BOLD and Underline Word should be written with color pen. Use pencil margin, Page number with color pen, all drawing with pencil, table body with pencil but text will be ball pen, write both sides.

Experiment Name: Charging and Discharging of RC Circuits.

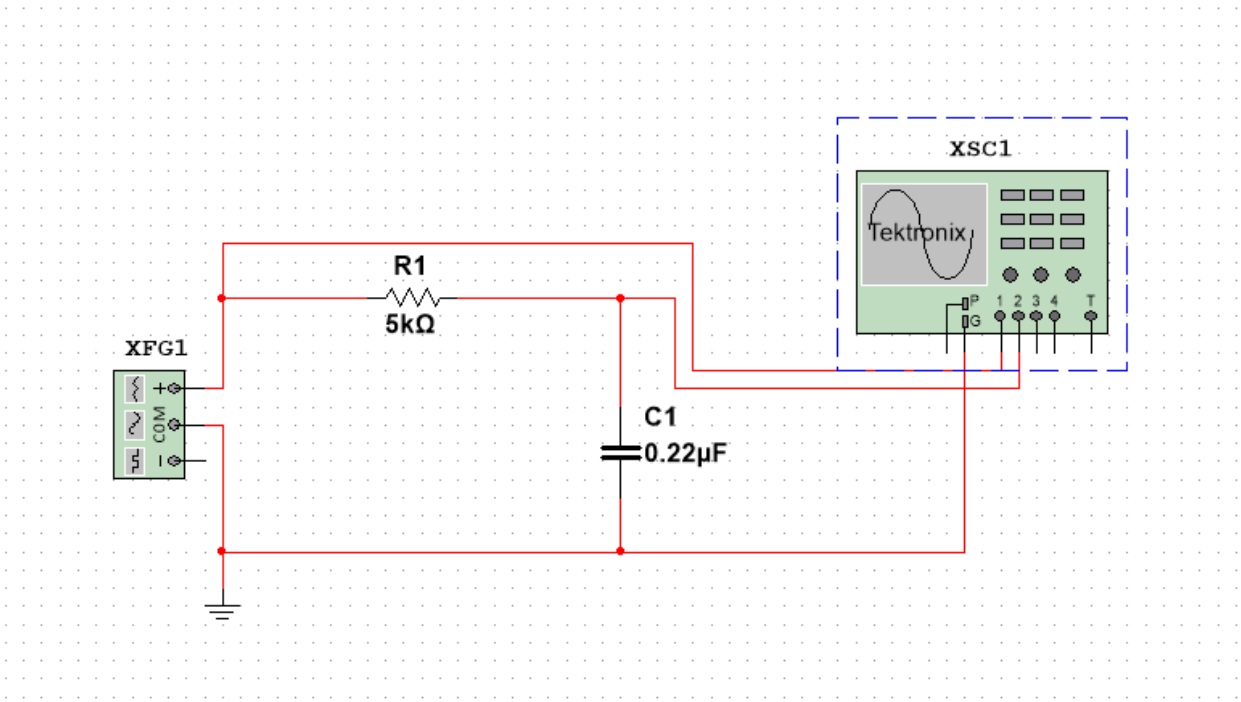
Objectives:

- To learn the use of Signal Generators and Oscilloscope.
- Investigate the behavior of charging and discharging of RC Circuits with changing Time Period, T of the input square wave.

Apparatus:

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

Circuit Diagram:



Data Table & Calculation:

Theoretical & Experimental calculation:

In our RC circuit:

Input voltage, $V_p = 5\ V$ (Square Wave)

$\Rightarrow V_o = 10\ V$

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, $t = 1\tau$

$$V_c = V_o\left(1 - e^{-\frac{\tau}{\tau}}\right)$$

$$= 10\left(1 - e^{-1}\right)$$

$$= 6.32\ V$$

In our experiment,

When $V_c = 6.32\,V$,

we found $\Delta t = 1.08$ msec

Therefore, experimental time constant, $\tau = 1.08$ msec

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

$$= 1.82\%$$

According to theory,

when, $t = 5\tau$

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

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

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

That means, a capaciton is will fully change 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 10 τ time.

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

$= 10 \times (1.1 \text{ msec})$

$= 11 \text{ msec}$

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

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

$= 90.91 \text{ Hz}$

Graph:

Simulation Attached.

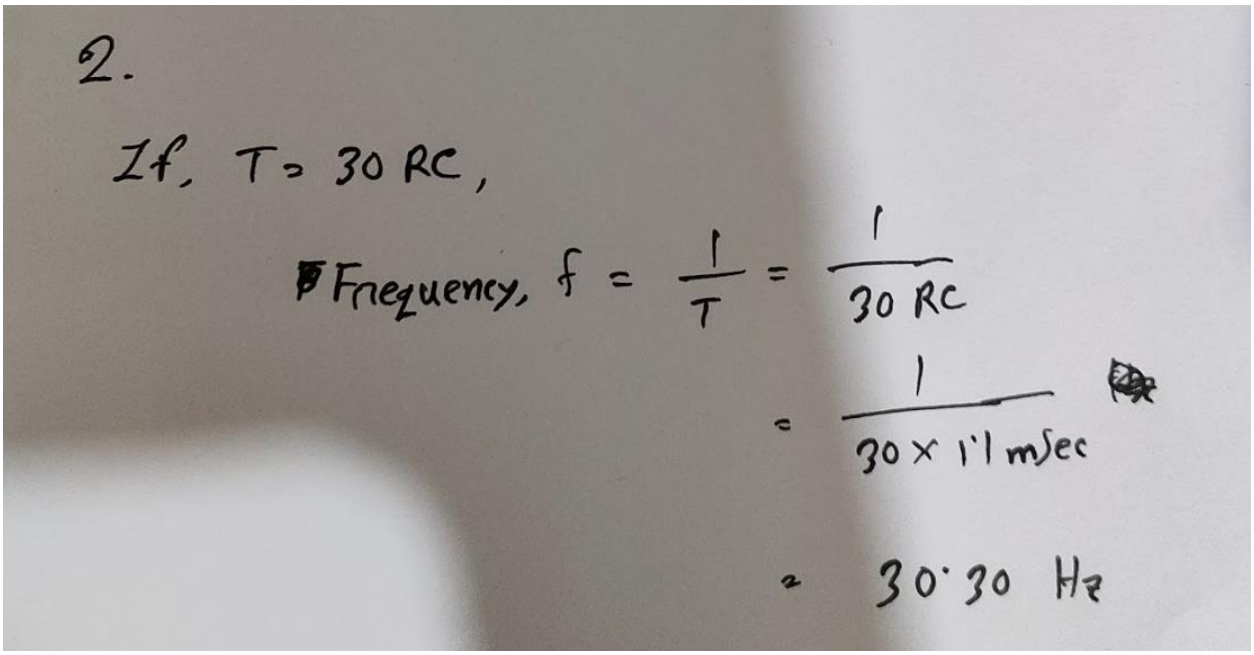
Result Analysis:

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

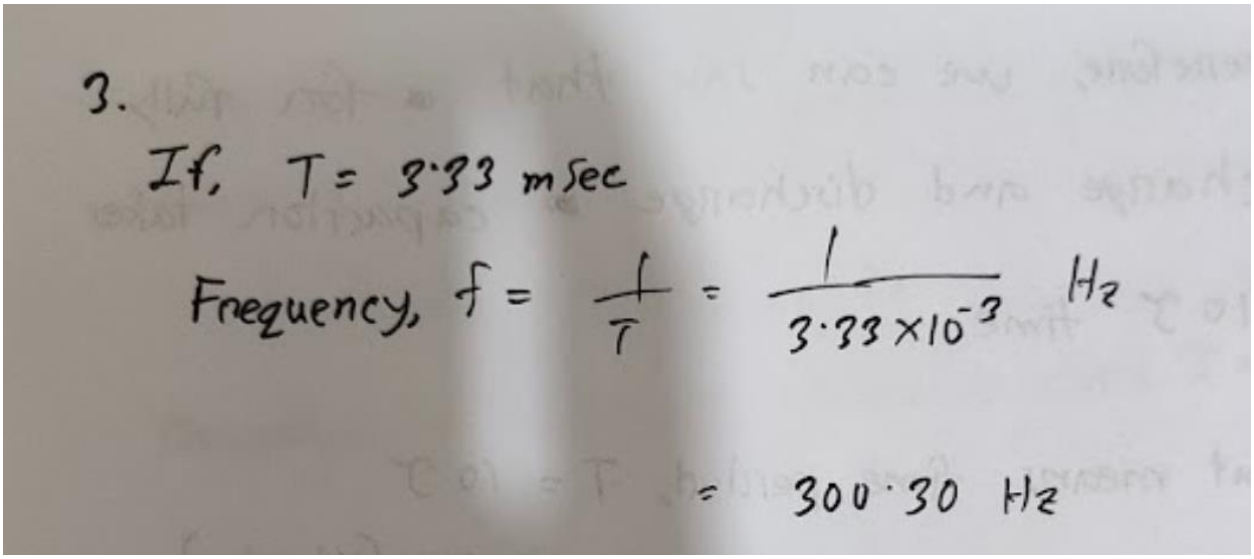
Questions and Answers:

01. Already showed in Data Table Section.

02.,,



03.



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 remaining 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 properly learn the usage of Oscilloscope. And completed the experiment in time.

Attachment:

01. Graph using Multisim.

02. Simulation using Multisim.