

Exercise week #7

Time-dependent RC circuits

Problem 1 (in class):

Consider the electrical circuit shown in Fig. 1 with the following parameters:

$R = 33.3 \, \Omega$, $C = 150 \, \mu\text{F}$, $U_1 = +200 \, \text{V}$, $U_2 = -200 \, \text{V}$. U_1 and U_2 are constant over time.

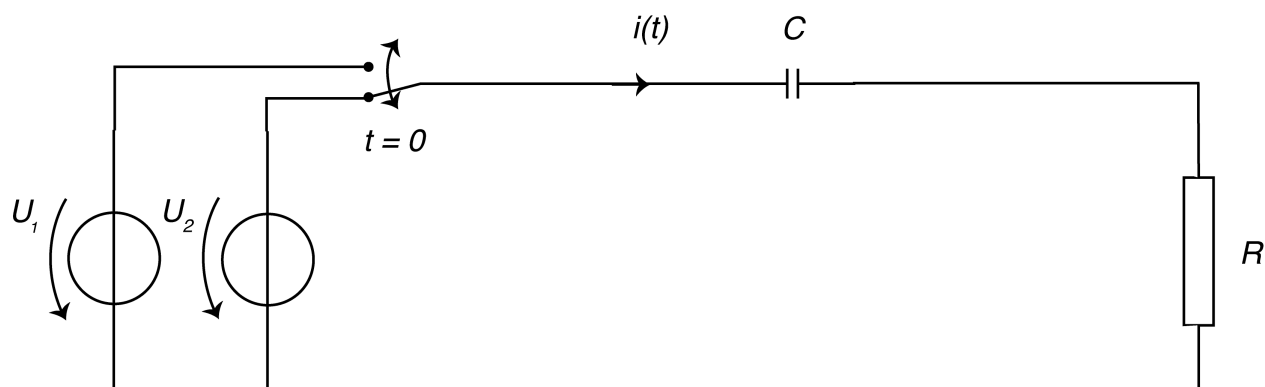


Figure 1: Electrical circuit.

At times $t < 0$, the switch is connected to voltage source U_2 , the system is in steady-state and the current flowing through the circuit is $i(t < 0) = 0$.

At time $t = 0$, the switch is toggled to connect voltage source U_1 with the circuit, and then continues toggling between sources U_1 and U_2 every 3 ms. The total period for toggling back and forth between the two voltage sources is thus $T = 6 \, \text{ms}$.

- Determine the current $i(t)$ and the voltage drop across the capacitor $u_C(t)$ as a function of time until $t = T$. Compute their values at times $t = 0$, $t = \frac{T}{2}$, $t = T$.
- Plot $i(t)$ and $u_C(t)$ as a function of time t until $t = T$ using a software of your choice. What can you observe?

Problem 2 (self-study):

Consider the same scenario as in problem 1, but now with $T = 50 \, \text{ms}$. The switch now toggles between sources U_1 and U_2 every 25 ms.

- Before performing the calculation, explain what you expect to happen?

- b) Determine the current $i(t)$ and the voltage drop across the capacitor $u_C(t)$ as a function of time until $t = T$. Compute their values at times $t = 0$, $t = \frac{T}{2}$, $t = T$.
- c) Plot $i(t)$ and $u_C(t)$ as a function of time t until $t = T$ using a software of your choice. What can you observe?