CHITTAGONG UNIVERSITY OF ENGINEERING AND TECHNOLOGY
DEPARTMENT OF ELECTRONICS & TELECOMMUNICATION ENGINEERING
CHITTAGONG-4349, BANGLADESH.

Course No. EEE-182

Course Title: Basic Electrical Engineering Sessional

Experiment No. 10

STUDY OF TRANSIENT BEHAVIOUR OF RC CIRCUIT

PRELAB WORK:

- **Read this laboratory manual carefully before coming to the laboratory class, so that you know what is required.**
- Try to **follow** the lecture notes of **EEE 111.**
- **DONOT** copy others blindly!!!
- **Submit your lab report before the roll call.**

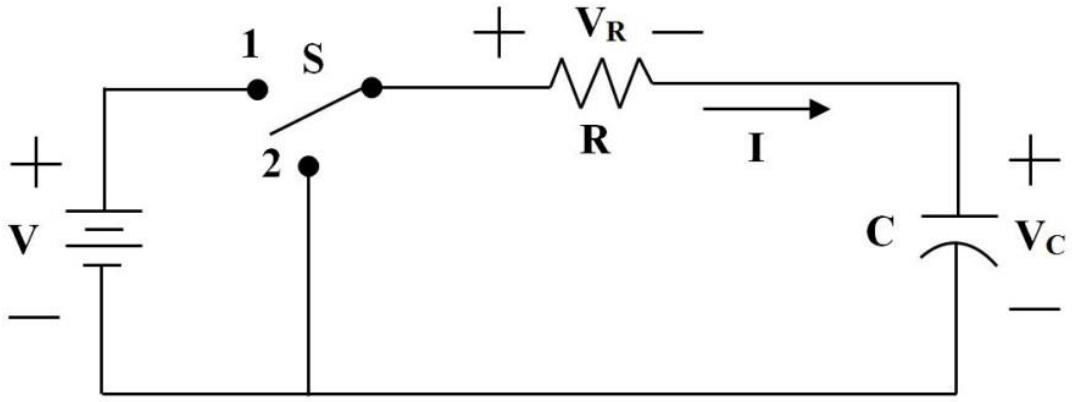
OBJECTIVE:

The objective of this experiment is to study Transient Response of RC circuit with step Input. In this experiment we shall apply a square wave input to an RC circuit separately and observe the respective wave-shapes and determine the time constants.

THEORY:

The transient response is the temporary response that results from a switching operation and disappears with time. The steady state response is that which exists after a long time following any switching operation.

Let us consider an RC circuit shown in figure.



Charging Phase:

When the switch is connected to position 1, applying KVL we can write –

$$V = Ri + \frac{1}{C}\int idt \text{ ----------(1)}$$

If the capacitor is initially uncharged, the solution of equation (1) is –

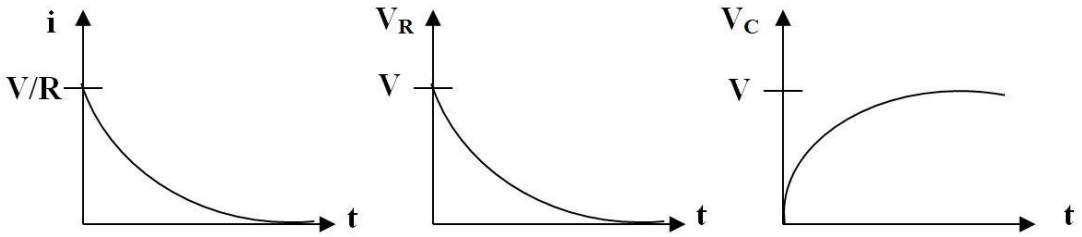
$$i = \frac{V}{R}e^{-\frac{t}{\tau}} \text{ ----------(2)}$$

Therefore the voltage across the resistor and capacitor are given by

$$V_R = Ve^{-\frac{t}{\tau}} \text{ ----------(3)}$$

$$V_C = V - V_R = V(1 - e^{-\frac{t}{\tau}}) \text{ ------(4)}$$

Where τ = RC and is called the time constant of the circuit. Equation (2), (3) & (4) are plotted below:



It is seen from the curves that the voltage across the capacitor raises from zero to V volts exponentially and the charging current is maximum at the start i.e. when **C** is uncharged, then it decreases exponentially and finally ceases to zero when the capacitor voltage becomes **V**.

Discharging Phase:

When the switch is connected to position 2, applying KVL we can write –

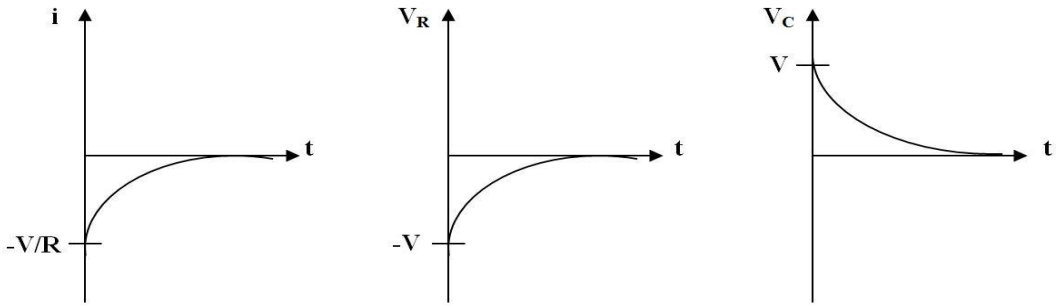
$$0 = Ri + \frac{1}{C}\int idt \text{ ----------(5)}$$

Therefore the voltage across the resistor and capacitor are given by –

$$V_R = -Ve^{-\frac{t}{\tau}} \text{ ----------(7)}$$

$$V_C = Ve^{-\frac{t}{\tau}} \text{ ----------(8)}$$

Equation (6), (7) & (8) are plotted below:



It is seen from the curves that the voltage across the capacitor falls from V to zero volts exponentially. The charging current is maximum at the start i.e. when the switch is just thrown to position 2, then it decreases exponentially and finally ceases to zero when the capacitor voltage becomes zero.

APPARATUS:

1. Resistance: 1KΩ.
2. Capacitance: 1μF.
3. Oscilloscope and Probes.
4. Signal Generator and Chords.
5. Wires.
6. Bread board.

CIRCUIT DIAGRAM:

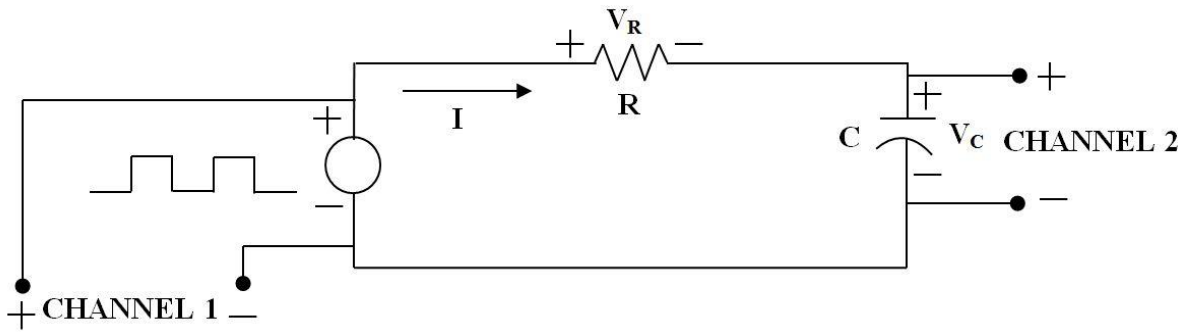


Figure 1

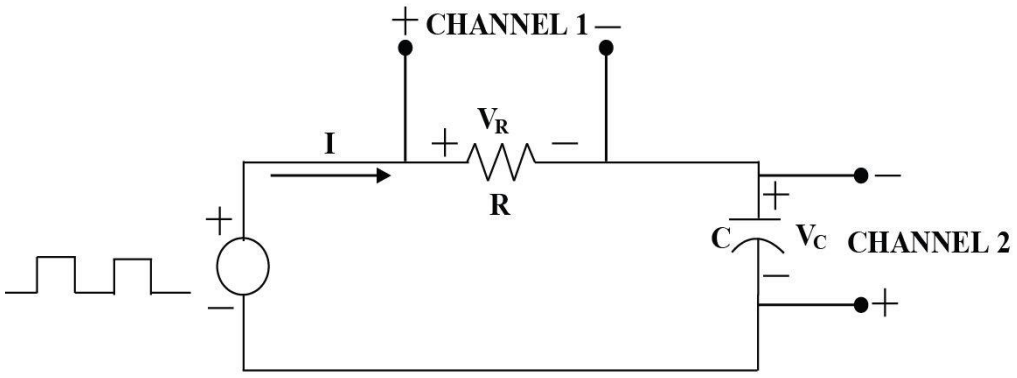


Figure 2

PROCEDURE:

1. Setup the circuit as shown in Fig. 1.
2. Apply 100Hz square wave from signal generator.
3. Observe the wave shapes at Channel-1 and Channle-2 in DUAL mode and draw them.
4. Find the time constant from the wave shape of V_C.
5. Disconnect Channel-1 and Channle-2 and reconnect them as shown in Fig. 2.
6. Observe the wave shapes at Channel-1 and Channle-2 (INV.) in DUAL mode and draw them.

REPORT:

1. Take snaps of the waves you see in the oscilloscope with your cell phone or a camera.
2. Print those images in gray scale and attach them in your report..

HOME TASK:

Answer the following questions-

1. Define capacitor and capacitance. Write the features of a capacitor. What does capacitance measure?
2. Deduce voltage-current relationship for a capacitor. Why the voltage across a capacitor cannot change instantaneously.
3. Define time constant for an RC circuit. What is the significance of time constant? How time constant can be determined?
4. Describe the charging and discharging phase of an RC circuit both qualitatively and quantitatively.