EE 451: Homework 7

1. Design $H(z)$ as a 6th order Butterworth filter with bandedges of 0.3 and 0.5.
   (a) Plot the frequency response of the above filter.
   (b) Use the quantization function below to quantize the coefficients of the filter to 8 bits, and plot the frequency response.
   (c) Implement $H(z)$ in cascade form and quantize the coefficients to 8 bits, then plot the frequency response of the resulting filter.
   (d) Compare the two approaches of implementing a filter and the effects of quantization on them.
   (e) Plot the poles and zeros of all systems. Function from Mitra, "Digital Signal Processing: A Computer Based Approach".

```
function beq = a2dT(d,n)
% BEQ = A2DT(D, N) generates the decimal
% equivalent beq of the binary representation
% of a decimal number D with N bits for the
% magnitude part obtained by truncation
%
m = 1; d1 = abs(d);
while fix(d1) > 0
   d1 = abs(d)/(2^m);
   m = m+1;
end
beq = fix(d1*2^n);
beq = sign(d).*beq.*2^(m-n-1);
```

2. (extra credit – will be used to replace your lowest homework grade)
   Design a linear-phase bandpass FIR filter with 41-taps with passband edges at $w_{p1} = 0.4\pi$ and $w_{p2} = 0.6\pi$ using the frequency sampling approach. (**You will not receive any credit if you use software tools that uses filter specification and generates the filter automatically. YOU MUST provide the low level implementation of the filter and include all your code**)
   (a) Plot the magnitude of the sample values of the filter, $H(k)$ (using the `stem` function).
   (b) Plot the impulse response of the filter, $h(n)$ (using the `stem` function).
   (c) Plot the magnitude response of the filter.
   (d) Modify the filter you have designed by making the points on the band edge to have half the normal magnitude and plot the magnitude of the new $H(k)$ (using the `stem` function).
   (e) Plot the impulse response, $h(n)$ of the modified filter (using the `stem` function).
   (f) Plot the magnitude response of the modified filter.
   (g) Which filter is better, the original from part (c) or the modified from part (f)? Justify your answer.