EC 300 Signals and Systems   Fall 2000
                                                               B.A. Black

Filter Design
by Wayne T. Padgett

Objectives

To carry out a complete filter design by doing the following steps:

1. Design a filter using a handbook approach.

2. Verify the design using a numerical simulation (e.g. PSPICE)

3. Build the design in hardware.

4. Verify that the circuit meets specifications by direct measurement using LabView.

The above design process will be carried out for both Butterworth and Chebyshev filter types.

Equipment

HP34401 Multimeter   Opamps: TL072, MC33072, or equivalent
HP8116A Function Generator   Resistors and capacitors as needed
Tektronix 2215A Oscilloscope

Pre-Lab

Do problems 11.26 and 11.29 in Eccles. Verify your designs using PSPICE.

Record your designs in your lab notebook. Include plots that show your filters meet the specifications.

Procedure

Build both filters. Measure the frequency response of each filter using the LabView virtual instrument FreqRsp.llb. (Note: FreqRsp.llb is identical to InsertionLoss.llb, except that it calculates voltage gain rather than insertion loss.)

Present and compare your measured and simulated results by plotting them together on the same graph. You can import PSPICE frequency response data into MATLAB by doing the following:

Importing PSPICE frequency response data into MATLAB

1. Attach the "PRINT1" device to your filter's output terminal. Double-click on the symbol and set the "analysis" option to "AC".

2. Run the simulation, then select "Analysis → Examine Output". Scroll down to the numerical frequency response values, then highlight the entire set of values with the cursor, and do Ctrl-C to copy them to the clipboard.

3. In MATLAB, start entering a matrix variable assignment command, e.g., A=[

4. Paste the clipboard contents into MATLAB using Ctrl-V.

5. Close the variable assignment by typing];

6. Plot the data. If you wish, you can get a Bode plot using
   `semilogx(A(:,1),20*log10(A(:,2))).`

Report

Make sure that your lab notebook contains clear fully documented schematics of your final filter designs. Also include a sketch of the frequency response measurement setup. Tape in the frequency response graphs for each filter. Comment on the accuracy of your designs. Have all members of your lab group sign the lab notebook, and hand the notebook in at the end of lab.