Lab 6
The 741 Operational Amplifier

In this lab, you will design and build several operational amplifier circuits on the breadboard.

Use $-V_{cc} = -15\text{V}$ and $+V_{cc} = +15\text{V}$ for all circuits.

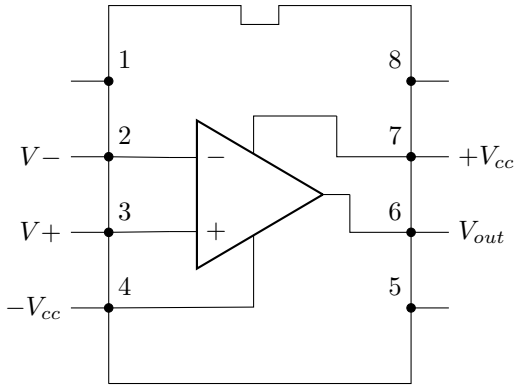

Figure 1: For this lab you don't need to connect pins 1, 5 or 8

Prelab

1. Given the circuit shown in Figure 2, assume that $V_{in} = 5\text{V}$. Calculate V_{out}.

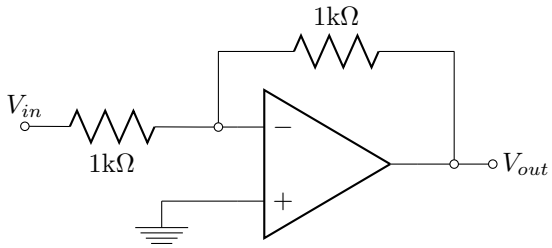

Figure 2:

2. For the circuit in Figure 3 (non-inverting op-amp), assume $V_{in} = 5\text{V}$. Calculate V_{out}.

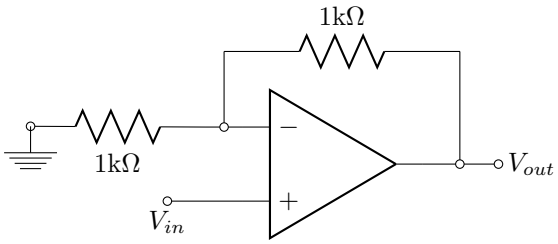

Figure 3:

3. For the above problems (1 and 2), what is the highest and lowest input voltages you could apply to each circuit before the op-amp would "rail" (saturate)?

4. Design an op-amp circuit with a total gain of 3.25.

5. Design an op-amp circuit with a total gain of -3.25.

6. Draw what will be displayed on the O-scope for an input $Vs = 5V_p$ at 1KHz signal for point 1 (of prelab). Be sure to draw both the input and output waveform.

7. Draw what will be displayed on the O-scope for an input $Vs = 5V_p$ 1KHz signal for point 2 (of prelab). Be sure to draw both the input and output waveform.

8. How would you design a circuit to provide a gain of 1/8 to an input signal without using an op-amp? (Hint: it was given in class lecture and only uses resistors).

Lab

1. Build the circuit shown in Figure 2 (inverting op-amp) on the protoboard. **After your wiring has been checked by a lab assistant**, apply a 5V dc input voltage. Measure and record V_{out}. Is this the value you expected to see? How close was your answer to your calculated result?

2. Apply an input signal of $5V_p$ at 1 KHz to the circuit. **Have your connection check by a lab assistant**. Measure the input signal with channel 1 and the output with channel 2. Record your results. Is the output signal the same as the input? Why or why not? Do a comparison of values (i.e., max. voltage, min. voltage, etc.

3. Build the circuit shown in Figure 3. Apply a 5V dc input voltage. Measure and record V_{out}. Is this the value you expected to get? How close is it to your expected value? Use channel 1 for input and channel 2 for output.

4. Apply a $5V_p$ input 1 KHz to the input of the noninvertint amplifier above. Use channel 1 for input and channel 2 for output. is the output the same as the input signal? Why or why not? Do a comparison of values.

5. Build the op-amp circuit you designed in the prelab with a total gain of 3.25. Apply a 5V dc input voltage and record V_{out}. Does this match the calculated results from the prelab? Why or why not?

6. Using the same circuit, now apply a 1 KHz $5V_p$ input signal. Use channel 1 for input and channel 2 for output. Record your result for V_{out}. Does the output match the input? Why or why not? What are the maximum and minimum voltages shown on the output channel of the O-scope? Why?

7. Build the op-amp circuit you designed in the prelab with a total gain of -3.25. Apply a 5V dc input signal and record V_{out}.

8. Now apply a 1 KHz $5V_p$ input signal. Use channel 1 for input and channel 2 for output. Record your results. Does the output match the input? Why or why not? What is the maximum and minimum voltages shown on the output channel of the O-scope? Why?

9. Build a circuit with an attenuation of 1/8, (refer to point 8 of the prelab). (Refer to your class notes for assistance if necessary). Apply a 5V dc input voltage and record results. Does the circuit output the expected value? Compare.

Extra Credit:

10. Design and build a cascaded op-amp circuit with a total gain of +1/8 (Refer to your class notes for assistance, if necessary). Calculate V_{out} for this circuit if you were to apply a 5V input. Apply a 5V input signal and record V_{out}. How close is your result to what you ideally would get?