

ECE 3043

Summer 2018 Homework Problem Set 7 for Experiment No. 8

Due First Meeting Week of June 25

The critical frequency, f_{crit} , for the filters that will be designed is the -3 dB frequency for the low-pass and high-pass filters, pole and/or zero for the shelving filters, and the center frequency for the all-pass filter. The critical frequency is the experimenter's birthday (sans year) in kHz for birthdays prior to July and the birthday divided by two for birthdays from July to December. For instance, if the experimenter was born on May 24 the critical frequency is 5.24 kHz and if the experimenter was born on December 13 the critical frequency is $12.13/2 = 6.065$ kHz.

1. Design a second-order Butterworth low-pass filter with a dc gain of $0db$ and a -3 dB frequency of $f_3 = f_{crit}$.
2. Design a second-order Butterworth order high-pass filter with a infinite frequency gain of $0dB$ and a -3 dB frequency of $f_3 = f_{crit}$.
3. Design a second-order bandpass filter with a center frequency of $f_p = f_{crit}$, a center frequency gain of $0dB$, and a quality factor of 3.
4. Design a second-order notch filter with a notch frequency of $f_z = f_{crit}$, a dc infinite frequency gain of $0dB$, and a quality factor of 3.
5. Design a second-order all pass filter with a phase shift of 180° at $f_o = f_{crit}$ and a quality factor of 3.

Simulate each of the circuits designed above with both National Instruments (Multisim) and LTSpice. Plot the Bode plots from a frequency a decade below the smallest pole/zero frequency to a decade above the pole/zero frequency. Make the same plots with both Mathcad and Matlab.

Each of these filters will be built in lab and the frequency response obtained. For the first four filters only the amplitude response is required to be measured in lab. But for the all pass filter both amplitude and phase must be measured; ELVIS might be the preferred choice for this filter.