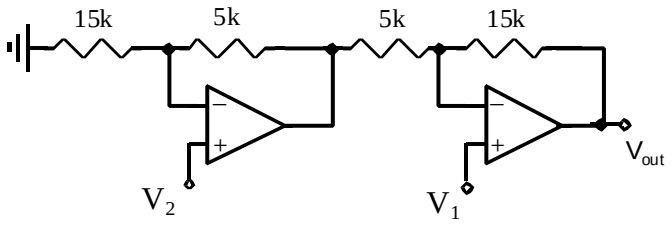
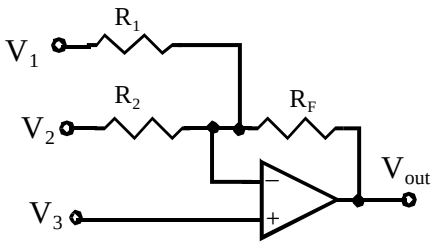
ANALOG & DIGITAL ELECTRONICS

HOMEWORK ASSIGNMENT 7: Due Friday, April 13.

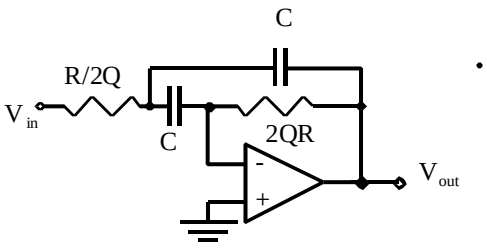
1. Consider the op amp circuit below. Find the output as a function of the inputs.



2. Consider the circuit at the right.
   a) Find the output voltage, V_o, in terms of the resistors R_1, R_2, and R_F; and the three input voltages, V_1, V_2, and V_3.
   b) Find the numerical value of V_o if R_1 = 5k, R_2 =10k, R_F = 20k, V_1 = 2V, V_2 =1V, and V_3 = 2.5V.



3. You have a device that produces an output voltage that depends linearly on the temperature, however the output at 0°C =200mV and the output at 100°C = 400mV. Design a single op amp circuit that will take the voltage produced by this device and produce an output voltage of 0V at 0°C and 1.00V at 100°C. You may use a fixed reference voltage of either 1.00V or – 1.00V in your circuit if you need to.
4. Design a simple band pass filter using a single op amp, the one that looks like two cascaded RC filters. The cutoff frequency of the low pass part should be 20,000 Hz and the cutoff of the high pass should be 5,000 Hz. The circuit should have a gain of −8 at 10,000 Hz.
5. Consider the single amp band pass filter you will use in the laboratory. Choose values to give a Q = 4 and a center frequency (resonant frequency) of 40,000 Hz. What is the gain at the center or resonant frequency?



6. Design a second order low pass filter with a damping of 0.5 and a "cutoff" or "resonant frequency of 16 kHz. Use a Sallen Key equal component value filter. Use an $R \geq 20k\Omega$. (See below for the reason.)
7. Convert the above Sallen Key filter into a third order filter by adding a RC stage in front of the Sallen Key filter. Choose the cutoff of this stage at 16kHz. Choose the component values so the two filters will not interact.