Lecture 3 Exercises on Signals

Write your answer clearly with complete solutio and graphs. Submit your work in pdf form.

3.1. Sketch each of the following special digital sequences:

a. $5\delta(n)$

b. $-2\delta(n-5)$

c. $-5u(n)$

d. $5u(n-2)$

3.2. Calculate the first eight sample values and sketch each of the following sequences:

a. $x(n) = 0.5^n u(n)$

b. $x(n) = 5\sin(0.2\pi n)u(n)$

c. $x(n) = 5\cos(0.1\pi n + 30^0)u(n)$

d. $x(n) = 5(0.75)^n \sin(0.1\pi n)u(n)$

3.3. Sketch the following sequences:

a. $x(n) = 3\delta(n+2) - 0.5\delta(n) + 5\delta(n-1) - 4\delta(n-5)$

b. $x(n) = \delta(n+1) - 2\delta(n-1) + 5u(n-4)$

3.4. Given the digital signals $x(n)$ in Figures 3.24 and 3.25, write an expression for each digital signal using the unit-impulse sequence and its shifted sequences.

3.5. Assuming that a DS processor with a sampling time interval of 0.01 second converts each of the following analog signals $x(t)$ to the digital signal $x(n)$, determine the digital sequences for each of the following analog signals.

a. $x(t) = e^{-50t}u(t)$

b. $x(t) = 5\sin(20\pi t)u(t)$

ns

c. $x(t) = 10\cos(40\pi t + 30^0)u(t)$

d. $x(t) = 10e^{-100t}\sin(15\pi t)u(t)$

3.6. Determine which of the following is a linear system.

a. $y(n) = 5x(n) + 2x^2(n)$

b. $y(n) = x(n-1) + 4x(n)$

c. $y(n) = 4x^3(n-1) - 2x(n)$

3.7. Given the following linear systems, find which one is time invariant.

a. $y(n) = -5x(n-10)$

b. $y(n) = 4x(n^2)$

3.8. Determine which of the following linear systems is causal.

a. $y(n) = 0.5x(n) + 100x(n-2) - 20x(n-10)$

b. $y(n) = x(n+4) + 0.5x(n) - 2x(n-2)$

3.9. Determine the causality for each of the following linear systems.

a. $y(n) = 0.5x(n) + 20x(n-2) - 0.1y(n-1)$

FIGURE 3.24 **The first digitial signal in Problem 3.4.**

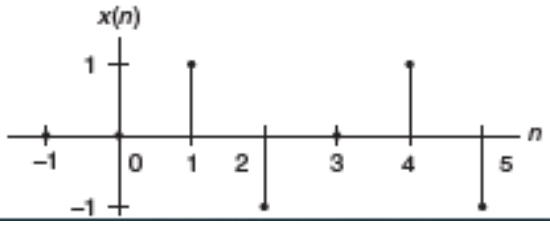

Figure 3.25 **The first digital signal in Problem 3.5**

b. $y(n) = x(n+2) - 0.4y(n-1)$

c. $y(n) = x(n-1) + 0.5y(n+2)$

3.10. Find the unit-impulse response for each of the following linear systems.

a. $y(n) = 0.5x(n) - 0.5x(n-2)$; for $n \geq 0$, $x(-2) = 0$, $x(-1) = 0$

b. $y(n) = 0.75y(n-1) + x(n)$; for $n \geq 0$, $y(-1) = 0$

c. $y(n) = -0.8y(n-1) + x(n-1)$; for $n \geq 0$, $x(-1) = 0$, $y(-1) = 0$

3.11. For each of the following linear systems, find the unit-impulse response, and draw the block diagram.

a. $y(n) = 5x(n-10)$

b. $y(n) = x(n) + 0.5x(n-1)$

3.12. Determine the stability for the following linear system.

$$y(n) = 0.5x(n) + 100x(n-2) - 20x(n-10)$$

3.13. Determine the stability for each of the following linear systems.

a. $y(n) = \sum_{k=0}^{\infty} 0.75^k x(n-k)$

b. $y(n) = \sum_{k=0}^{\infty} 2^k x(n-k)$

3.14. Given the sequence

$$h(k) = \begin{cases} 2, & k = 0,1,2 \\ 1, & k = 3,4 \\ 0 & \textit{elsewhere}, \end{cases}$$

where k is the time index or sample number,

a. sketch the sequence $h(k)$ and the reverse sequence $h(-k)$;

b. sketch the shifted sequences $h(-k+2)$ and $h(-k-3)$.