Problem 1 [5 marks]

Determine all the FIR filters which are specified by the lattice parameters $K_1 = 1/2$, $K_2 = 0.6$, $K_3 = -0.7$ and $K_4 = 1/3$. 
Problem 2  

Design a 5-tap FIR bandpass filter with a lower cutoff frequency of 1600 Hz, an upper cutoff frequency of 1800, and a sampling rate of 8000 Hz using 

a) Rectangular window function.
b) Hanning window function. [3 marks]

c) For part (b), find the magnitude and phase for the digital filter at the frequency 
\[ \omega = 0.425\pi \] [1 mark]
Problem 3 [13 marks]
Given that \( h(n) = \{1, 2, 3, 3, 2, 1\} \) with DFT: \( H(K) = \{12, -3 - j1.7321, 0, 0, 0, -3 + j1.7321\} \)

a) Sketch the most-simplified direct-form realization. [5 marks]

b) If \( \alpha = 0 \), sketch the most simplified frequency-sampling realization. [7 marks]
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Problem 3

a) If \( z(k) = \{4.0, 1.0 - j1.0, -2.1 + 1j\} \), by using the IFFT \textit{decimation in frequency} method, find \( z(n) \).

b) If the DFT for \( x(n) = \{0, 1, 2, 3, 0, 0, 0, 0\} \) is

\[
X(k) = \{6, 5.0313e^{-j106^\circ}, 2.8284e^{j135^\circ}, 1.639e^{-j30.36^\circ}, 2e^{j180^\circ}, 1.639e^{j30.36^\circ}, 2.8284e^{-j135^\circ}, 5.0313e^{j106^\circ}\}
\]

Find the DFT for \( c(n) = \{2, 3, 0, 0, 0, 0, 0, 1\} \)
c) For the system shown in the graph,

\[ x(n) \rightarrow h(n) \rightarrow y(n) \]

\[ x(n) = \{0, 1, 2, 3\} \] and a three-tap linear filter has a system function of

\[ H(\omega) = 0.1871 + 0.2e^{-j\omega} + 0.1871e^{-j2\omega} \]

By means of discreet Fourier Transform for the system, find the DFT of the output which is \( Y(k) \). [8 marks]