Homework for Module 6

1. Using the Parks-McClellan algorithm, design a lowpass decimation filter for M=5 with the following specifications: $\omega_p=\pi/M-\Delta\omega$, $\omega_s=\pi/M+\Delta\omega$, Rp=1dB, R_s=30dB with $\Delta\omega=\pi/100$. Plot the impulse response and the frequency response magnitude. Show clearly that your design meets all specifications by plotting the specification template on the frequency response graph.
2. Determine the Type I polyphase representation for the filter designed in Part 1 and plot the magnitude and phase response for each polyphase section.
3. Evaluate the response of a system consisting of the decimation filter designed in Part 1 followed by a M-sample compressor for the following inputs: $x(n) = \cos(\omega_0 n)$, $\omega_0=\pi/50$, $\omega_0=\pi/50+2\pi/5$, $\omega_0=\pi/50+4\pi/5$. Determine the output frequency and approximate peak amplitude (steady state) for each input frequency. Make a rough comparison of the relative amplitudes and compare with predictions based on the passband/stopband specifications for the decimation filter.
4. Describe, in general terms, how your observations in Part 3 would be changed by the use of a decimation filter with a stopband decay rate of 1/f (as opposed to the minimax stopband characteristic of the Parks-McClellan design).