YILDIRIM BEYAZIT UNIVERSITY
CENG 205 LABORATORY
EXPERIMENT 5

Objective

Analyze the natural response of RC circuit.

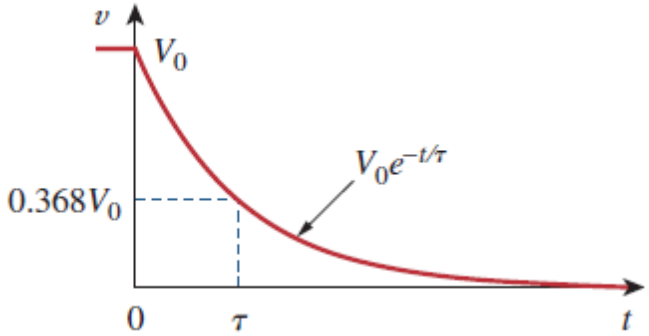
Theory

The natural response of a circuit refers to the behavior (in terms of voltages and currents) of the circuit itself, with no external sources of excitation.

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

The time constant of a circuit is the time required for the response to decay to a factor of 1/e or 36.8 percent of its initial value.

$$\tau = RC$$



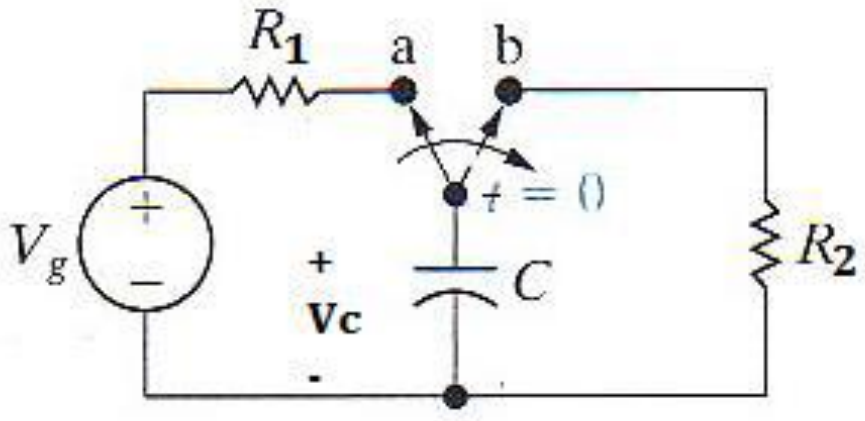
The voltage *v(t)* is less than 1 percent of V_o after 5τ (five time constants). Thus, it is customary to assume that the capacitor is fully discharged (or charged) after five time constants. In other words, it takes 5τ for the circuit to reach its final state or steady state when no changes take place with time.

Pre-work

1) Study the natural response of RC circuits. Write down your studies.
2) Calculate desired values given in Question part by hand.

Questions:

1) In the figure below, an RC circuit is given. In this circuit, the switch is at position 'a' for a long time. Then, at t=0, it is switched to position 'b'.
$V_g = 12\ V, C = 1000\ \mu F,\ and\ R_1 = R_2 = 4.7\ k\Omega$ for this circuit. Find the time constant and obtain the capacitor voltage at τ, 2 τ, 3 τ, 4 τ, and 5 τ. Plot the characteristic of the natural response of an RC circuit using these values.
2) Repeat part 1) for $V_g = 12\ V, C = 1000\ \mu F,\ and\ R_1 = R_2 = 10\ k\Omega$
3) Repeat part 1) for $V_g = 12\ V, C = 10\ \mu F,\ and\ R_1 = R_2 = 2.2\ k\Omega$
4) Repeat part 1) for $V_g = 12\ V, C = 10\ \mu F,\ and\ R_1 = R_2 = 1\ M\Omega$



Laboratory Exercises:

1. Set up the circuit that shown in figure above. Use $V_g = 12\ V, C = 1000\ \mu F,$ $and\ R_1 = R_2 = 4.7\ k\Omega$. The switch is at position 'a' until the capacitor voltage V_C is reached the steady-state* value. At t=0, switch is switched to position 'b'.
2. Measure the capacitor voltage V_C at τ, 2τ, 3τ, 4τ, and 5τ by using multimeter. Is there any difference between the measurements and calculations?
3. Repeat part 1) for $V_g = 12\ V, C = 1000\ \mu F,\ and\ R_1 = R_2 = 10\ k\Omega$
4. Repeat part 1) for $V_g = 12\ V, C = 10\ \mu F,\ and\ R_1 = R_2 = 2.2\ k\Omega$
5. Repeat part 1) for $V_g = 12\ V, C = 10\ \mu F,\ and\ R_1 = R_2 = 1\ M\Omega$

* the capacitor is fully charged