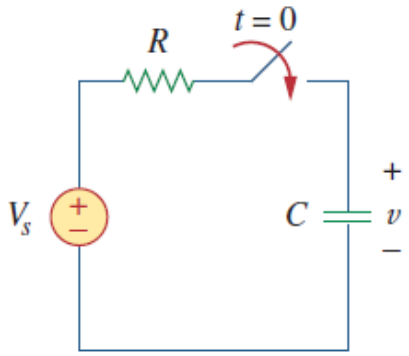
YILDIRIM BEYAZIT UNIVERSITY
CENG 205 LABORATORY
EXPERIMENT 6

Objective

To analyze the step response of RC circuit.

Theory

The step response of a circuit is its behavior when the excitation is the step function, which may be a voltage or a current source.



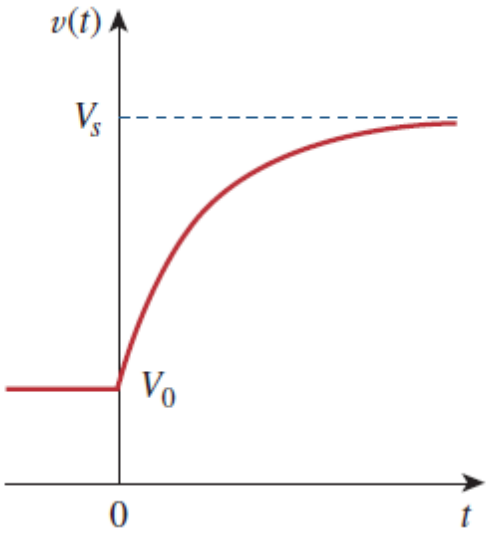
The step response is the response of the circuit due to a sudden application of a dc voltage or current source.

We assume there is an initial voltage V_o on the capacitor.

$$v(t) = \begin{cases} Vo, & t < 0 \\ Vs + (Vo - Vs)e^{-t/\tau}, & t \geq 0 \end{cases}$$

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.

$$\tau = RC$$



Pre-work

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

Questions:

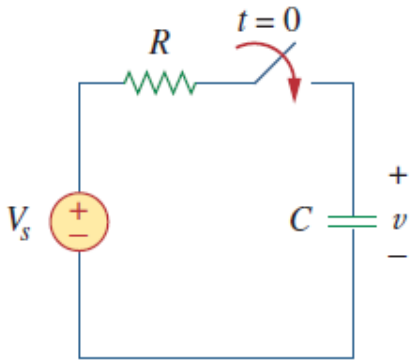
1) In the figure below, an RC circuit is given. In this circuit, the switch has been open for a long time. At t=0, the switch is closed. $V_s = 10\ V, C = 470\ \mu F, and\ R = 10\ k\Omega$ for this circuit. Find the time constant and obtain the capacitor voltage v at τ,2 τ,3τ, 4τ, and 5τ. Plot the characteristic of the step response of an RC circuit using these values.

2) Repeat part 1) for $V_s = 10\ V, C = 1000\ \mu F, and\ R = 4.7\ k\Omega$

3) Repeat part 1) for $V_s = 10\ V, C = 100\ \mu F, and\ R = 22\ k\Omega$

4) Repeat part 1) for $V_s = 10\ V, C = 2\ \mu F, and\ R = 1\ M\Omega$

INITIAL VOLTAGE ON THE CAPACITOR SHOULD BE ZERO!



Laboratory Exercises:

1) Construct the circuit that shown in figure above. Use$V_s = 10\ V, C = 470\ \mu F, and\ R = 10\ k\Omega$. The switch has been open for a long time. At t=0, the switch is closed.

2) Measure the capacitor voltage v at τ,2 τ,3τ, 4τ, and 5τ by using multimeter. Is there any difference between the measurements and calculations?

3) Repeat part 1) for $V_s = 10\ V, C = 1000\ \mu F, and\ R = 4.7\ k\Omega$

4) Repeat part 1) for $V_s = 10\ V, C = 100\ \mu F, and\ R = 22\ k\Omega$

5) Repeat part 1) for $V_s = 10\ V, C = 2\ \mu F, and\ R = 1\ M\Omega$

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