Lab Activity #1

Preparation:

Class will be divided randomly in to groups of three to four students. Members of the group are to discuss and consider the expected outcome from the following situations:

(1) Consider the wiring of an op amp using +/-15V power supplies and tying both inputs together and to ground. What voltage do you think you would measure across a 10kΩ output resistor at the op amp's output?

(2) Consider figures 2-4, 2-5, and 2-6 in your text book. Are there any issues you need to identify in order to construct those circuits and recreate those traces on Multisim and the lab bench? Make sure everyone in the group understands the circuit operation of those six circuits.

Procedure:

Questions AND answers are to be typed directly in to Microsoft Word. Answering the questions is meant to be a ***team effort*** even though a single individual must take responsibility for making sure the answers are submitted in good form and on time. Use full sentences and be accurate and descriptive when answering questions. The use of Multisim to draw any circuit diagrams is strongly recommended.

1. One group member wires the circuit described in (1) of the preparation section above. While wiring the circuit, the other group members are to solve the following problems in the textbook: 2-6, 2-7, 2-11. (*Wiring Note*: Use the +/- variable power supply where you set 15V from the red connector to the black connector, set –15V from the green connector to the black connector, and then the black connector is used for the ground in your circuit).
2. Once wired, the group members should certify that the circuit is wired correctly. Turn on power and make a DC measurement of the output voltage. Determine out of 6 op amps, how many go to $+V_{sat}$ and how many to $-V_{sat}$. (*Wiring Note*: Turn off the power supply every time you change ICs).
   QUESTIONS: What was the percentage of op amps that went to $+V_{sat}$ and the percentage that went to $-V_{sat}$? What is causing the op amp to saturate? Why do some op amps go to the positive limit and some to the negative limit? Is the percentage what you expected? Why?
3. A different group member is to modify the circuit in order to create the circuit shown in Figure 2-4(a). (*Wiring Note*: Let the peak-to-peak voltage of the triangle wave be 20V which means the amplitude is 10V and set the frequency to 1kHz, use chA to monitor the triangular wave and use chB to monitor the output). While wiring the circuit, the other group members are to construct the circuit in Multisim using a practical op amp for which the power supplies must be connected.
4. Once wired, the group members should certify that the circuit is wired correctly. Turn on power and verify that the voltage traces are the same as those from Multisim. Switch the wires at the inverting and non-inverting inputs on the bench and in Multisim, again verifying correct circuit operation. Set the scope to operate in X-Y mode on the bench and in Multisim, again verifying correct circuit operation.

QUESTIONS: Which circuit is the inverting zero-crossing detector? Which input is the source connected to for the inverting zero-crossing detector? How do you place the scope in X-Y mode on the lab bench? On Multisim?

5. A different group member is to modify the previous circuit in order to create the circuit shown in Figure 2-5(a). (*Wiring Note*: Use the constant 5V source available on the bottom right of the power supply for the reference voltage and use the same triangular wave as used in the previous steps). The other team members are to modify the Multisim circuit from the previous step in order to create the circuit shown in Figure 2-5(a).
6. Once wired, the group members should certify that the circuit is wired correctly. Turn on power and verify that the voltage traces are the same as those from Multisim. Switch the wires at the inverting and non-inverting inputs on the bench and in Multisim, again verifying correct circuit operation. Set the scope to operate in X-Y mode on the bench and in Multisim, again verifying correct circuit operation. **QUESTIONS:** Which circuit is the non-inverting positive level detector? Which input is the source connected to for the non-inverting positive level detector? Why is it useful to look at the trace using the X-Y mode?

To Be Submitted

- Within one week of the lab, each group must submit their answers to the lab questions given above along with the answers to the textbook problems given in step 1 above.
- Individual Lab Assessment Forms must be ***fully completed*** or your grade will be affected. A participation grade is determined from these assessment forms and represents an average of your self-assessment and peer-assessment. If you do not ***completely*** fill out the form then you will automatically get a zero. Please submit assessment forms electronically or hard copy no later than during class one week after the lab is performed. In this way you can more effectively assess team members' participation in answering lab questions.
- Students are invited to submit electronically if possible.

Late submissions are not accepted and a grade of zero is recorded.