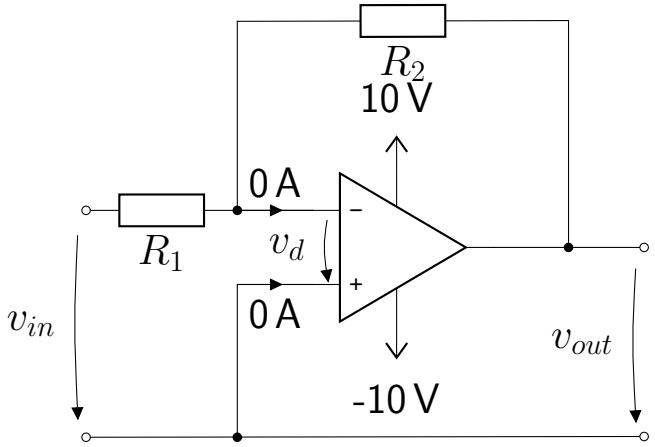
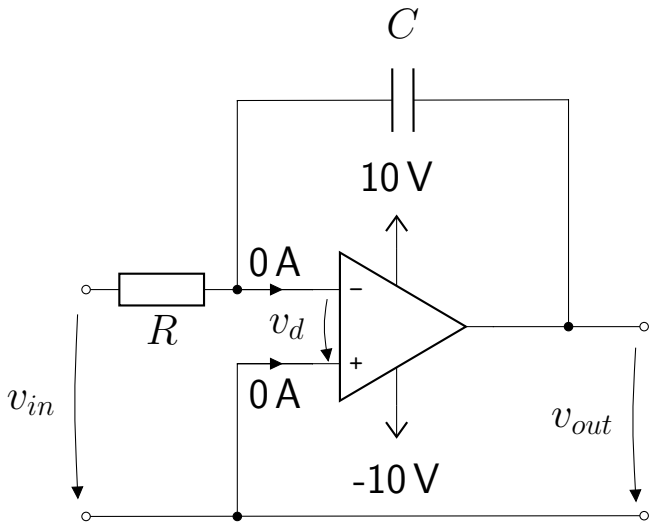
Seminars - 3nd week

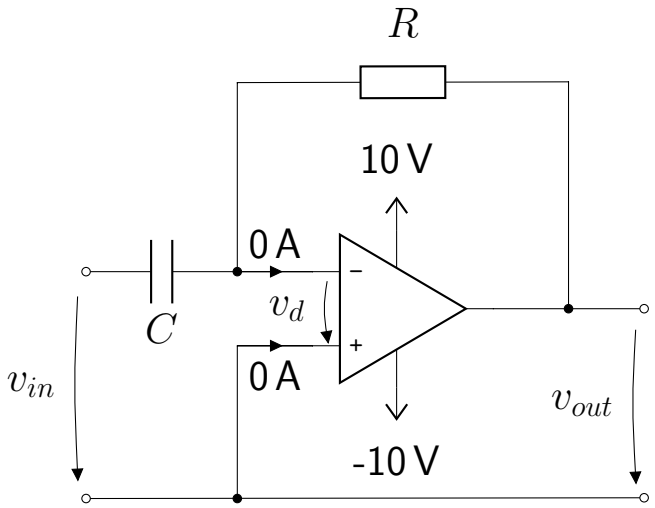
1. The kettle has an input power of 1000 W. To heat up 1 liter of water from 20 °C to 100 °C lasts for 7 minutes. What is kettle energy efficiency?
2. DC current 1 mA flow in the capacitor with capacitance 100 nF.
   a) Compute the charge stored in the capacitor at $t = 1$ ms.
   b) Compute the voltage across capacitor's terminals at $t = 1$ ms.
   c) Determine the energy stored in the capacitor at $t = 1$ ms.
   d) Draw waveforms of charge, voltage and stored energy for DC current source, as well as for triangular, rectangular and sinusoidal waveforms of source current).
3. Find voltage across capacitor with capacitance 45 µF, if it stores energy 400 J.
4. The inductor with inductance $L = 2$ H is connected to DC voltage source $V = 12$ V. The initial current was zero.
   a) Compute the current in the inductor at $t = 2$ s.
   b) Determine the energy stored in the inductor at $t = 2$ s.
   c) Is possible just simply dicsonnect inductor from the voltage source?
5. The resistive load is connected to the MOSFET switch with wire which has inductance $L = 50$ µH. The current falls from the value $I = 10$ A to zero within time interval of $t = 1$ µs. Calculate voltage on the MOSFET transistor.
6. The circuit in the figure below contains an ideal operational amplifier. It can be replaced with voltage-controlled voltage source. It has two inputs, v_+ and v_-, input resistance is infinite, and the gain $A \to \infty$, so, for finite output voltage v_{out} the input differential voltage $v_d = V_+ - v_- \to 0$.
   Find general relation between v_{in} and v_{out}. Find v_{out}, if $R_1 = 100$ kΩ, $R_2 = 10$ kΩ and $v_{in} = 0.1$ V.



7. The circuit in the figure below contains an ideal operational amplifier.
   a) Find general relation between v_{in} and v_{out}.
   b) Find values of R and C, if the input voltage is rectangular waveform with magnitude ±1 V and period 2 µs, the output voltage should be triangular waveform with amplitude of 5 V.



8. The circuit in the figure below contains an ideal operational amplifier.
   a) Find general relation between v_{in} and v_{out}.
   b) Find values of R and C, if the input voltage is triangular waveform with magnitude ±1 V and period 2 µs, the output voltage should have amplitude of 5 V.



9. In the network in the figure below find

   a) Currents I_1, I_2 and I_3.
   b) All voltages, and resistance R_1, if R_2 = 600 Ω, R_3 = 1 kΩ, R_4 = 6 kΩ, R_5 = 1 kΩ.