Your report has five sections:

• **Introduction**, explain the benefits of using the active filters over the passive filters in one paragraph.

• **Theory**, assuming that OpAmps are ideal, theoretically derive the transfer function \( \frac{V_o}{V_i} \) of the given filter. Compare this transfer function with a standard second order transfer function and find the Q and \( f_0 \) of the filter based on the values of resistors \( R_1 = \frac{1}{G_1} \) and \( R = \frac{1}{G} \) and capacitor \( C \). Find the value of the resistors \( R_1 \) and \( R \) in the filter for \( f_0 = 4 \text{kHz} \), \( Q = 5 \), and \( C = 0.01 \mu\text{F} \).

• **SPICE simulation**, simulate the designed circuit with SPICE. To model the OpAmp use ideal voltage-controlled voltage source (VCVS) with a large gain (like 100,000). In this filter, 741 OpAmp behaves like an ideal OpAmp because the frequency of operation is much smaller than the unity gain frequency of 741. VCVS element in SPICE is a 2-port element which senses a voltage at its input port and amplifies that at its output port with the specified gain. You can consider the input port terminals as inverting and non-inverting terminals of your OpAmp. For the output port, you can ground one of the terminals to have a single ended output. Be careful about the polarities, you should have negative feedback in your circuit. For SPICE simulations, please submit circuit schematic and magnitude plot of the transfer function showing the \( f_0 \) and the upper and the lower -3dB frequencies. Also calculate Q using your simulation data. Write your calculation on the same page you have plotted the magnitude response.

• **Measurement**, tabulate your measured data as amplitude vs. frequency. Explain how you have measured the transfer function in one paragraph. Plot your measured data and find \( f_0 \) and the upper and the lower -3dB frequencies from this plot. Also calculate Q using your data.

• **Conclusion**, in a paragraph, write what you have learned from this experiment.

... continued on the back
Few general rules about writing your reports:
1. A lab report shall be concise, brief, and to-the-point.
2. Long reports with unnecessary description of theory or the procedure are strongly discouraged.
3. Reports shall be typed and the graphs shall be drawn by computer. Make sure that the graphs are large enough to show the details.
4. There shall be a cover page for the report with your name, your partner’s name, your SIDs, experiment name, and delivery date on it.

**Acknowledgement:** I would like to thank Mr. Saeed Chehrazi for the initial draft of this how-to.

Ali Karimi, December 2004