North South University
Department of Electrical & Computer Engineering

LAB REPORT

Course Name: EEE141 Lab

Experiment Number: 07

Experiment Name: Charging and Discharging of RC circuits

Faculty: SSH1

Experiment Date: 14-08-22

Report Submission Date: 21-08-22

Section: 08

Group: 04

Name and ID: 1.Nasim Anzum Promise 2022655642 2. Mosroor Mofiz Arman 1921079642 3. Sumit Kumar Kar 2021646642 4. Muhammad Raiyan Alam 1831100642	14.25/20 Score
Remarks:	

Experiment - 07: Charging and Discharging of RC circuits

Objective:

In this experiment we have learnt

- Learning the use of Signal Generators and Oscilloscopes.
- Investigating the behavior of charging and discharging of RC circuits with changing Time Period, T of the input Square wave.

List of Equipment:

- Bread Board
- AC power supply
- 1 x 5kΩ resistor
- 1 x 0.22μF Capacitor
- Oscilloscope
- Wires

Signal generator, Oscilloscope? (-0.025)

Theory:

Capacitor: Capacitor is a passive electronic component that stores electric charge. It consists of two conductive plates separated by a dielectric material.
The amount of electric charge a capacitor can hold at 1 volt is called the capacitance of a capacitor. Is is measured is Farads.
Capacitance can be measured using these formulas:

$$C = \frac{\epsilon A}{d}$$

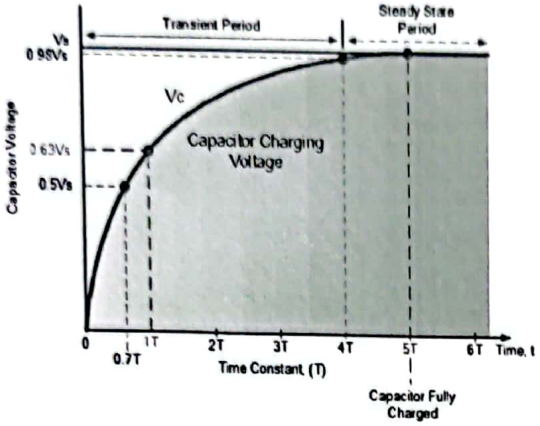
$$C = \frac{Q}{V}$$

RC Charging: When there is an AC supply, the capacitor will charge up progressively through the resistor until the voltage of the capacitor reaches equal to the power supply. The time it takes a capacitor to charge up fully is called the transient response time. It is measured by

$$\tau = R \times C$$

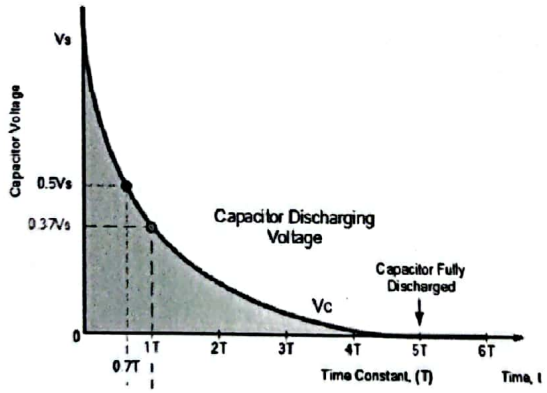
The voltage across the capacitor (V_C) as a function of time during charging can be calculated using the following formula:

$$V(t) = V_o(1 - e^{-t/RC})$$

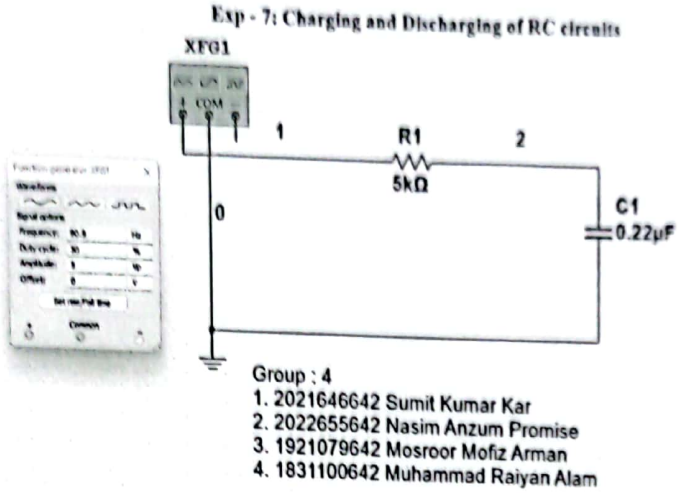


RC Discharging: When the power supply becomes neutral, the capacitor will discharge itself reversely through the resistor.
The voltage across the capacitor (V_C) as a function of time during discharging can be calculated using the following formula:

$$V(t) = V_o e^{-t/RC}$$



Circuit Diagram:



Group : 4
1. 2021646642 Sumit Kumar Kar
2. 2022655642 Nasim Anzum Promise
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4. 1831100642 Muhammad Raiyan Alam

Figure 1: Circuit 1

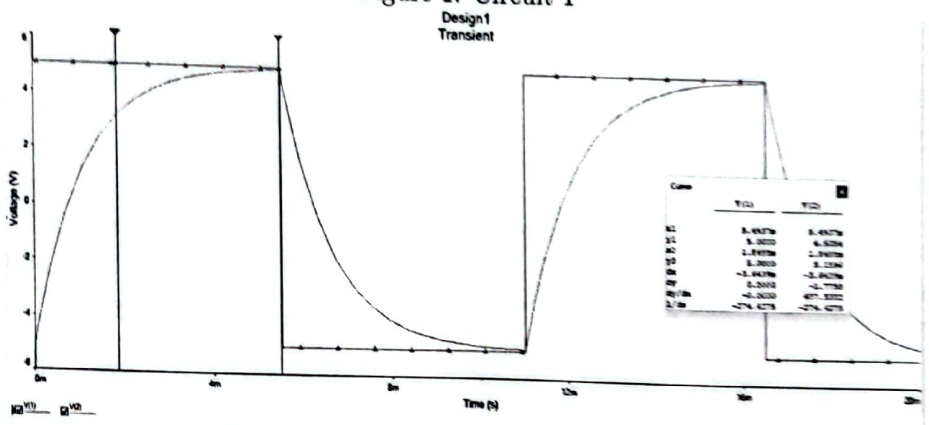


Figure 2: Circuit 2

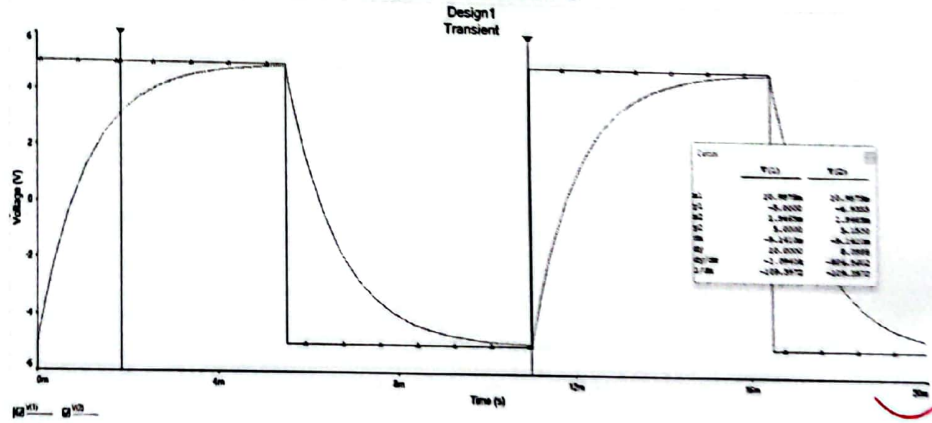
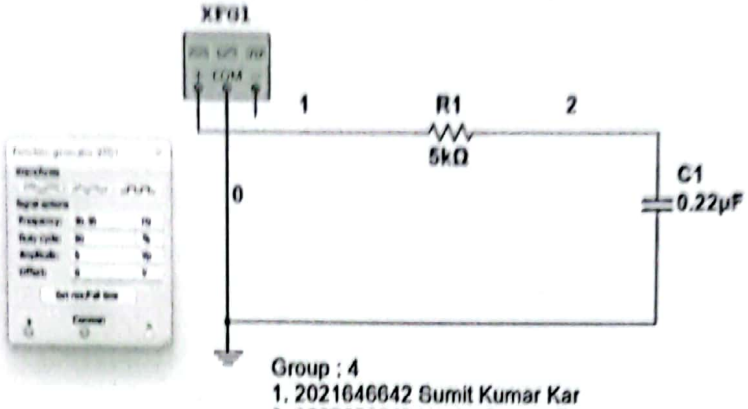


Figure 3: Circuit 3

Exp - 7: Charging and Discharging of RC circuits



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1. 2021646642 Sumit Kumar Kar
2. 2022655642 Nasim Anzum Promise
3. 1921079642 Mosroor Mofiz Arman
4. 1831100642 Muhammad Raiyan Alam

Figure 4: Circuit 4

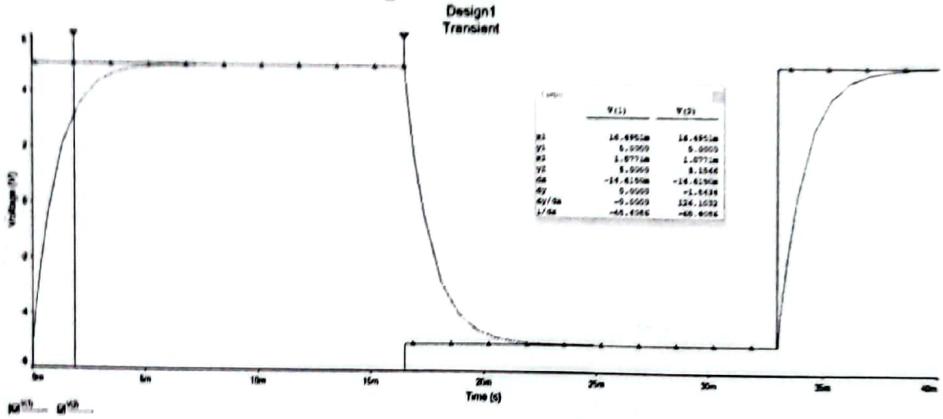


Figure 5: Circuit 5

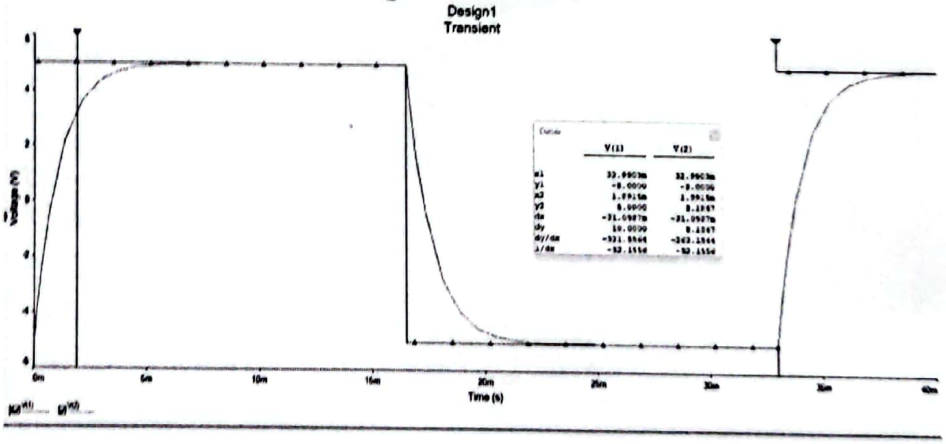
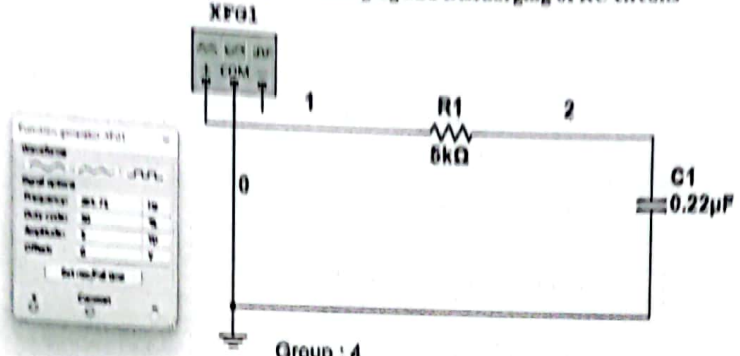


Figure 6: Circuit 6

Exp - 7: Charging and Discharging of RC circuits



Group : 4
1. 2021646042 Sumit Kumar Kar
2. 2022655042 Nasim Anzum Promise
3. 1921070042 Mosroor Mofiz Arman
4. 1831100642 Muhammad Raiyan Alam

Figure 7: Circuit 7

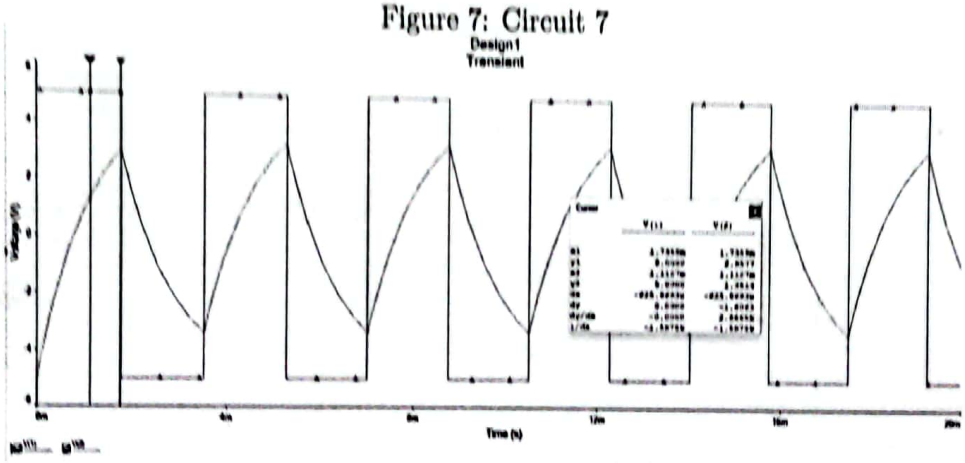


Figure 8: Circuit 8

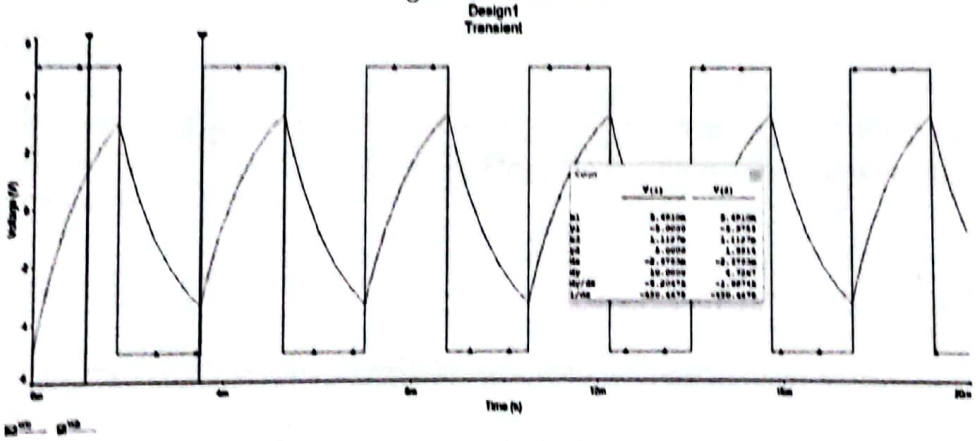


Figure 9: Circuit 9

NORTH SOUTH UNIVERSITY

DEPARTMENT OF ELECTRICAL & COMPUTER ENGINEERING

EEE/ETE141

Data Collection for Lab 7

Group: 07

Instructor's Signature:

Data Table:

Measurement	T=10RC	T=30RC	T=3.5ms
Frequency of input signal	90.90Hz	30.30Hz	285.71Hz
Time constant, τ	2ms	1.8ms	1.12ms
Final Output Vc	5V	4.80V	3.04V
Measure the time the capacitor charges up to Vc	5.5ms	16.40ms	1.76ms
Time the capacitor starts to discharge	5.51ms	16.41ms	1.77ms
Time the capacitor stops discharging	11.1ms	33.60ms	3.52ms

Report:

1. In separate graph papers, draw the charging-discharging phase for the RC circuit for 3 different values of T. **The graphs should be drawn using values from Table-1.**
2. Explain what is τ.
3. Theoretically calculate τ and compare with the measured value of τ.
4. **Using the data table, explain in details** the charging-discharging pattern for all the 3 cases.

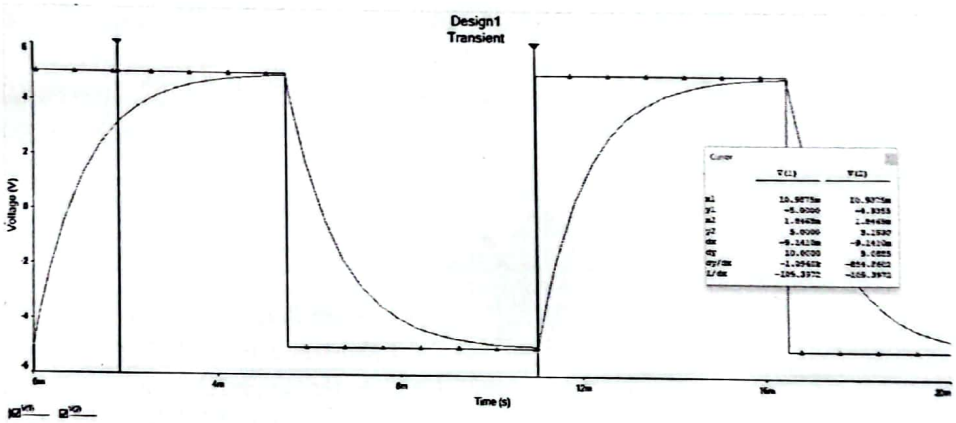
Data table

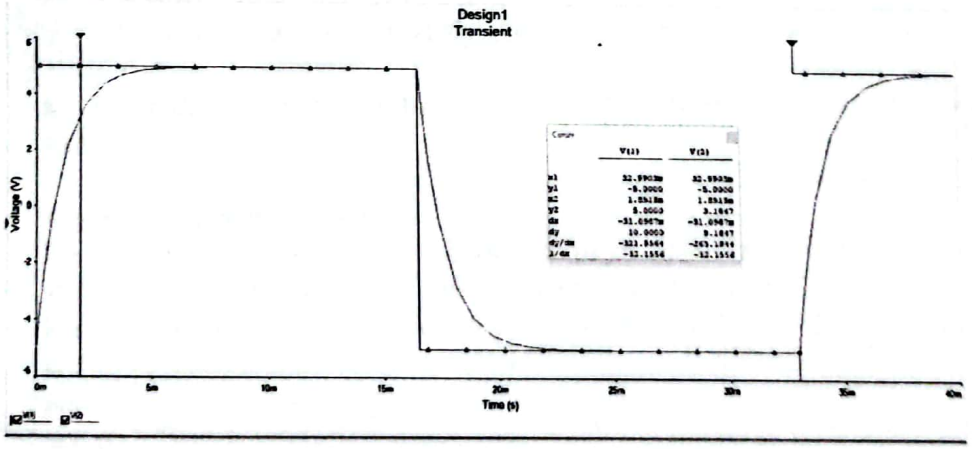
Here, R=5k ohm
C=0.22 uF
Vin=10V
Time constant, τ =10RC
= $(10 \times 5k\omega \times 0.22\mu F)$s =1.1ms.
Time constant, τ =30RC
= $(30 \times 5k\omega \times 0.22\mu F)$s
=3.3ms.
Again,
Frequency of input signal, f = 1/T =90.91 Hz
Frequency of input signal, f = 1/T =30.30 Hz
Frequency of input signal, f = 1/T =285.71 Hz

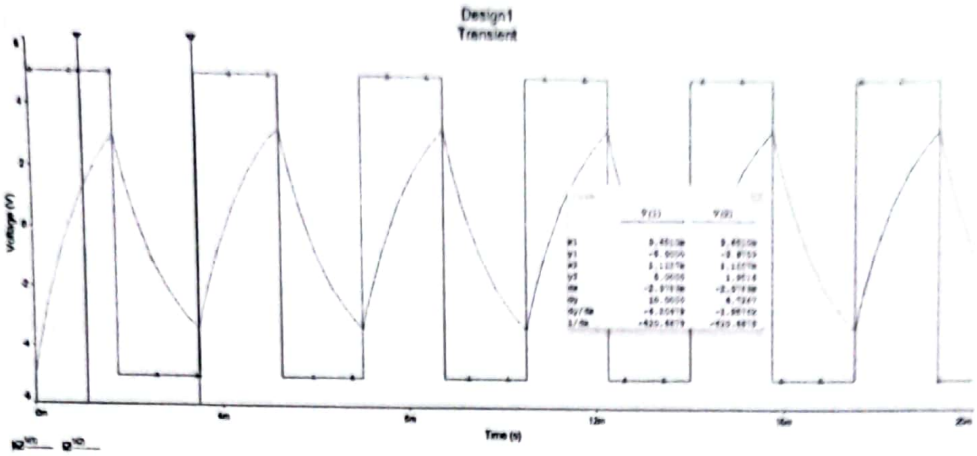
Question and Answers:

1. In separate graph papers, draw the charging-discharging phase for the RC circuit for 3 different values of T. The graphs should be drawn using values from Table-1.

Answer:







2. Explain what is τ.

Answer: It is the time required to charge the capacitor, through the resistor, from an initial charge voltage of zero to approximately 63.2% of the value of an applied voltage, or to discharge the capacitor through the same resistor to approximately 36.8% of its initial charge voltage.
The formula for calculating τ is:

$$\tau = R \times C$$

Here R is the resistance and C is the Capacitance.

3. Theoretically calculate τ and compare with the measured value of τ

Answer: Theoretically calculating value of τ
We know that,

$$\begin{aligned} \tau &= R \times C \\ &= 5K\Omega \times 0.22\mu F \\ &= 1.1ms \end{aligned}$$

From our measured data we get,
For T = 10RC, Time constant, τ =2ms
For T = 30RC, Time constant, τ =1.8ms
For T = 10RC, Time constant, τ =1.12ms
Here, Theoretical value of τ is equal to measured value of τ at T = 3.5ms

4. Using the data table, explain in details the charging-discharging pattern for all the 3 cases.

Answer: Here we can see,
For, T = 10 RC, The capacitor charges up to 5V and it takes 5.5ms to charge up. and at 5.51ms it starts discharging and completely discharge at 11.1ms.
For, T = 30 RC, The capacitor charges up to 4.8V and it takes 16.40ms to charge up. and at 16.41ms it starts discharging and completely discharge at 33.60ms.
For, T = 3.5ms, The capacitor charges up to 3.04V and it takes 1.76ms to charge up. and at 1.77ms it starts discharging and completely discharge at 3.52ms.

Result analysis and Discussion

In this experiment we learned about Charging and Discharging of RC circuits. For this experiment we were provided Capacitor,Resistor (5kΩ), Oscilloscope, AC power supply. First ,we calculated the value of input frequency such that $\tau = 10RC$. Then we adjusted the frequency of the input signal to that calculated in part 1.Next we, Connected the Channel 1 of the oscilloscope to the input signal. Then we adjusted the input peak to peak value to 10v. Next we connected channel 2 of the oscilloscope with the capacitor.After that,we measured τ final output voltage of the capacitor Vc ,the time the capacitor charges up to Vc , the time the capacitor starts to discharge, the time the capacitor stops discharging from the oscilloscope.Then we calculated the input frequency such that T=30RC. Using the same procedure we calculated the input frequency such that T= 3.5ms ($T > 5RC$). That was the end of our experiment.

(-0.5)

Table of Contributions

During the experiment in class:

- 2021646642 Sumit Kumar Kar :
  Measured and Wrote Values
- 2022655642 Nasim Anzum Promise:
  Helped with Measuring Values
- 1831100642 Muhammad Raiyan Alam:
  Helped to build the circuit
- 1921079642 Mosroor Mofiz Arman:
  Built The Circuit

During Lab Report:

- 2022655642 Nasim Anzum Promise:
  Wrote objective, theory part and Discussion.
- 2021646642 Sumit Kumar Kar:
  Drew Multisim and Solved Questions and Answers
- 1831100642 Muhammad Raiyan Alam:
  Helped with Question and Answer
- 1921079642 Mosroor Mofiz Arman:
  Report Writing according to the Guideline given in the canvas.