ICE503 DSP-Homework#15

1. Draw the direct form I and linear-phase form for the FIR filters
   (a) $H(z) = 2 + z^{-1} + 2z^{-2}$
   (b) $H(z) = 3 - z^{-1} + 2z^{-2} + 2z^{-3} - z^{-4} + 3z^{-5}$

2. To design a FIR filter $h_t[n]$, we can use a rectangular window $w_R[n]$ to window an ideal filter $h_d[n]$. Truncation of $h_d[n]$ to $2M + 1$ points is multiplication with a rectangular window.

$$h_t[n] = h_d[n] \cdot w_R[n]$$

$$w_R[n] = \begin{cases} 1, & -M \le n \le M \\ 0, & \text{otherwise} \end{cases}$$

   Given $M = 7$.

   (a) Calculate $W_R(e^{j\omega})$.

   (b) Plot $|W_R(e^{j\omega})|$, and indicate the magnitude of the mainlobe.

   (c) Indicate the frequency of the mainlobe and sidelobe.

3. Plot the flow graph of a 16 point decimation in time FFT structure, and determine the number of complex multiplications.

4. MATLAB simulation:

   Use fdatool/filterDesigner to design filters. Show the parameter that you choose and the magnitude response the filters. Specify the structure and the order of the filters.

   (a) Design a highpass Butterworth filter. The normalized passband edge is at 0.8 and stopband edge is exactly at 0.7. The stopband attenuation is 40 dB

   (b) Design a lowpass Kaiser window filter. The normalized passband edge is exactly at 0.22 and stopband edge is at 0.29. The stopband attenuation is 40 dB