1. A system is given by
   \[ y[n] = x[n] + x[n+2] + x[n-4]. \]
   (a) What is the impulse response of this system?
   (b) Compute the output signal of the system if the input signal is given by
   \[ x[n] = \begin{cases} 
   3^{-n} & \text{if } n \geq 0 \\
   0 & \text{if } n < 0 
   \end{cases} \]
   (c) Using Matlab, plot the output signal \( y[n] \) that you computed above as a function of \( n \) for \( n \) in the range \([-100, 100]\).
   (d) What is the order of this system?
   (e) Is this system causal? Is it an FIR system?

2. The impulse response of an LTI (linear time-invariant) system is known to be
   \[ h[n] = 2\delta[n] + \delta[n-1] + 0.2\delta[n-2]. \]
   (a) Compute the output signal \( y[n] \) when the input signal is given by
   \[ x[n] = \delta[n] + \delta[n+2] + \delta[n+4] \]
   (b) Plot the signals \( x[n] \) and \( y[n] \) using Matlab.

3. When the input signal \( x[n] \) given by
   \[ x[n] = \sum_{k=0}^{\infty} 2^{-k}\delta[n-k] \]
   is applied to an unknown LTI system, the output signal is observed to be
   \[ y[n] = \delta[n] + 5 \sum_{k=1}^{\infty} \delta[n-k]. \]
   Find the impulse response of the system using the following steps:
(a) Prove that
\[ \delta[n] = x[n] - 0.5x[n - 1] \]

(b) Knowing the output signal when the input signal is \( x[n] \), compute the output signal when the input signal is \((x[n] - 0.5x[n - 1])\).

Also, find the equation relating \( y[n] \) and \( x[n] \).

4. Consider the interconnection of systems shown below.

The signal \( x[n] \) is passed in as input to both System 1 and System 2. The resulting output signals of System 1 and System 2 are added together and passed in as input to System 3. The output of System 3 is the output of the overall system. The impulse responses of Systems 1, 2, and 3 are \( h_1[n] \), \( h_2[n] \), and \( h_3[n] \) given below:

\[
\begin{align*}
    h_1[n] &= \delta[n] + \delta[n - 1] + 2\delta[n - 2] \\
    h_2[n] &= 0.1\delta[n + 3] + \delta[n - 4] \\
    h_3[n] &= \sum_{k=0}^{\infty} 4^{-k}\delta[n - k].
\end{align*}
\]

(a) Find the impulse response of the overall system.

(b) Express the output signal \( y[n] \) in terms of the input signal \( x[n] \).

(c) Is the overall system LTI?