AL-MUSTAQBAL UNIVERSITY COLLEGE

Department of Biomedical Engineering

Dr. Zaidoon AL-Shammari

BME 322
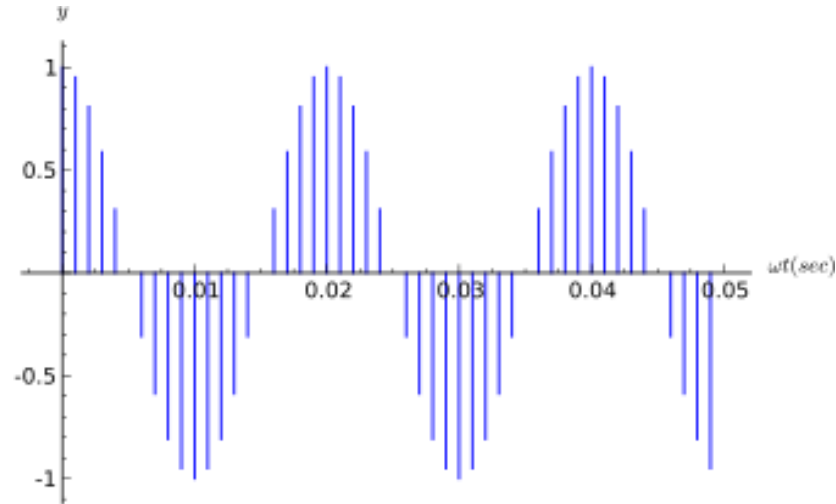# Signals and systems for BME

- 3 -
Discrete-Time Signals

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DISCRETE-TIME SIGNALS

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Learning Outcomes

Students are able to:
1. represent discrete-time signals in frequency domain.
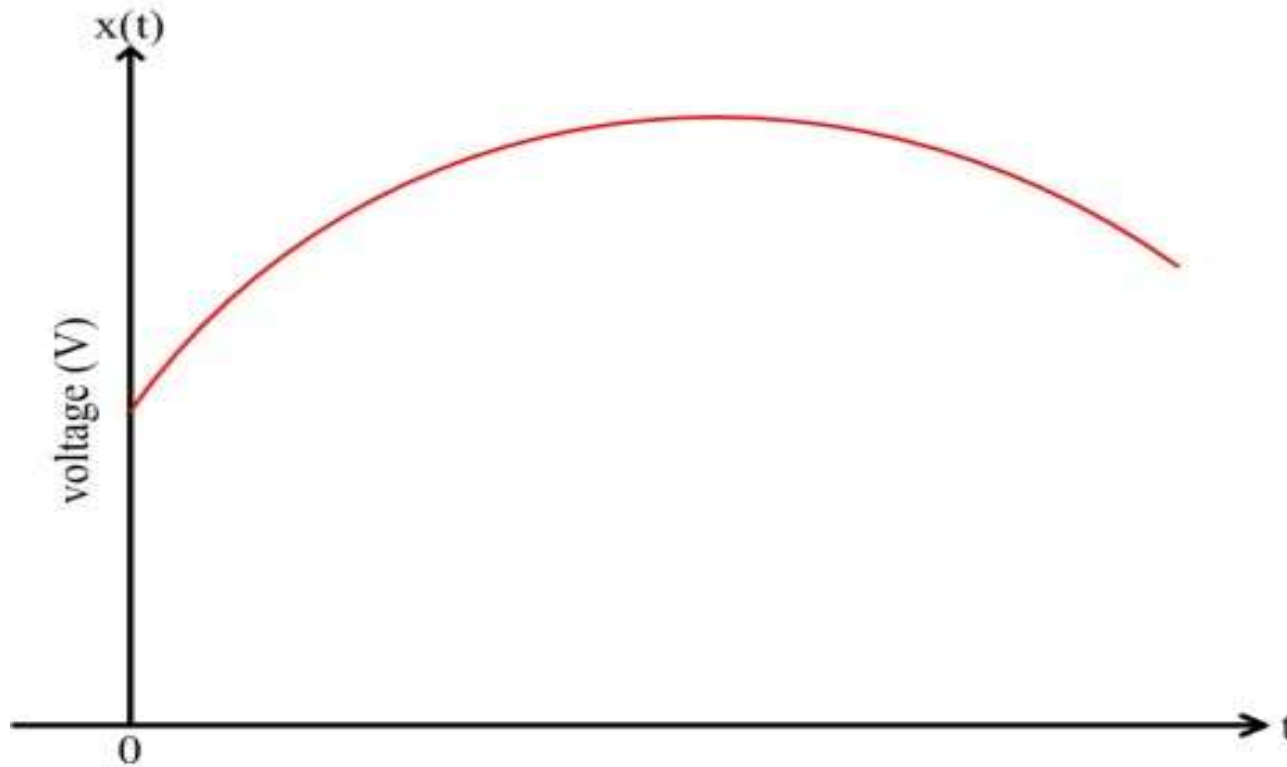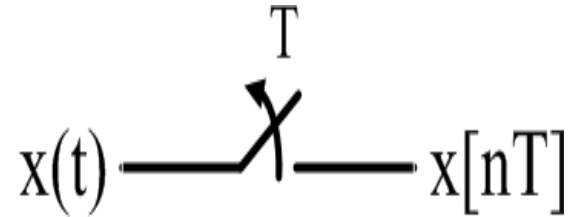2. perform basic operations on discrete-time signals.

Discrete-time Signals

- A discrete-time signal is defined only for discrete values of the independent variable at uniform intervals $t = nT$ where T is the interval between time samples and n is an integer.

- This signal, which is a sequence of numbers, may be obtained by sampling a continuous time signal.
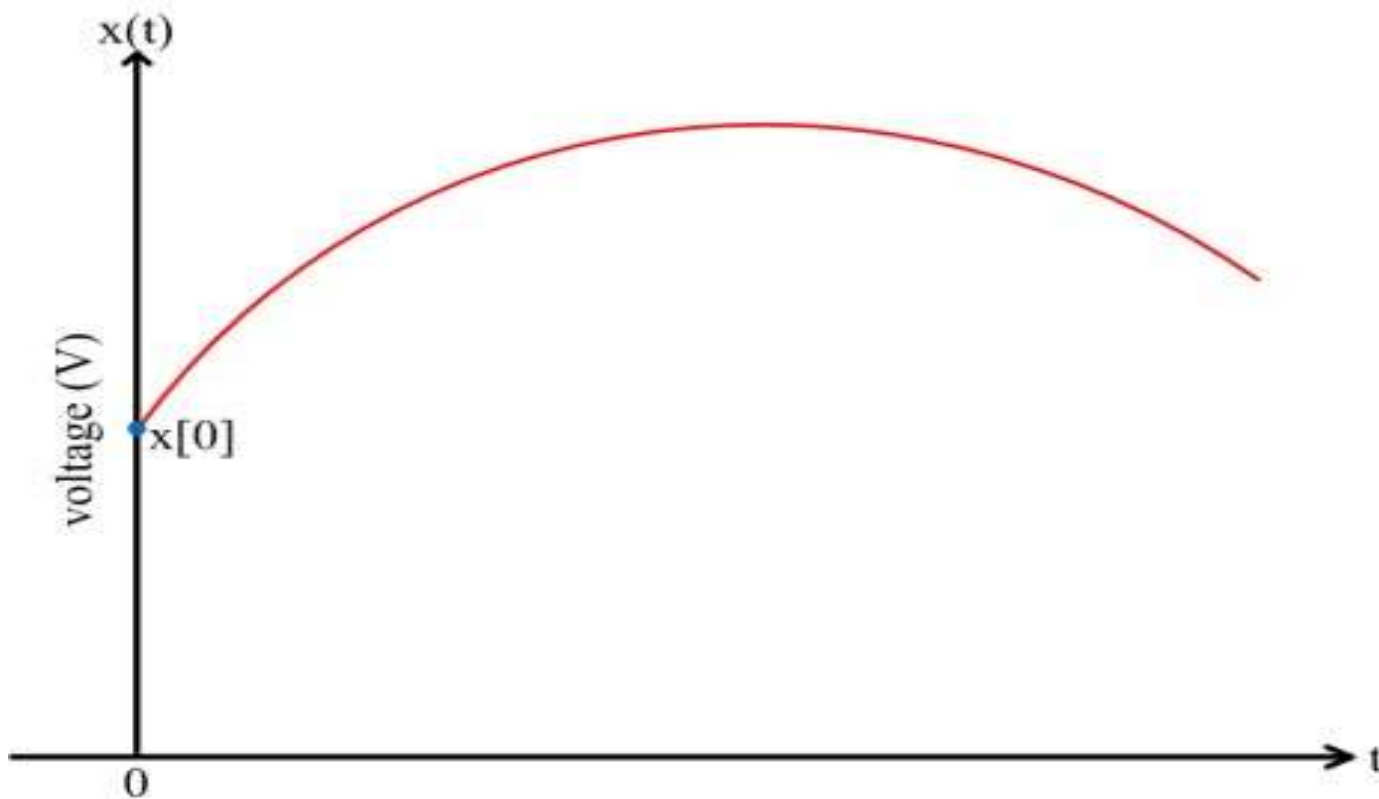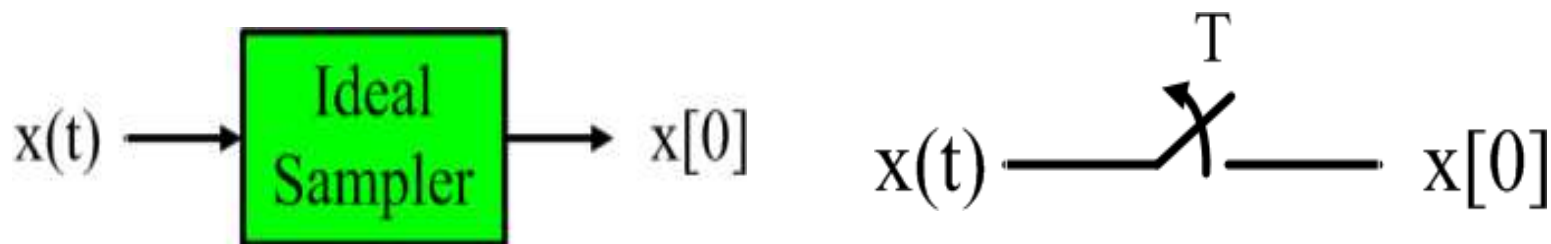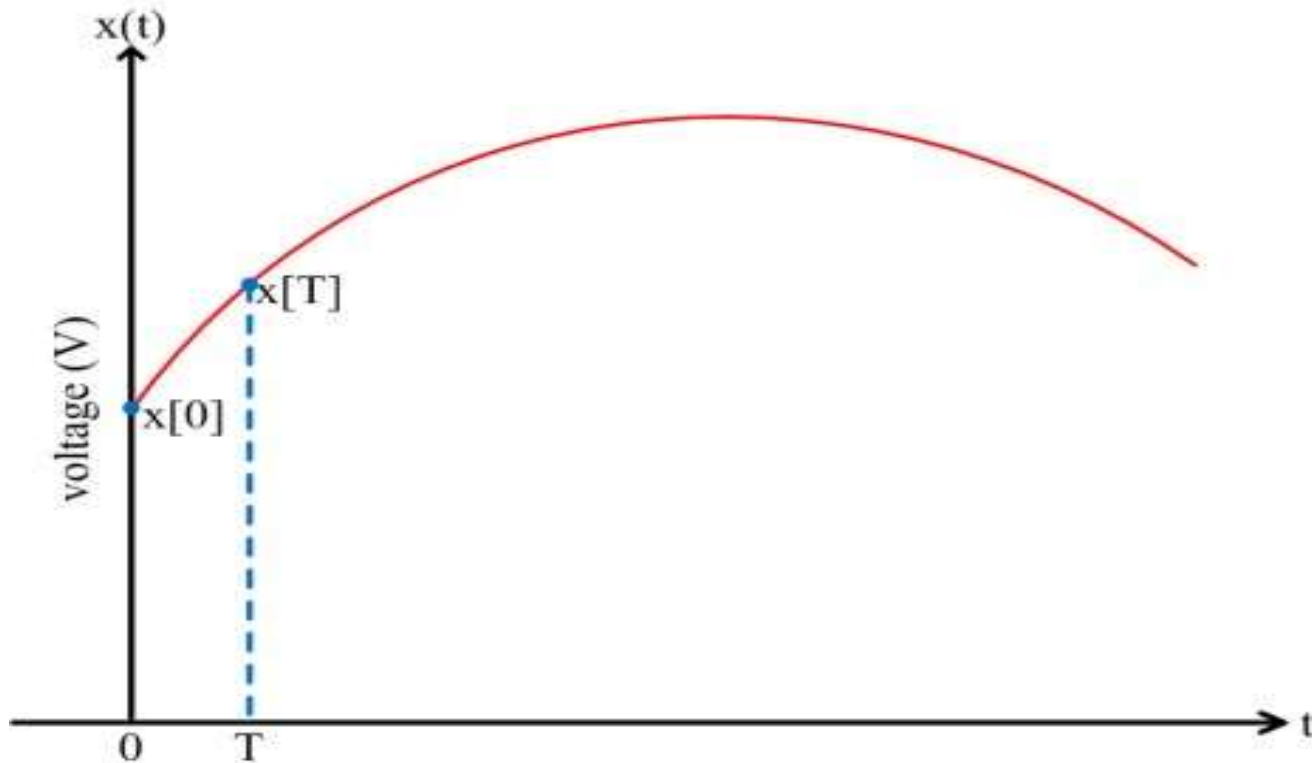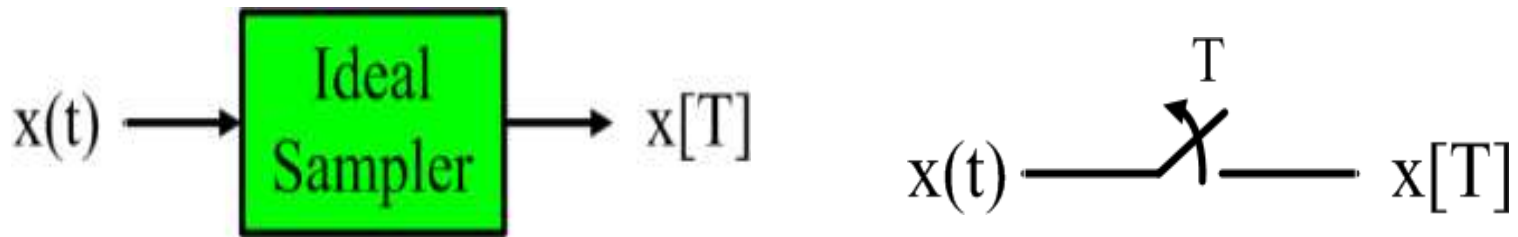
3

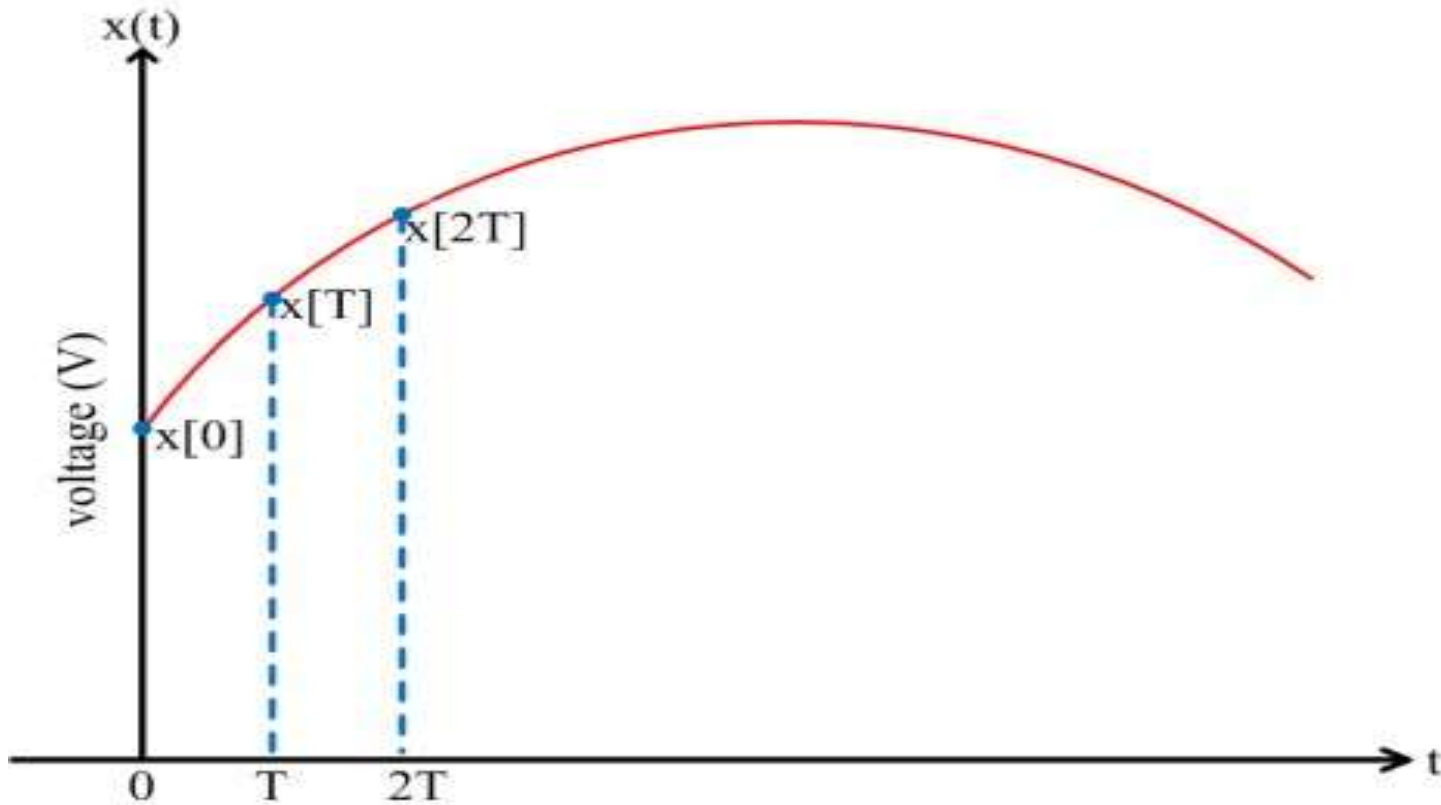# Sampling Process

Sampling Process

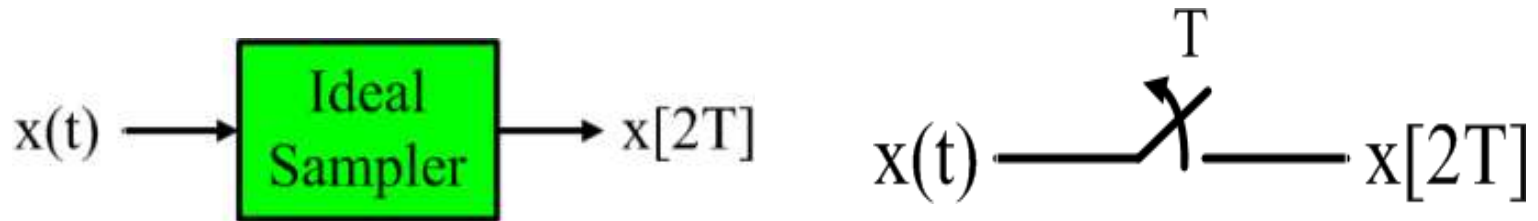# Sampling Process

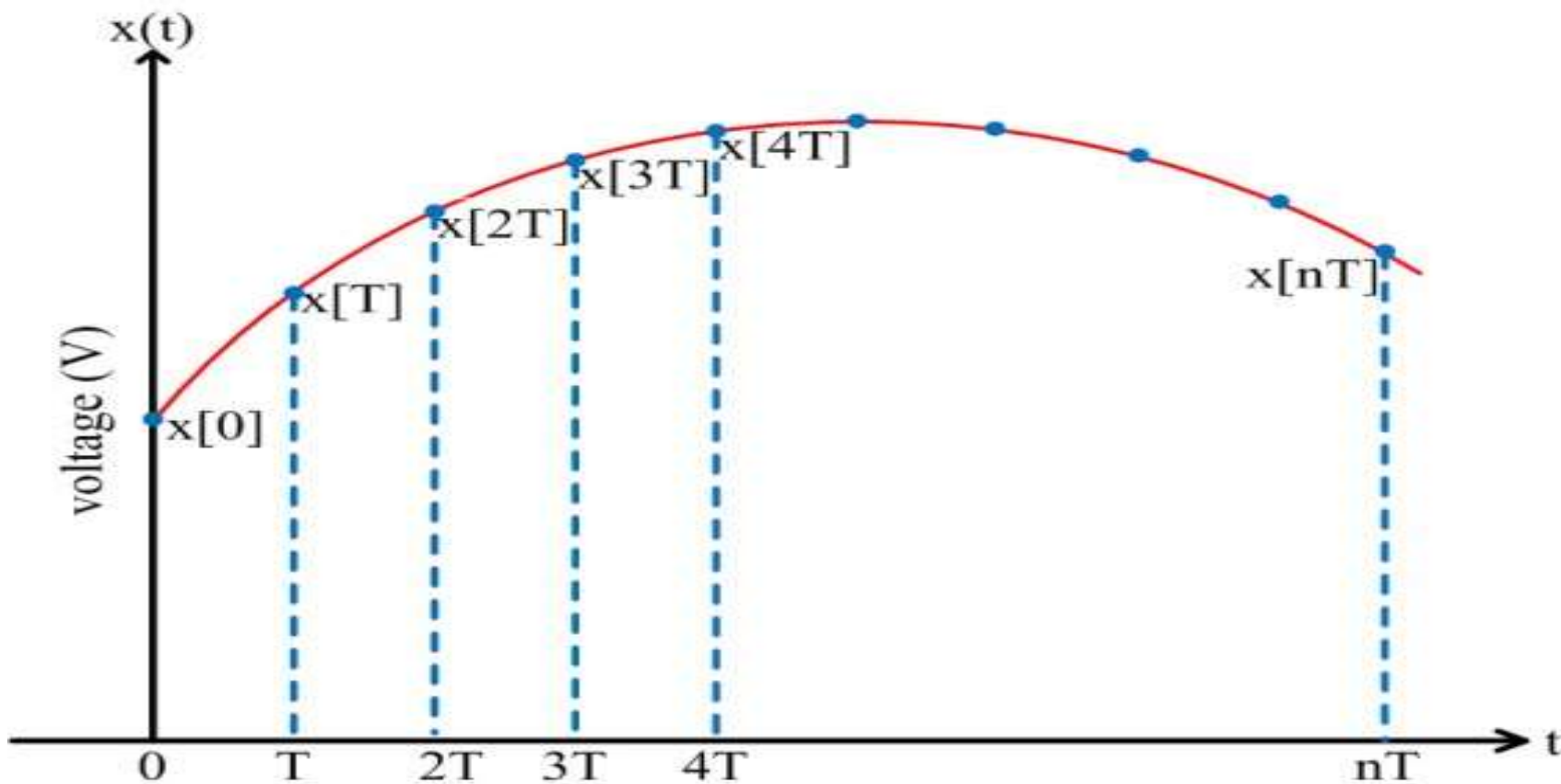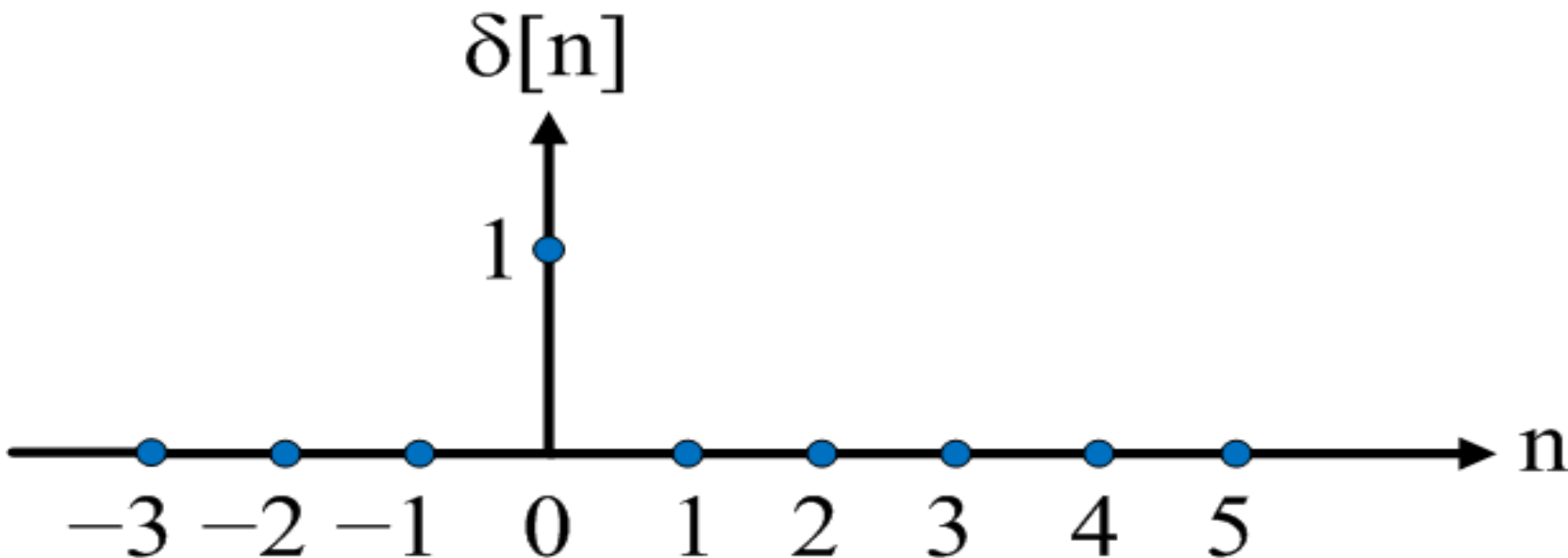# Sampling Process

Sampling Process

$$x[nT] = \{x[0], x[T], x[2T], \ldots x[nT]\}$$

- A discrete-time impulse or an impulse.

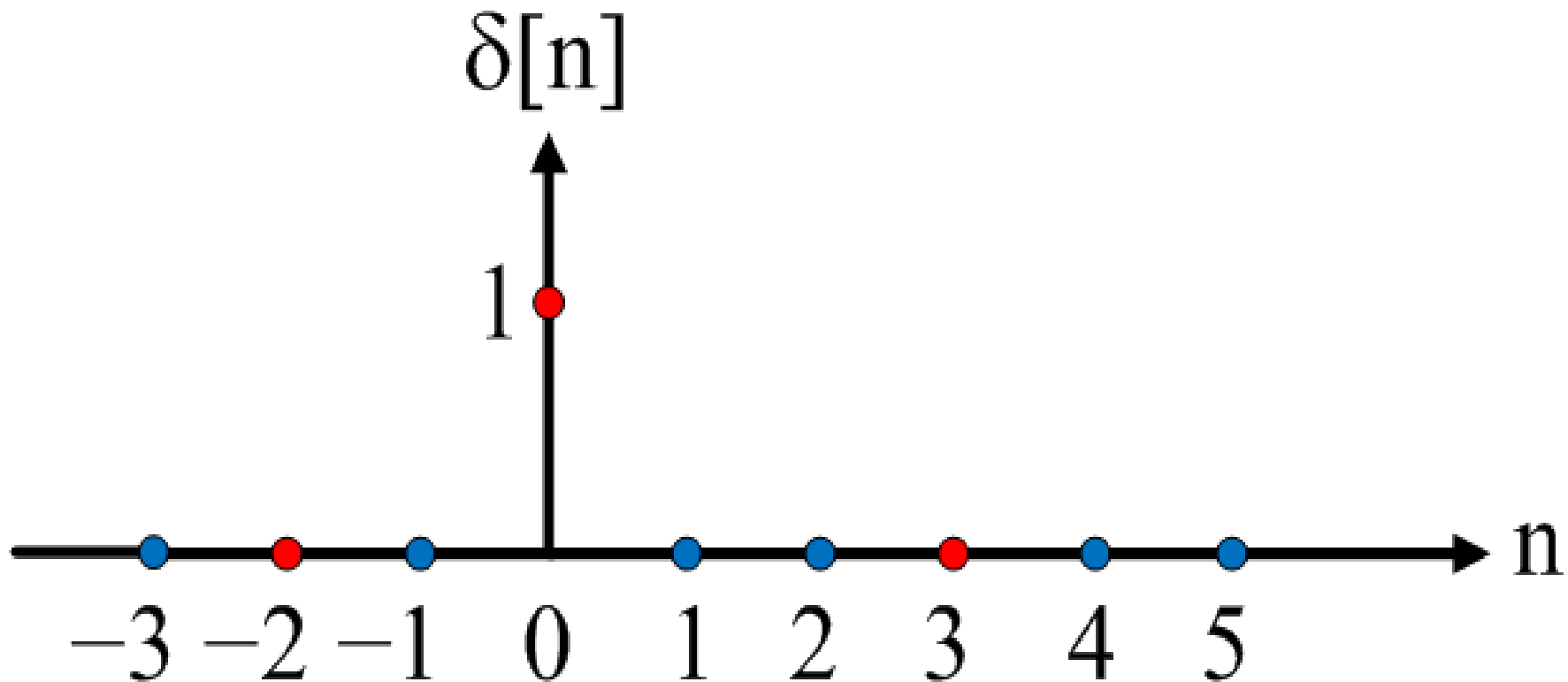$$\delta[n] = \begin{cases} 1 & n = 0 \\ 0 & n \neq 0 \end{cases}$$

Example 1

Determine the values δ[0], δ[3] and δ[−2].

δ[0] = 1, δ[3] = 0 and δ[−2] = 0

Example 2

Draw the signals:

(a) $x[n] = 48\delta[n]$

(b) $x[n] = -2\delta[n]$

(c) $x[n] = \delta[n-3]$
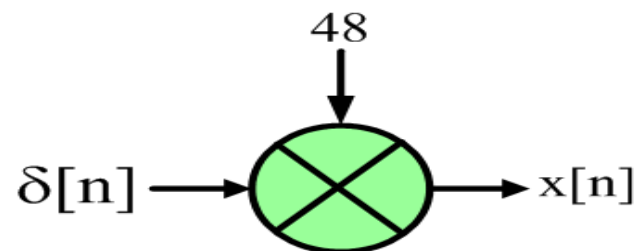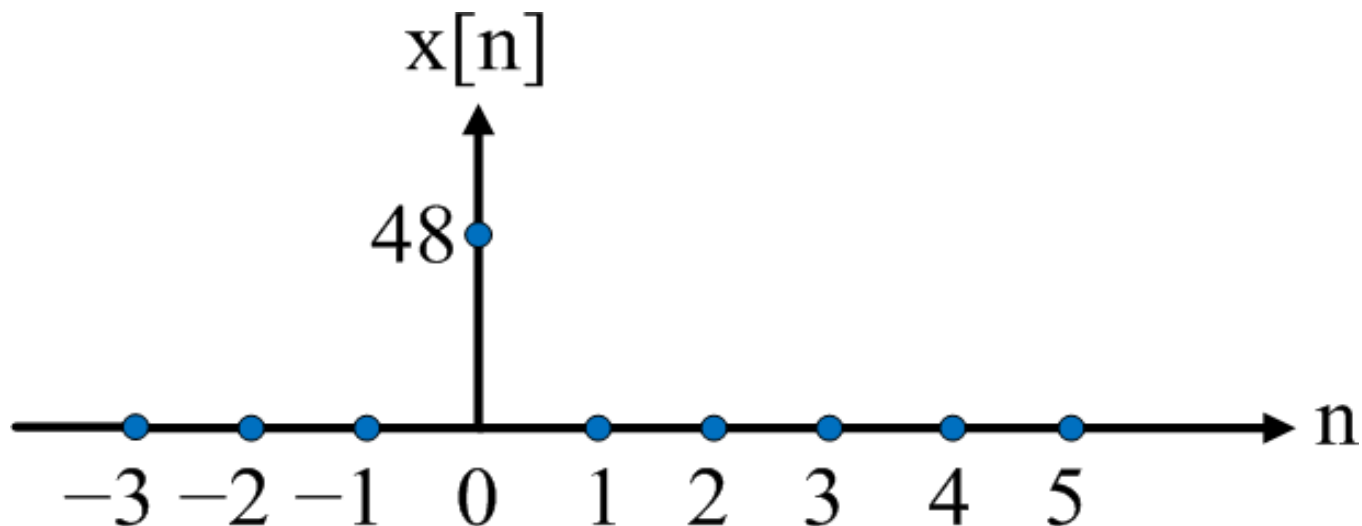
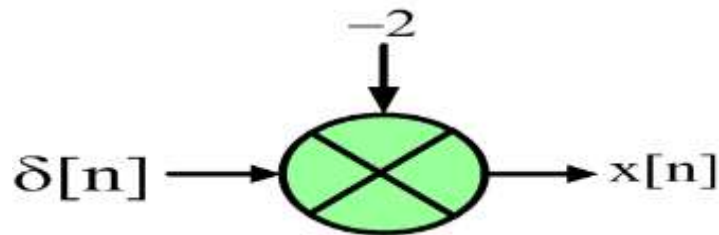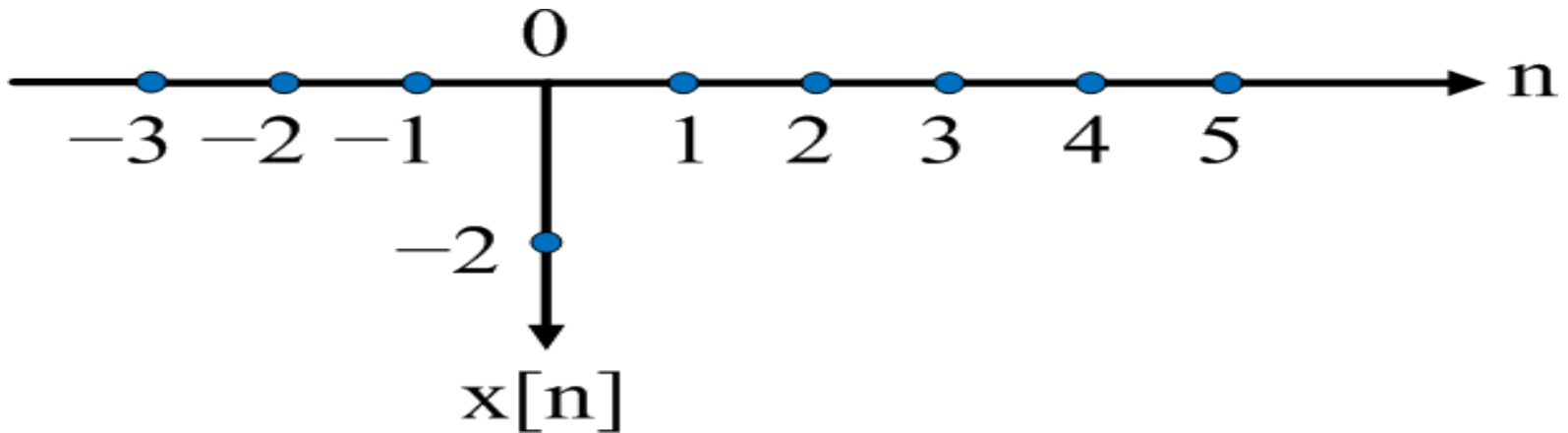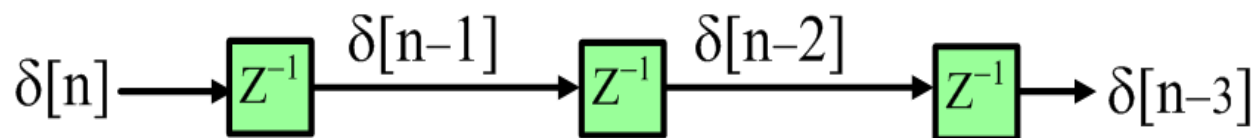(d) $x[n] = 5\delta[n] + 4\delta[n-1] - \delta[n-3]$
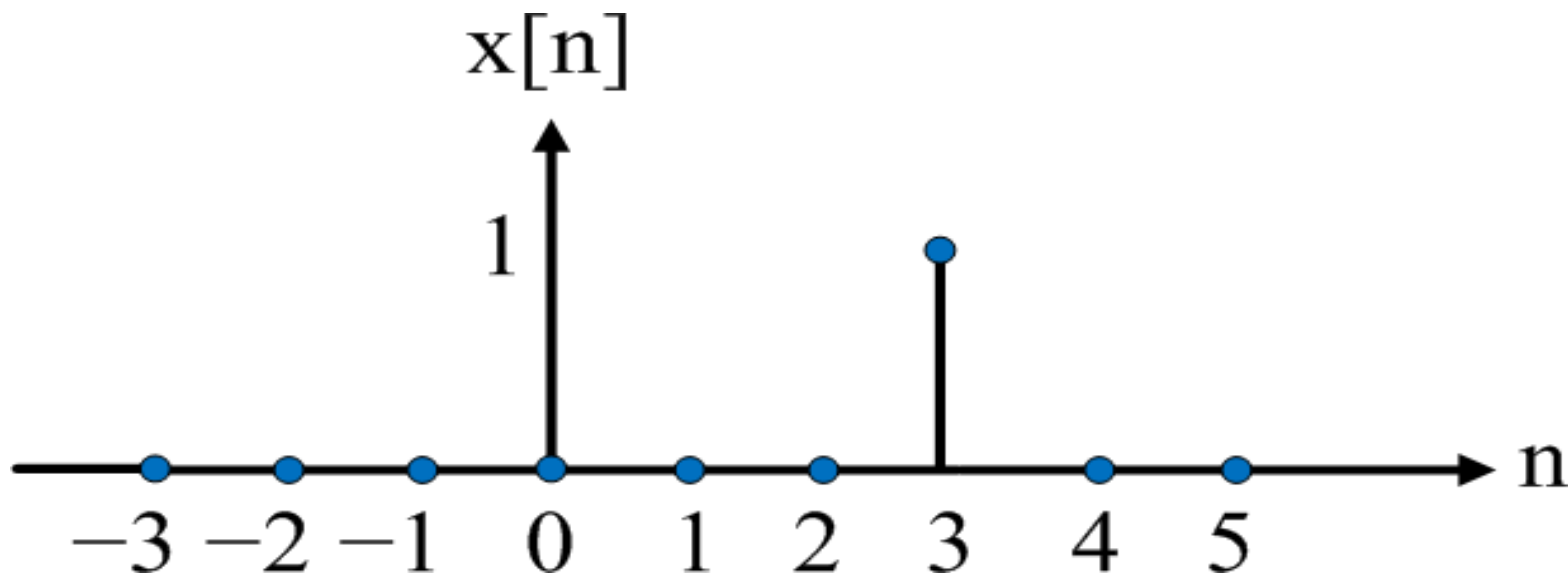
Example 2

(a) x[n] = 48δ[n]

Example 2

(b) $x[n] = -2\delta[n]$

Example 2

(c) x[n] = δ[n − 3]

Example 2
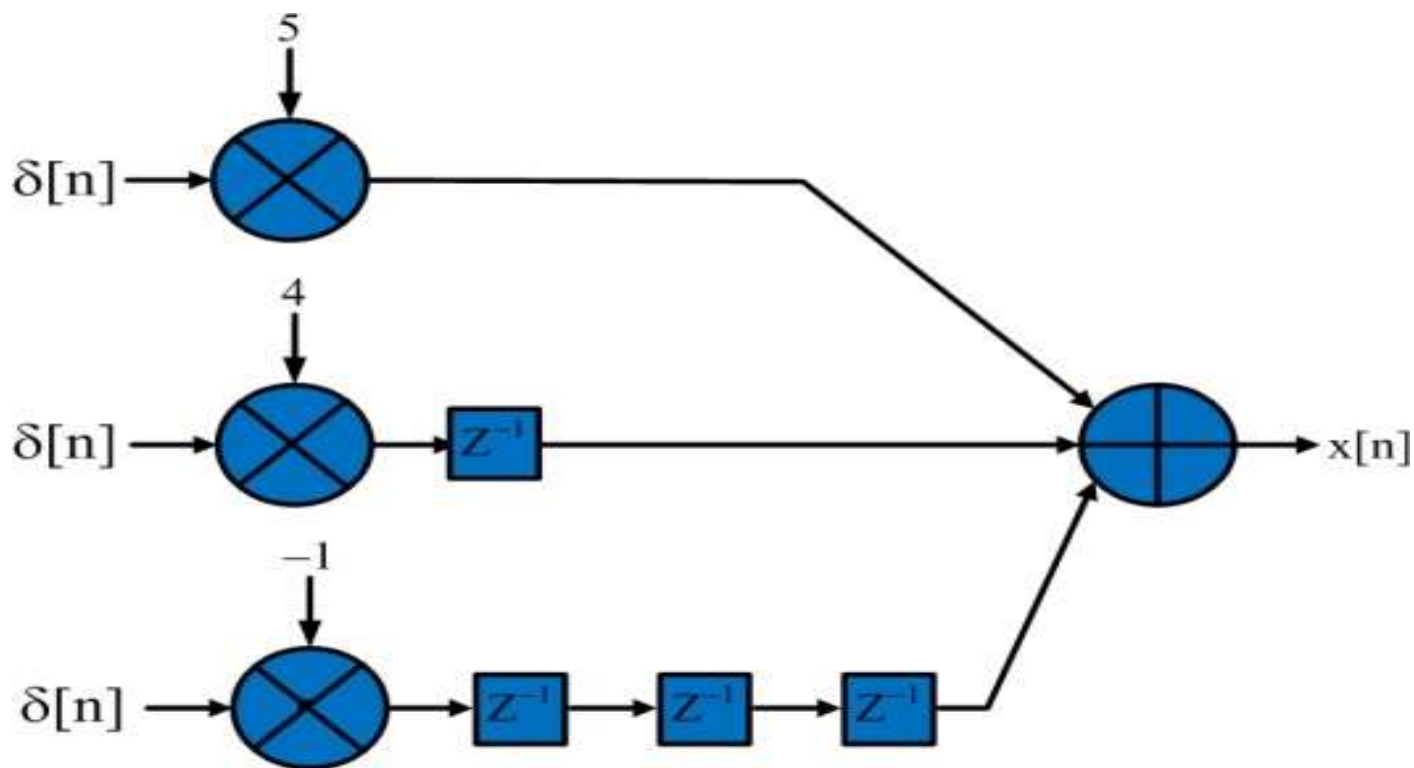
(d) $x[n] = 5\delta[n] + 4\delta[n - 1] - \delta[n - 3]$
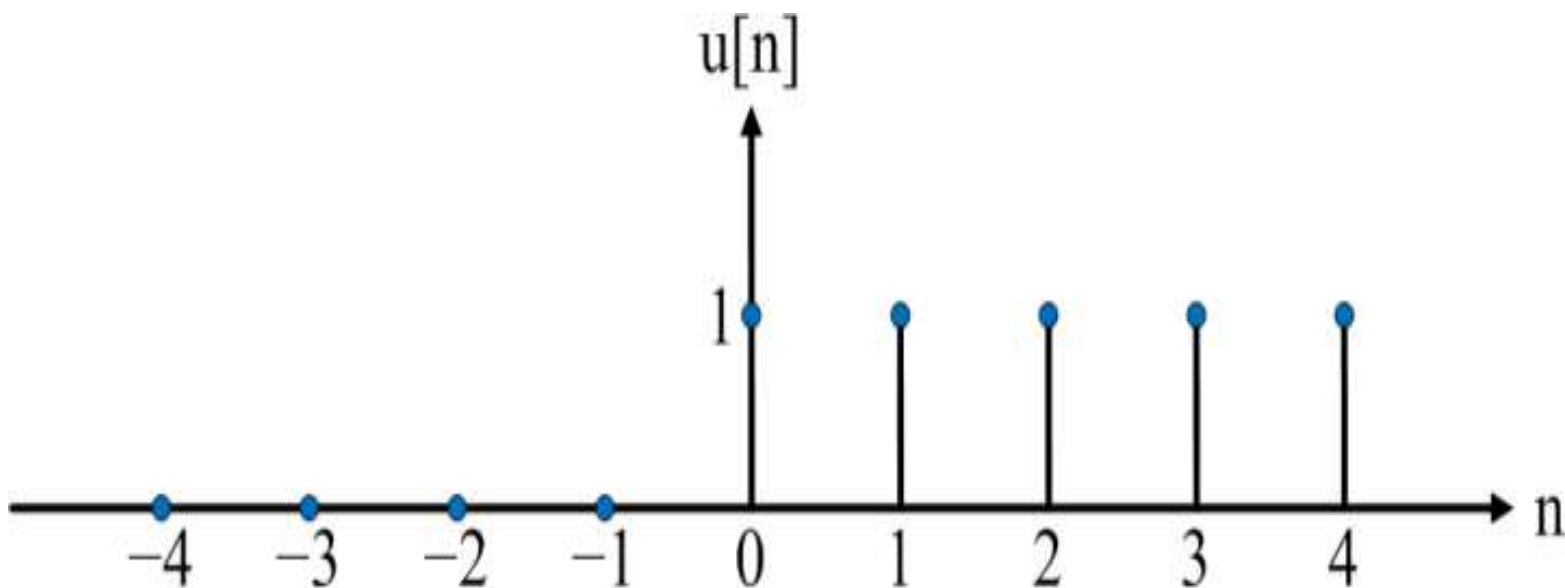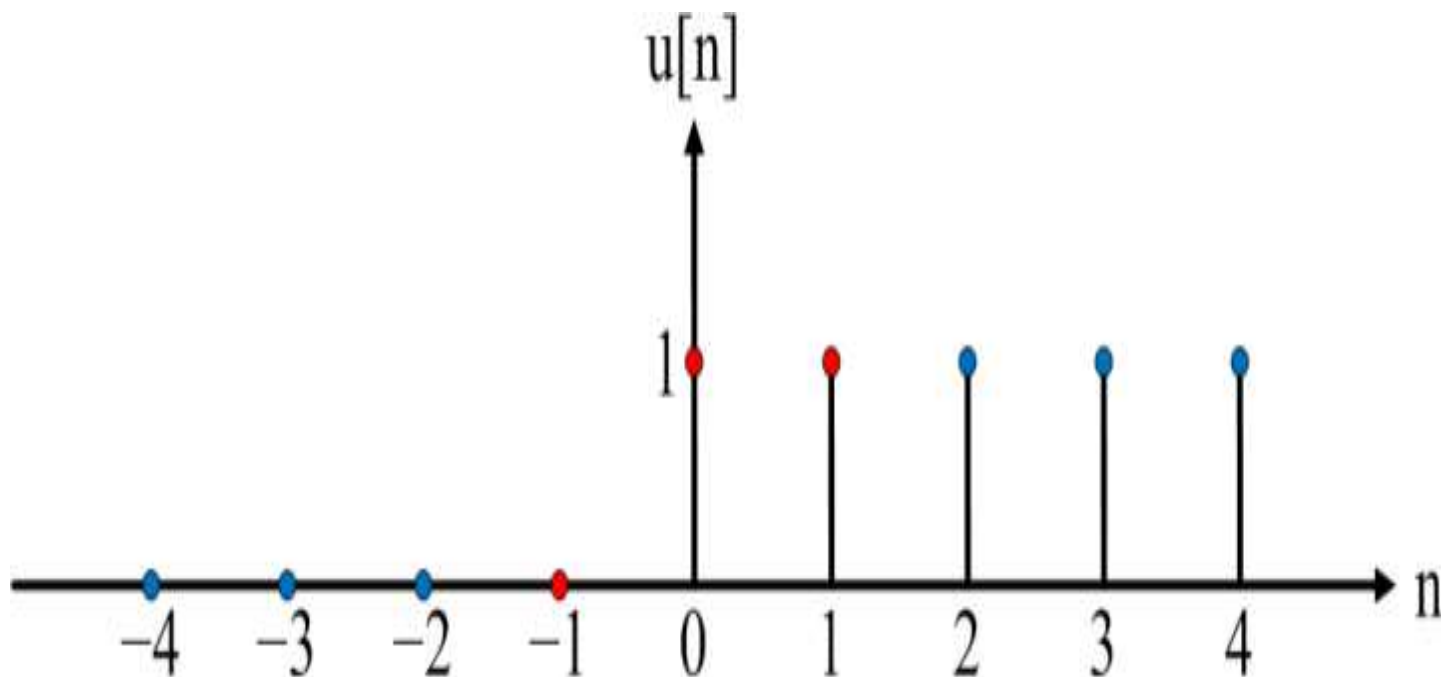
Example 2

(d) x[n] = 5δ[n] + 4δ[n − 1] − δ[n − 3]

$$u[n] = \begin{cases} 1 & n \geq 0 \\ 0 & n < 0 \end{cases}$$

Example 3

Determine the values of u[− 1], u[0] and u[1].

u[− 1] = 0, u[0] = 1 and u[1] = 1

Example 4

Draw the signals:

(a) x[n] = 3u[n]
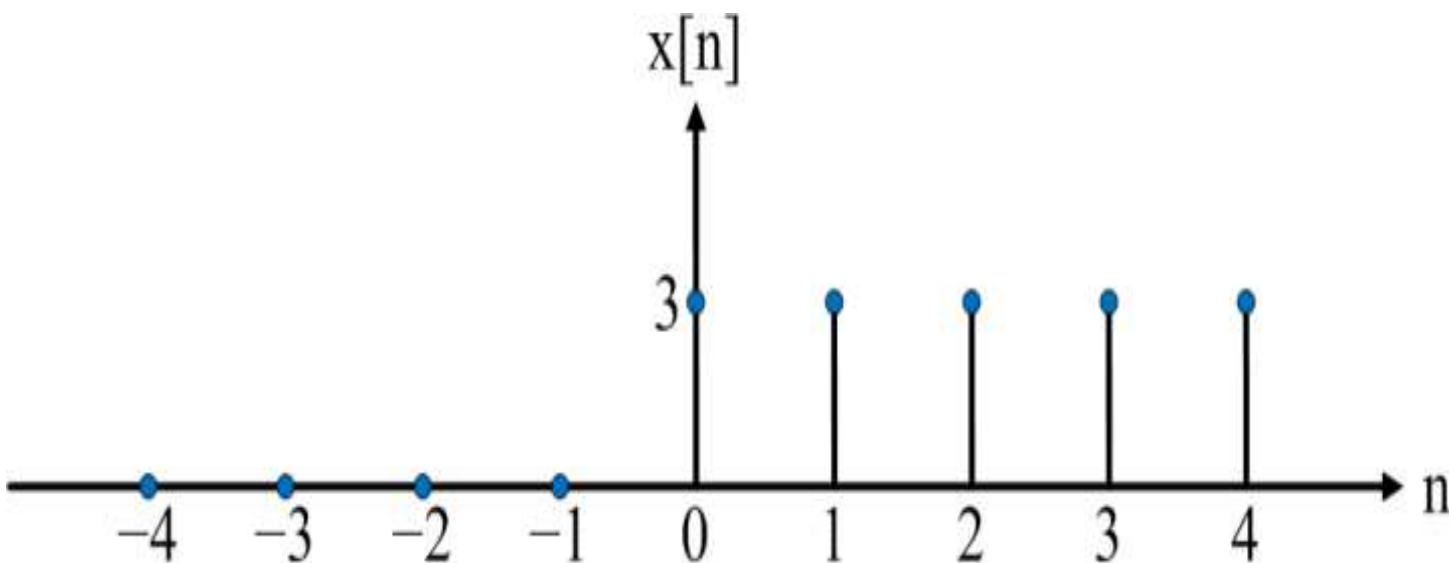(b) x[n] = u[− n]
(c) x[n] = u[n − 3]
(d) x[n] = u[3 − n]
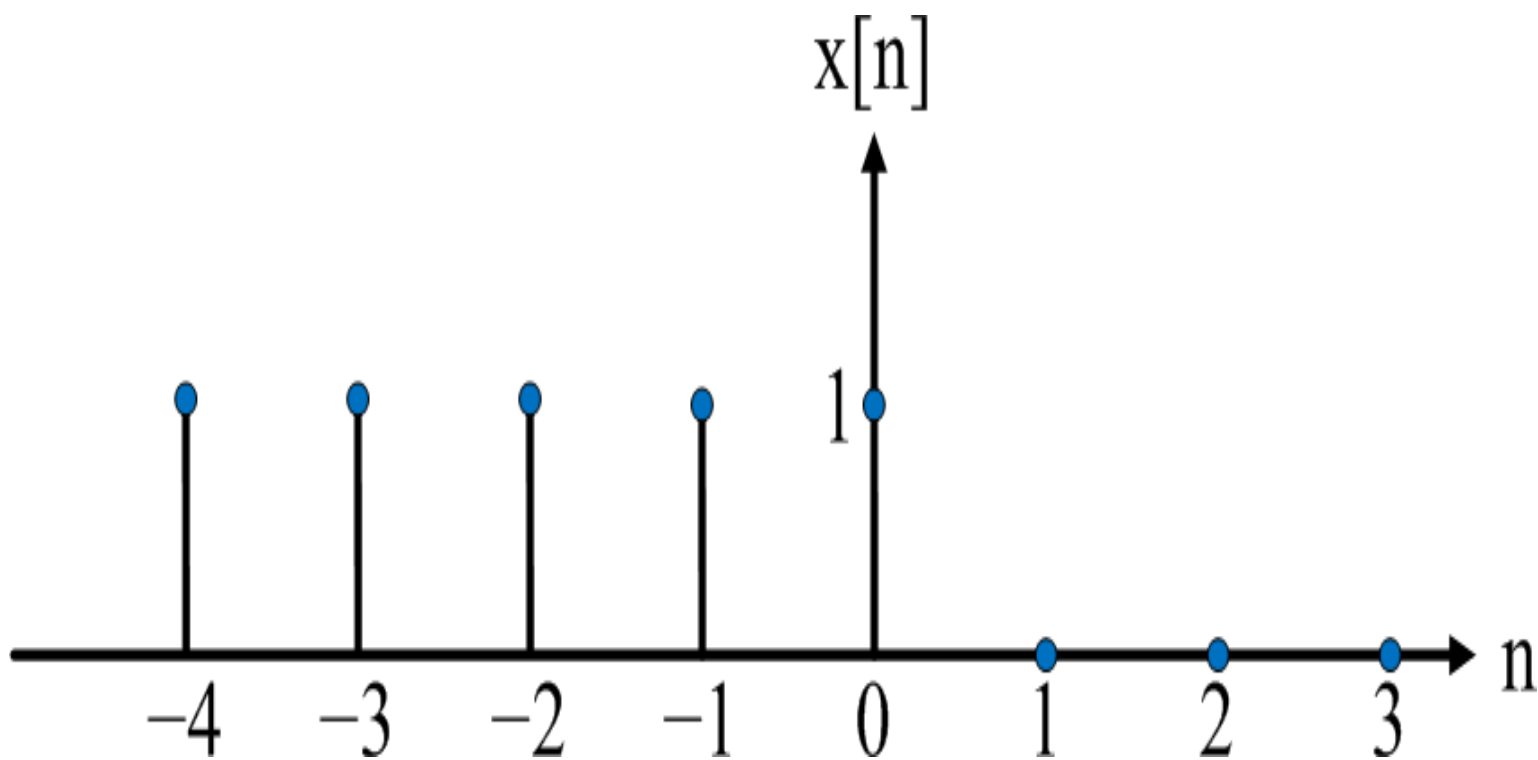(e) x[n] = u[n] + 2u[n − 2]

Example 4
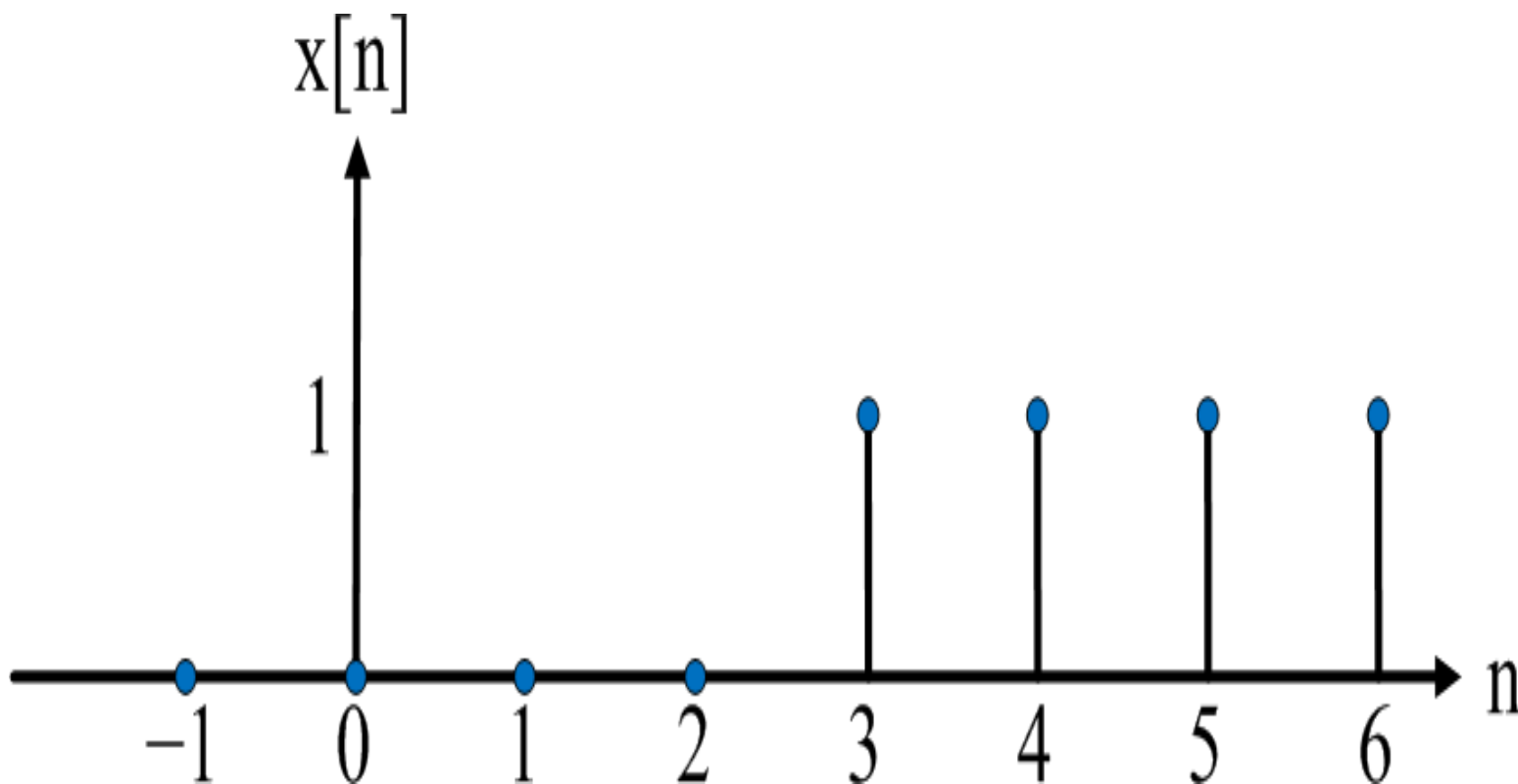
(a)   x[n] = 3u[n]

Example 4

(b) $x[n] = u[-n]$

Example 4
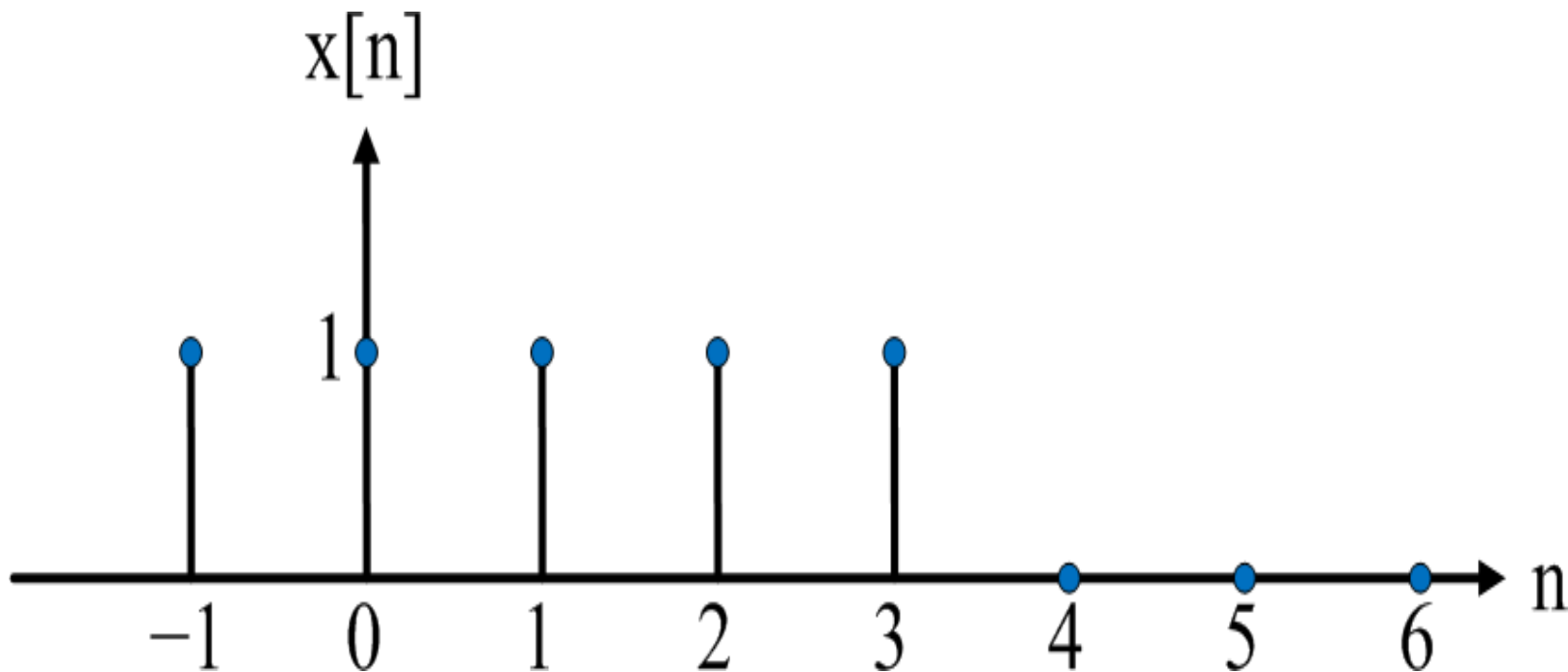
(c)   x[n] = u[n − 3]

Example 4
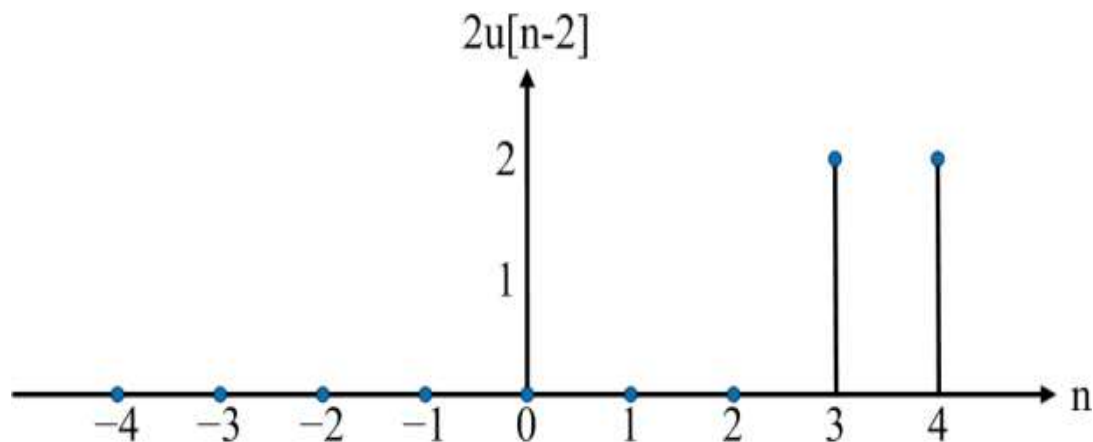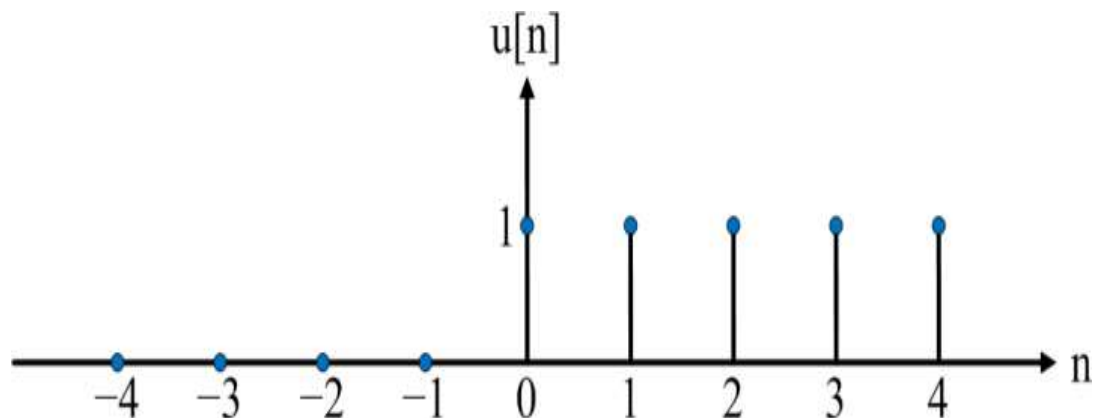
(d) $x[n] = u[3 - n]$

Example 4

(e)   x[n] = u[n] + 2u[n − 3]

Example 4

(e)   x[n] = u[n] + 2u[n − 3]