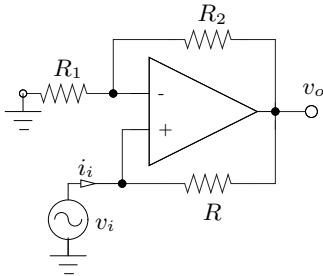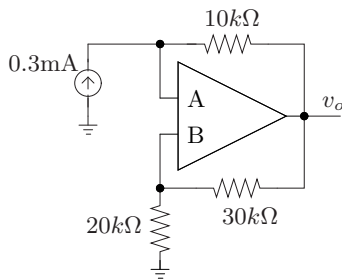# Introduction to Electrical Engineering - Howework 6
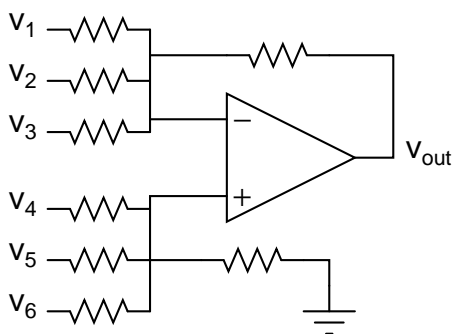
1. For the OP-AMP circuit shown, find the input resistance R_i of the amplifier ($R_i \triangleq \frac{V_i}{I_i}$).
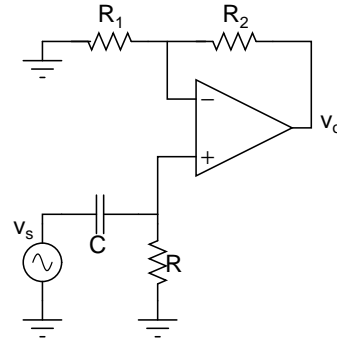

2. In the OP-AMP circuit shown, determine the signs to ensure negative feedback. Find v_o.

3. If all the resistances in the circuit shown are equal, find v_{out}.

4. Derive the transfer function v_o/v_s for the following circuit.

5. A signal $x(t) = \sin^2 5\pi t$ is sampled at the rate of (a) 5 Hz, and (b) 15 Hz. Sketch the magnitude spectrum of the sampled signal in both cases.

6. Consider the situation where stereo music is recorded and stored in digital form using two microphones defining two channels. Each channel is separately sampled with a sampling frequency of 44.1 kHz and each sample is quantized using 16 bits (two bytes). Find the storage required in bytes for one hour of music.

7. Derive the truth table for the circuit shown below. The output is F and the inputs are x, y and z.
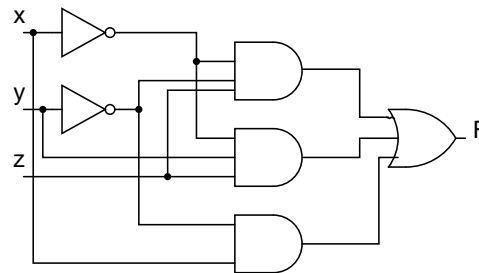
8. A majority function is generated in a combinational circuit when the output is equal to 1 if the input variables have more 1's than 0's. The output is 0 otherwise. Design a 3-input majority function using AND, OR and NOT gates.

9. Design a circuit with 3 inputs and 1 output using only $NAND$ gates. The output should

be 1 if the value of the binary input is less than 4. The output is logic 0 otherwise.

10. A half subtractor is a circuit that finds the difference between two 1-bit numbers. Derive the truth table for it and write the logical expressions for the difference and borrow output.

11. For five clock cycles, the inputs J and K in an edge triggered J-K flipflop are 11001 and 01010. What is the output?

12. Write the truth table for the digital circuit shown in figure.