

**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.

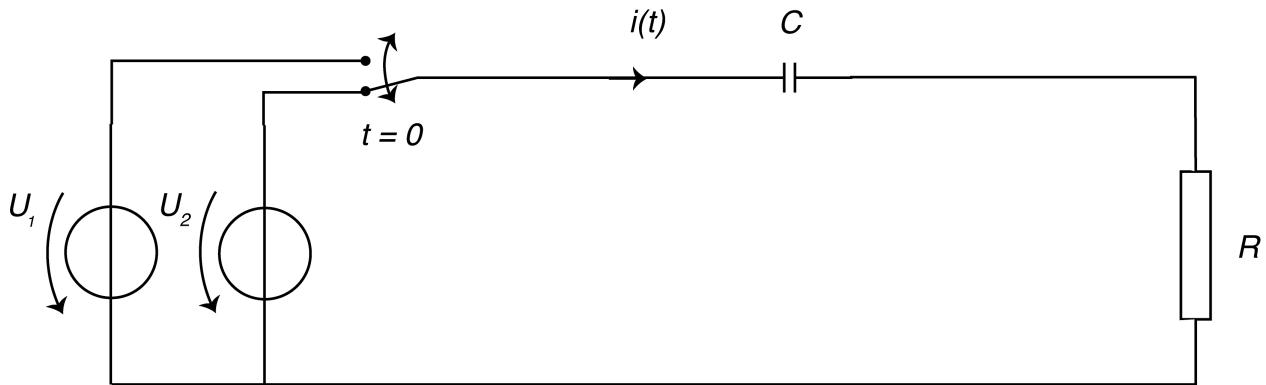


Figure 1: Electrical circuit.

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?