DEPT. OF ELECTRICAL & ELECTRONICS ENGINEERING

SRM INSTITUTE OF SCIENCE AND TECHNOLOGY, Kattankulathur – 603 203

Title of Experiment	: **3.Transient analysis of Series RL, RC circuits**
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Register Number	: RA2111028010094
Date of Experiment	: 11-10-2021

Sl. No.	Marks Split up	Maximum marks (50)	Marks obtained
1	Pre Lab questions	5	
2	Preparation of observation	15	
3	Execution of experiment	15	
4	Calculation / Evaluation of Result	10	
5	Post Lab questions	5	
Total		**50**	

Staff Signature

PRE LAB QUESTIONS

1) **Define Transient.**

Transient is a period of disturbance in an electrical circuit, in which the circuit is needed settle from its disturbed state to a steady state. It is common in circuits with energy storing components such as capacitor or an inductor.

2) **Time constant for RL Circuit.**

The time constant for an RL circuit is defined as the ratio of impedance to that of resistance,

$\tau = L / R$

3) **Time constant for RC Circuit.**

The time constant for an RC circuit is defined as the product of resistance to that of conductance,

$\tau = R * C$

4) **How will you design the values of L & C in a transient circuit?**

While designing L and C transient response of the circuit, the wave form related to the circuit is time constant determining how it is affected by an RC or RL circuit. Here wave form is in the form of tube as it is from a square type AC voltage source.

Experiment No. 3 Date : 11-10-2021	Transient analysis of series RL, RC circuits

Aim:

To obtain the transient response and measure the time constant of a series RL and RC circuit for a pulse waveform.

Apparatus Required:

Sl. No.	Apparatus	Range	Quantity
1	Function Generator (square wave)	5V, 5 Hz	1
2	Inductor	1 H	1
3	Resistor	1 kΩ	1
4	Capacitor	10 microF	1
5	Bread Board & Wires	--	Required
6	CRO		1
7	CRO Probes		2

Theory

In this experiment, we apply a pulse waveform to the RL or RC circuit to analyze the transient response of the circuit. The pulse-width relative to a circuit's time constant determines how it is affected by an RC or RL circuit.

Time Constant (τ): A measure of time required for certain changes in voltages and currents in RC and RL circuits. Generally, when the elapsed time exceeds five time constants (5τ) after switching has occurred, the currents and voltages have reached their final value, which is also called steady-state response.

The time constant of an RC circuit is the product of equivalent capacitance and the Thevenin's resistance as viewed from the terminals of the equivalent capacitor.

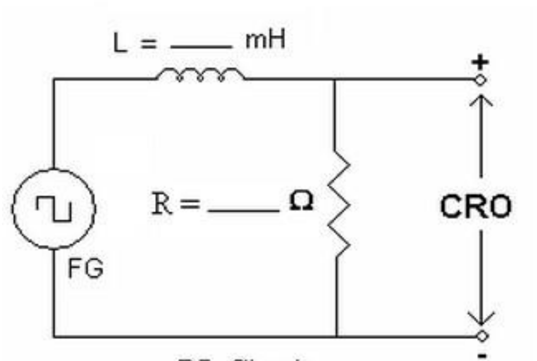
$$\tau = RC$$

A Pulse is a voltage or current that changes from one level to the other and back again. If a waveform's high time equals its low time, as in figure, it is called a square wave. The length of each cycle of a pulse train is termed its period (T). The pulse width (tp) of an ideal square wave is equal to half the time period.

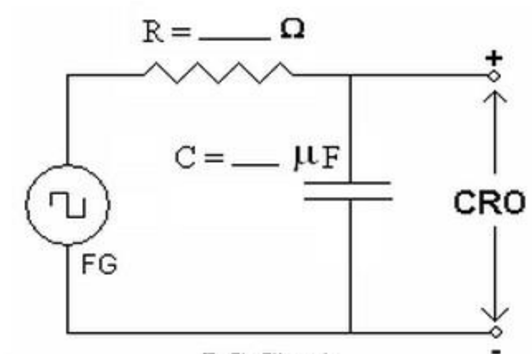
Procedure for RL:

1. Make the connections as per the circuit diagram.
2. Choose square wave mode in signal generator
3. Using CRO, adjust the amplitude to be 2 volts peak to peak.
4. Take care of the precaution and set the input frequency.
5. Observe and plot the output waveform.
6. Calculate the time required by the output to reach 0.632 times the final value (peak).
7. This value gives the practical time constant. Tabulate the theoretical and practical values.

Circuit Diagram:



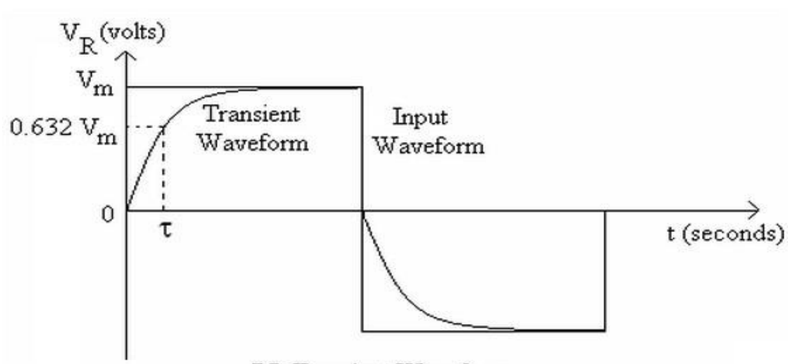
RL Circuit



RC Circuit

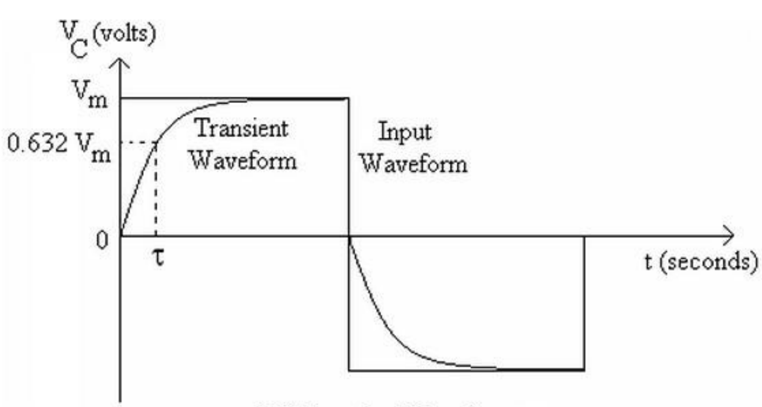
Model Graph:

a) RL Transient :Output voltage across Resistor:



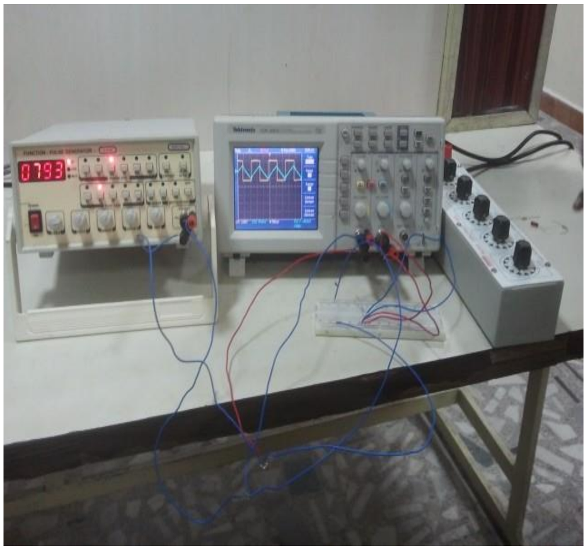
RL Transient Waveform

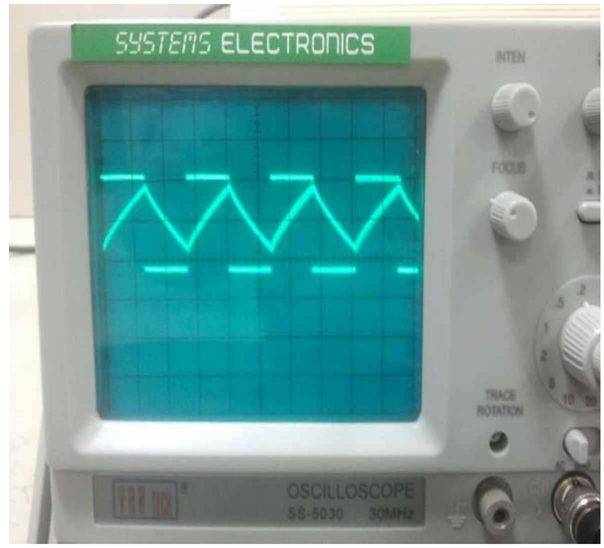
b) RC Transient :Output voltage across Capacitor:



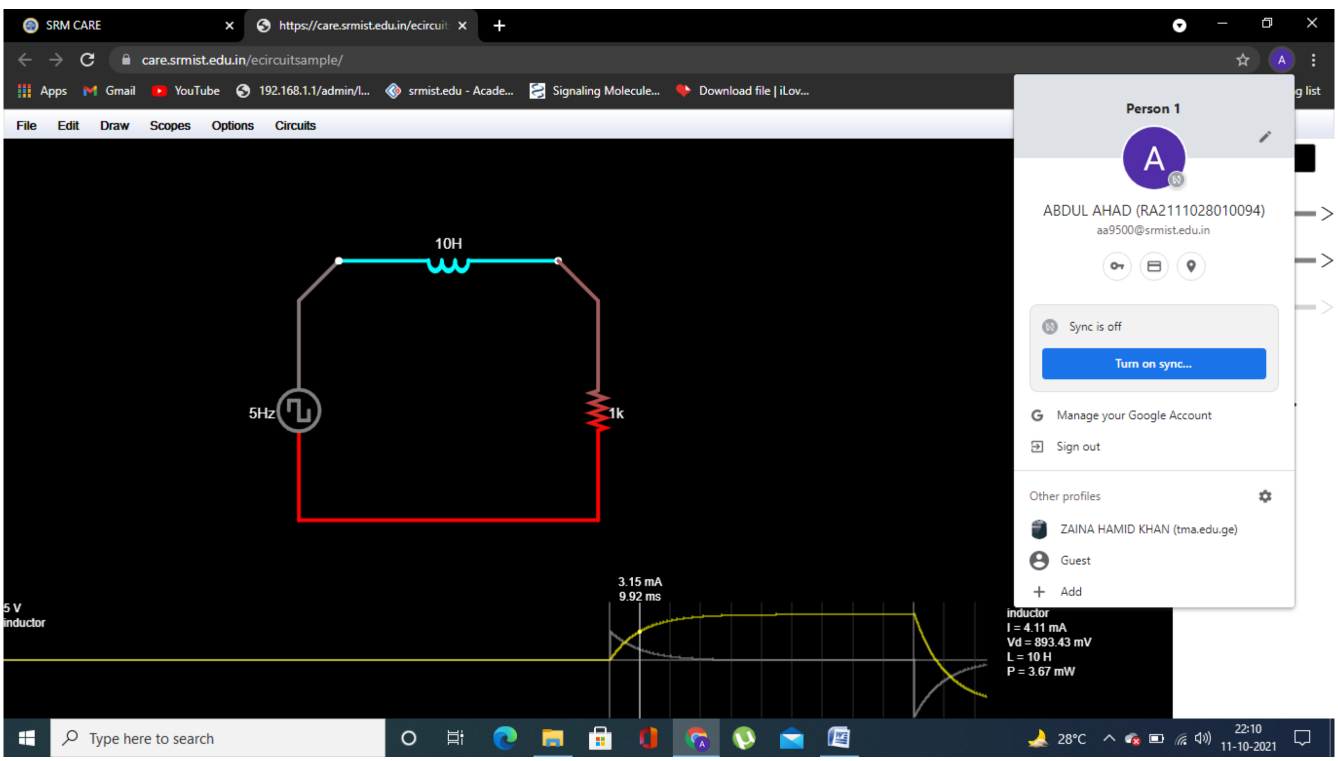
RC Transient Waveform

Hardware setup:

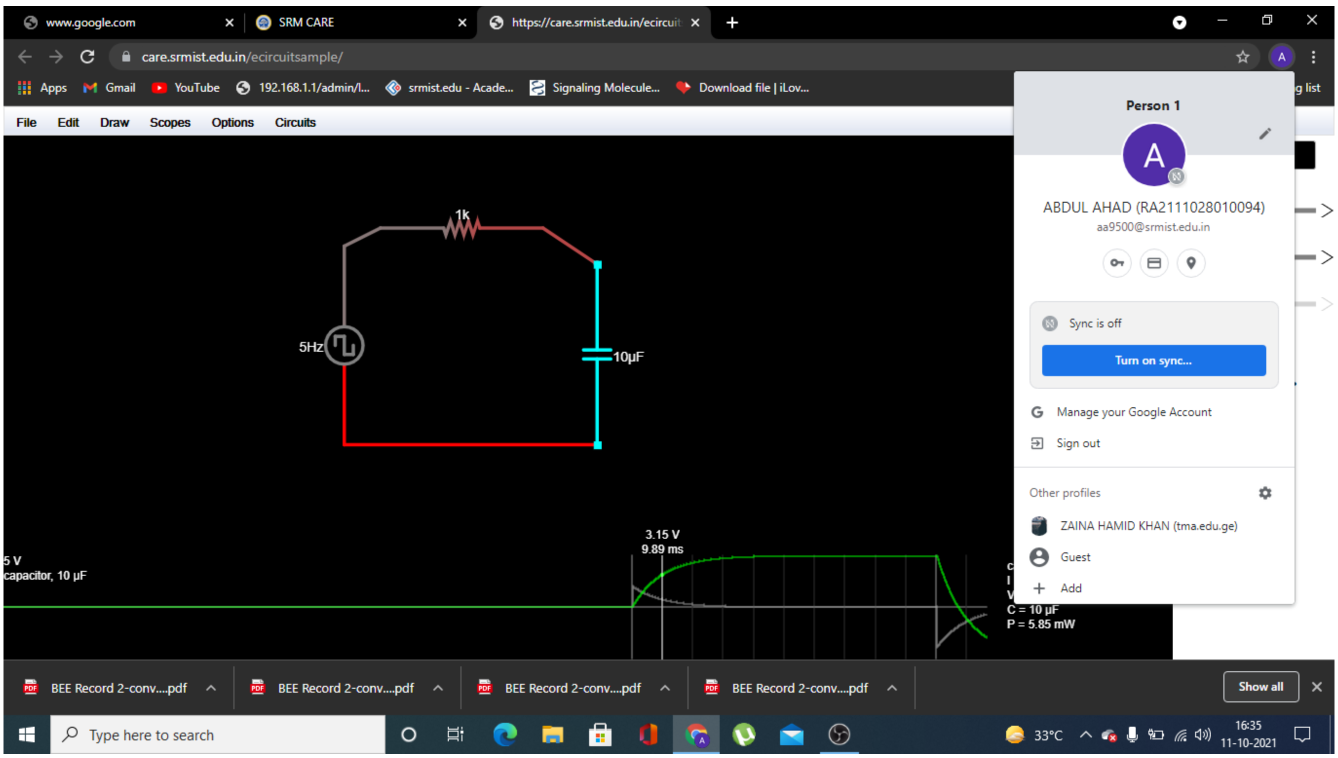




e-circuits



Input voltage	frequency	R	L	Theoretical time constant=L/R	Simulated time constant Time to reach 63.2 % of final value
5 V	5 Hz	1 KΩ	10 H	10 ms	9.92 ms



Input voltage	frequency	R	C	Theoretical time constant=RC	Simulated time constant Time to reach 63.2 % of final value
5 V	5 Hz	1 KΩ	10 µF	10 ms	9.89 ms

Result:

We got the time period in E-Circuit nearly to theoretical calculations which is equal to 10 mille seconds in both LR as well as RC transient circuits.

POST LAB QUESTIONS

1) Why is it necessary to discharge the capacitor every time you want to record another transient voltage across the capacitor?

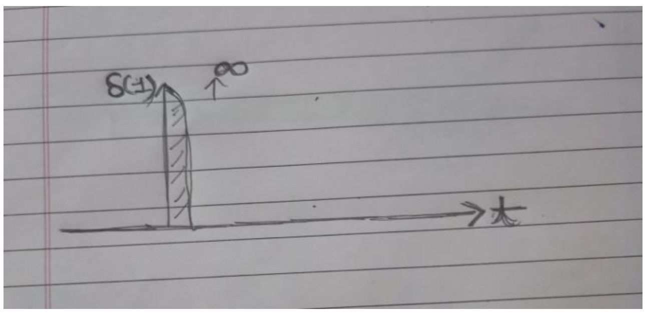
We need to discharge the capacitor every time before recording another transient voltage across the capacitor so that there is no residual charge to affect the final value.

2) If the capacitor remains charged, what would you expect to see across the capacitor when you re-close the switch to try to record another transient?

If we don't discharge the capacitor completely before switching measurements to another transient we will get inaccurate results while measuring the second transient due to residual charges.

3) What does the derivative of a step function look like?

The unit step function is level in all places except for a discontinuity at t = 0. For this reason, the derivative of the unit step function is 0 at all points t, except where t = 0. Where t = 0, the derivative of the unit step function is infinite. The derivative of a unit step function is called an impulse function.



4) What does the integral of a step function look like?

The integral of a unit step is a "ramp" function. This function is 0 for all values that are less than zero, and becomes a straight line at zero with a slope of +1.