## Problems for Signals and Systems

### Chapter 3. Time Domain Analysis of Discrete Time System

- **Solve Difference Equation**

1. Solve difference equation $y(n) - y(n-1) = n^2$, $y(-1) = 0$.

(a) Use the iterative method to successively obtain numerical solution. for $n \geq 0$, induce a closed-form solution.

(b) Use the classical method to obtain homogeneous and particular solution respectively. Determine the assumption of the functional expression of particular solution.

2. What are the zero-input responses, zero-state responses and complete responses of the LTI systems described by the following difference equations?

(1) $y(n) + 3y(n-1) + 2y(n-2) = x(n)$

$x(n) = u(n), y(-1) = 1, y(-2) = 0$;

(2) $y(n) - y(n-1) - 2y(n-2) = x(n) + 2x(n-2)$

$x(n) = u(n), y(-1) = 2, y(-2) = -\frac{1}{2}$.

3. One LTI discrete time system has a certain initial state. When the excitation is $x(n)$, the system's complete response is $y_1(n) = [1 + (\frac{1}{2})^n]\ \varepsilon(n)$; keeping the same initial state, when the excitation is $[-x(n)]$, the system's complete response is $y_2(n) = [\left(-\frac{1}{2}\right)^n - 1]\ \varepsilon(n)$. What is the complete response $y(n)$ when system's initial state is doubled, and the excitation is $4x(n)$?

- **Convolution Operation**

4. Compute the convolutions of the following signals:

(1) $2^n u(n) * 3^n u(n)$;

(2) $2^{-n} u(-n) * 3^{-n} u(-n)$.

5. Compute the convolutions of the following signals:

(1) $2^n u(n) * [u(n) - u(n-4)]$;

(2) $\cos\frac{n\pi}{2} * \{\sin\frac{n\pi}{2}[u(n) - u(n-5)]\}$.

- **Properties of Systems**

6. The following unit impulse responses belong to discrete-time LTI systems. Determine whether or not each of the following system is (1) causal system? (2) stable? State your reasons.

(a) $h(n) = (\frac{1}{2})^n u(n)$;

(b) $h(n) = (\frac{1}{2})^n u(-n)$;

(c) $h(n) = 3^n u(2-n)$;

(d) $h(n) = 3u(n)$.

7. For the compound system as shown in the Figure 3.1, it is known that $h_1(n) = u(n),\ h_2(n) = \delta(n),\ h_3(n) = \delta(n-N)$, and N is constant, what is the unit impluse response $h(n)$ of the compound system?

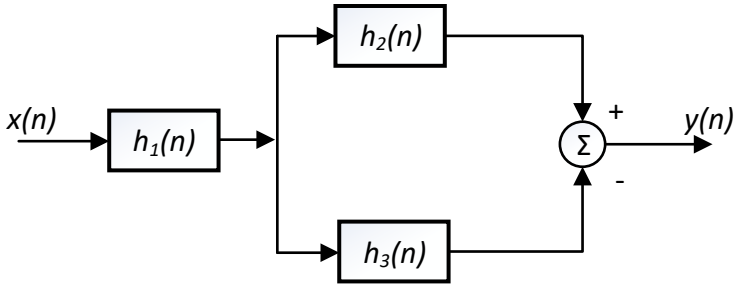


Figure 3.1