A Fourth Order Chebychev High-Pass Filter

The object of this design project is to design, assemble, and evaluate a 4th order Chebychev high-pass filter. The specifications are:

- dB ripple: 1.25 dB
- gain constant: $H_0 = 1.0$
- $-3$ dB cutoff frequency: $f_3 = 5$ kHz

The filter is to be realized with one second-order KRC filter and one second-order state-variable or Tow-Thomas type filter. Preferably, the resistor values should be in the 1 kΩ to 100 kΩ range.

A basic reference for the design is the filter potpourri located at:

http://users.ece.gatech.edu/~mleach/ece4435/filtrpot.pdf

There is an example on pages 14 and 15 that you can follow to determine the transfer function. Page 12 shows how to determine the cutoff frequency $f_c$ from the $-3$ dB frequency $f_3$. The second-order KRC filter is covered on page 23. The textbook covers state-variable type circuits that may be used. All you have to do is to determine the resonance frequency and quality factor of each second-order filter section, select suitable component values for each section, assemble the filter, and test it. As part of the report, you should include theoretical plots similar to Fig. 8 in the filter potpourri and a standard Bode plot on log-log scales. These can easily be done with Mathcad or any other math software.

It is suggested that you test each second-order section by itself before testing the overall filter. Check the resonance frequency by determining the frequency at which the phase shift between the input an output voltages is 90°. The quality factor is the relative gain at the resonance frequency. Each section must have the correct resonance frequency and quality factor for the overall filter to be correct.