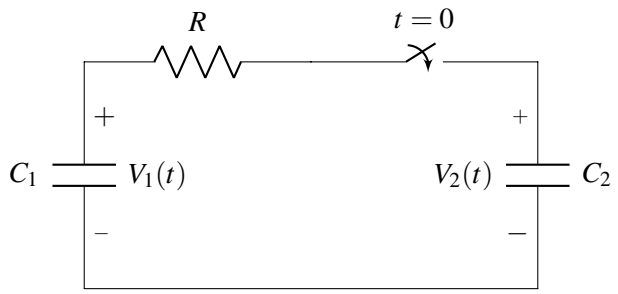
EECS 16B Designing Information Devices and Systems II
Fall 2018 Elad Alon and Miki Lustig

Discussion 2B

1. Two capacitors



(a) Using nodal analysis, find the differential equation describing $V_2(t)$ after the switch closes ($t \geq 0$).

(b) Assuming $V_1(0) = 10\text{V}$ and $V_2(0) = 5\text{V}$, find the solution to the differential equation found in part (a). Use component values $C_1 = 1\text{fF}$, $C_2 = 4\text{fF}$, and $R = 10\text{k}\Omega$.

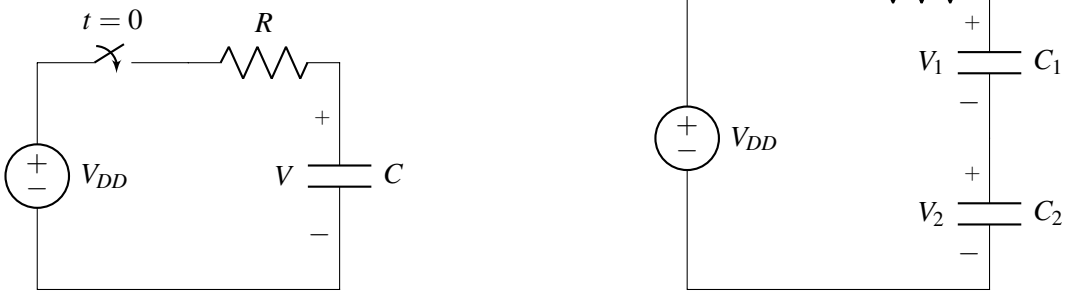
(c) How does $V_2(t = \infty)$ compare with what we expect from 16A (charge sharing)?

(d) Calculate the energy stored in C_1 and C_2 versus time.

(e) Find the difference in total energy stored in the capacitors at $t = \infty$ and $t = 0$.

(f) Calculate the energy dissipated by the resistor. Compare it to the difference in the total energy stored in the capacitors at $t = 0$ and $t = \infty$.

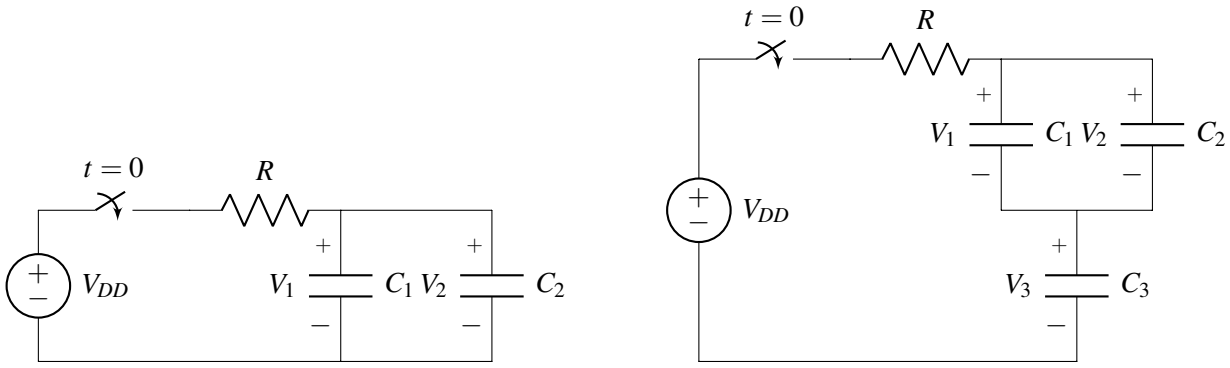
2. RC Circuit Variants



Circuit A on left, circuit B on right

(a) Using nodal analysis, find and solve the differential equation describing V after the switch closes ($t \geq 0$) in circuit A. Assume the capacitor is initially discharged ($V(t \leq 0) = 0\text{V}$).

(b) Using nodal analysis, find and solve the differential equation describing $V_1 + V_2$ (the total voltage across the capacitors) after the switch closes ($t \geq 0$) in circuit B. Assume both capacitors are initially discharged ($V_1(t \leq 0) = V_2(t \leq 0) = 0$).



Circuit C on left, circuit D on right

(c) Using nodal analysis, find and solve the differential equation describing V_1 (the total voltage across the capacitors) after the switch closes ($t \geq 0$) in circuit C. Assume both capacitors are initially discharged ($V_1(t \leq 0) = V_2(t \leq 0) = 0$).

(d) Using nodal analysis, find and solve the differential equation describing $V_1 + V_3$ (the total voltage across the capacitors) after the switch closes ($t \geq 0$) in circuit D. Assume all capacitors are initially discharged ($V_1(t \leq 0) = V_2(t \leq 0) = V_3(t \leq 0) = 0$).

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