Quiz 3

Consider a linear time-invariant (LTI) system with impulse response $h[n]$. When the input to the system is $2u[n]$, the output is $y[n] = 3\delta[n-1] + 4\delta[n-3]$.

1. Determine $h[n]$.

\[ y[n] = 3u[n-1] - u[n-2] \]
\[ y[n] = 4u[n-3] - u[n-4] \]
\[ y[n] = 3\left(\frac{1}{2}x[n-1] - \frac{1}{2}x[n-2]\right) + 4\left(\frac{1}{2}x[n-3] - \frac{1}{2}x[n-4]\right) \]
\[ h[n] = 3\delta[n-1] - 3\delta[n-2] + 2\delta[n-3] - 2\delta[n-4] \]

2. Explain if the system is causal.

- It is causal as the output only depends on past or current inputs.

3. Is the system a finite impulse response (FIR) filter? If so, what is the filter order and what are the filter coefficients? If not, why not?

- This system is a FIR filter.

\[ b_k = \{0, \frac{3}{2}, -\frac{3}{2}, 2, -2\} \quad k = 0 \]

\[ M = 4 \]
Quiz 3

Consider a linear time-invariant (LTI) system with impulse response $h[n]$. When the input to the system is $2u[n]$, the output is $y[n] = 2\delta[n-2] + 4\delta[n-3]$.

1. Determine $h[n]$.

$$y[n] = 2(u[n-2] - u[n-3]) + 4(u[n-3] - u[n-4])$$


$$\Rightarrow h[n] = 6\delta[n-2] + 8\delta[n-3] - 2\delta[n-4]$$

2. Explain if the system is causal.

It is causal as the output $y$ depends only on past or current inputs.

3. Is the system a finite impulse response (FIR) filter? If so, what is the filter order and what are the filter coefficients? If not, why not?

The system is a FIR filter

$$b_n = \begin{cases} 0 & n \leq 0 \\ 1 & n = 2 \\ -2 & n = 3 \\ 0 & n > 3 \end{cases} \quad M = 4$$
Quiz 3

Consider a linear time-invariant (LTI) system with impulse response $h[n]$. When the input to the system is $2u[n]$, the output is $y[n] = 2\delta[n - 1] + 4\delta[n - 4]$.

1. Determine $h[n]$.

$$
\begin{align*}
Y[n] &= 2U[n] \Rightarrow Y[n] = 2\delta[n-1] + 4\delta[n-4] \\
\hat{y}[n] &= 2(u[n-1] - u[n-2]) + 4(u[n-4] - u[n-5]) \\
\Rightarrow h[n] &= 2\delta[n-1] - 8\delta[n-2] + 28\delta[n-4] - 28\delta[n-5] \\
\end{align*}
$$

2. Explain if the system is causal.

It is causal as the output $y$ depends only on past or current inputs.

3. Is the system a finite impulse response (FIR) filter? If so, what is the filter order and what are the filter coefficients? If not, why not?

This system is a FIR filter.

$$
\begin{align*}
K &= \{0, 1, -10, 2, -23\} \\
M &= 5 \\
K &= 0
\end{align*}
$$