Filter Homework

March 3, 2013

Minimum required order design

Find the minimum order required for a Butterworth and Chebyshev low-pass filter to implement the following. Each problem illustrates a different way that a specification might be given. Your first job is to translate the specification into the Fp, Rp, Fs, Rs values that are used to determine the required filter order.

1. A response to 3.5 kHz with at least a factor of 0.9 is needed and the response for signals higher than 5 kHz is to be no higher than 0.01.

2. A low-frequency instrument needs a frequency response to 5 Hz with at least a factor of 0.95 and the filter should attenuate 60 Hz by a factor of at least 50.

3. A filter is needed to respond to signals up to 300 Hz with no more than 1 dB loss and to attenuate signals above 1 kHz by at least 40 dB.

4. A filter is needed to pass a 0.1 Vpp signal at 1 kHz with no more than 10 percent loss and reduce a 0.5 Vpp signal at 1.5 kHz to no more than 0.005 Vpp. This one takes a little thought.

5. Calculate the pole locations and use the frs spreadsheet on the class website to plot the Butterworth and Chebyshev filters in problem 3. Study the plots to confirm that the filter meets the specification.

Answers:

	Butterworth	**Chebyshev**
1.	15	7
2.	3	2
3.	5	4
4.	14	7

Filter Homework

Sallen-Key LPF design

For each of the following determine the required resistor and capacitor values for the Sallen-Key circuit. No specific answers are given as there are a variety of good answers. Check your answers using the sallen_key_design spreadsheet on the class website.

1. Implement a pole pair at s = -3,000 +-j20,000.

2. Implement a pole pair defined by wn = 10,000 rad/sec and zeta = 0.4.

3. Implement a pole pair defined by Fn = 1 kHz and Q = 5.

4. Implement a pole pair defined by s = -1,000 +-j1,000.

5. Implement a pole pair defined by wn = 377 rad/sec and zeta = 0.1.

6. Implement a pole pair defined by Fn = 20 kHz and Q = 0.7.