Assignment no 03: Chapter 3

Note: You can check the exercises after the book Chapter.
In our assignment, we are using the first edition of "Signals and Systems: A MATLAB Integrated Approach" By Oktay Alkin.

Problems

3.1. A number of discrete-time systems are specified below in terms of their input-output relationships. For each case **determine** if the system is linear and/or time-invariant.

a. $y[n] = x[n]\,u[n]$

c. $y[n] = 3\,x[n] + 5\,u[n]$

e. $y[n] = \cos(0.2\pi n)\,x[n]$

f. $y[n] = x[n] + 3\,x[n-1]$

3.2. **Determine** if the system is linear or not.

b. $y[n] = \sum_{k=0}^{n} x[k]$

3.3. **Consider** the cascade combination of two systems shown in Fig. P.3.3(a).

Figure P. 3.3

a. **Let** the input-output relationships of the two subsystems be given as

$$\text{Sys}_1\{x[n]\} = 3\,x[n] \quad \text{and} \quad \text{Sys}_2\{w[n]\} = w[n-2]$$

Write the relationship between $x[n]$ and $y[n]$.

b. **Let** the order of the two subsystems be changed as shown in Fig. P.3.3(b).

Write the relationship between $x[n]$ and $\bar{y}[n]$.

Does changing the order of two subsystems change the overall input-output relationship of the system?

3.5. The response of a linear and time-invariant system to the input signal $x[n] = \delta[n]$ is given by

$$\text{Sys}\{\delta[n]\} = \{\ \underset{\uparrow}{2}_{n=0},\ 1,\ -1\ \}$$

Determine the response of the system to the following input signals:

a. $x[n] = \delta[n] + \delta[n-1]$

b. $x[n] = \delta[n] - 2\,\delta[n-1] + \delta[n-2]$

c. $x[n] = u[n] - u[n-5]$

3.7. The discrete-time signal is used as input to a length-2 moving average filter.

$$x[n] = \{\ \underset{\uparrow}{1.7}_{n=0},\ 2.3,\ 3.1,\ 3.3,\ 3.7,\ 2.9,\ 2.2,\ 1.4,\ 0.6,\ -0.2,\ 0.4\ \}$$

Determine the response $y[n]$ for $n = 0, \ldots, 9$. **Use** $x[-1] = 0$.

3.25. For each system described below, **determine** whether the system is causal and/or stable.

a. $y[n] = \text{Sys}\{x[n]\} = \sum_{k=-\infty}^{n} x[k]$

c. $y[n] = \text{Sys}\{x[n]\} = \sum_{k=0}^{n} x[k] \qquad \text{for } n \geq 0$

e. $y[n] = \text{Sys}\{x[n]\} = \sum_{k=n-10}^{n+10} x[k]$

Examples

Example 3.19: A discrete-time system is described through the impulse response

$$h[n] = \{\ \underset{\uparrow}{4}_{n=0},\ 3,\ 2,\ 1\ \}$$

Use the convolution operation to find the response of the system to the input signal

$$x[n] = \{\ \underset{\uparrow}{-3}_{n=0},\ 7,\ 4\ \}$$