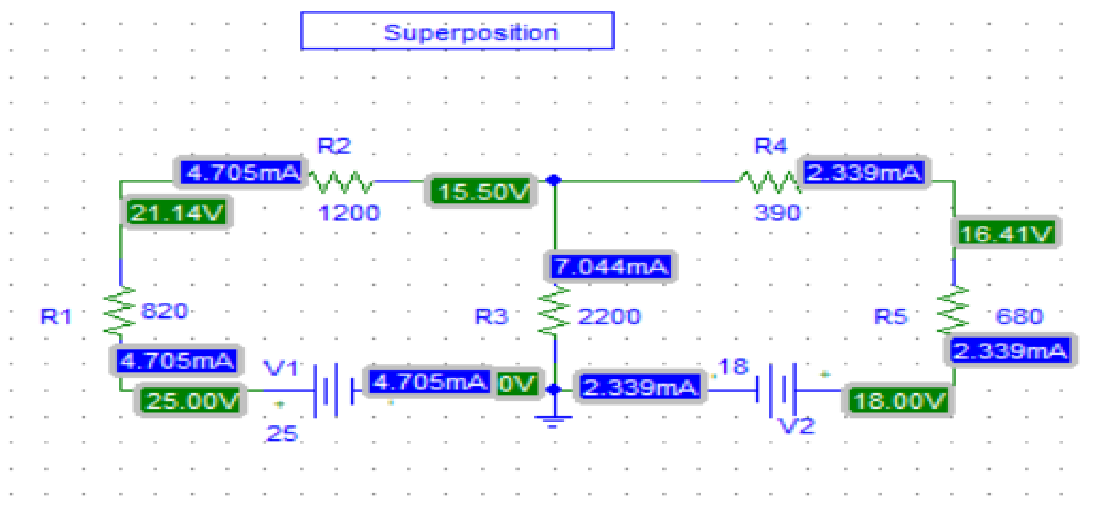
Question # 1: Superposition Technique

For the circuit shown below:



1. Use Pspice software to simulate the circuit and get the voltage across and the current through the resistor R3.

1.



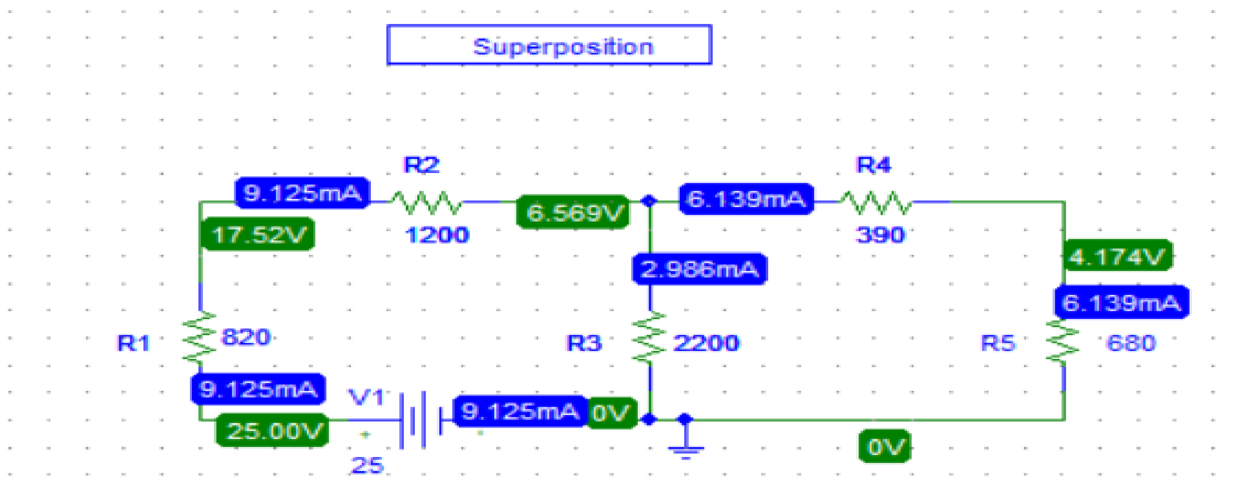
-After simulate the circuit we find that:

1)Voltage across R3 = 15.50 V

2)Current through R3 = 7.044 mA

2. Apply superposition theorem to get the voltage across and the current through the resistor R3. You have to show all the results of simulation.

-The first step is to replace the second source with short circuit and then find the current and voltage across R3.

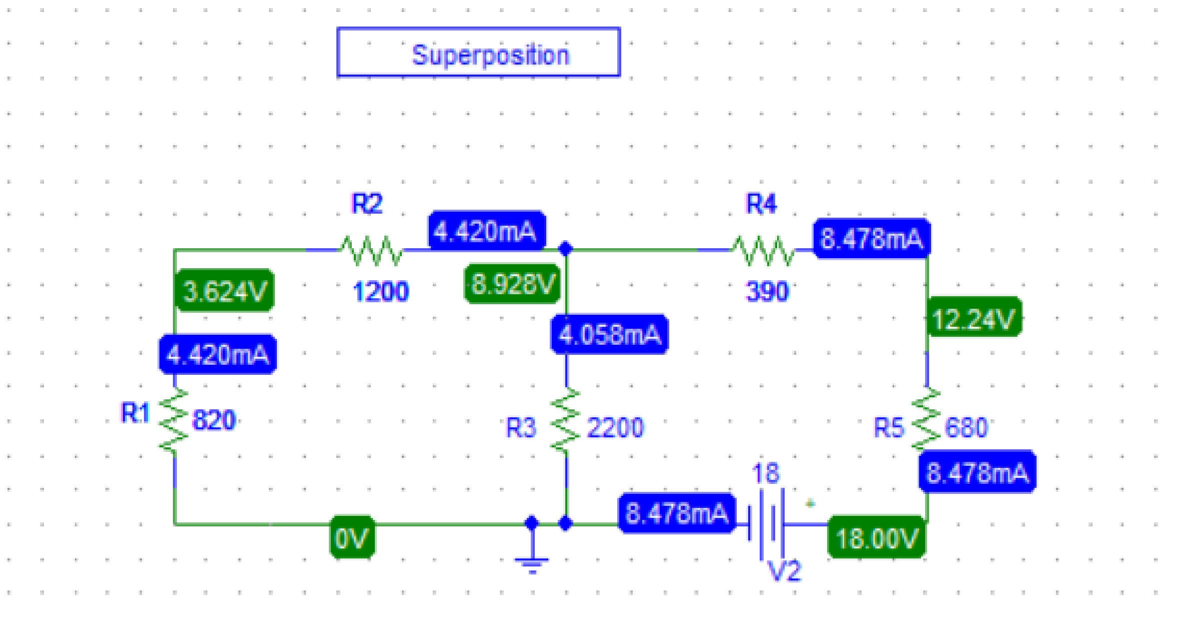


- After simulate circuit we find that:

1) Vo1 = 6.569 V

2) Io1 = 2.986 mA

-The second step is to replace the first source with short circuit and then find the current and voltage across R3.



- After simulate circuit we find that:

  1) Vo2 = 8.928 V

  2) Io2 = 4.058 mA

-By superposition theorem :

1)Voltage across R3= Vo1+Vo2

V=6.569+8.928

V =15.50 V

2)Current through R3=Io1+Io2

I=2.986+4.058

I=7.044 mA

3. Compare the results obtained from step 1 and step 2.

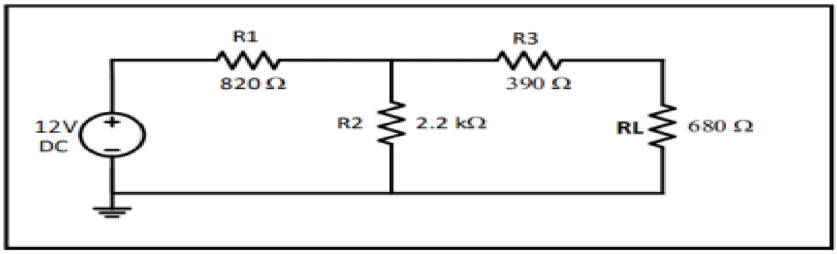
The results that obtained from step1 are equal to the results from step2

voltage across R3 = 15.50 V

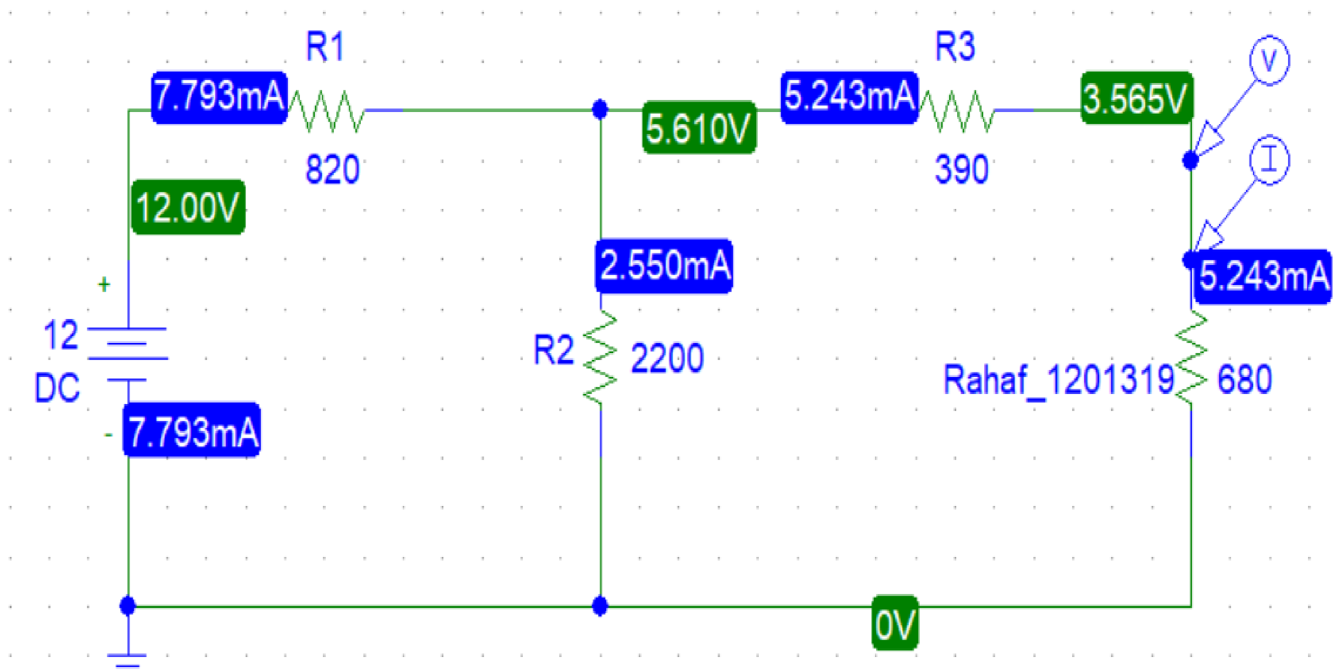
current through R3 = 7.044 mA

Question #2: Thevenin's Theorem & Maximum Power Transfer

For the circuit shown below:



1. Use Pspice software to simulate this circuit and get the voltage across and the current through the resistor RL (680 Ω).

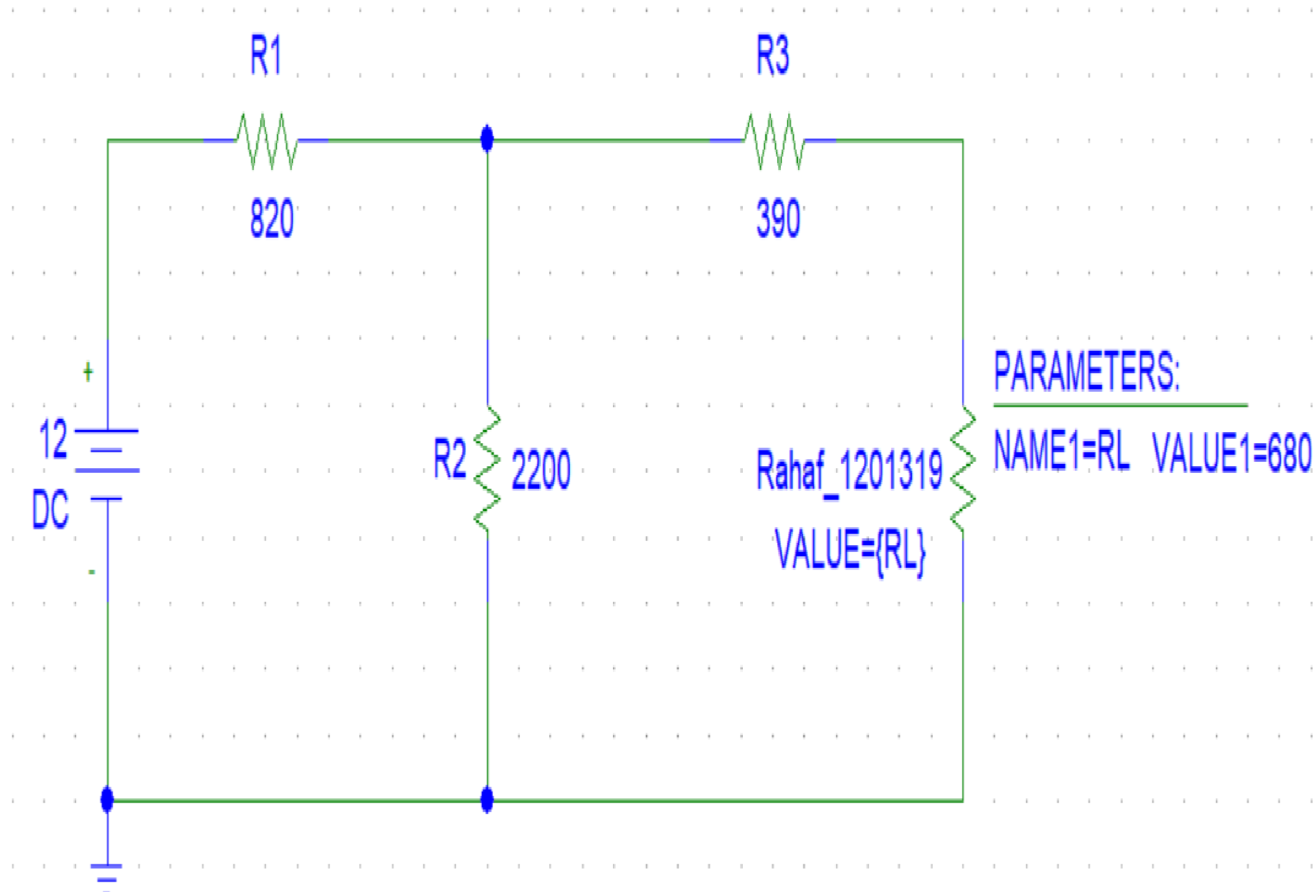


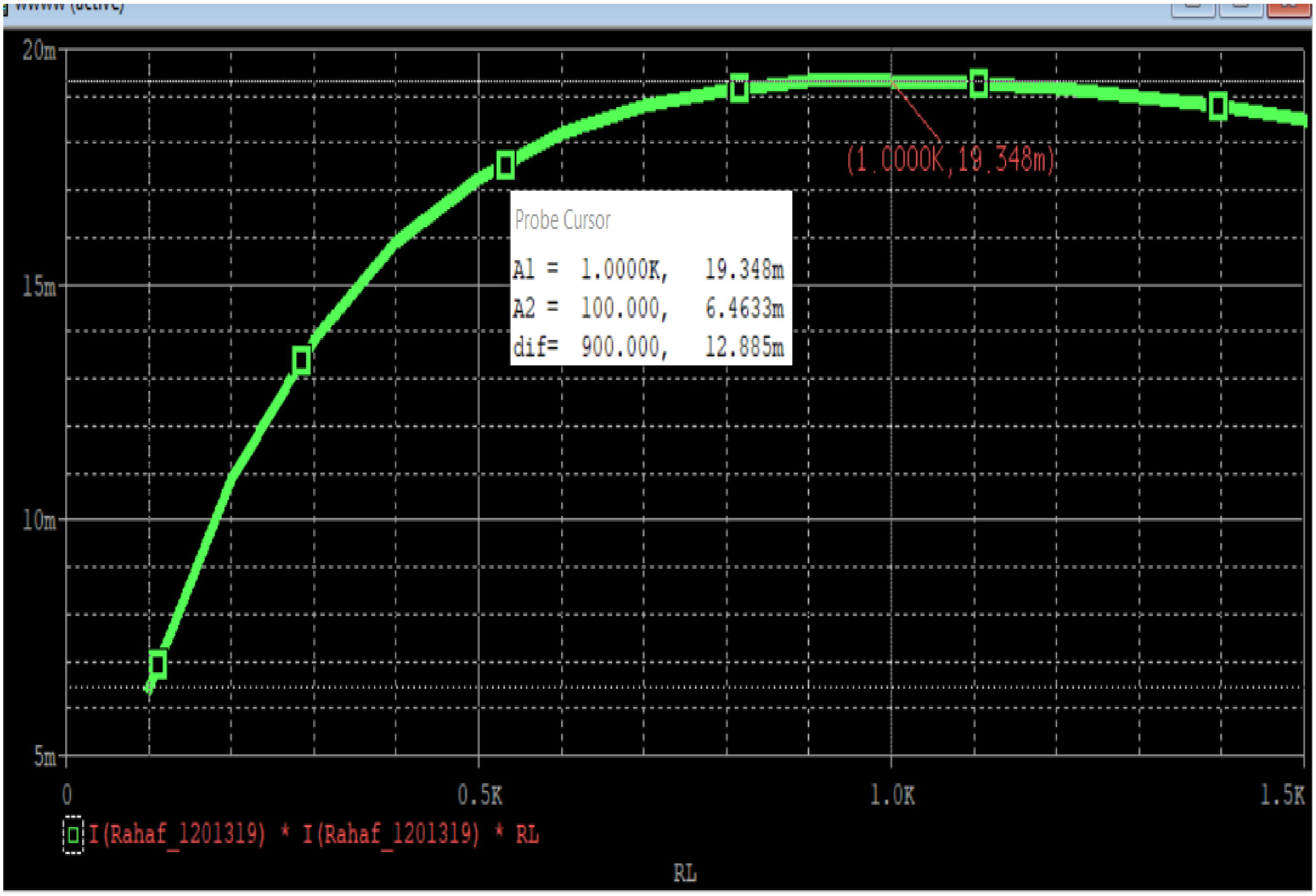
-The voltage across RL= 3.565 V

-The current through RL = 5.243 mA

2. Using DC sweep, set RL as a parameter that varies from 100 Ω to 1.5 kΩ and **plot** the power dissipated by RL as it varies (plot the power of RL versus the value of RL). With the help of cursors on Pspice simulation window, approximate at which value of RL the power maximizes)

The circuit:



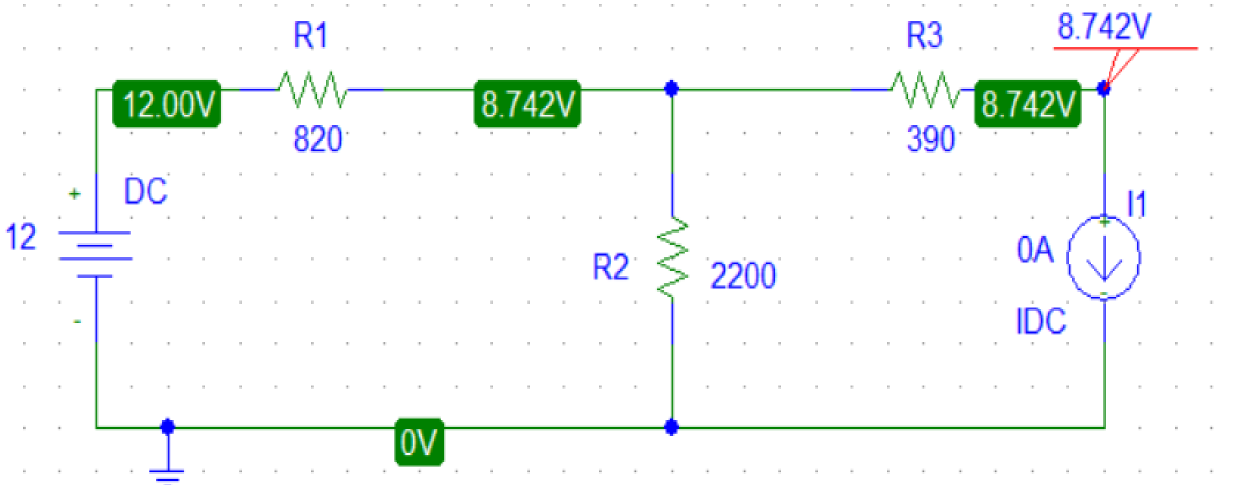


Plot the power of RL versus the value of RL.

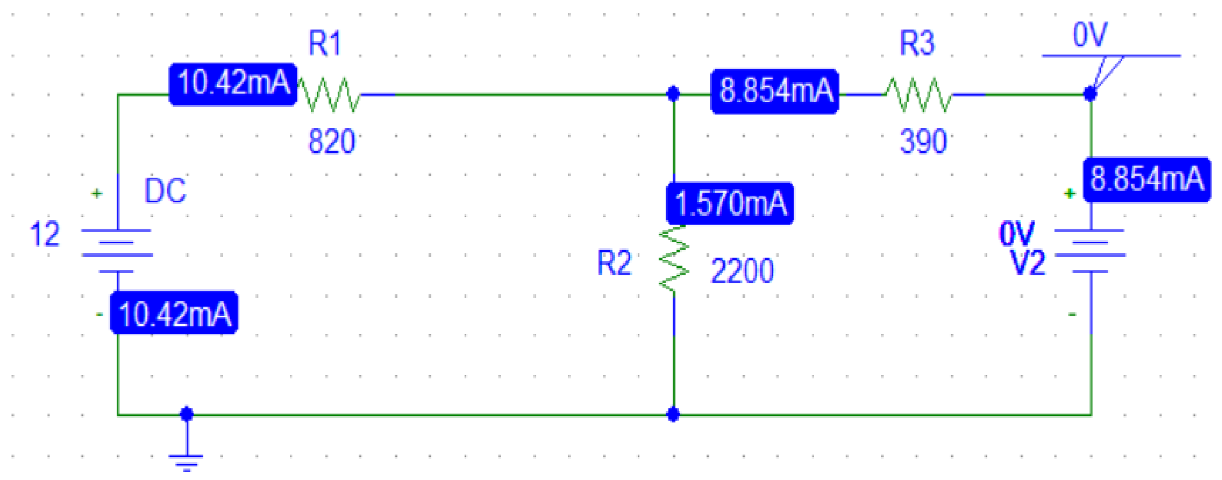
The maximum power=19.348 mW

At RL = 1 K ohm

3. Use Pspice software to calculate $R_{thevenin}$ seen by the resistor RL. **Use V_{oc} and I_{sc} method only**. You have to show all the simulation results when getting V_{oc} and I_{sc}.



VTH=8.742 V



I short circuit = 8.854 mA

RTH = VTH/I short circuit

RTH = 8.742 v/ 8.854 mA= 990 ohm

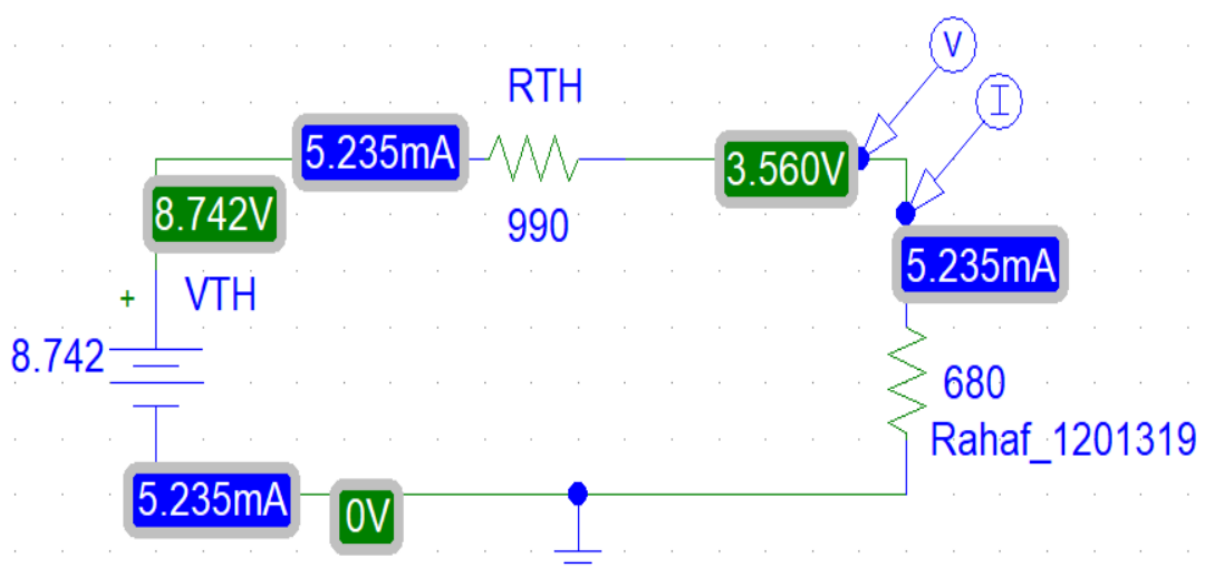
4. Compare the value of RL at P_{max} obtained from step 2 and the value of $R_{thevenin}$ obtained from step 3.

-RL at maximumPower = 1000 ohm

- R Thevenin = 990 ohm

The result is RL = RTH

5. Build and then simulate the Thevenin equivalent circuit with the load resistor RL and show the voltage across and the current through the resistor RL.



*Voltage across RL = 3.560v

*Current through RL = 5.235 mA

6. Compare the results obtained from step 1 and step 5.

1- The result of the step 1 is:

*The voltage across RL= 3.565 V

*The current through RL = 5.243 mA

2- The result of step 5 is:

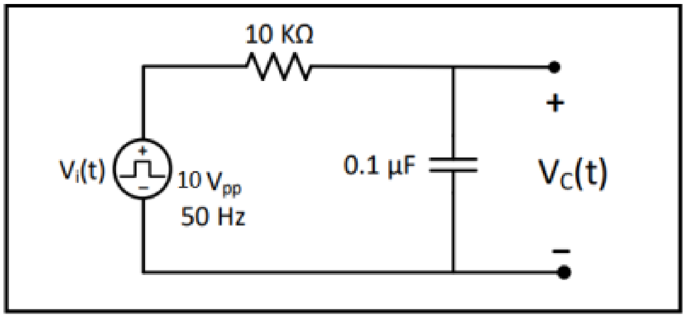
*Voltage across RL = 3.560v

* Current through RL = 5.235 mA

The results are almost equal

Question #3: First Order RC Circuit Analysis

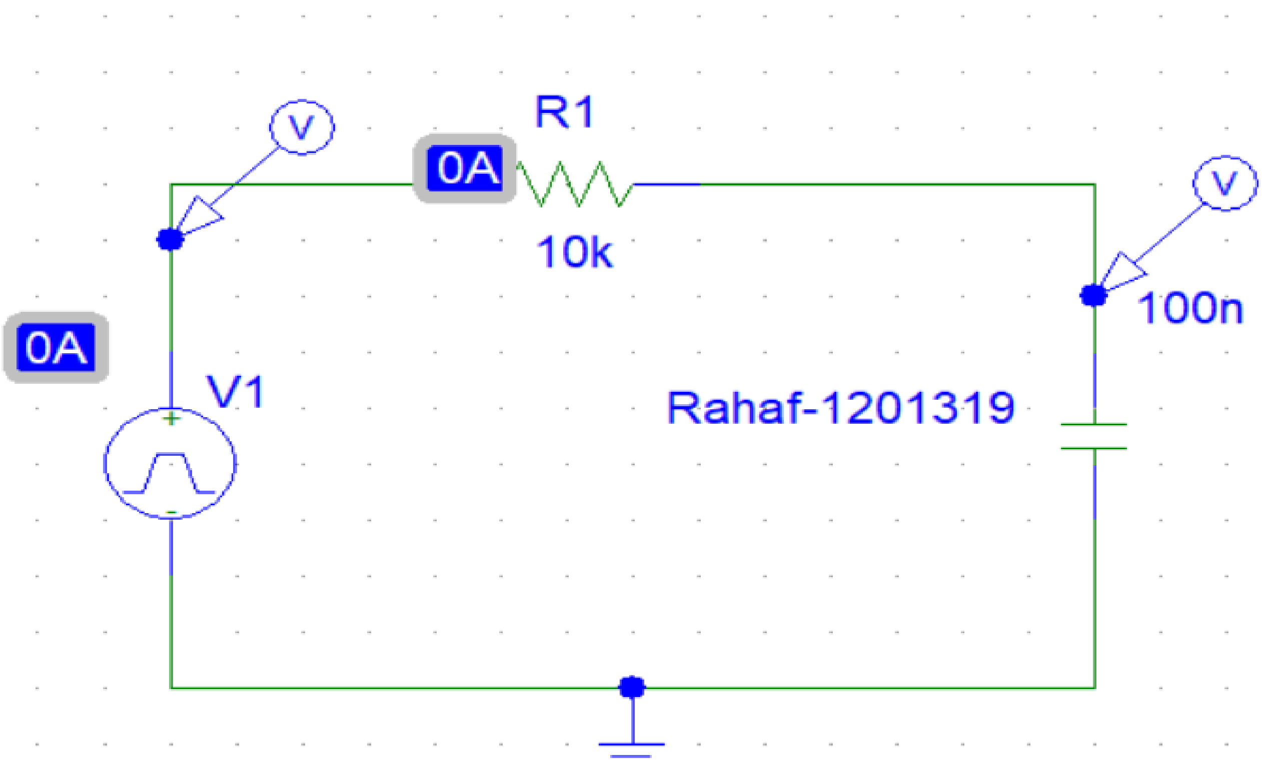
For the circuit shown below:

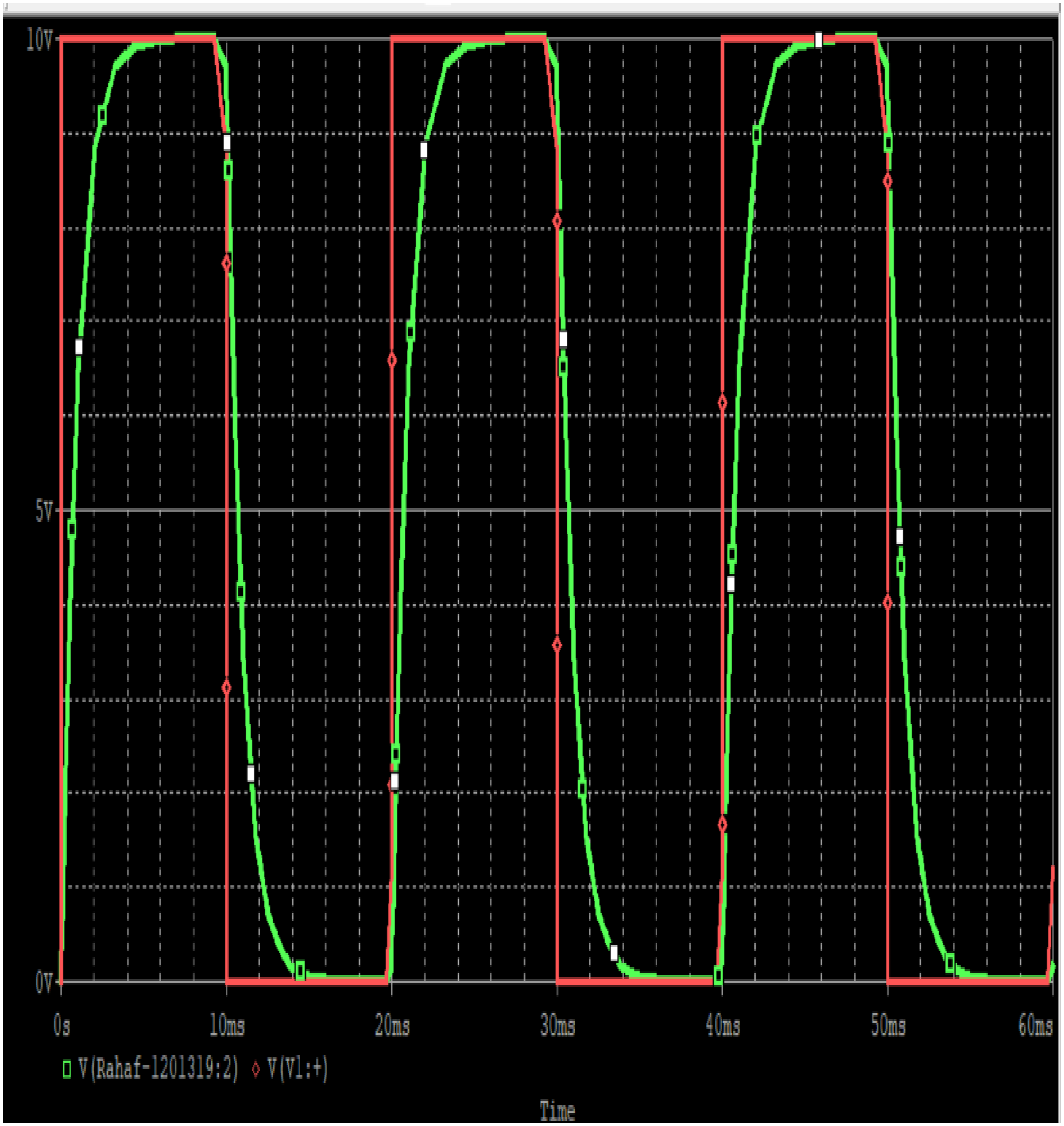


The input voltage is square signal with 10 V peak-peak (0 V to 10 V) and frequency of 50Hz.

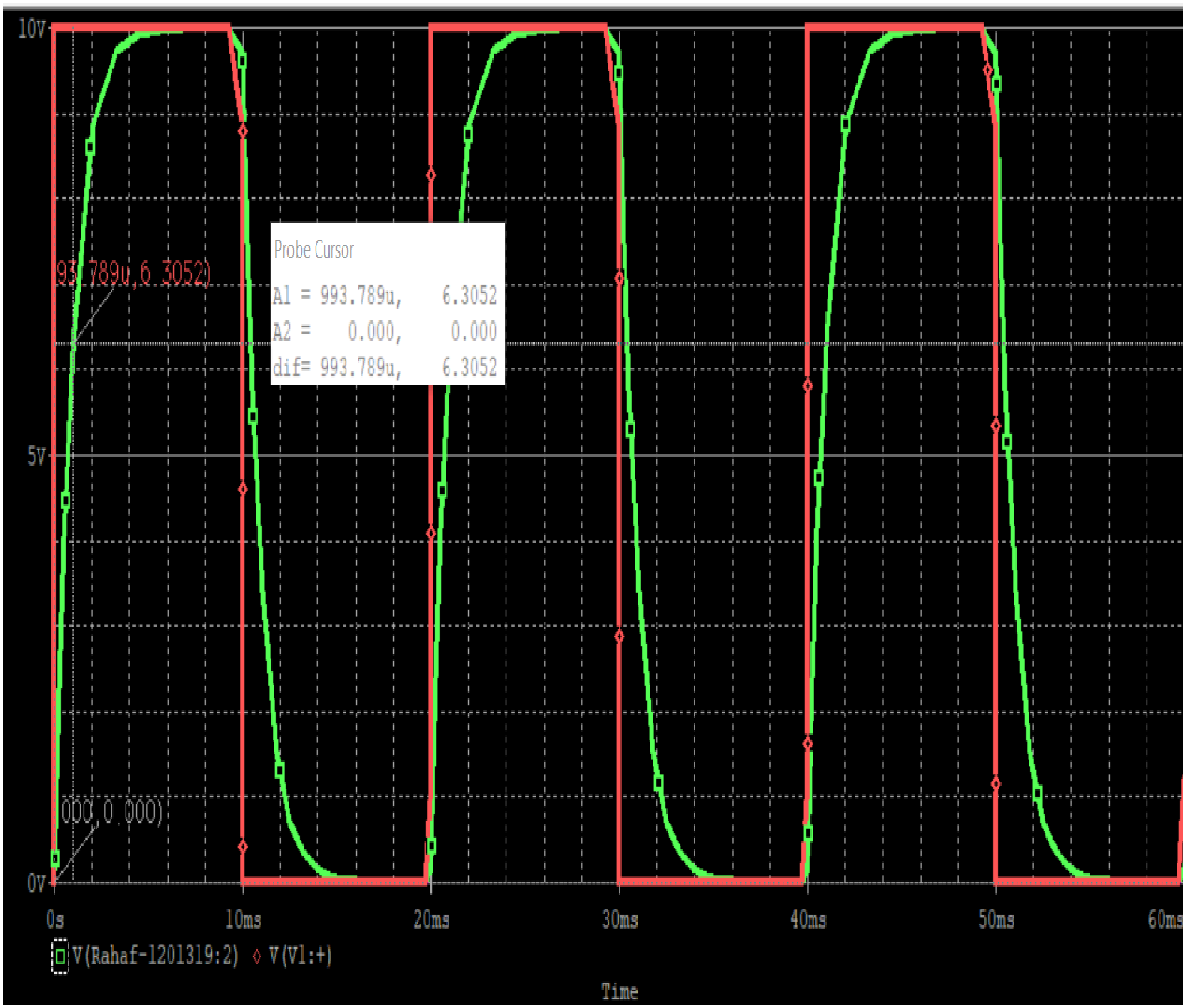
1. Use Pspice software to plot both Vi(t) and Vc(t) (on the same graph) for a meaningful period of time.

The Circuit:




10V
5V
0V
0s
10ms
20ms
30ms
40ms
50ms
60ms
V(Rahaf-1201319:2)
V(V1:+)
Time

2. With help of cursors on Pspice simulation window, show the value of the time constant (τ). You have to show both the circuit and the simulation result.



➔ T = R*C = 10000 * 0.1

➔ = 1 msec

From the graph:

-> Vmax = 10 volt

->0.63*10=6.3 volt

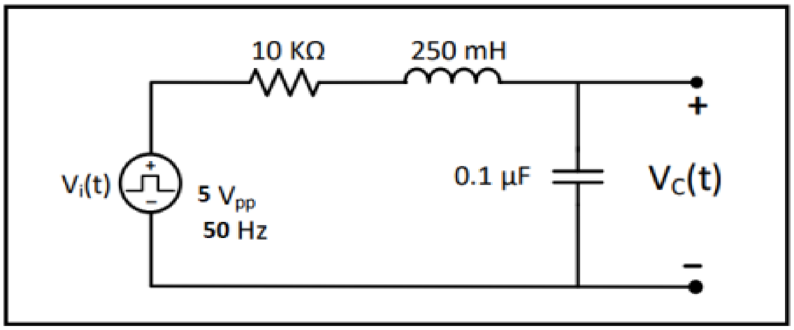
By using cursor I find that when:

v = 6.3 **->** T = 0.994 msec

->time constant almost equal 1 msec

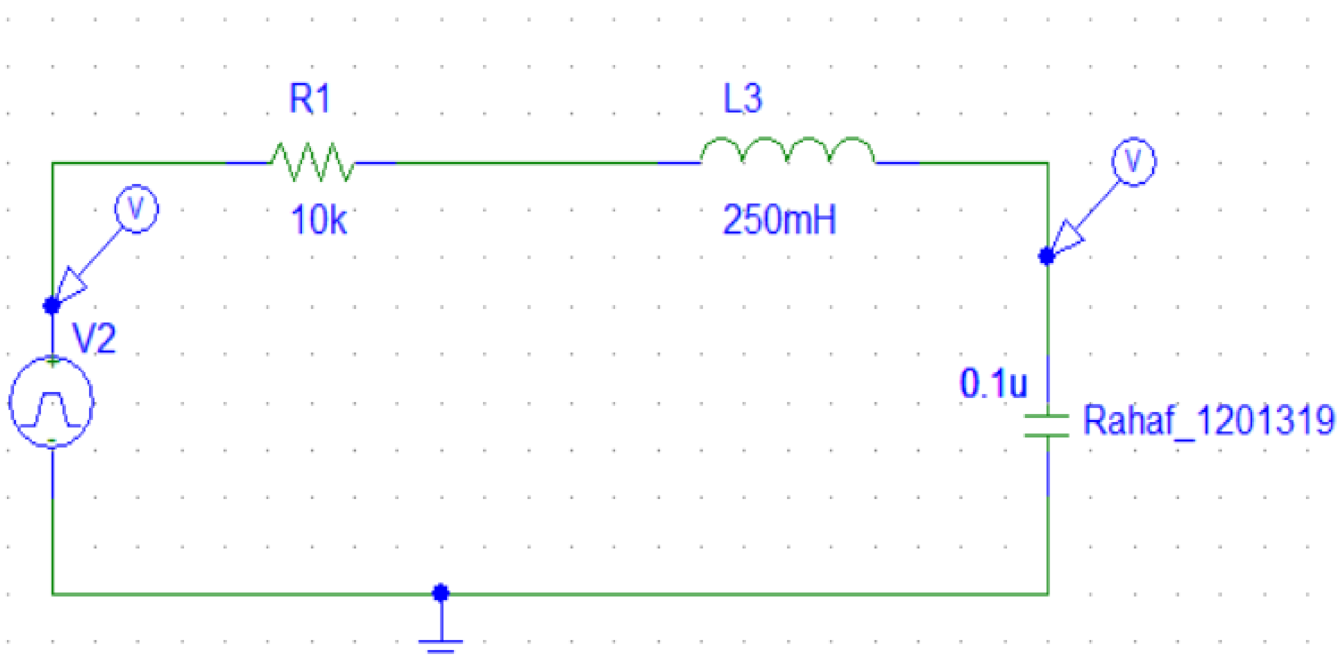
Question #4: Second Order RLC Circuit Analysis

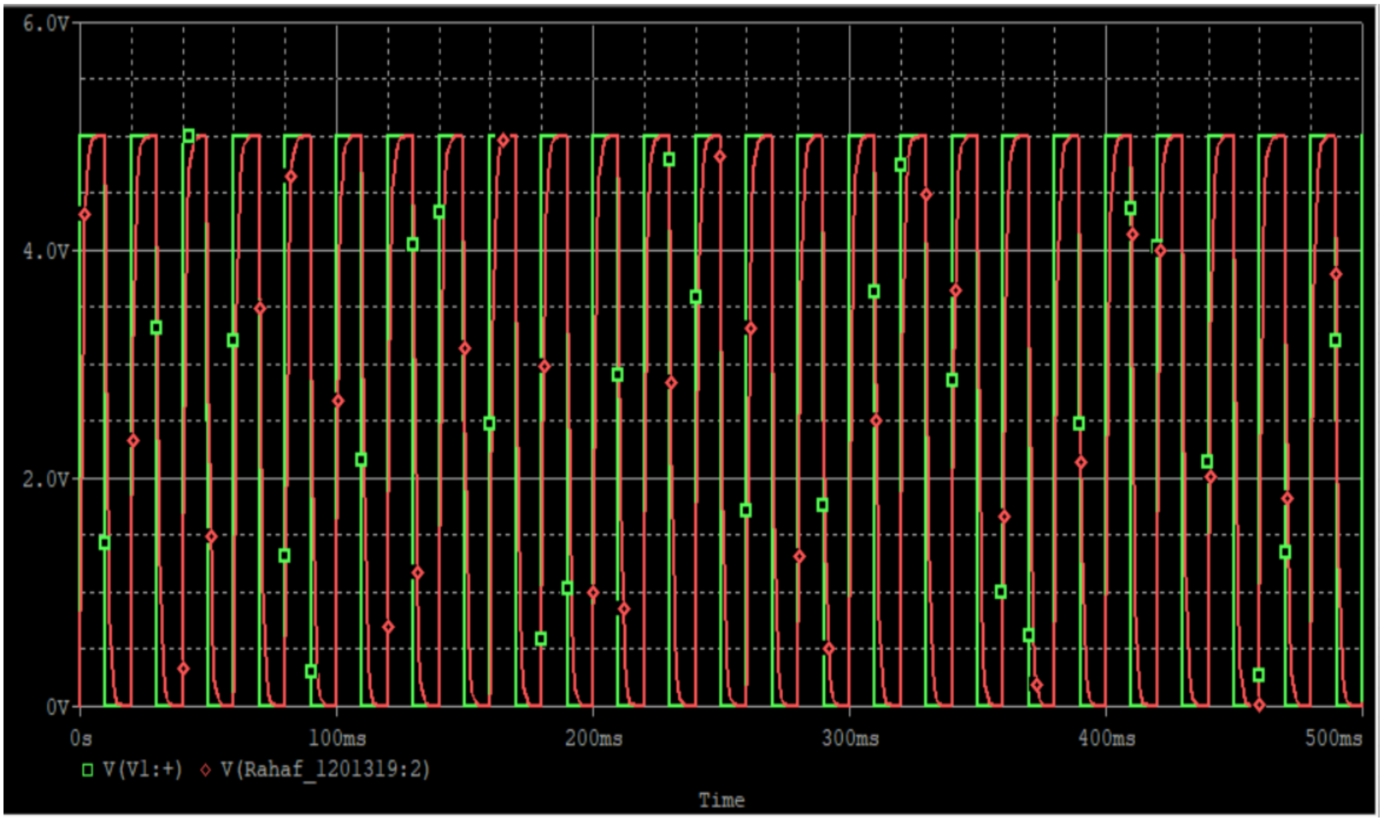
For the circuit shown below:



The input voltage is square signal with 5 V peak-peak (0 V to 5 V) and frequency of 50Hz.

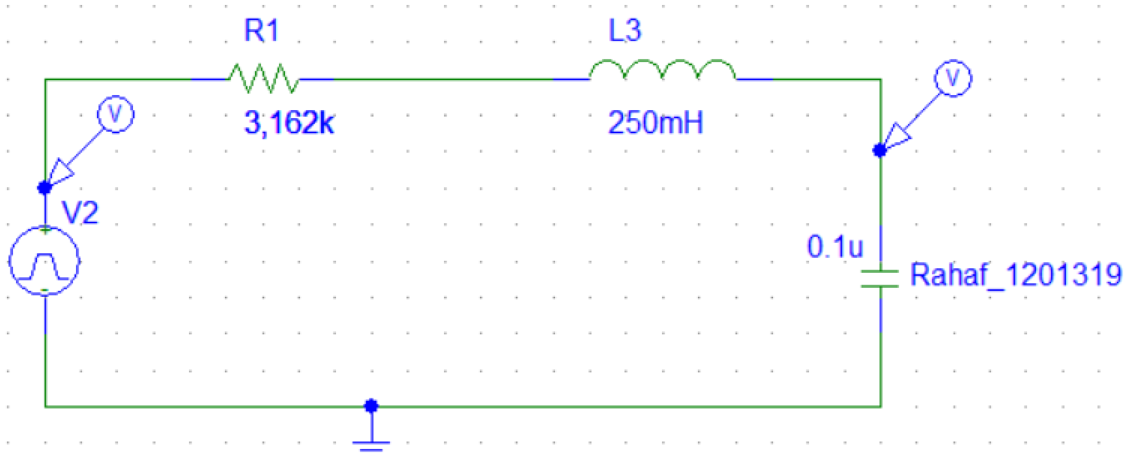
1. Use Pspice software to plot both Vi(t) and Vc(t) (on the same graph).

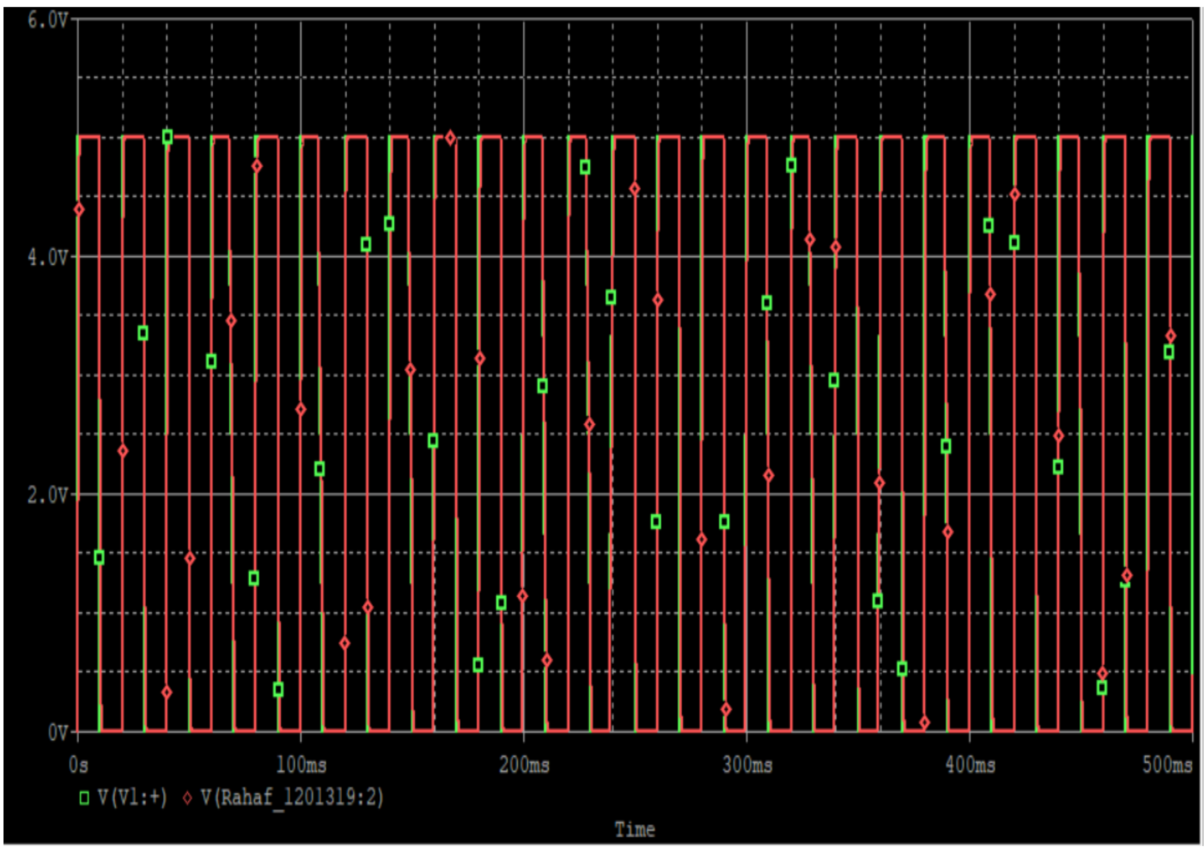




-Over damping response

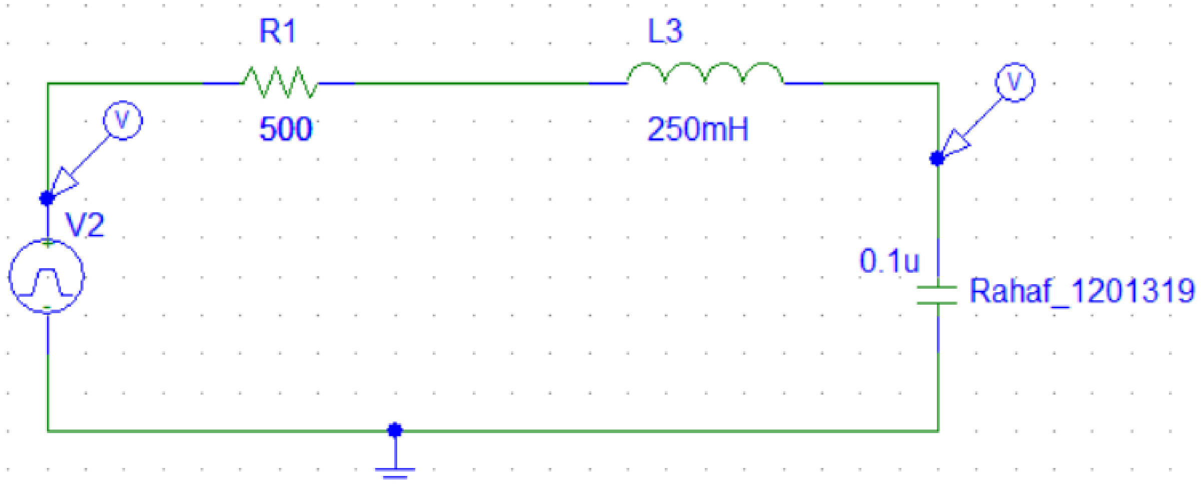
2. Change the Value of R to 3.162 kΩ, repeat step 1.

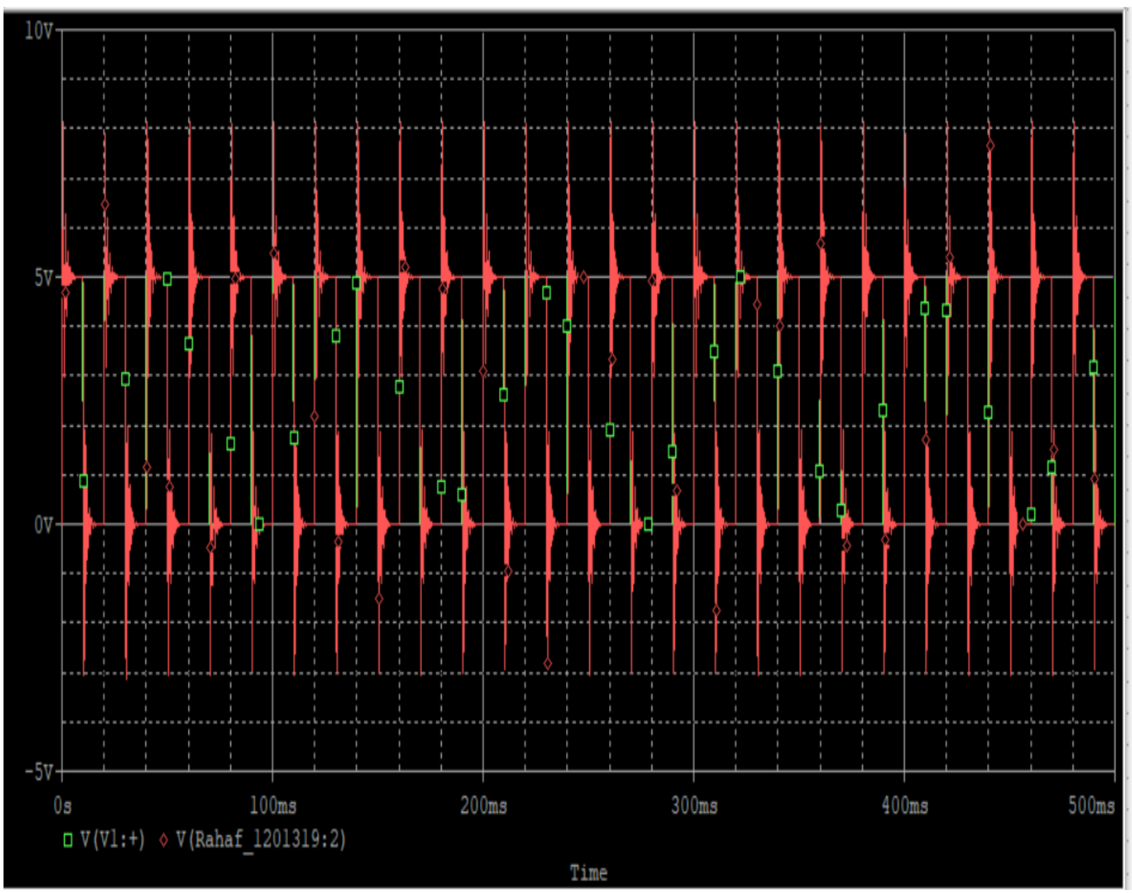




-Critical damping response

3. Change the Value of R to 500 Ω, repeat step 1.





-Under damping response

4. Comment on each result: is it over-damping, critical-damping, or under-damping response.

* RLC circuit can be modeled by
this 2nd-order linear diffarential equations:

$$L\frac{d^2i}{dt^2} + R\frac{di}{dt} + \frac{1}{C}i = 0$$

The charactaristic equation is:

$$s^2 + \frac{R}{L}s + \frac{1}{LC} = 0$$

$$s = \frac{-R \pm \sqrt{R^2 - 4L/C}}{2L}$$

$$s = -\alpha \pm \sqrt{\alpha^2 - w_0^2}$$

where $\alpha = \frac{R}{2L}$ $w_0 = \frac{1}{\sqrt{LC}}$

* when $\alpha > w_0$ overdamped response
* when $\alpha = w_0$ critically damped response
* when $\alpha < w_0$ Underdamped response

$$\alpha = \frac{R}{2L} \qquad w_0 = \frac{1}{\sqrt{LC}}$$

$$w_0 = \frac{1}{\sqrt{250\times10^{-3} \times 0.1\times10^{-6}}} = \frac{1}{\sqrt{2.5\times10^{-8}}} \doteq 6329.1$$

(a) when $R = 10K\Omega$

$$\alpha = \frac{10\times10^{3}}{2\times250\times10^{-3}} = 20000$$

$\alpha > w_0$ overdamping response

(b) when $R = 3.162K\Omega$

$$\alpha = \frac{3.162\times10^{3}}{2\times250\times10^{-3}} = 6324$$

$\alpha = w_0$ critically damping Response

(c) when $R = 500\ \Omega$

$$\alpha = \frac{500}{2\times250\times10^{-3}} = 1000$$

$\alpha < w_0$ underdaming response.