CENG4480 Homework 1

Due: Oct. 18, 2020

Q1 (10%)

Given the circuit as shown in Figure 1, $R_1 = 2K\Omega$, $R_f = 5K\Omega$, $R_2 = 2K\Omega$, $R_3 = 18K\Omega$, $u_i = 1V$, please compute output voltage u_o.

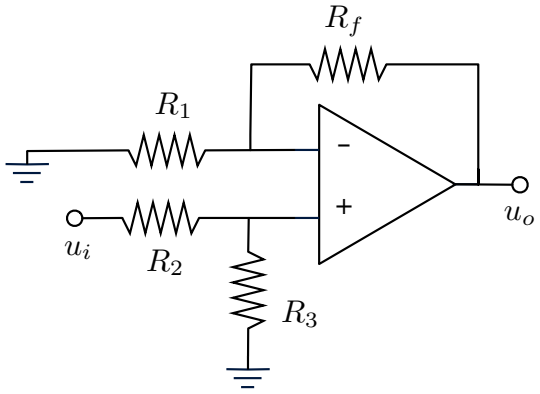

Figure 1: The circuit.

Q2 (10%)

Given a non-inverting amplifier as shown in Figure 2, $R_1 = 4R_2$ and $A_0 = 1000$.

1. Calculate the exact finite gain.
2. Determine the gain difference if the circuit is expected to have an ideal gain under $A_0 = \infty$.

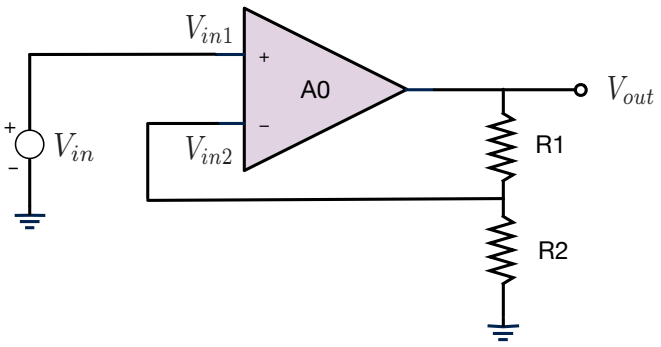

Figure 2: Non-inverting Amplifier.

Q3 (10%) Given the inverting amplifier as shown in Figure 3, its supply voltage is $\pm 15V$.

1. Compute and sketch transmission curve between u_i and u_o.
2. The input signal is given to be $u_i = 5sin\omega t(V)$, sketch the waveform of u_o.

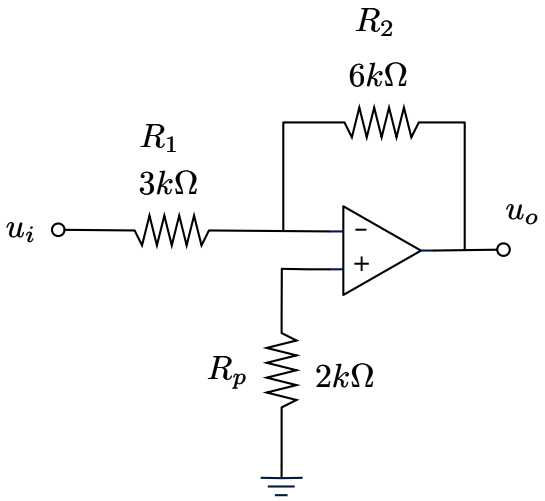

Figure 3: Inverting Amplifier.

Q4 (10%)

As shown in Figure 4, $R_f = 2R_1$, $u_i = -2V$, $R_2 = 5K\Omega$, $R_3 = 2K\Omega$, please compute the output voltage u_o.

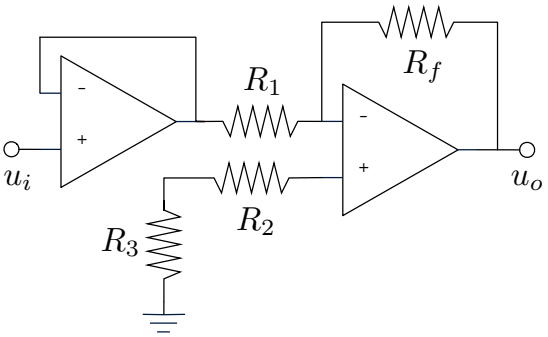

Figure 4: The circuit.

Q5 (20%) A differential integrator is shown in Figure 5.

1. Determine the relationship among u_{i1}, u_{i2} and u_o.
2. If we want $u_o = 0V$ when $u_{i2} = 1V$, determine u_{i1}
3. When $t = 0$, $u_{i2} = 1V$, $u_{i1} = 0V$, $u_o = 0V$, determine u_o when $t = 10s$.

Q6 (10%) Given a low-pass filter as shown in Figure 6.

1. If $R_1 = 10K\Omega$, $R_2 = 200K\Omega$, determine low-frequency gain $A_u(dB)$;
2. If cutoff frequency $f_c = 6Hz$, determine C value.

Q7 (20%) Let us consider the Schmitt Trigger shown in Figure 7

1. Due to the manufacturing defects, a parasitic resister R_3 occurs between the output node and ground, calculate the reference voltages.

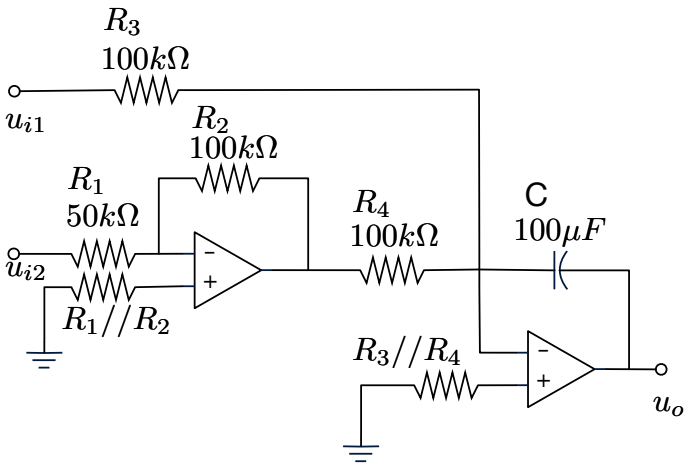

Figure 5: A differential integrator.

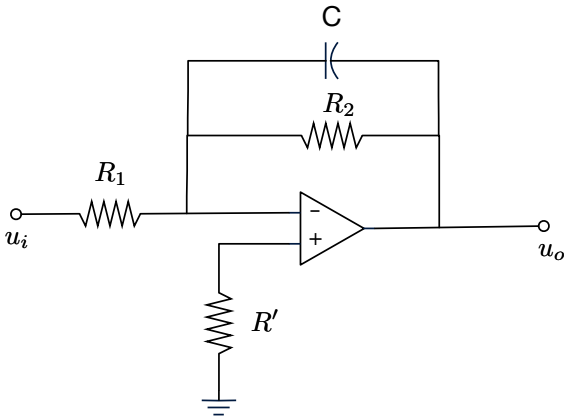

Figure 6: A low-pass filter.

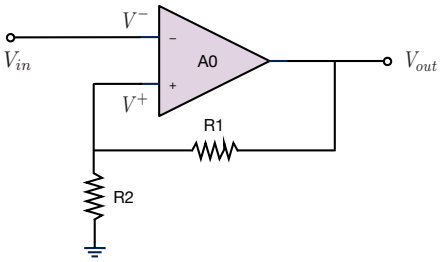

Figure 7: Schmitt Trigger.

2. If the parasitic device is a capacitor C, sketch v_{out} versus v_{in}. Label the key coordinates on the curve.

Q8 (10%) An ADC is used to sample an analog signal.

1. If the maximum frequency of the analog signal is $10kHz$, determine the minimum sampling frequency.
2. As shown in Figure 8, if the ADC is integrating ADC with 15 bits and clock frequency is $2MHz$, determine the maximum conversion frequency.

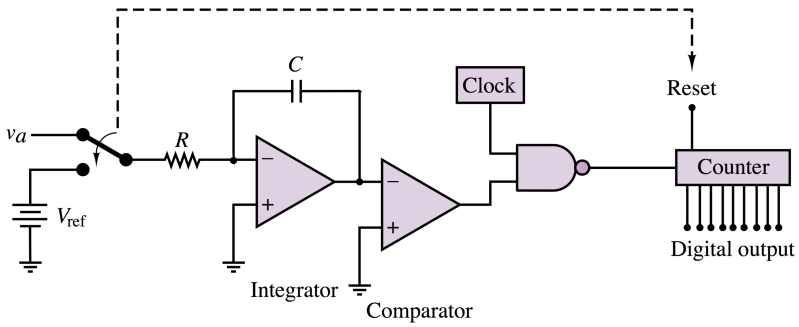

Figure 8: Integrating ADC.