Principles of Electronics Design summer exam 27.6.2015

1. Explain shortly question shown below. Pictures can be used to clarify the answers.

   a) What are the input and output resistances of a current amplifier (I_{out}/I_{in})?(2p)

   b) What are total impedances of parallel connected capacitance C = 1 nF and resistance R = 1000 Ω at the frequencies 0 Hz and ∞ Hz?(2p)

   c) At the input of an amplifier has the signal of 10mV ·sin(2πft) and you want to get the signal of 150mV·cos(2πft) at the output. What should be the gain?(2p)

2. Derive the output voltages of operational amplifiers (v_o) shown in figure 1 a) ja b) (4p). Draw the output voltage of the operational amplifier (V_{outC}) shown in figure 1 c) as a function of time when the signal at the input V_{in} = 0,5*sin($2\cdot\pi\cdot 1kHz\cdot t$).(2p) Operational amplifiers are ideal.

3. a) Draw the output voltage V_{out} of the circuit in figure 2 using the small signal model of the diode. (3p)

   b) Draw the schematic of a diode-based half-wave rectifier and explain how the circuit operates. (3p)

4. Design a common emitter amplifier inside the empty box in figure 3. The input signal is $V_s(t)$ and the output signal *is* V_o. The gain should be 10 as accurately as possible. The amplitude of $V_s(t)$ is about 10 mV, the frequency is > 0 Hz and its DC component is 0 V. You may use a +20 V DC power supply, resistors, capacitors, diodes and NPN-type BJTs (bipolar junction transistors). (6p)

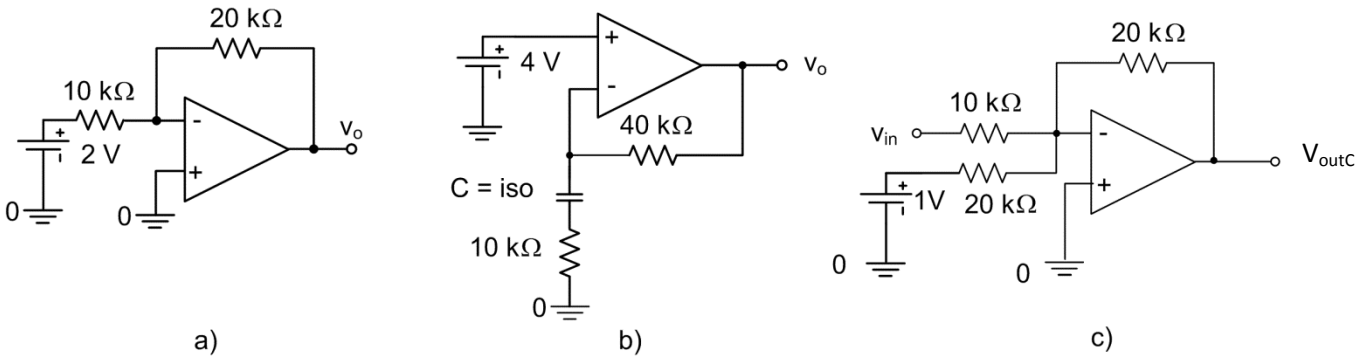

Figure 1.

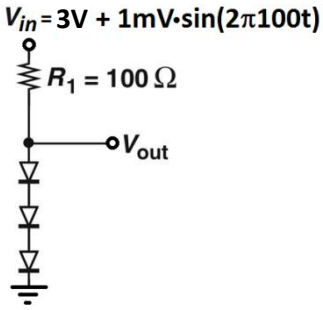

Figure 2.

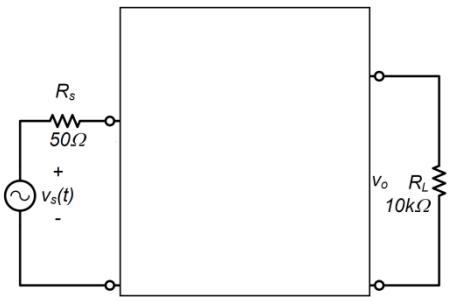

Figure 3.