

1. Design a Chebyshev digital filter with a sampling rate of  $f_s=20000$ , and 3dB roll off at 2kHz and at least 40dB down at 6kHz. Show your work. Express your answer in the form of a difference equation and list your values for the  $a_k$ 's and the  $b_k$ 's.
2. Check your work using MATLAB's `cheby1()` command.
3. Verify your design by using MATLAB's `freqz()` command to plot the frequency response of your filter. Use the `axis()` command to zoom in on the 0 to 8 kHz frequency range and the -50 to 0 dB amplitude range. Mark your design specs on your plot.
4. Design a Butterworth digital filter with a sampling rate of  $f_s=10000$ , and 3dB roll off at 1kHz and at least 35dB down at 3kHz. Show your work. Express your answer in the form of a difference equation and list your values for the  $a_k$ 's and the  $b_k$ 's.
5. Check your work using MATLAB's `butter()` command.
6. Verify your design by using MATLAB's `freqz()` command to plot the frequency response of your filter. Use the `axis()` command to zoom in on the 0 to 8 kHz frequency range and the -50 to 0 dB amplitude range. Mark your design specs on your plot.
7. Prove that a system with one real pole at A is unstable if  $A>1$ . Hint: find the impulse response.