Laboratory Assignment 3

EML 4930/5930 Mechatronics II

Purpose:
This lab is intended to acquaint you with the behavior of operational amplifiers.

(*** : In lab)

<u>Part 1: Op Amp</u>

1.1) Set up a circuit with both positive and negative inputs tied to ground. Draw your circuit below

Theoretical Output Voltage	
Actual Output Voltage	

Why do you get this result?

1.2) Set up a non-inverting amplifier with a gain of 10. Use a 1kΩ resistor connected to ground. Use as small a non-zero input voltage as possible (about 15 mV should do). Draw your circuit below

Actual (Measured) resistance values for R1 and R2	R1 = R2 =
Theoretical (Ideal) Output Voltage	
If there were a "Typical" V_{IO} for a LM358 on this Op-Amp, what would the range of expected output voltages be?	
If there were a "Typical" I_{BIAS} for a LM358 on this Op-Amp, what would the range of expected output voltages be?	
Measured Output Current (a Non-zero value!)	

Show your work for computed values!

1.3) *** Set up a 10kΩ load on the output of the circuit built above. Apply a 30V supply voltage to the OpAmp. Set V_{in} = 4 V. Draw your circuit below

What is the specified typical output voltage for this system?	
Switch the resistor from 10kΩ to 2kΩ, what is the specified typical output voltage for this system?	
What would you expect the output current to be at this point?	
Measured Output current	

Show your work for computed values!

Alter the supply to the Op-Amp to be 5V. Set the input to be 0.5V. Start with a 20kΩ load resistor, record the output voltage and then decrease the load resistor until the output voltage reaches 3.5V.

Output Voltage with 20kΩ load	
Load resistor when Vout = 3.5 V	
Measured Output Current at this point	
Measured current at the OpAmp's positive input terminal	
Measured current at the OpAmp's negative input terminal	

Show your work for computed values!

What output current can you expect from a LM358 OpAmp?

*1.4) Build the circuit for problem 1.2 in LTSpice. Record the output using a simulated ideal OpAmp. How does this compare to your calculated and measured values? What happens if you put in an OpAmp with characteristics similar to that of the LM358? (Note: you may have to find a close substitute)

Part 2: Phototransistor ***

2.1) Build a circuit using a 100 Ω resistor and a visible LED as shown in Figure 2. Be sure to place the anode (the longer lead) towards the voltage source and the cathode towards the ground. Turn the power on, and *observe & record what happens.* Replace the visible LED with the IR LED. *Record below what happens.* Note: IR signals can often been seen through a digital camera, such as the one on your phone.

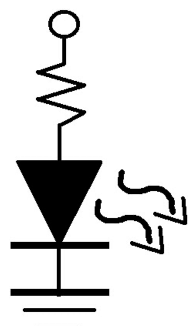
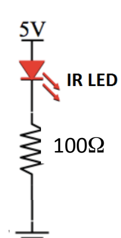


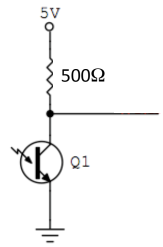
Figure 1: LED Circuit

2.2) Set up the LED to be connected to a 10Hz, 5V signal from the function generator. Connect the oscilloscope to measure the input and output signal. *Show the instructor/TA that the LED blinks rapidly.*

2.3) In this part you will see the difference between a sinking and a sourcing configuration using a phototransistor. First hook the LED circuit shown below

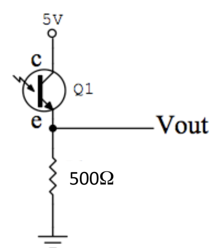


2.4) Hook up the phototransistor circuit shown below next to the LED circuit and aim the led and the phototransistor at each other. Measure the output of the phototransistor



	Expected Output (V)	Actual Output (V)
Led faces Phototransistor		
LED does not face Phototransistor		

2.5) Rearrange the phototransistor circuit to match the circuit shown and aim the led and the phototransistor at each other. Measure the output of the phototransistor



	Expected Output (V)	Actual Output (V)
Led faces Phototransistor		
LED does not face Phototransistor		

Part 3: Microcontroller

3.1) In this part you will set up an LED on a separate breadboard and use the microcontroller to power it. Set one of the ports on the microcontroller to be an output port. Use this output port as the power source for the LED (do not forget to set a resistor in series with the LED). Have the LED blink at a 2 Hz frequency. *Is there any difference in this behavior and when using the function generator as an input signal? Submit a copy of your code.*

3.2) Hook up a servo motor to the microcontroller. Write code so that the servo motor cycles through a full 180 degree range of motion. Attach your code. Plug signal input for the servo into pin P0.