Passive Filters:

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Purpose:

To get some practice with filters, and using complex algebra to deduce qualities about filtering circuits. Attributes of impedance Z are to be used to algebraically manipulate component values of a given circuit in order to deduce gain curves and phase shifts.

Procedure:

Build the circuits shown in Fig. (1-5) and use the Bode analyzer from the NI ELVIS II to measure the gain curve and phase shift. Calculate the gain curve and phase shift theoretically as well, and plot with the experimentally measured data on the same graphs for comparison.

Data:

The plots were created using Python, with the theoretical plots in the color blue, and the experimental plots in the color red.

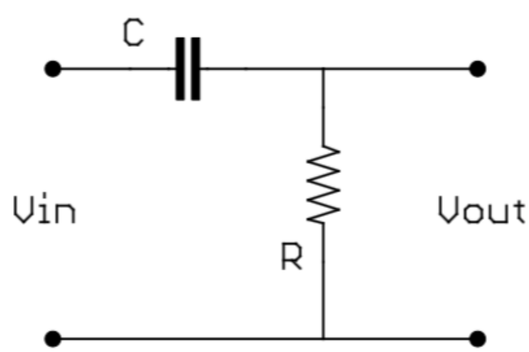
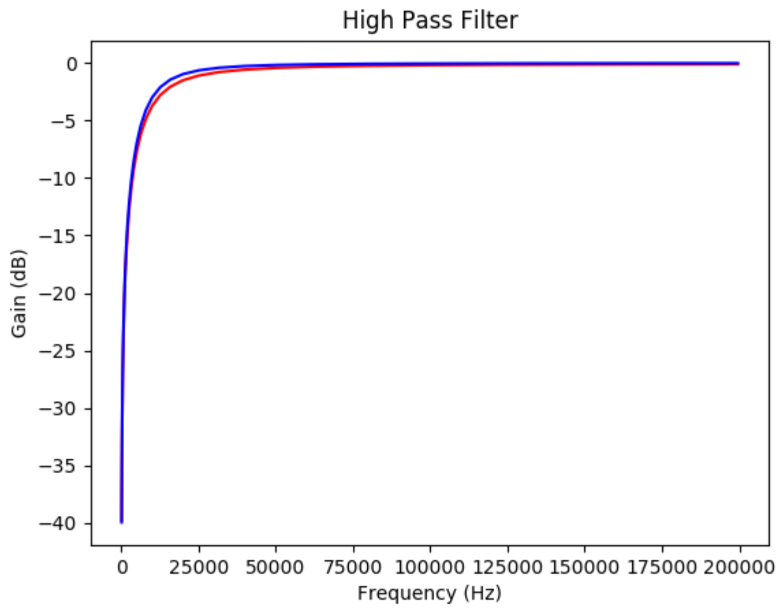
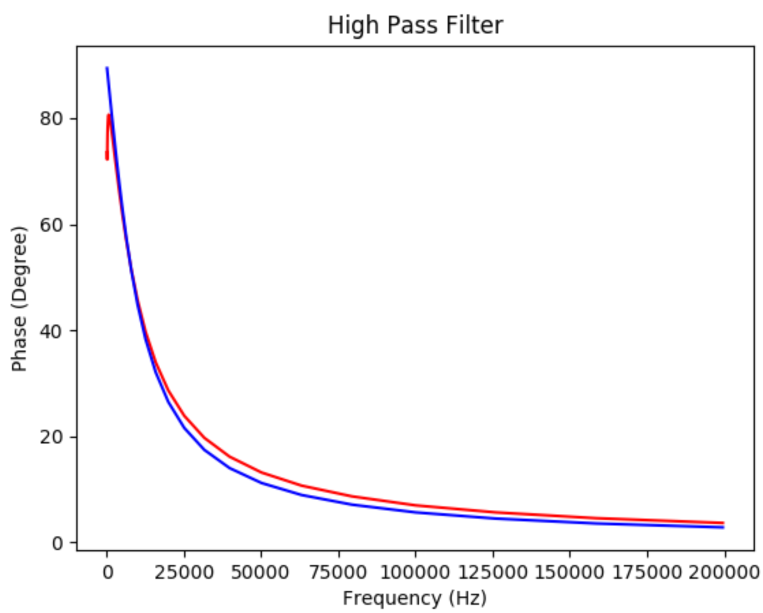


Figure 1: Highpass Filter

The second Bandpass filter is running with a 2.7k Ohm resistor rather than a 270 Ohm. With a larger resistor the frequency response covers a narrower bound of frequency values, meaning a lower center frequency.





A notch filter could be useful when trying to remove a specific frequency that is having a particularly negative effect on a system when trying to take other waveform measurements on that system. The theoretical gain curve for the notch filter did not come out like the experimental gain curve, and after reworking the math for calculating the voltage ratio function in several different ways, the same graphical result persisted, although the phase shift appeared to be correct every time.

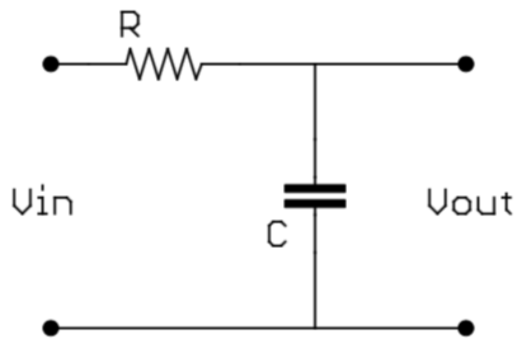
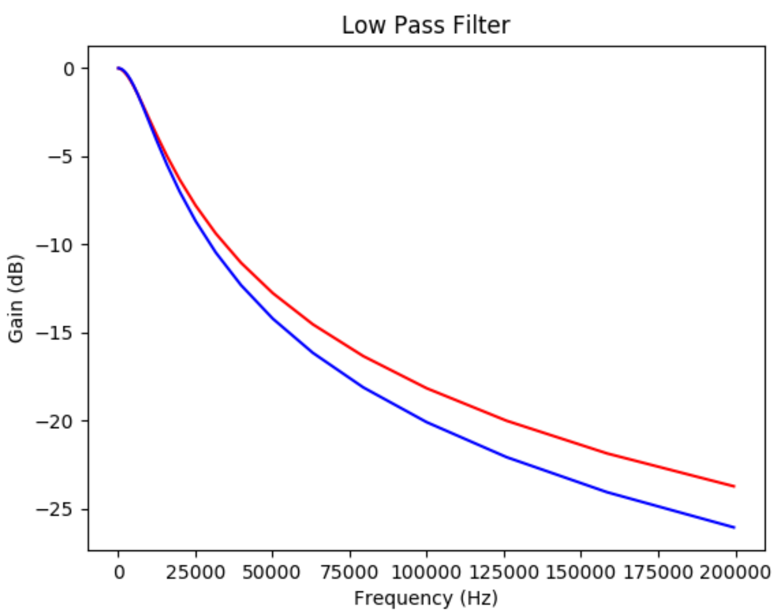
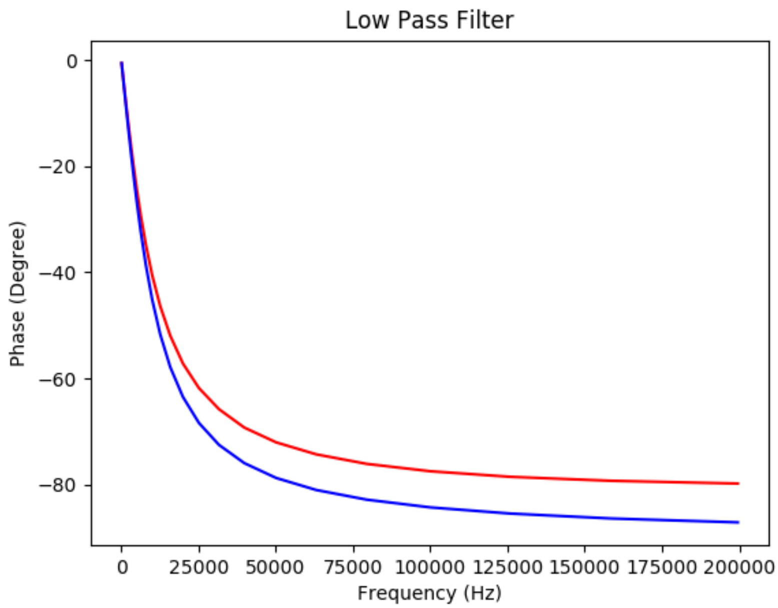


Figure 2: Lowpass Filter





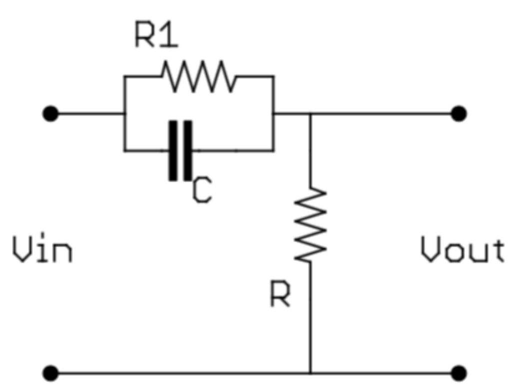
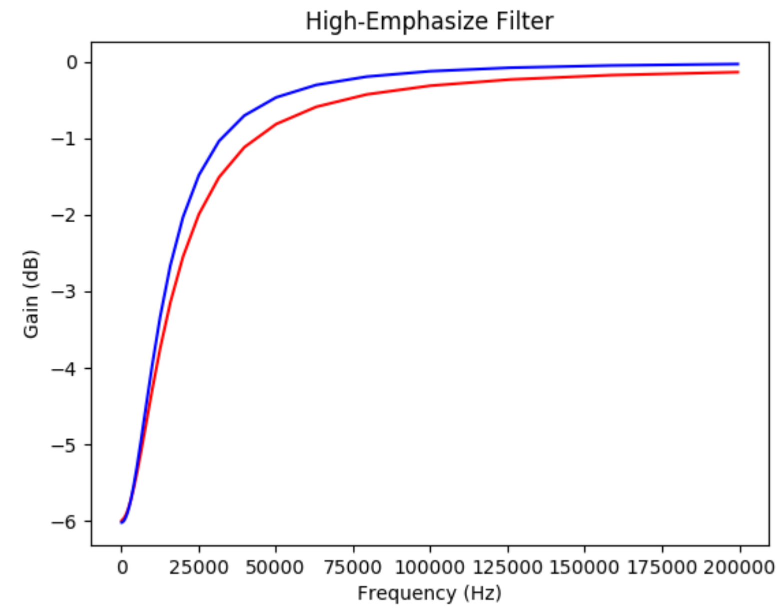
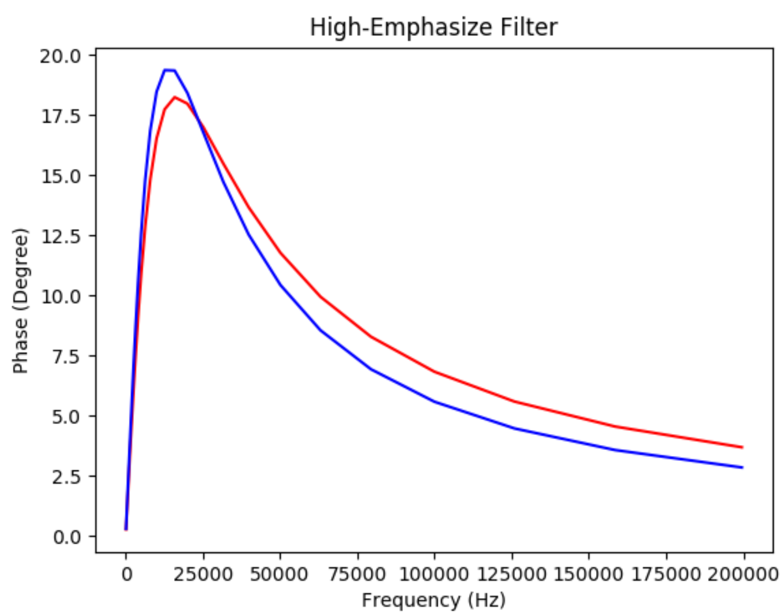


Figure 3: High Emphasize Filter


High-Emphasize Filter
Gain (dB)
0
−1
−2
−3
−4
−5
−6
0
25000
50000
75000
100000
125000
150000
175000
200000
Frequency (Hz)


High-Emphasize Filter
Phase (Degree)
20.0
17.5
15.0
12.5
10.0
7.5
5.0
2.5
0.0
0
25000
50000
75000
100000
125000
150000
175000
200000
Frequency (Hz)

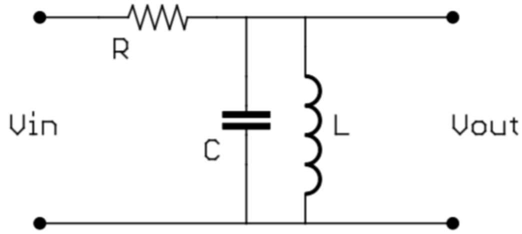
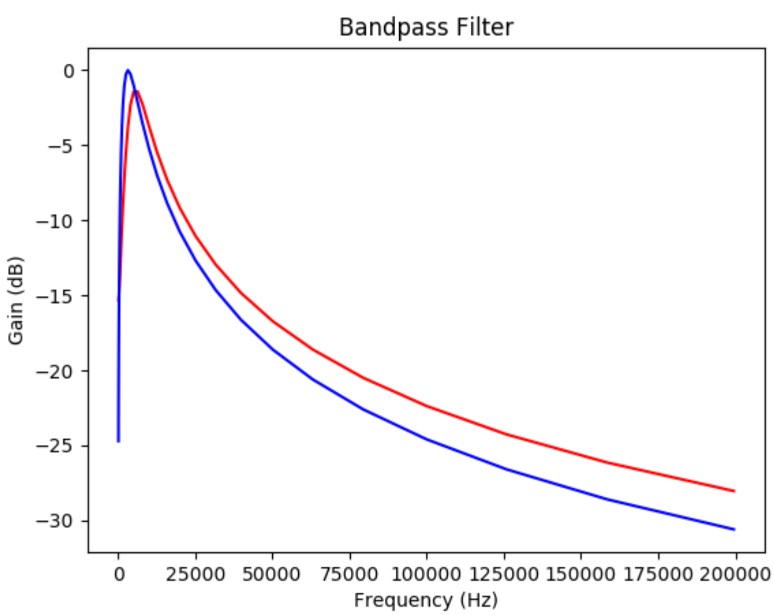
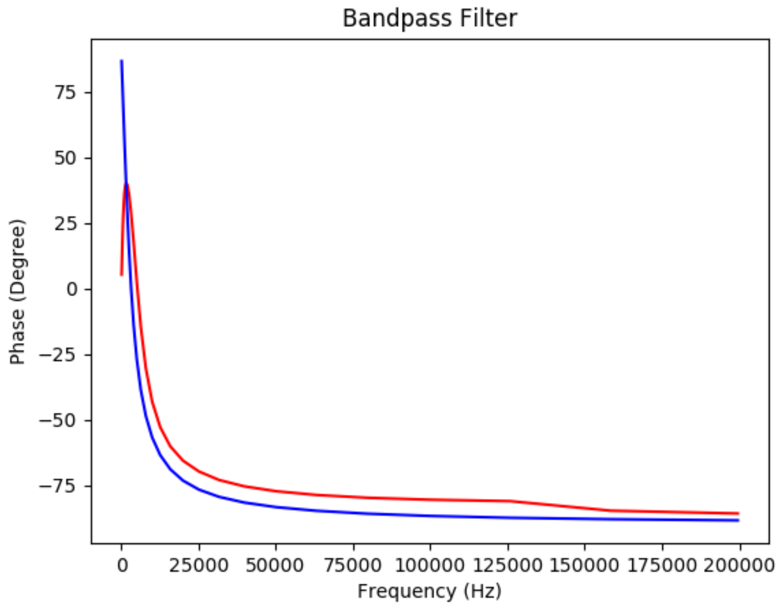
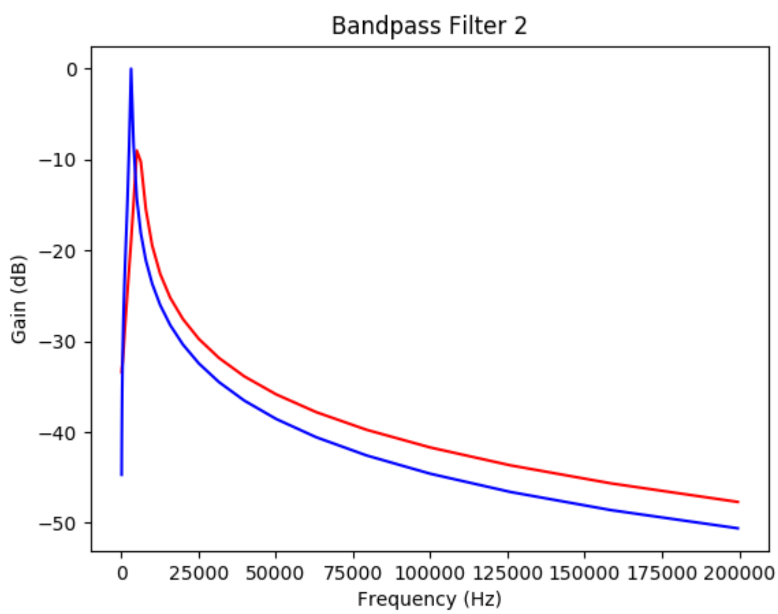
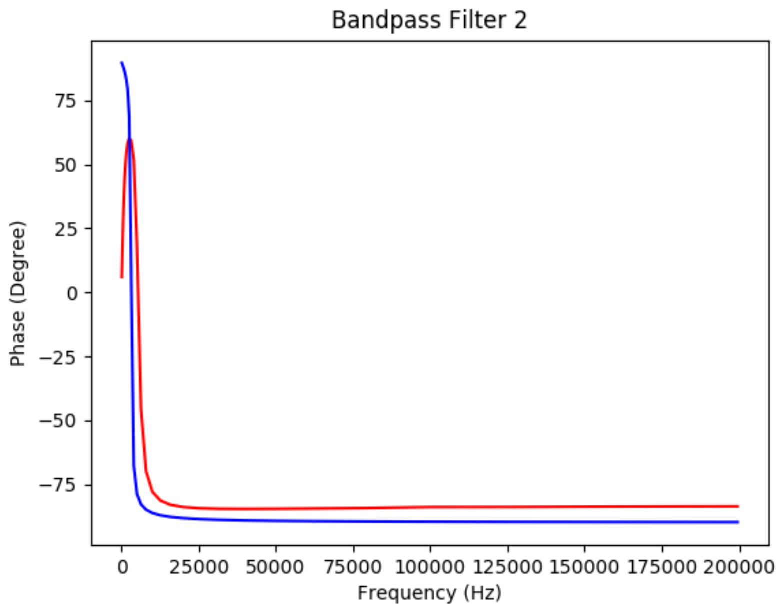


Figure 4: Bandpass Filter




Bandpass Filter
Phase (Degree)
75
50
25
0
−25
−50
−75
0
25000
50000
75000
100000
125000
150000
175000
200000
Frequency (Hz)


Bandpass Filter 2
Gain (dB)
0
−10
−20
−30
−40
−50
0
25000
50000
75000
100000
125000
150000
175000
200000
Frequency (Hz)



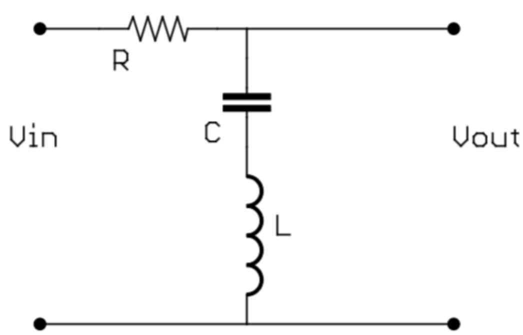
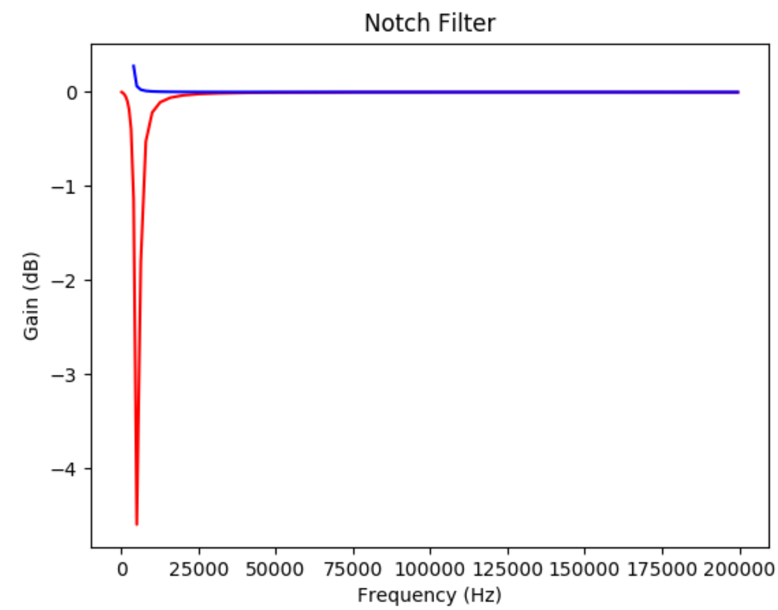
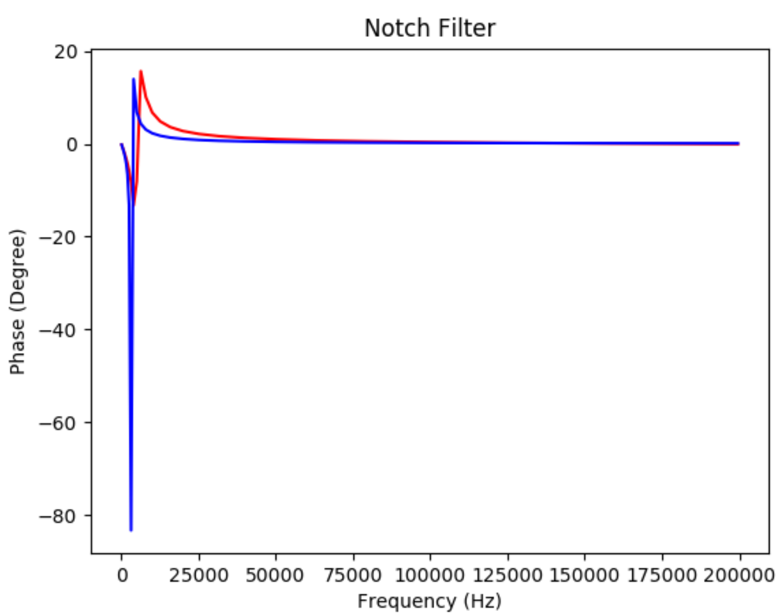


Figure 5: Notch Filter


Notch Filter
Gain (dB)
0
−1
−2
−3
−4
0 25000 50000 75000 100000 125000 150000 175000 200000
Frequency (Hz)


Notch Filter
Phase (Degree)
20
0
−20
−40
−60
−80
0 25000 50000 75000 100000 125000 150000 175000 200000
Frequency (Hz)