Spring 2023

EEE/ETE 141L

Electrical Circuits-I Lab (Sec-19)

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Instructor: Md. Rabiul Karim Khan

Lab Report 08: Charging and Discharging of RC Circuits.

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07 May 2023

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14 May 2023

Group no.: 05

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Experiment Name: Charging and Discharging of RC Circuits.

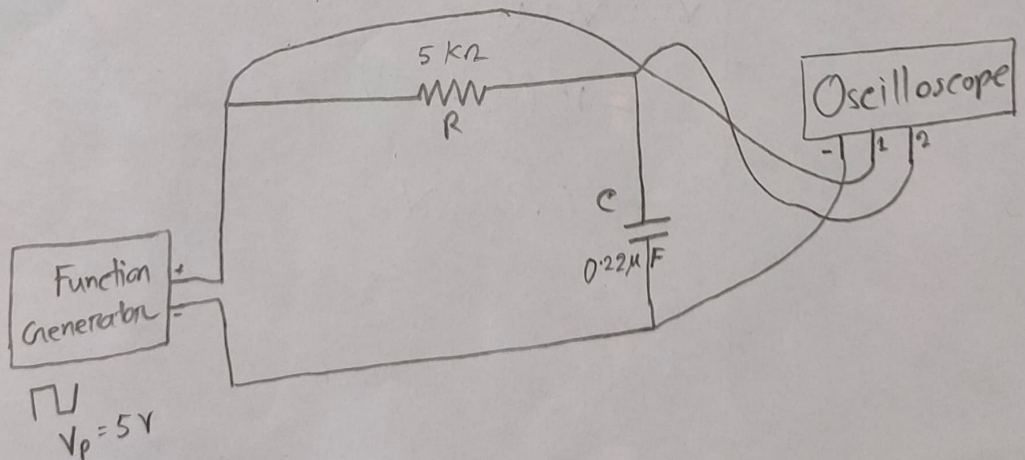
Objectives:

- To learn the use of signal Generators and Oscilloscope.

Apparatus:

- Breadboard
- Resistors (1 × 5 KΩ)
- Capacitor (0.22 μF)
- Digital Multimeter (DMM)
- Function Generators
- Oscilloscope
- Wires

Circuit Diagram: Attached.



Data Table & Calculation :

Theoretical & Experimental Calculation :

In our RC Circuit :

Input Voltage, $V_p = 5\,V$ (square wave)

$\Rightarrow V_0 = 10\,V$

Resistor, $R = 5\,K\Omega$

Capacitor, $C = 0.22\,\mu F$

Therefore,

Time constant, $\tau = RC$

$= (5 \times 10^3 \times 0.22 \times 10^{-6})$

$= 1.1\,m\,sec$

According to theory,

When, $t = 1\tau$

$V_c = V_0 (1 - e^{-\tau/\tau})$

$= 10 (1 - e^{-1})$

$= 6.32\,V$

In our experiment,

When $V_c = 6.32\,V$,

We found $\Delta t = 1.08$ m sec

Therefore, experimental time constant, $\tau = 1.08$ m sec

$$\therefore \text{Error} = \left| \frac{1.1 - 1.08}{1.1} \right| \times 100\,\%$$

$$= 1.82\,\%$$

According to theory,

When, $t = 5\tau$

$$V_c = V_0 (1 - e^{-5t/\tau})$$

$$= 10 (1 - e^{-5})$$

$$= 9.93\,V \simeq 10\,V \quad (\text{Almost full charge})$$

That means, a capacitor will fully charge with in 5τ time and also can be fully discharge with in 5τ time.

Therefore, we can say that for fully charge and discharge capacitor takes 10τ time.

That means time period, $T = 10\,\tau$

$= 10 \times (1.1 \text{ m sec})$

$= 11 \text{ m sec}$

Therefore, frequency, $f = \frac{1}{T}$

$= \frac{1}{11 \times 10^{-3}} \text{ Hz}$

$= 90.91 \text{ Hz}$

Graph:

Simulation Attached

Result Analysis:

According to theory Time constant is 1.1 msec, that means capacitor can charge 63.2 % with in one time constant. In our experiments, when V_c was 6.32 V, we found that ~~different~~ difference of time is 1.08 msec. That means time constant is 1.08 msec approximately same as theory. Therefore, our RC circuits was working perfectly.

Questions and Answers:

01. Already showed in Data Table Section.

02. If,

$T = 30RC$,

Frequency, $f = \frac{1}{T} = \frac{1}{30RC}$

$= \frac{1}{30 \times 1.1 \text{ msec}}$

$= 30.30 \text{ Hz}$

03. If,

$T = 3.33 \text{ msec}$

Frequency, $f = \frac{1}{T} = \frac{1}{3.33 \times 10^{-3}} \text{ Hz}$

$= 300.30 \text{ Hz}$

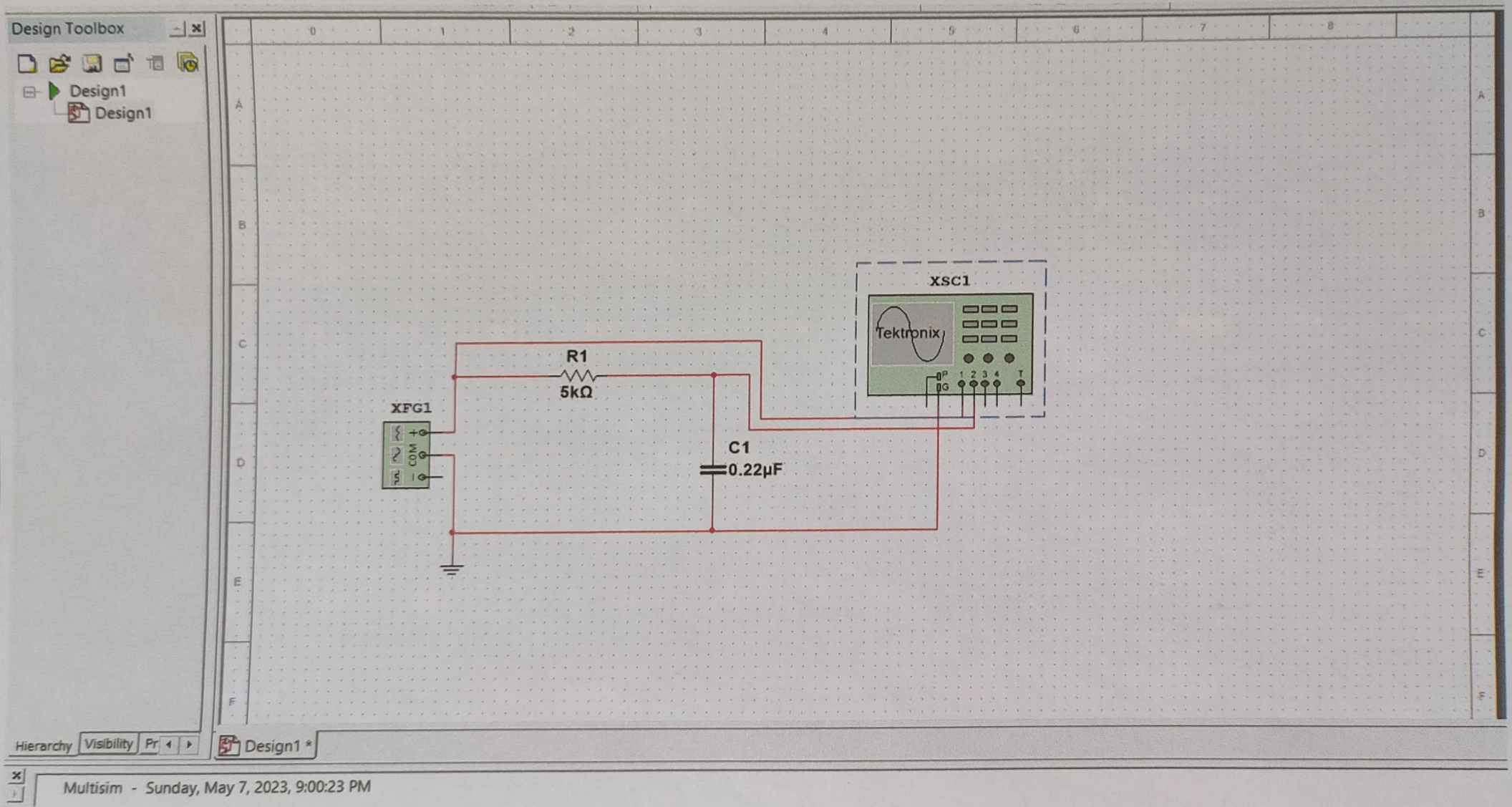
Discussion:

In this experiment we learned the usage of signal Generators and Oscilloscope. We also observed the charging and discharging behavior of RC circuits with changing time period. We found that in an RC circuits capacitor can charge 63% of its remainning capacity in every RC time. That's why RC is called the time constant of an RC Circuits.

We also saw that a capacitor can fully charge in 5RC time. In this experiment we faced some difficulties operating the Oscilloscope. But with the help of instructor, we probably learn the usage of Oscilloscope. And completed the experiment in time.

Attachement :

01. Graph using multisim.
02. Simulation using multisim.


Design Toolbox
Design1
Design1
R1
5kΩ
XFG1
COM
C1
0.22µF
XSC1
Tektronix
P
G
1 2 3 4
T
Hierarchy
Visibility
Design1 *
Multisim - Sunday, May 7, 2023, 9:00:23 PM

Tektronix oscilloscope-XSC1