Solutions to Chapter 8 Problems - MATLAB Problems

8.22 A requirement exists for a bandpass digital filter with a Chebyshev characteristic to meet the following specifications:

passband	*1200 – 1800 Hz*
stopband attenuation	*> 30 dB*
passband ripple	*< 0.5 dB*
transition width	*400 Hz*
sampling frequency	*7.5 kHz*

Using a suitable software program, obtain the filter coefficients.

Solutions

The filter may have either a Chebyshev Type I or Chebyshev Type II characteristic. We will use the later.

The MATLAB m-file, prob822.m, listed in the Appendix was used to compute the coefficients is listed below. First, the order of the prototype LP filter order is determined (using *cheb2ord*), then the filter coefficients are calculated using the *cheby2* command (which maps the LPF and uses the BZT). This doubles the order of the LPF to 8.

The order of the LP is estimated to be 4. The filter coefficients, in direct form, are listed below. The magnitude-frequency response and the pole-zero diagram for the filter are shown in Figure s8.22.

Filter coefficients

```
a =
   1.00000000000000,  -2.00374281823766, 3.81091538210020,
 -4.10869211694908, 4.14997865746504, -2.66876541394871,
  1.60420127965693, -0.53294134847505, 0.17342585701242
b =
   0.04675282436909, -0.06761971415012, 0.06783154779197,
   -0.07964979691986, 0.11041311186639, -0.07964979691986,
   0.06783154779197, -0.06761971415012, 0.04675282436909
```

8.23 An analog filter is to be converted into an equivalent digital filter that will operate at a sampling frequency of 256 Hz. Assume that the analog filter has the following transfer function:

$$H(s) = \frac{1}{s^3 + 2s^2 + 2s + 1}$$

(1) Obtain suitable coefficients for the digital filter
(2) Assuming that the digital filter is to be realized using the cascade structure, draw a suitable realization block diagram and develop the difference equations.
(3) Repeat part (2) for the parallel structure.