

Homework Assignment #5

1. For each of the following systems, find an expression for the impulse response $h(k)$ by iterating until you see a pattern.

(a) $y(k) = \frac{1}{E - 0.25} \{x(k)\}$ [Ans: $h(k) = (0.25)^{k-1}u_s(k-1)$.]

(b) $y(k) = \frac{1}{E(E - 0.25)} \{x(k)\}$

(c) $y(k) = \frac{1}{E^2 + 2E + 1} \{x(k)\}$

2. Find the simulation diagrams and transfer functions of the systems having the following impulse responses:

(a) $h(k) = \begin{cases} 1, & k = 2 \\ 0, & k \neq 2 \end{cases}$

(b) $h(k) = \begin{cases} 1, & k \geq 0 \\ 0, & k < 0 \end{cases}$

(c) $h(k) = \begin{cases} 1, & k \geq 1 \\ 0, & k < 1 \end{cases}$

(d) $h(k) = \begin{cases} 1, & k \geq 2 \\ 0, & k < 2 \end{cases}$

(e) $h(k) = \begin{cases} 3, & k = 0 \\ 2, & k = 1 \\ 1, & k = 2 \\ 0 & \text{otherwise} \end{cases}$

3. Use a convolutional sum to find the zero-state response of an LTI system to a unit step sequence if the system impulse response is

(a) $h(k) = \begin{cases} 1, & k \geq 0 \\ 0, & k < 0 \end{cases}$

(b) $h(k) = \begin{cases} 1, & k = 0 \\ 2, & k = 1 \\ 3, & k = 2 \\ 0 & \text{otherwise} \end{cases}, \quad [h(k) = \begin{cases} 1, & k = 1 \\ 2, & k = 2 \\ 3, & k = 3 \\ 0 & \text{otherwise} \end{cases}]$

(c) $h(k) = \begin{cases} (0.9)^k, & k \geq 0 \\ 0, & k < 0 \end{cases}$ [Ans: $y(k) = 10 u_s(k) - 9(0.9)^k u_s(k)$.]

(See Problem 4 on reverse.)

4. (a) Plot the impulse response and the step response of the discrete-time system whose operational transfer function is

$$H_1(E) = \frac{E}{E - 0.5}.$$

- (b) Plot the impulse response and the step response of the discrete-time system whose operational transfer function is

$$H_2(E) = \frac{E^4 + 0.5E^3 + 0.25E^2 + 0.125E + 0.0625}{E^4}.$$