Homework for Module 3

1. Design a lowpass elliptic filter with the following specifications:
   $\omega_p=0.45\pi$, $\omega_s=0.55\pi$ and $R_p=0.1$dB, $R_s=30$dB. List the coefficients for the resulting transfer function in direct form. Plot the magnitude response and group delay for the filter design.
2. Realize the lowpass filter as a parallel combination of allpass sections. List the coefficients and plot the phase response for each allpass section.
3. Find the magnitude response for the highpass power complement to the lowpass filter. Adjust the passband ripple specification (R_p) for the lowpass filter to achieve equal stopband attenuation for both lowpass and highpass filters (within ±1dB). Plot the magnitude response for both filters.
4. Determine the lattice realization for each allpass section. List the multiplier coefficients for each stage of the lattice for both allpass sections (use the MATLAB function tf2latc).
5. Quantize the filter coefficients for the lowpass filter (direct form) designed in step 1 to 16 bits. Quantize the lattice coefficients to 16 bits. Determine the frequency response for both direct form and lattice realizations with quantized coefficients (use the MATLAB function latc2tf to convert the lattice coefficients back to direct form). Compare both to the direct form frequency response without coefficient quantization. Repeat step 5 with 10 bit coefficient quantization. To ensure uniformity of results, please use the supplied MATLAB function quantize.m.