RC Charging Circuit

Introduction :

All Electrical or Electronic circuits or systems suffer from some form of "time-delay" between its input and output, when a signal or voltage, either continuous, (DC) or alternating (AC) is firstly applied to it. This delay is generally known as the **time delay** or **Time Constant** of the circuit and it is the time response of the circuit when a step voltage or signal is firstly applied.

The resultant time constant of any Electronic Circuit or system will mainly depend upon the reactive components either capacitive or inductive connected to it and is a measurement of the response time with units of, **Tau –** τ

When an increasing DC voltage is applied to a discharged Capacitor, the capacitor draws a charging current and "charges up", and when the voltage is reduced, the capacitor discharges in the opposite direction. Because capacitors are able to store electrical energy they act like small batteries and can store or release the energy as required.

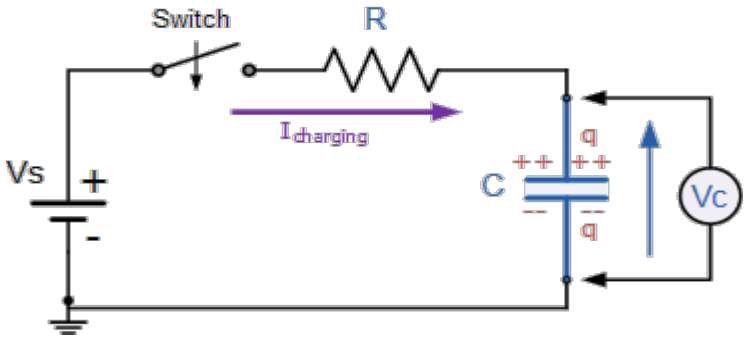
The charge on the plates of the capacitor is given as: Q = CV. This charging (storage) and discharging (release) of a capacitors energy is never instant but takes a certain amount of time to occur with the time taken for the capacitor to charge or discharge to within a certain percentage of its maximum supply value being known as its **Time Constant** (τ).

If a resistor is connected in series with the capacitor forming an RC circuit, the capacitor will charge up gradually through the resistor until the voltage across the capacitor reaches that of the supply voltage. The time called the transient response, required for this to occur is equivalent to about **5 time constants** or 5T.

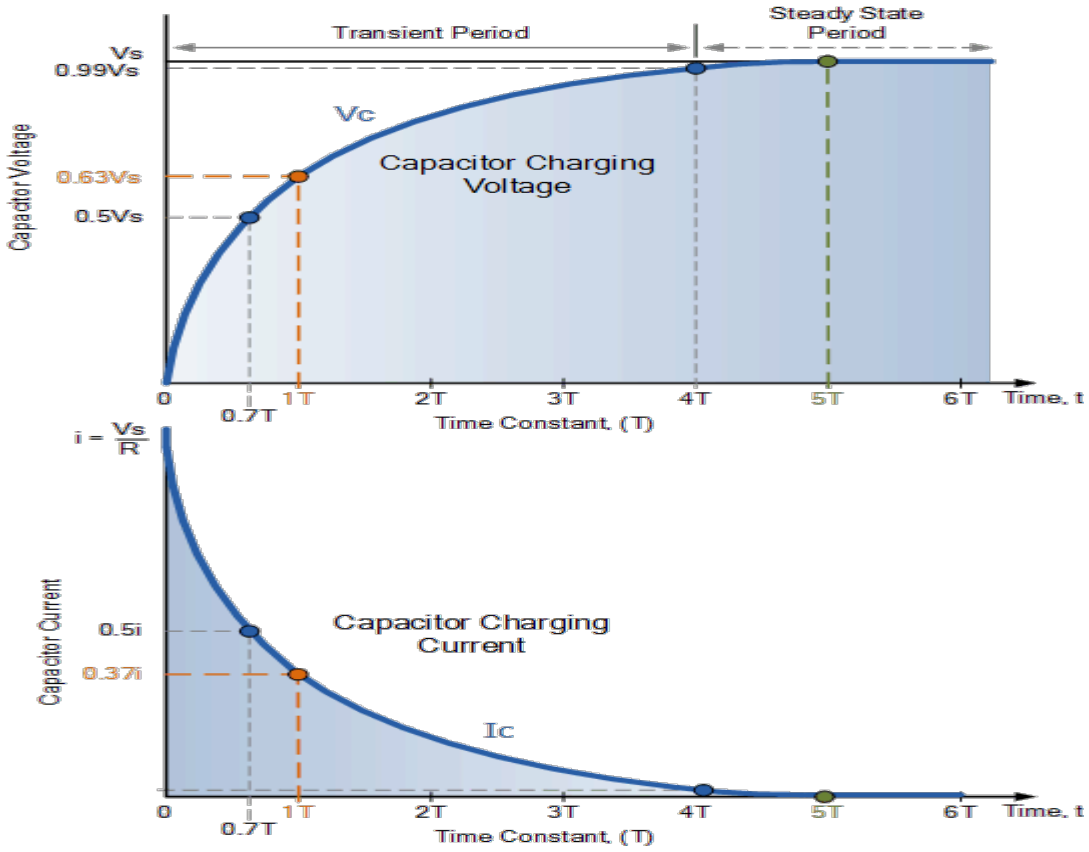
This transient response time T, is measured in terms of τ = R x C, in seconds, where R is the value of the resistor in ohms and C is the value of the capacitor in Farads. This then forms the basis of an RC charging circuit were 5T can also be thought of as "5 x RC".

RC Charging Circuit :

The figure below shows a capacitor, (C) in series with a resistor, (R) forming a **RC Charging Circuit** connected across a DC battery supply (Vs) via a mechanical switch. When the switch is closed, the capacitor will gradually charge up through the resistor until the voltage across it reaches the supply voltage of the battery. The manner in which the capacitor charges up is also shown below.

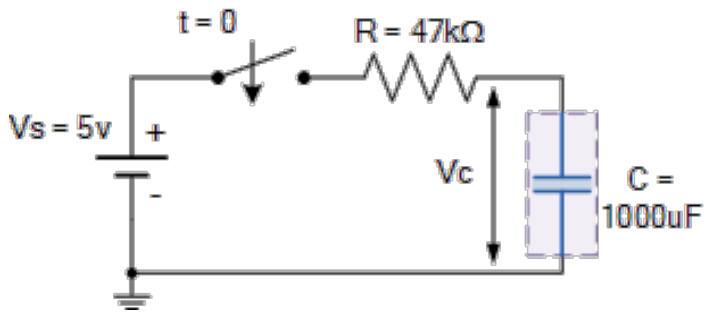


RC Charging Circuit Curves:



Example 1 :

Calculate the RC time constant, τ of the following circuit.



The time constant, τ is found using the formula T = R x C in seconds.

Therefore the time constant τ is given as:
T = R x C = 47k x 1000uF = 47 Secs