2.10 Problems

Q2-1 Sketch the following discrete-time signals for $0 \le n \le 8$:

(a)	$x(n) = \delta(n)$	(b)	$x(n) = 0.5\delta(n-2)$
(c)	$x(n) = u(n)$	(d)	$x(n) = 0.5u(n-3)$
(e)	$x(n) = u(n) - u(n-3)$	(f)	$x(n) = 2\delta(n) - 3\delta(n-1) + \delta(n-3)$
(g)	$x(n) = \{2, -3, 0, 1\}$	(h)	$x(n) = 3(0.5)^n u(n-2)$

Q2-2 A discrete signal is given as $x(n) = \delta(n-1) - 2\delta(n-2) + 4\delta(n-3)$. Sketch the following signals for $-6 \le n \le 6$:

(a)	$x(n-2)$	(b)	$x(n+3)$
(c)	$x(-n)$	(d)	$x(2-n)$

Q2-3 Write down the difference equations for the digital network shown in Figure 2.32 and Figure 2.33.

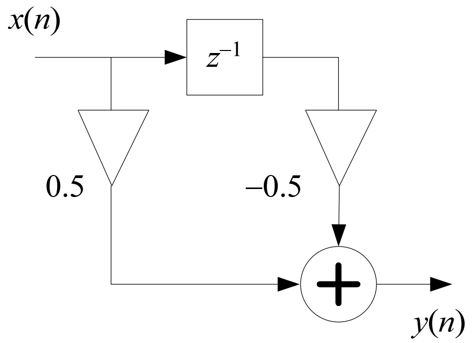

Figure 2.32 Digital network I

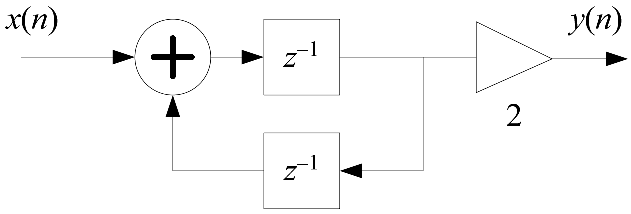

Figure 2.33 Digital network II

Q2-4 Draw the digital network for the system whose difference equation is:

$$y(n) = 0.5x(n) + 0.8x(n-1) + 0.7y(n-1) - 0.2y(n-2)$$

Q2-5 (a) Explain what the impulse response of a system means.

(b) A system is described by the difference equation,

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

Calculate, for $0 \le n \le 5$:

(i) The system impulse response, $h(n)$.

(ii) The output, $y(n)$, if $x(n) = \{1, 0.5, -2\}$.

Q2-6 For the digital system in Figure 2.33, determine the output of the system for $0 \le n \le 8$, assuming that $y(n) = 0$ when $n < 0$, if the input applied to the system is:

(a)	$x(n) = \delta(n)$	(b)	$x(n) = 2\delta(n) - 3\delta(n-1) + \delta(n-3)$

Q2-7 Find the impulse response of the system for $0 \le n \le 5$ whose difference equation is given by:

$$y(n) = 0.5x(n) + 0.8x(n-1) + 0.7y(n-1) - 0.2y(n-2)$$

Assume that $y(n) = 0$ when $n < 0$.

Q2-8 For the digital network shown in Figure 2.34, obtain the impulse response of the system for $0 \le n \le 10$. Assume that $t(n) = 0$ when $n < 0$.

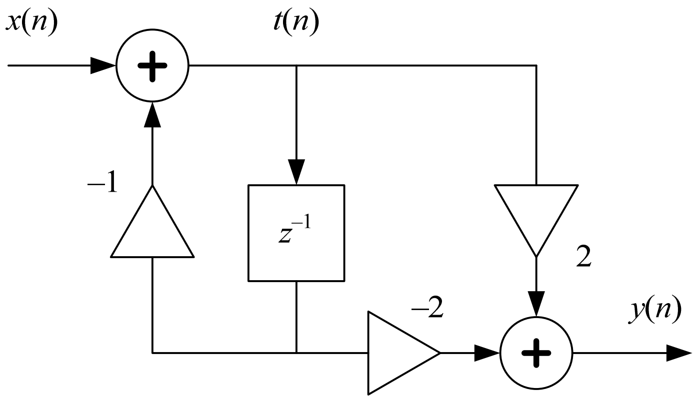

Figure 2.34 Digital network of a system

Q2-9* A digital system has its digital network shown in Figure 2.35.

(a) Derive the difference equation.

(b) Calculate its impulse response for $n = 0, \ldots, 3$ assuming that $y(n) = 0$ when $n < 0$.

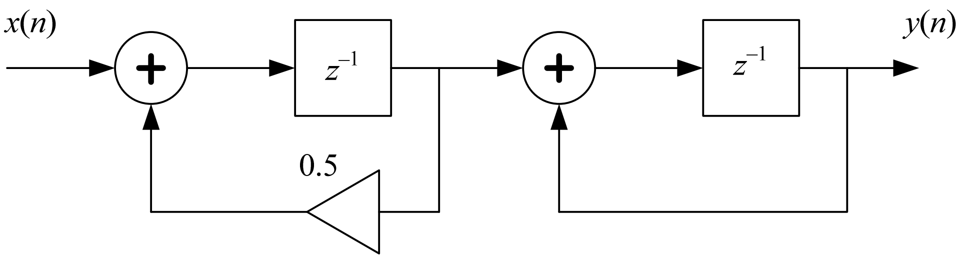

Figure 2.35 Digital network of a system

Q2-10* The difference equation of a digital system is given by:

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

Assume that $y(n) = 0$ when $n < 0$.

(a) Compute the impulse response of this system for $n = 0, \ldots, 7$.

(b) Based on the impulse response, what can you conclude about the stability of this system?

Q2-11* A linear time invariant system's response to a unit impulse is given by $y(n) = \left(\frac{1}{2}\right)^n u(n)$. Let $y_1(n)$ be the output of this system for a given input $x_1(n) = 4\delta(n) + \delta(n-2)$. What will be the value of $y_1(8)$?

Q2-12* A linear time invariant system's response to a unit step function is given as $y(n) = e^{-n}u(n)$. Determine the impulse response of this system and calculate the values of $y(0)$, $y(1)$ and $y(2)$.

Q2-13* Consider the discrete-time sequences given below:

(i) $x_1(n) = 2\delta(n-1) - 0.5\delta(n-2) - \delta(n-3)$

(ii) $x_2(n) = -4\delta(n) + 2\delta(n-2) - 2\delta(n-3)$

(iii) $h_1(n) = \delta(n) + 3\delta(n-1)$

(iv) $h_2(n) = 2\delta(n) - 2\delta(n-1) + \delta(n-2)$

Determine the following output sequences:

(a) $y(n) = h_1(n) * x_1(n)$

(b) $y(n) = h_2(n) * x_1(n)$

(c) $y(n) = x_2(n) * x_1(n)$

(d) $y(n) = [h_1(n) * h_2(n)] * x_1(n)$

(e) $y(n) = [h_1(n) + h_2(n)] * x_2(n)$

(f) $y(n) = [h_1(n) - h_2(n)] * [x_1(n) + x_2(n)]$

Q2-14* Determine the cross-correlation of the two sequences given as:

$x_1(n) = \delta(n) + 2\delta(n-1) - \delta(n-2) - 2\delta(n-3)$ and

$x_2(n) = 2\delta(n) - \delta(n-1)$.

At which lag index will the maximum correlation peak be obtained?

Q2-15* Determine the autocorrelation of the sequence $x_1(n)$ in Q2-13.