University of Oulu
Department of Electrical and Information Engineering, Electronics Laboratory

Principles of Electronics Design 521431A
Exam $04/13/2007$

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1. Assume that the operational amplifier shown in figure 1 is ideal and $R_1 = R_3 = 1{,}5\,\text{k}\Omega$, $R_2 = 30\,\text{k}\Omega$, $C_1 = 106\,\text{nF}$ ja $C_2 = 0{,}53\,\text{nF}$.

   (a) What is the lower cutoff frequency?

   (b) What is the higher cutoff frequency?

   (c) What is the passband gain (in decibels)?

   (d) Draw Bode plot.

   (e) What is the resistive part of the input impedance at midband?

   (f) What is the output impedance?

   (g) If the frequency of the input signal is $100\,\text{Hz}$ and the amplitude $1\,\text{V}$ what is the amplitude of the output signal?
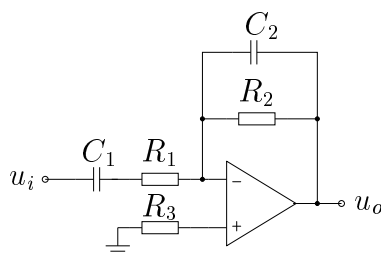
PSfrag replacements

Figure 1: Figure for question 1.

2. For the circuit shown in figure 2 $\beta = 100$, $R_L = 10\,\text{k}\Omega$, $R_{src} = 2\,\text{k}\Omega$ and capacitors C_1 and C_2 are large coupling capasitors. It is required that $I_E = 1\,\text{mA}$, $U_C = 10\,\text{V}$ and gain is between $-10\ldots -20\,\text{V}/\text{V}$. Find values for R_1, R_2, R_C and R_E. Find the input and the output impedance of the amplifier. How is it possible to boost the gain of the amplifier without changing the DC operating point, source impedance or load?
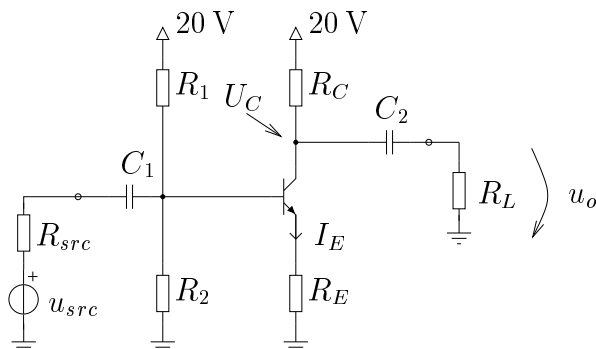
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Figure 2: Figure for question 2.

3. Explain the following concepts and principles.

   (a) Properties of a diode and its basic operation. (2p)

   (b) The load line analysis of a circuit consisting of a voltage source, a resistor and a forward biased diode (all components connected in series). (2p)

   (c) The ideal diode model and its use in the analysis of a circuit consisting of several voltage sources, resistors and diodes. (2p)

4. AD converters. The basic idea of the AD conversion, different converter structures and their operation. (6p)