جامعة بيرزيت

BIRZEIT UNIVERSITY

Circuit Analysis – ENEE2304

Pspice Project

Dr. Jaser Sa'Ed

Section (1)

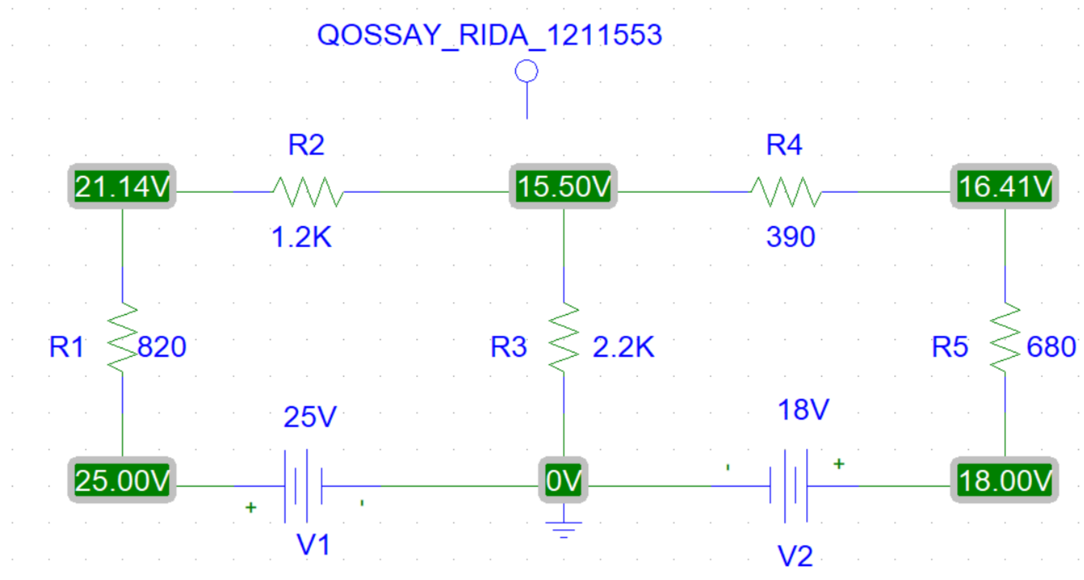
QOSSAY RIDA (1211553)

Contents:

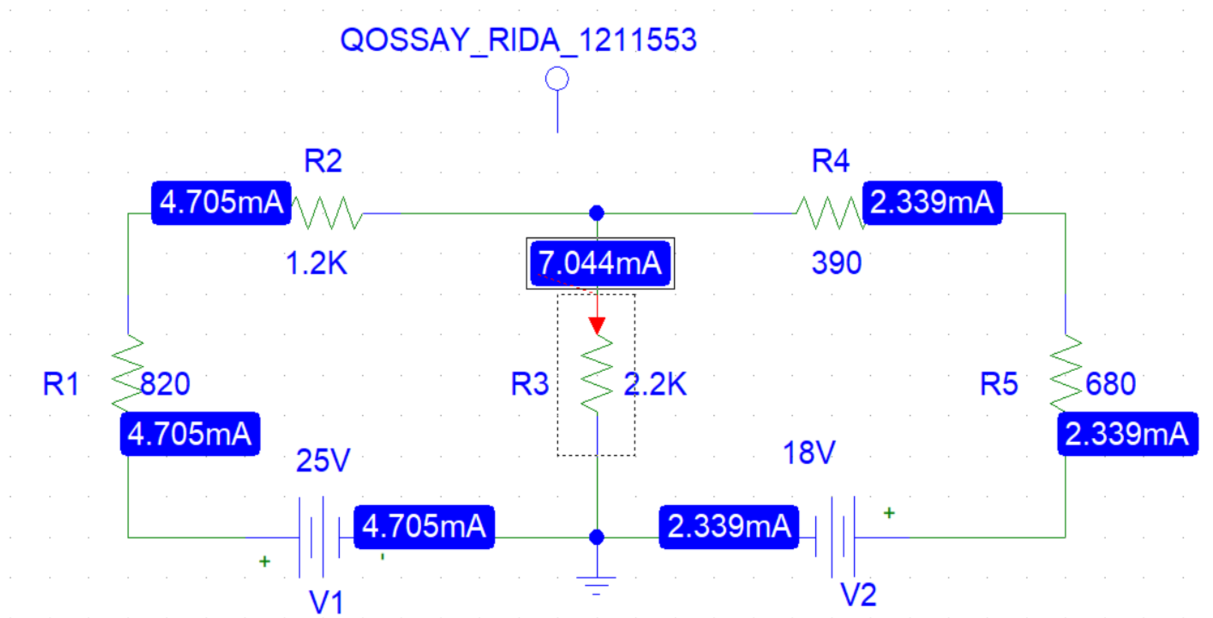
Question 1: Superposition Technique

1- find the voltage and current on R_3:

Then the voltage on R_3 equal 15.50 – 0 that equal 15.5 volt

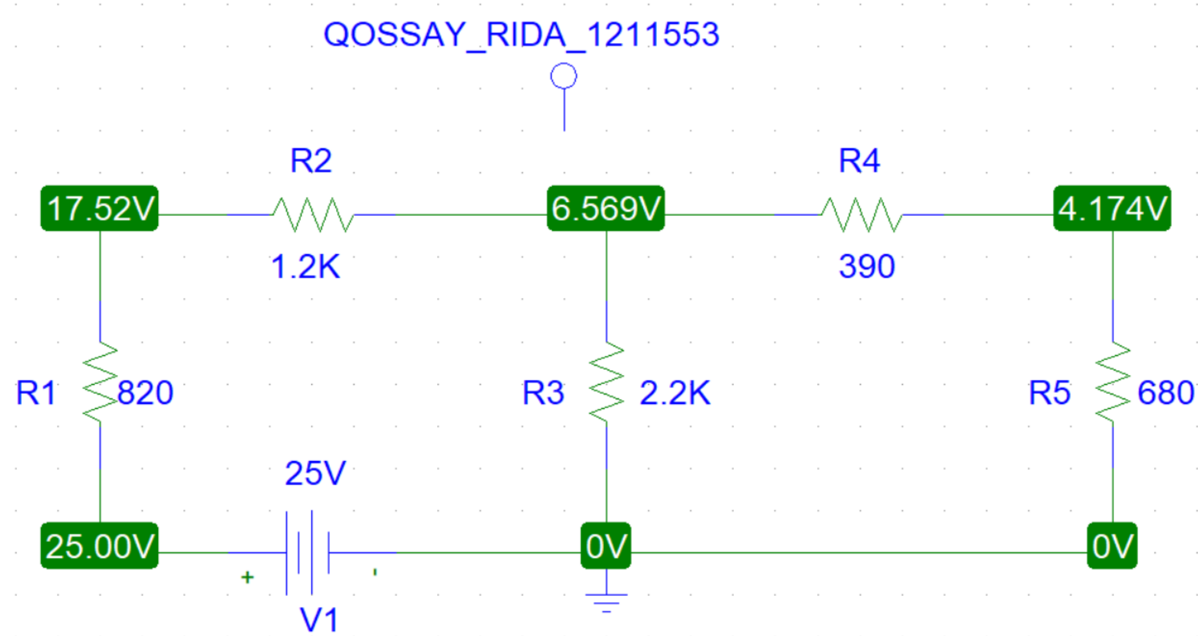


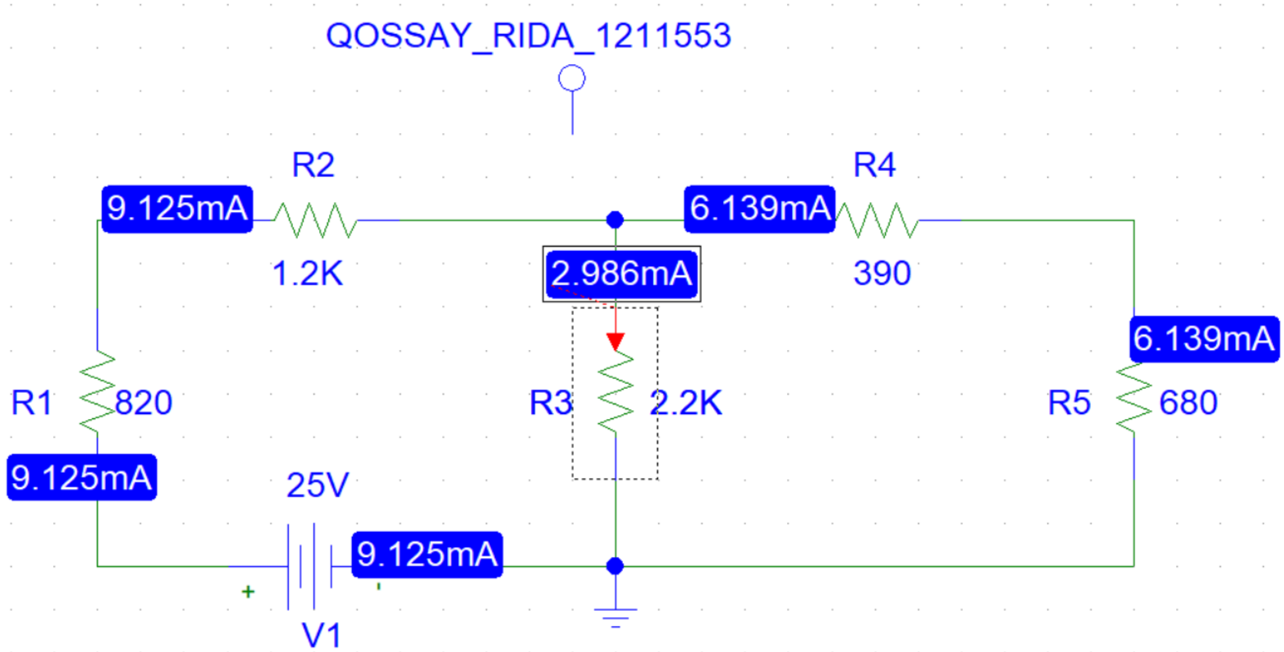
Then the current across R_3 equal 7.044 mA (down)



2- Apply Superposition theorem:

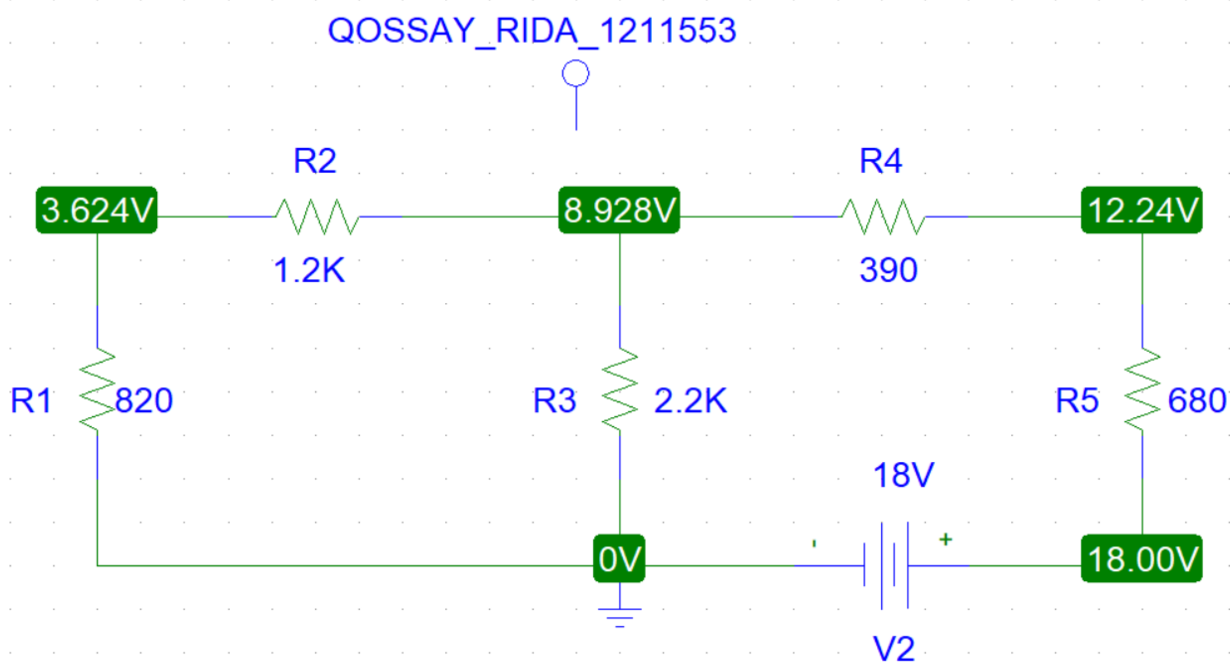
By source V1: The voltage on R_3 equal 6.569 volt
The current across R_3 equal 2.986 mA (down)

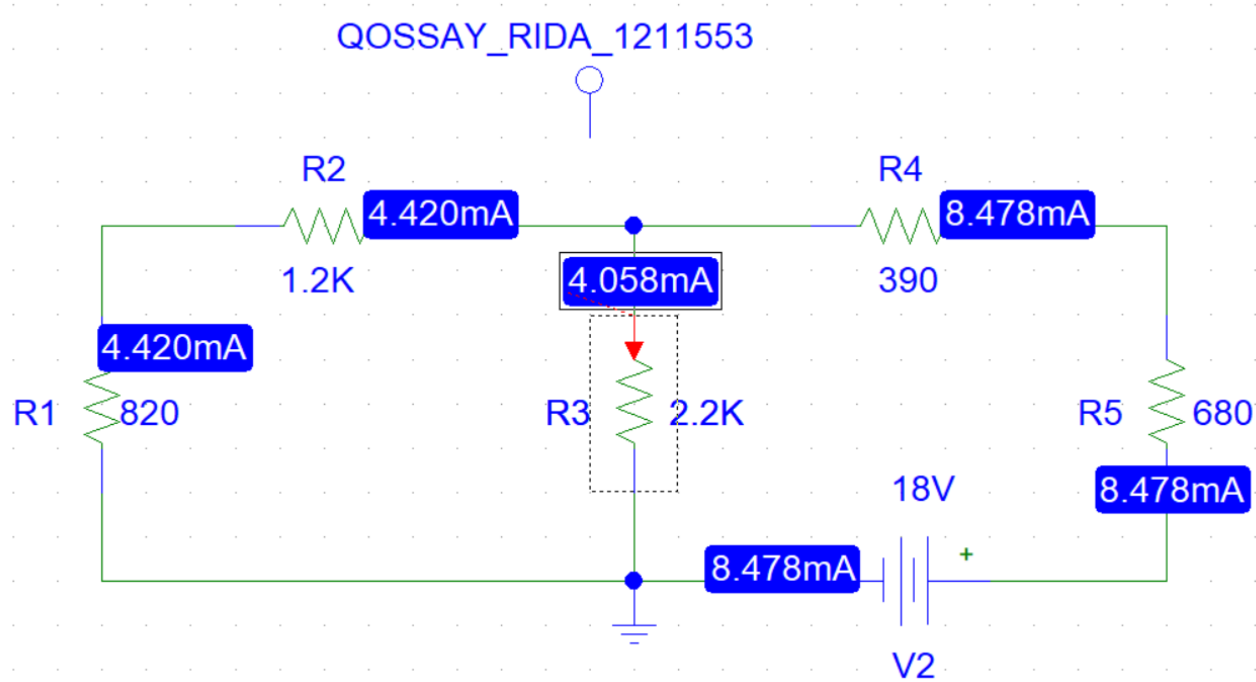




By source V2: The voltage on R_3 equal 8.928 volt

The current across R_3 equal 4.058 mA (down)





By Superposition theorem:

Voltage on R_3 = Voltage on R_3 from V_1 + Voltage on R_3 from V_2

Voltage on R_3 = 6.569 + 8.928 = 15.497 volt

Current across R_3 = Current across R_3 from V_1 + Current across R_3 from V_2

Current across R_3 = 2.986 (down) + 4.058 (down) = 7.044 mA (down)

3- Compare the results:

Result in Step 1:

Voltage on R_3 = 15.5 volt
Current across R_3 = 15.497 volt

Result in Step 2:

Voltage on R_3 = 7.044 mA (down)
Current across R_3 = 7.044 mA (down)

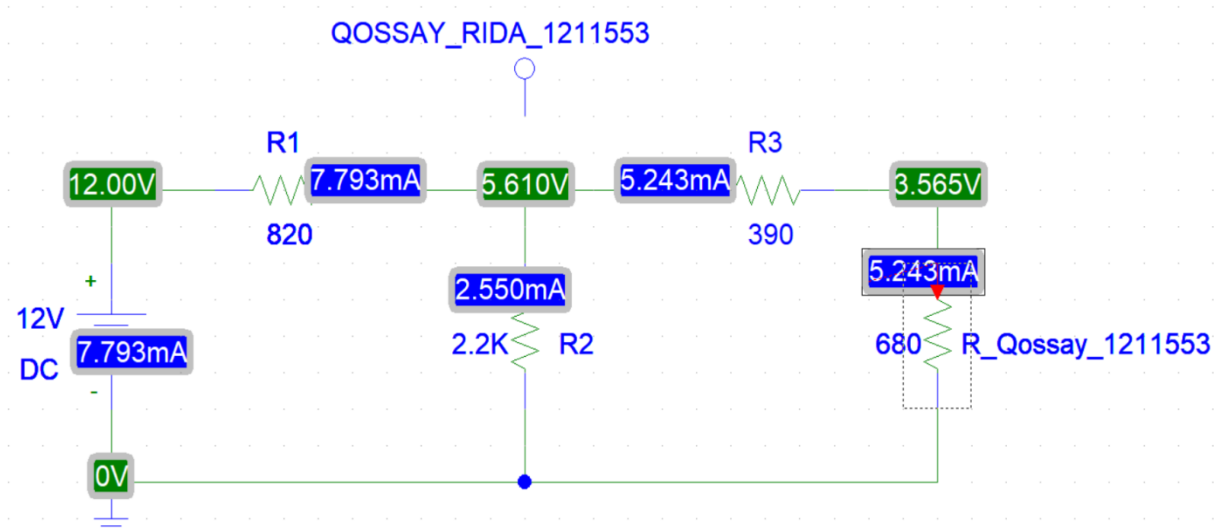
The results in each step are equal and this proves the validity of the Superposition theorem which states that in a linear circuit, the response (voltage or current) in any branch is equal to the algebraic sum of the responses produced by each independent source acting alone, while all the other sources are turned off. This theorem allows us to simplify complex circuits by breaking them down into smaller, simpler components that can be analyzed and combined to find the overall response of the circuit.

Question 2: Thevenin's Theorem & Maximum Power Transfer

1- find the voltage and current on R_L:

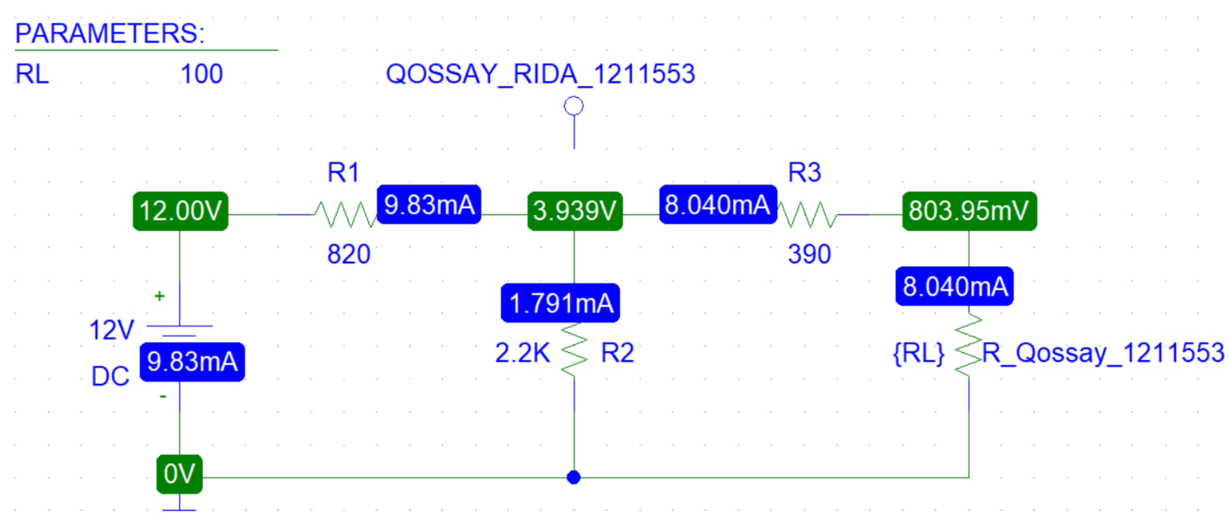
Then the voltage on R_L equal 3.565 – 0 that equal 3.565 volt

Then the current across R_L equal 5.243 mA (down)



2- Plot the power of R_L versus the value of R_L:

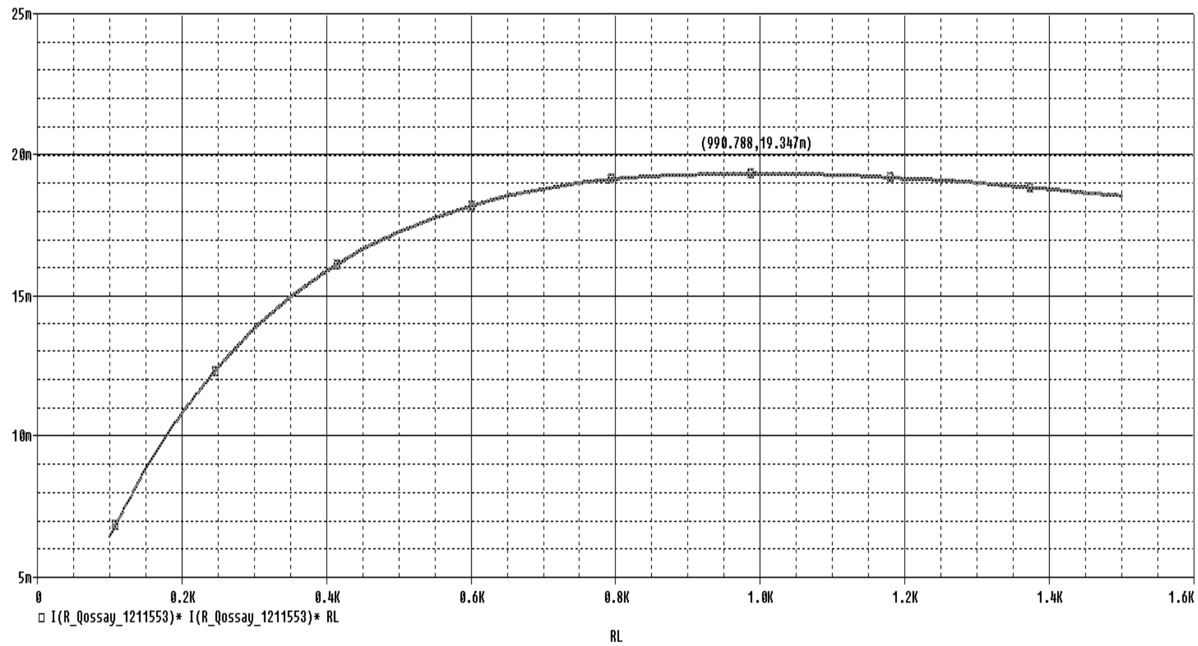
The circuit:



We will define R_L as parameter from 100 Ω to 1.5KΩ then plot the power of R_L versus the value of R_L by using DC sweep.

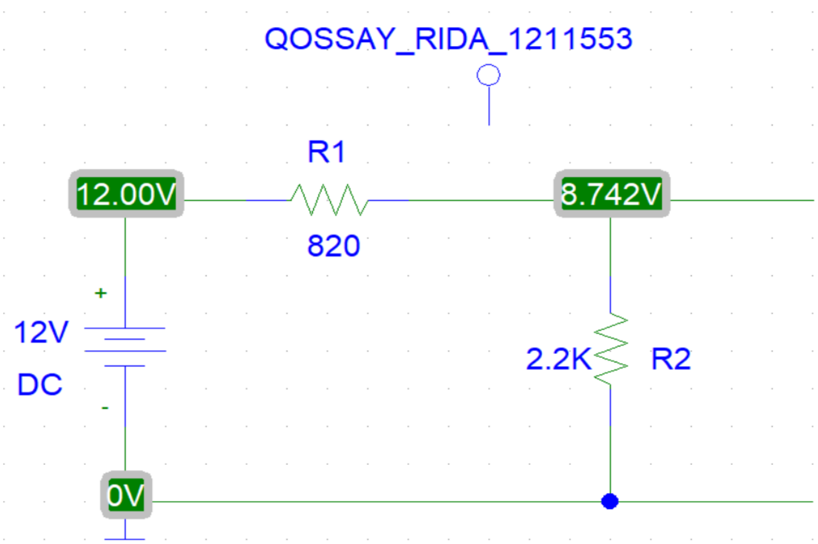
And from the graph we see R_L equal 990.788 Ω when the power be maximum

The graph:

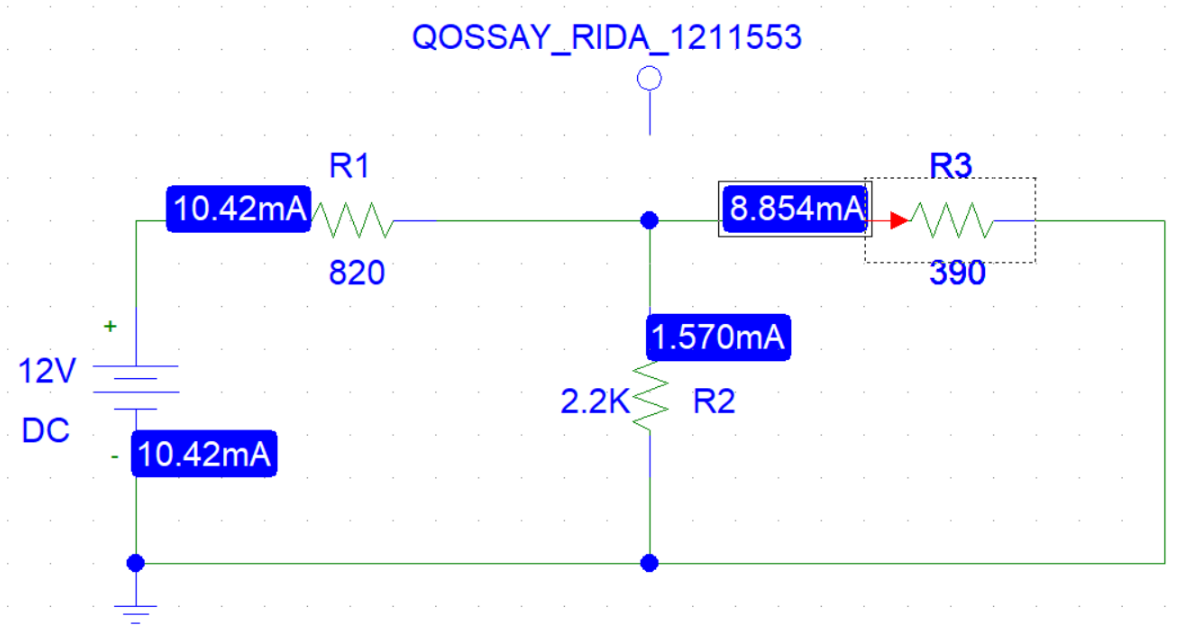


3- Calculate $R_{Thevenin}$ seen by R_L:

From this simulation V_{os} equal 8.742 – 0 that equal 8.742 volt



From this simulation I_{sc} equal 8.854 mA



Now we can calculate $R_{Thevenin}$:

$$R_{Thevenin} = {}^{V_{os}}/_{I_{sc}}$$

$$R_{Thevenin} = 8.742 \ /(8.854 * 10^{-3})$$

$$R_{Thevenin} = 987.35 \ \Omega$$

4- Compare the result for step2 & step3:

Result in Step 1:

R_L equal 990.788 Ω when the power be maximum

Result in Step 2:

$R_{Thevenin} = 987.35 \ \Omega$

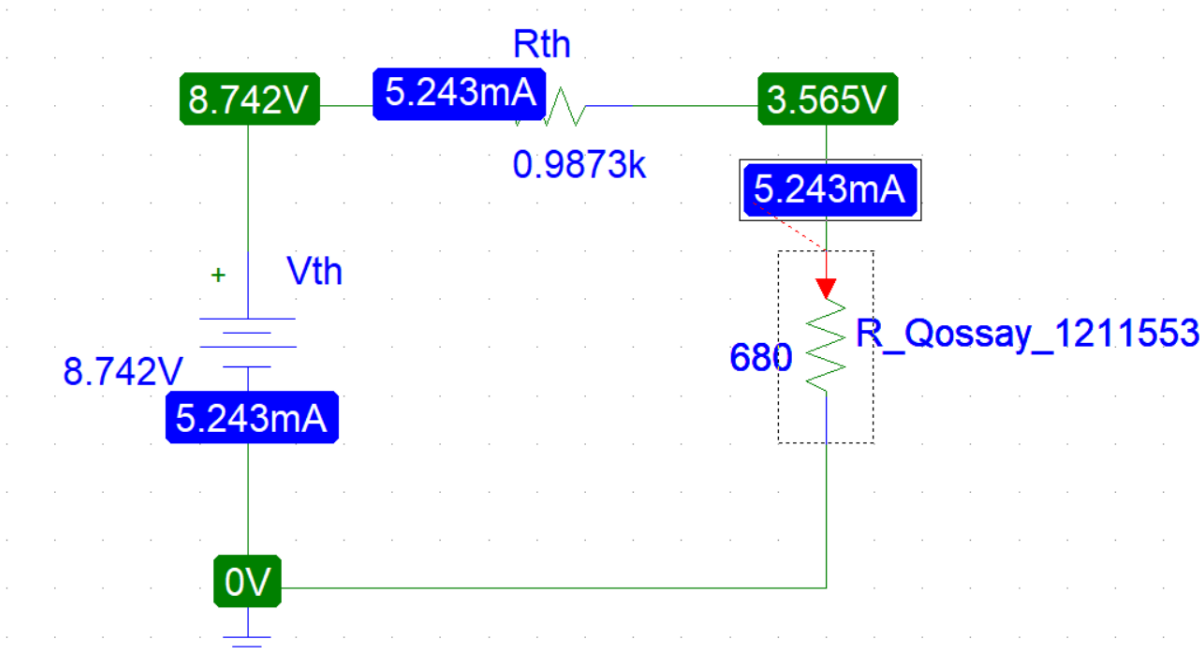
We see:

The $R_{Thevenin}$ is equal to R_L that has a maximum power

5- Thevenin equivalent circuit:

From the simulation for thevenin equivalent circuit we see:

The voltage on R_L equal 3.565 – 0 that equal 3.565 volt
The current across R_L equal 5.243 mA (down)



6- Compare the result for step1 & step5:

Result in Step 1:

The voltage on R_L equal 3.565 – 0 that equal 3.565 volt

The current across R_L equal 5.243 mA (down)

Result in Step 5:

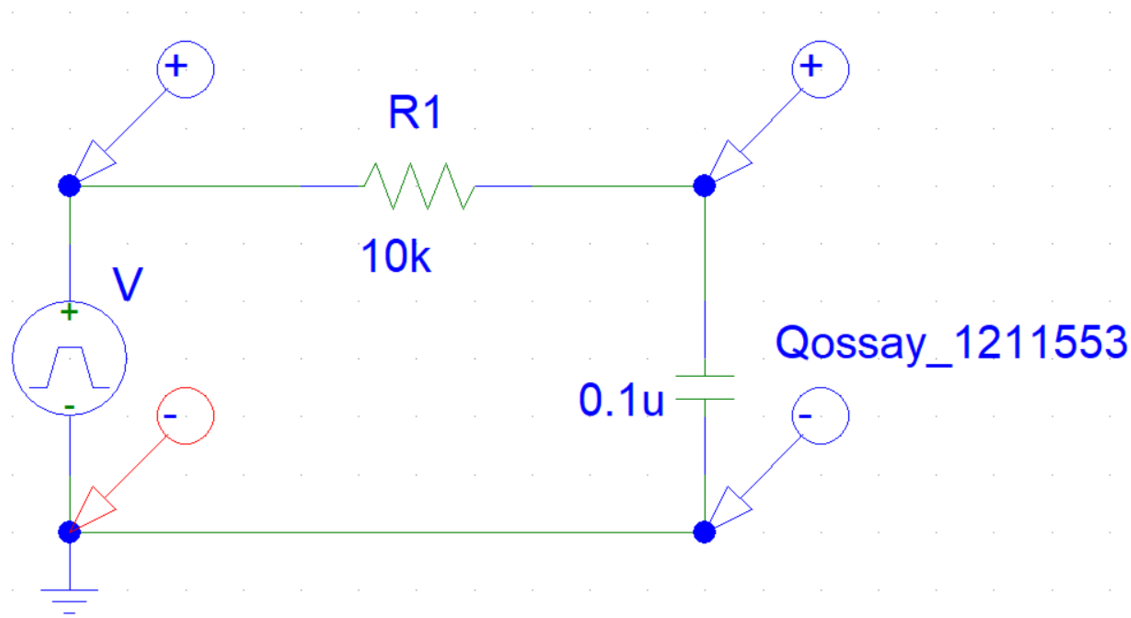
The voltage on R_L equal 3.565 – 0 that equal 3.565 volt

The current across R_L equal 5.243 mA (down)

Result in step1 is equal result in step5 that mean, The Thevenin equivalent circuit is a way of representing a complex electrical network with a single voltage source and single impedance (resistor), to simplify analysis and design.

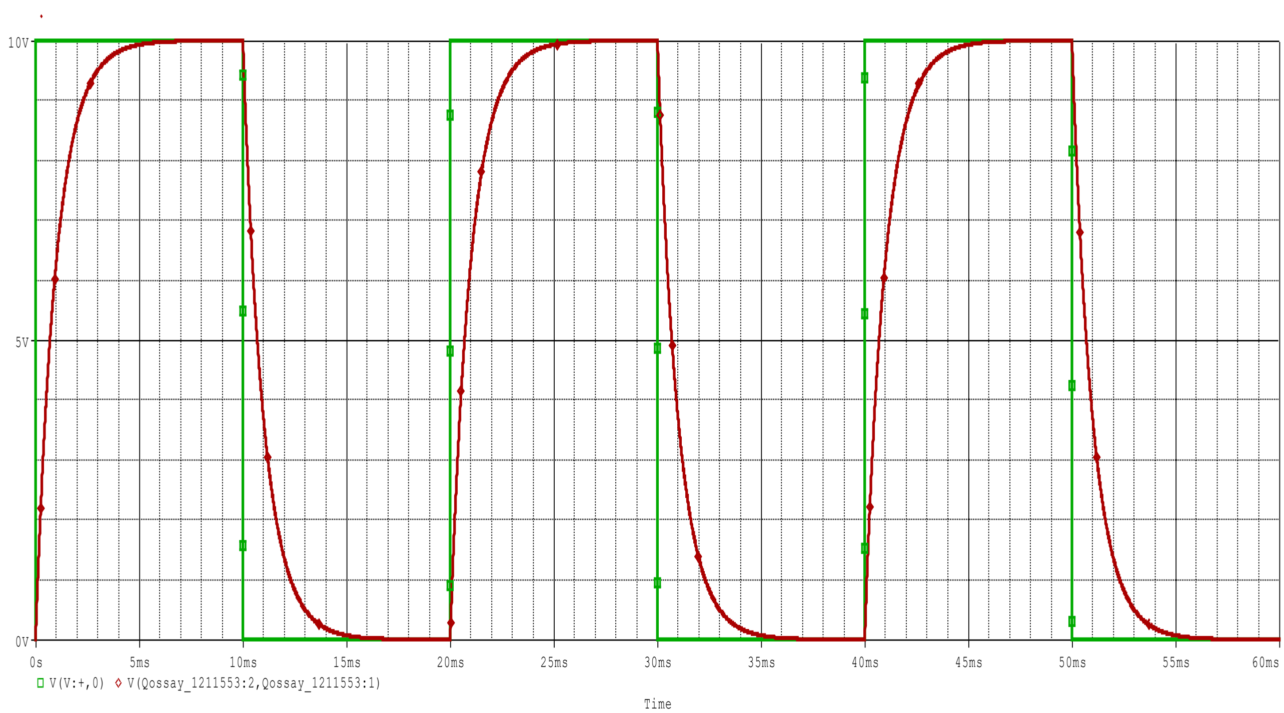
Question 3: First Order RC Circuit Analysis

The circuit we build:



1- Plot $V_i(t)$ & $V_i(t)$:

$V_i(t)$ *is Green* $V_i(t)$ *is Red*

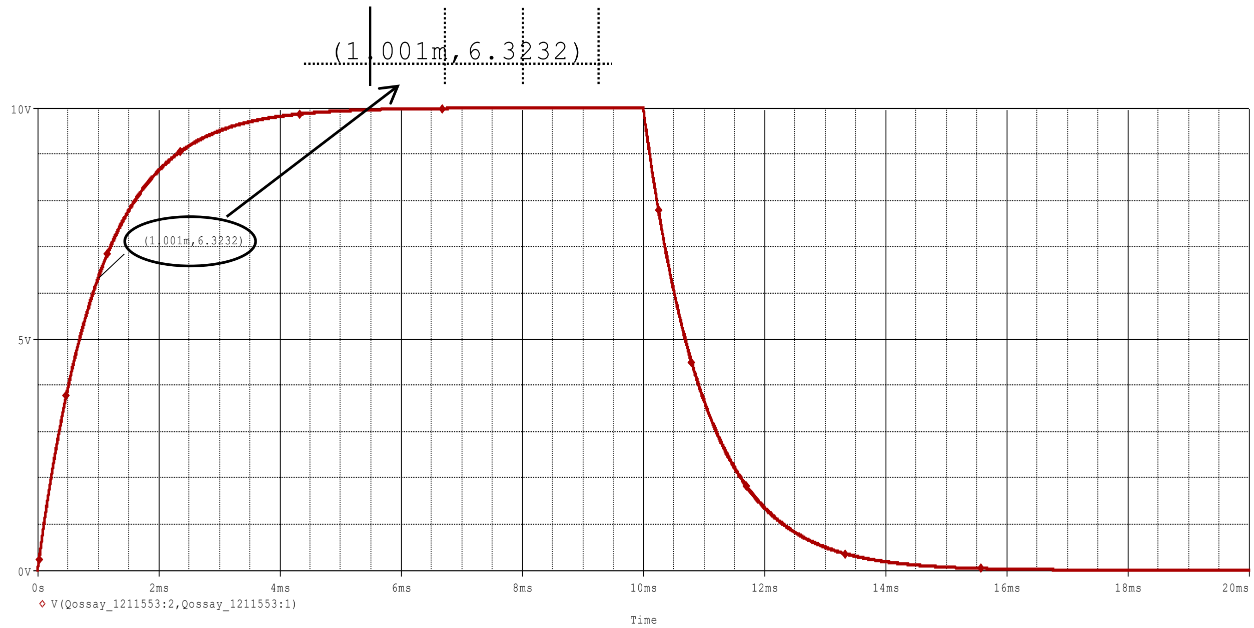


2- Find τ:

$$V_c(\tau) = 0.63\ \varepsilon_0$$

$$V_c(\tau) = 6.32$$

From the graph when $V_c(\tau) = 6.32 \rightarrow \tau = 1\ ms$



Find τ theoretically:

$$\tau = R * C$$

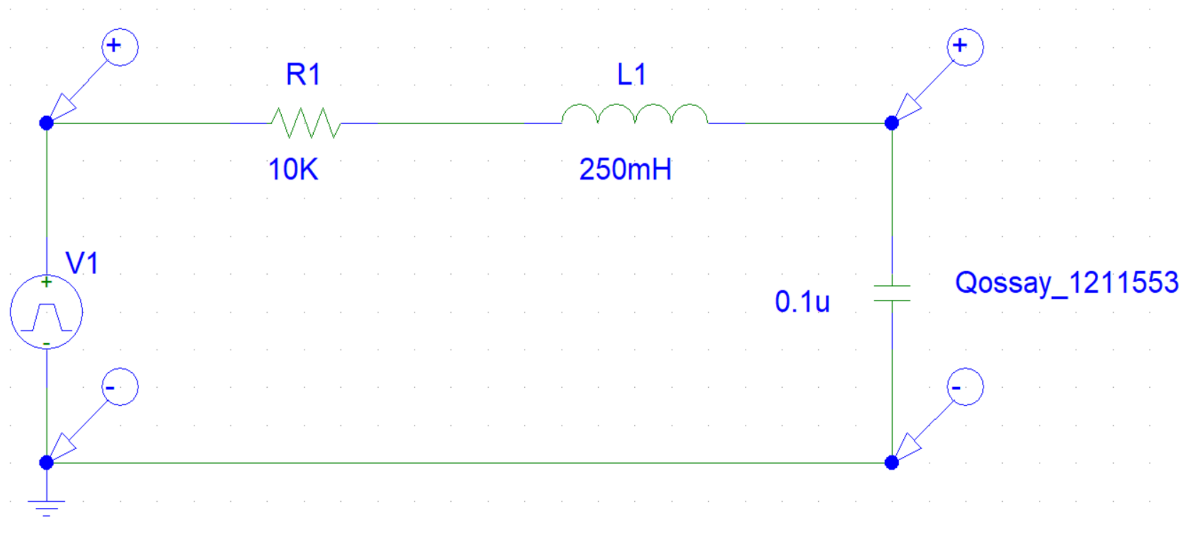
$$\tau = 10 * \ 10^3 * 0.1 * \ 10^{-6}$$

$$\tau = \ 10^{-3}\ sec$$

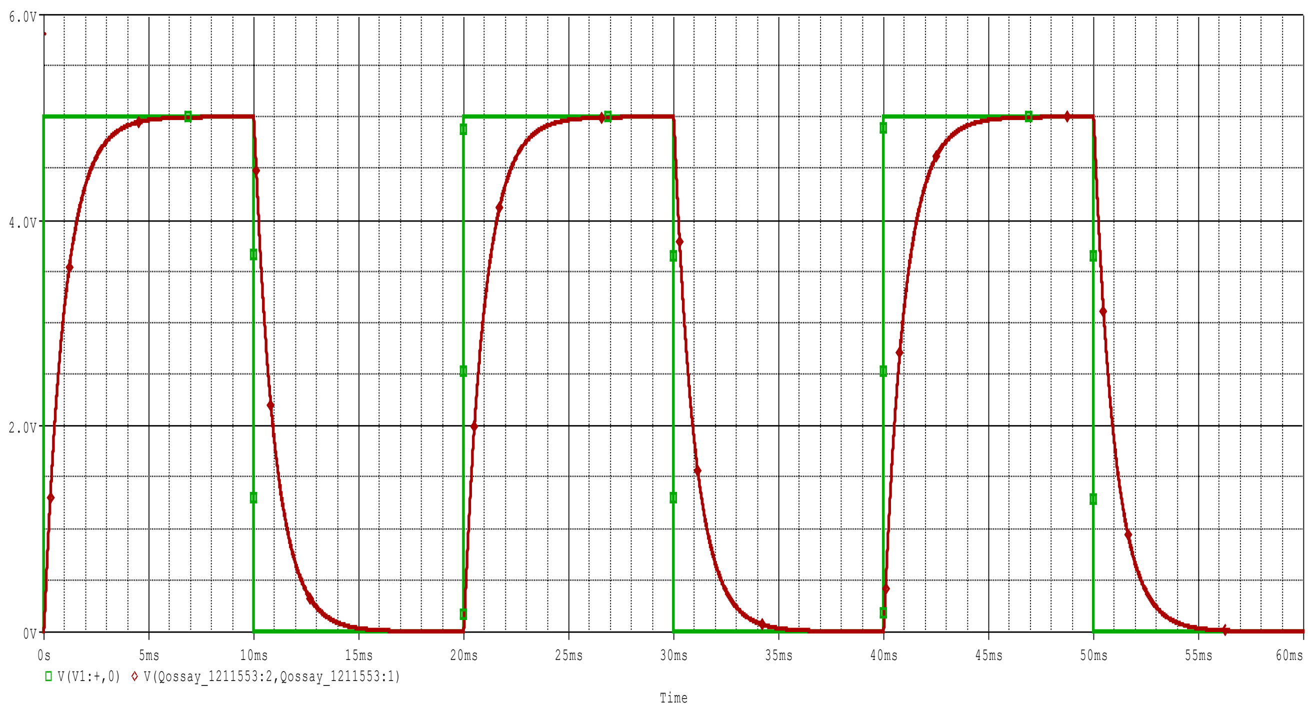
We see τ theoretically is equal τ from the graph of $V_c(t)$

Question 4: Second Order RLC Circuit Analysis

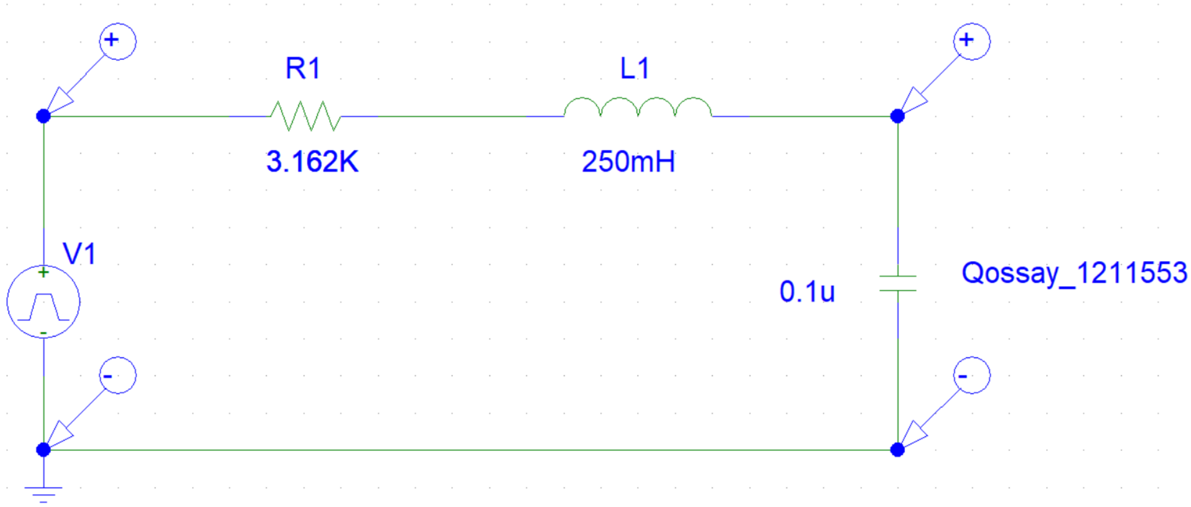
1- Plot $V_i(t)$ & $V_c(t)$ when R = 10KΩ:



$V_i(t)$ *is Green* $V_c(t)$ *is Red*

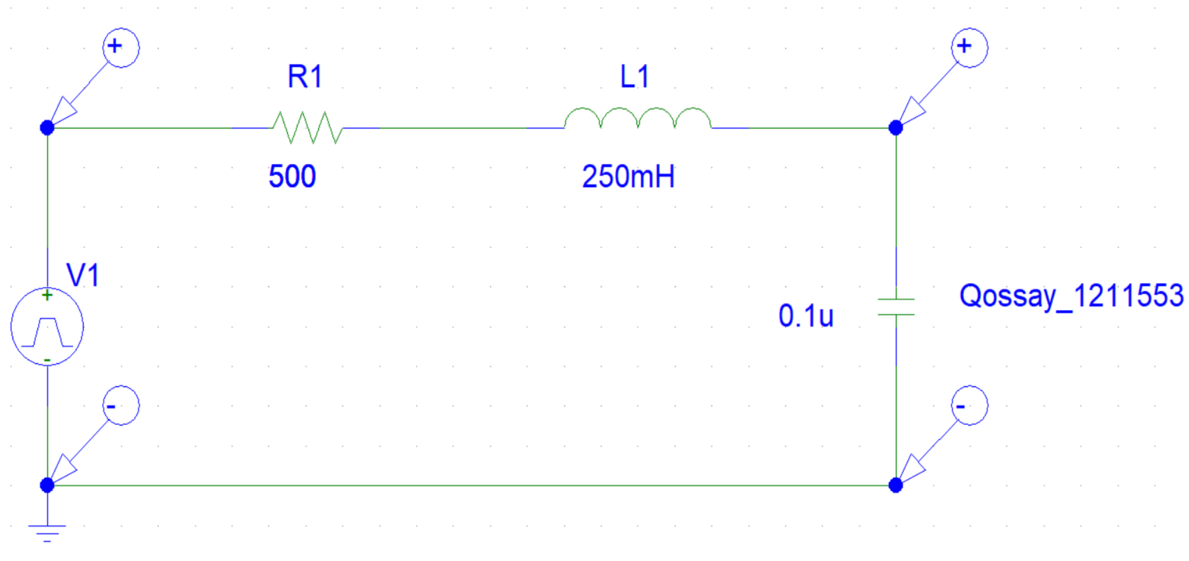


2- Plot $V_i(t)$ & $V_c(t)$ when R = 3.162KΩ:

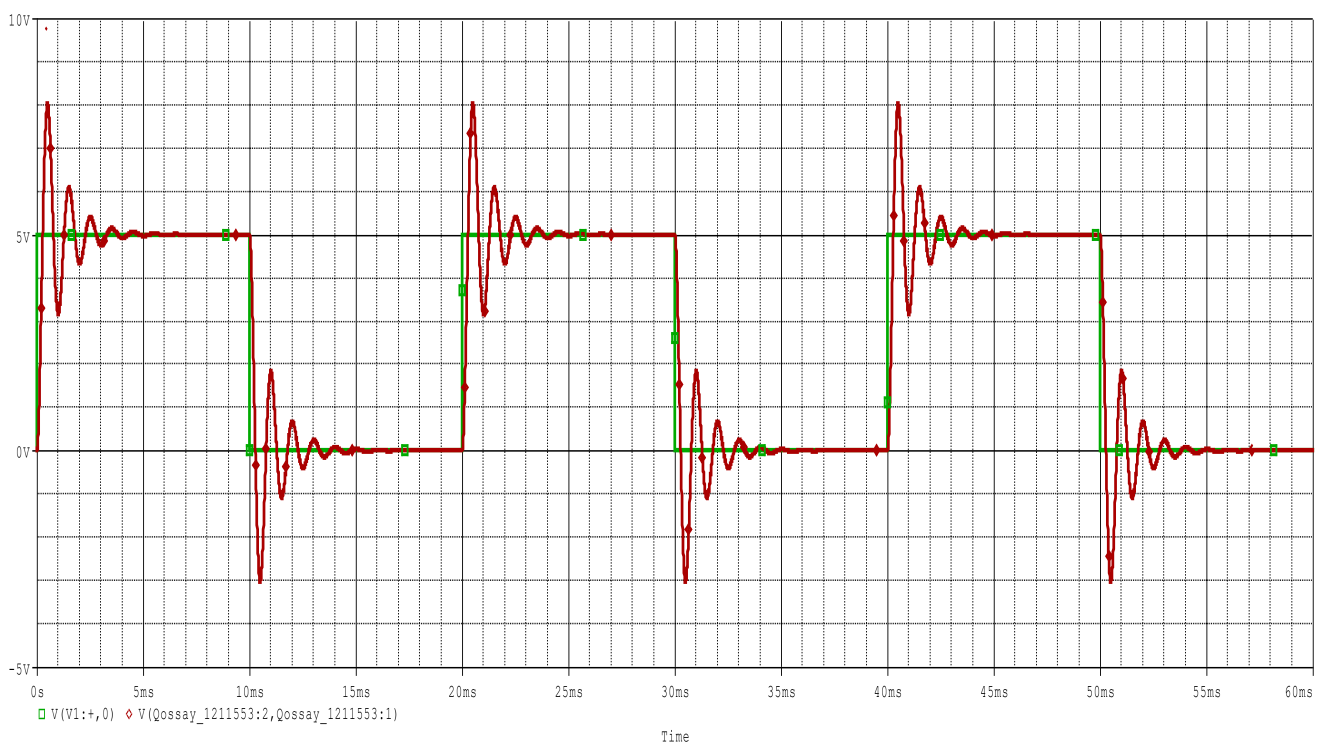


$V_i(t)$ *is Green* $\quad V_c(t)$ *is Red*

3- Plot $V_i(t)$ & $V_c(t)$ when R = 500Ω:

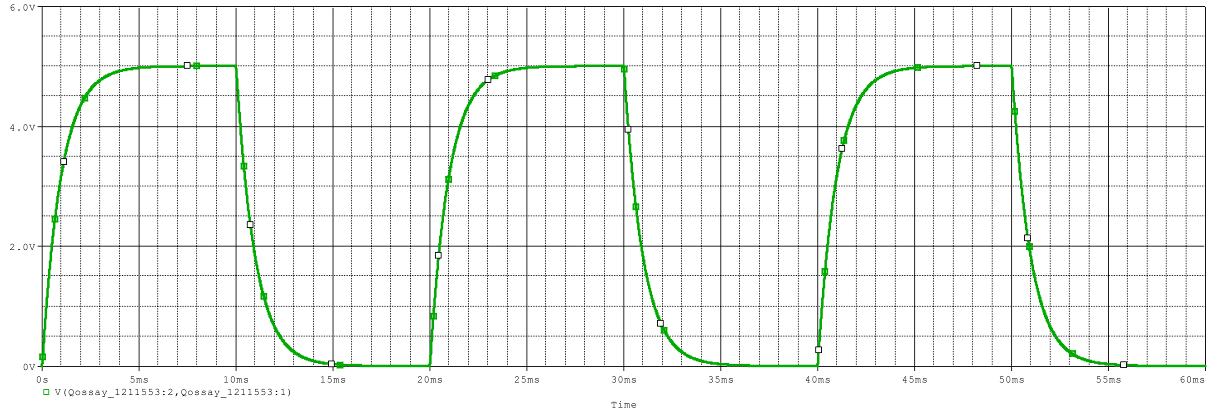


$V_i(t)$ *is Green* $V_c(t)$ *is Red*

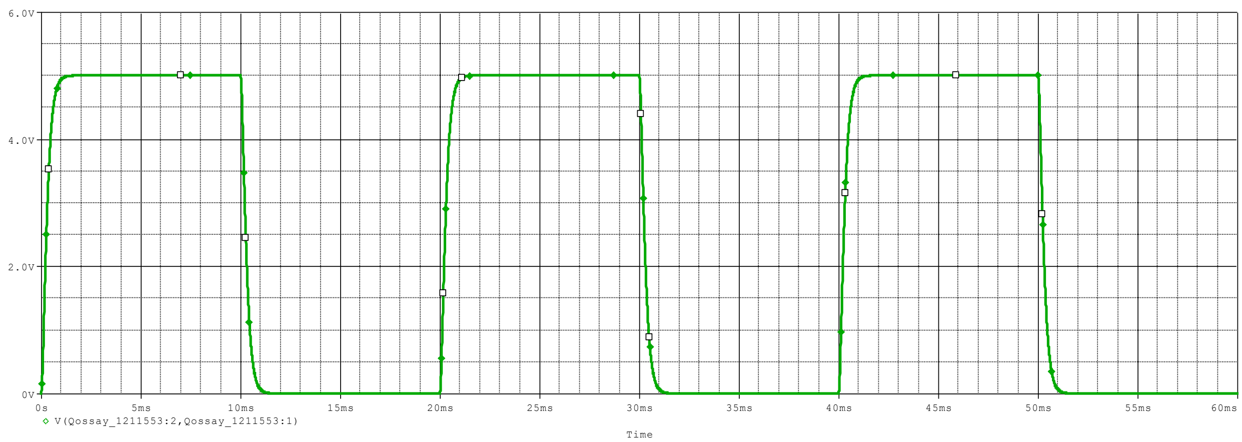


4- comment on each result:

Step1: is it over_damping



Step2: is it critical_damping



Step3: is it under_damping