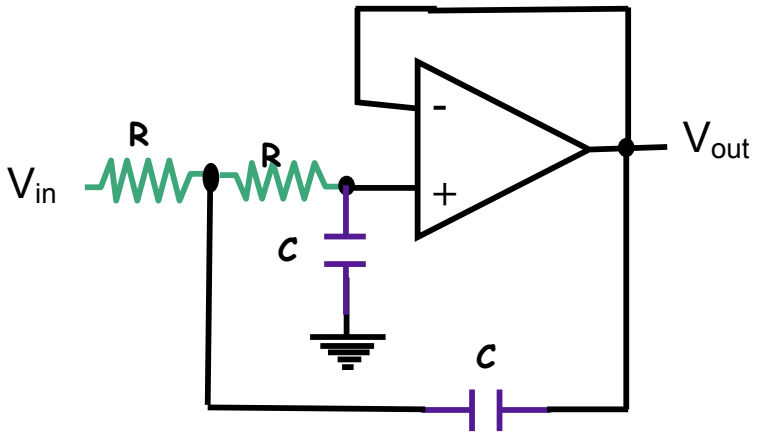
1. Design and construct a 2-pole, low pass, active Sallen Key filter (circuit shown below) with an f3dB frequency of around 750 Hz. It doesn't need to be exact, but you should measure your resistors and capacitors and determine what frequency you have. You will need to pick the values of the resistors and capacitors. Start by picking the capacitor because you have fewer choices there. Make sure that your resistor is larger than 500 Ω.
2. **Carefully** test the circuit's performance (Vout/Vin) as a function of frequency. Pay special attention to the frequency region where the signal rolls off (near the f_{3dB} point). You should also pay attention to the "pass" frequencies in this circuit, so make sure you take data both below and above the f3db point. Get data for frequencies up to 30 kHz.
3. Plot $\frac{V_{out}}{V_{in}}$ vs. frequency on a log-log plot.
4. Does this circuit behave like a 2-pole filter (two RC filters)? To be sure compare your data to the theory of two RC filters connected in series where Vout/Vin= $1/(1+(\omega RC)^2)$ by plotting the theory with the data.
5. Explain why Vout/Vin is not 0.707 at $f=1/(2\pi RC)$. What is Vout/Vin at this frequency? Explain why.



6. Sketch in your notebook what you think a Sallen Key 2-pole high pass filter would look like.

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Theory

1. Show the derivation for the theoretical response of the passive filter. (Calculate the response for one stage. Show that the response for two stages (or more) will be the product of the response for each stage.)
2. Derive the expected response ($\frac{V_{out}}{V_{in}}$ as a function of frequency) for the 2-pole active filter circuit using the golden rules of op-amps.
3. Show that the 4 pole active filter response is merely the product of the response of two 2-pole active filters.

Analysis

1. Plot the data and the theory for each of the four filters on its own graph to see how the data compares to the theory.
2. Plot the data from the two passive filters on the same plot to see how the number of poles changes the filter response.
3. Plot the data from the two active filters on the same plot to see how the number of poles changes the filter response.
4. Plot the data from the 2-pole active and the 2-pole passive filters on the same plot to see how the active and passive filters compare.
5. Plot the data from the 4-pole active and the 2-pole passive filters on the same plot to see how the active and passive filters compare.
6. In your paper discuss each graph as you present it in your paper. Talk about the pros and cons between active and passive filters and between 2 pole and 4 pole filters. Remember to think about input and output impedance. (Hint: How many passive RC filters can you cascade together? How many active filters?)

The report

•Your report should follow the normal formal report format.
•You should include an introduction that talks generally about filters. What are they used for? What kinds exist? What other sorts of background information about filters can you think of?
•Your theory section should include the derivations of Vo/Vin for the active and passive circuits along with a discussion of how active filters work.
•Include a procedure section that does the following:

-shows a sketch of each circuit
-explains the design principles behind each circuit
-explains how the data was collected

•Put your graphs in the data/analysis section of your report with appropriate figure captions. Your actual data should not go in the report, but rather in an appendix. Make sure you explain each graph in the report as you go along. In other words, I'd like to see the graphs in line with the text. You can paste as a picture from either excel OR kaleidagraph.
•In your analysis discuss how well each filter behaves compared with the theory AND some pros and cons of each type of circuit. Talk about the pros and cons between active and passive filters and between 2 pole and 4 pole filters.
•Write a conclusion that summarizes your results and draws conclusions about filters. You could suggest improvements or extensions for future work if you were to continue studying filters.

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Check out Horowitz and Hill or some other source and make sure you include answers to the following questions in your lab report

a) What does the number of poles mean with regard to how fast the circuit cuts off the filtered frequencies?

b) What are three considerations that should be made in choosing an appropriate filter?

Last	First	Filter type	Filter frequency
Garcia	Kelly	Low Pass	500 Hz
Wright	Kit	High Pass	12 kHz
Kusnezov	Alex	High Pass	10 kHz
Pilato	Joe	Low Pass	300 Hz
Paul	Antony	High Pass	15 kHz
Coutinho	Neil	Low Pass	700 Hz
Wolfe	Tristan	High Pass	18 kHz
Golley	Shawn	Low Pass	400 Hz

Sallen Key Filters