PSWD

Sinyal Waktu Diskrit

LATIHAN SOAL

Deret Sinyal Waktu Diskrit (SWD)

Posisi n=0

$$\Downarrow$$

$$x[n] = \{\ldots \quad 2, \quad 4, \quad 6, \quad 8, \quad \ldots\}$$

$$\Downarrow$$

$$x[n] = \{0, \quad 1, \quad 4, \quad 1, \quad 0, \quad 3, \quad 0, \quad 2, \quad \ldots\}$$

$$\Downarrow$$

$$x[n] = \{3, \quad -1, \quad -2, \quad 5, \quad 0, \quad 4\}$$

Contoh Pencuplikan Sinyal

- Sinyal waktu kontinyu (analog): $x_a(t) = \cos(20\pi t), \quad -\infty < t < \infty$
- Dicuplik dengan $F_p = 100$ Hz, atau dengan perioda pencuplikan (sampling) $T = 0{,}01$ detik, maka sinyal waktu diskit:

$$x[n] = \cos(20\pi nT) = \cos\left(20\pi \frac{n}{100}\right) = \cos\left(\frac{2\pi}{10} n\right), -\infty < n < \infty$$

- Bila $F_p = 200$ Hz, atau $T = 0{,}005$ detik, maka sinyal waktu diskrit:

$$x[n] = \cos(20\pi nT) = \cos\left(20\pi \frac{n}{200}\right) = \cos\left(\frac{2\pi}{20} n\right), -\infty < n < \infty$$

- Bila $x_a(t) = \cos(10\pi t), \quad -\infty < t < \infty$

$$F_p = 100 \text{ Hz}, \qquad \text{maka } x[n] = \cos\left(\frac{2\pi}{20} n\right), \qquad -\infty < n < \infty$$

$$F_p = 200 \text{ Hz}, \qquad \text{maka } x[n] = \cos\left(\frac{2\pi}{40} n\right), \qquad -\infty < n < \infty$$

Sinyal Genap

Sebuah sinyal waktu diskrit riil disebut sinyal genap bila untuk semua n,

$$x[n] = x[-n]$$

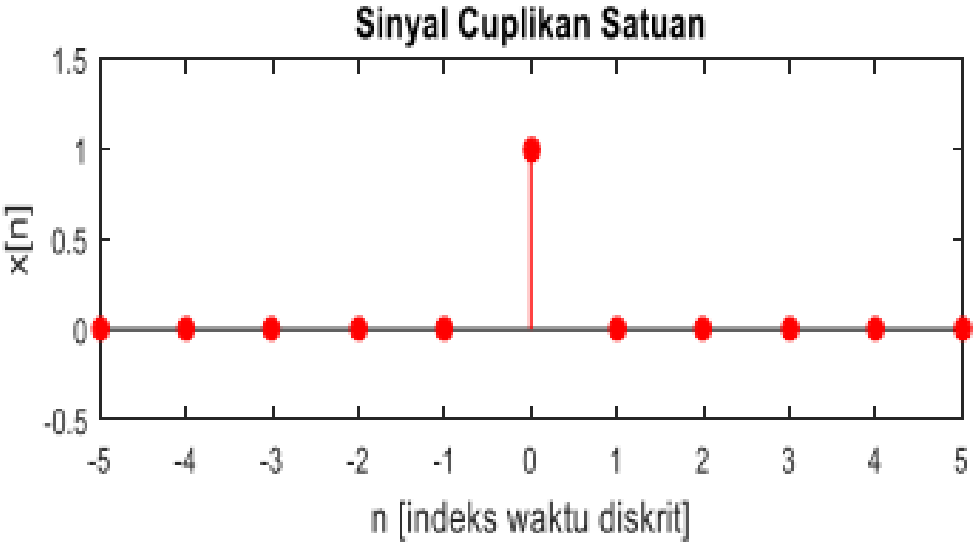
Contoh: $x[n] = 5x[n+5] - 4x[n+4] + 3x[n+3] - 2x[n+2] + x[n+1] + x[n] + x[n+1] - 2x[n+2] + 3x[n+3] - 4x[n+4] + 5x[n+5]$

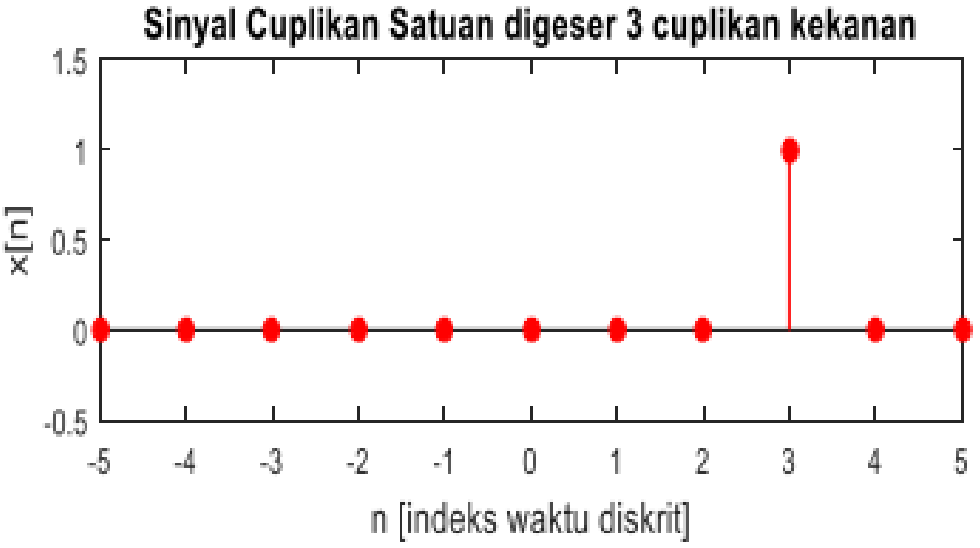
Sinyal Ganjil

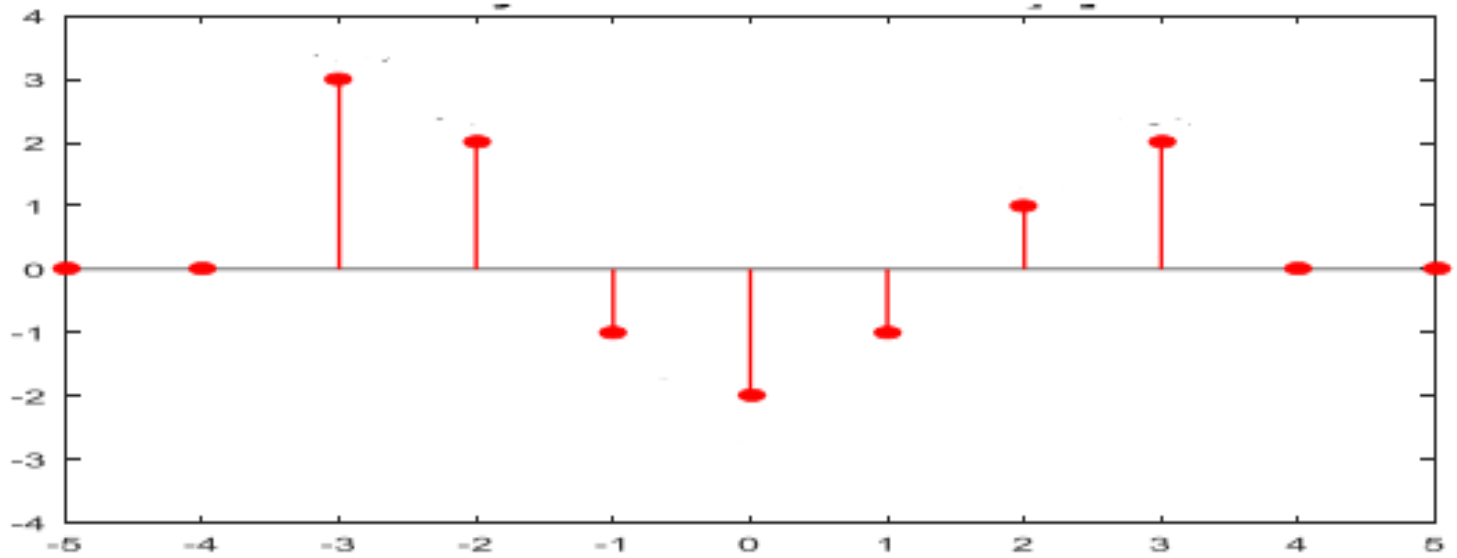
Sebuah sinyal waktu diskrit riil disebut sinyal ganjil bila untuk semua n,

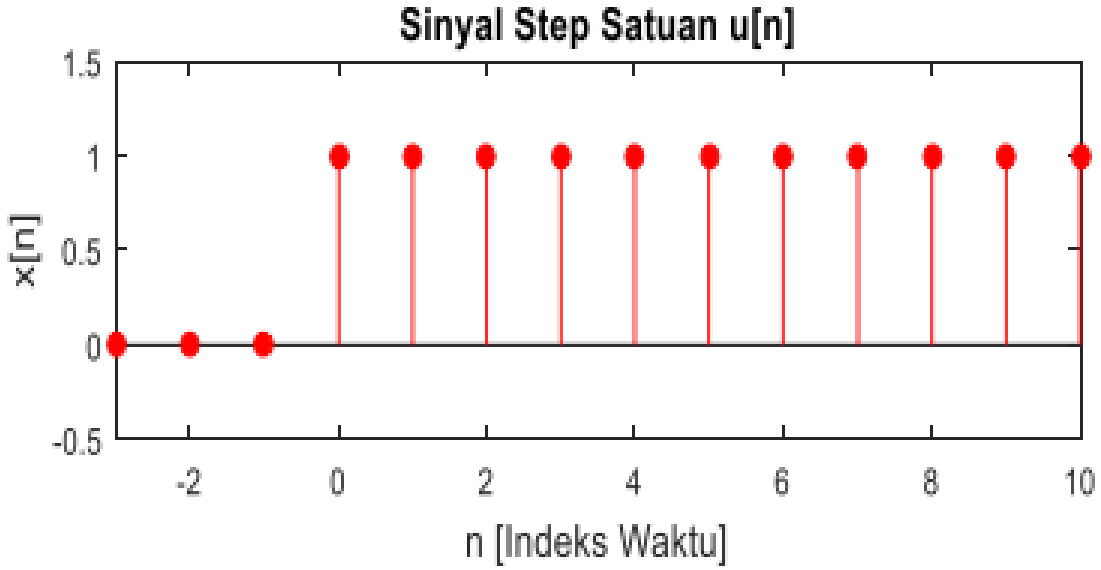
$$x[n] = -x[-n]$$

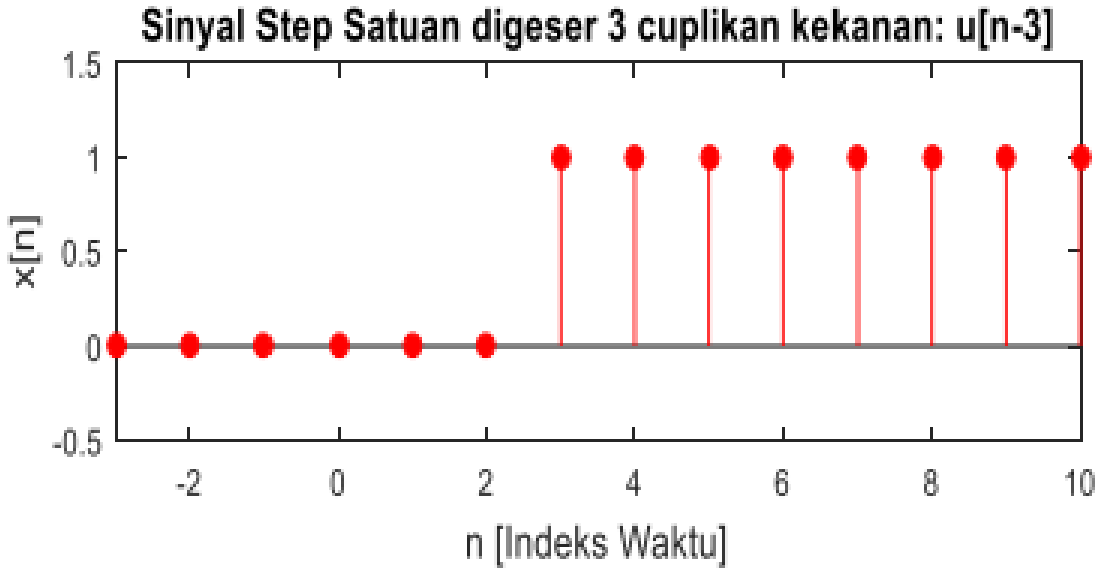
Contoh: $x[n] = -5x[n+5] + 4x[n+4] - 3x[n+3] + 2x[n+2] - x[n+1] + x[n+1] - 2x[n+2] + 3x[n+3] - 4x[n+4] + 5x[n+5]$


Sinyal Cuplikan Satuan
x[n]
n [indeks waktu diskrit]


Sinyal Cuplikan Satuan digeser 3 cuplikan kekanan
x[n]
n [indeks waktu diskrit]

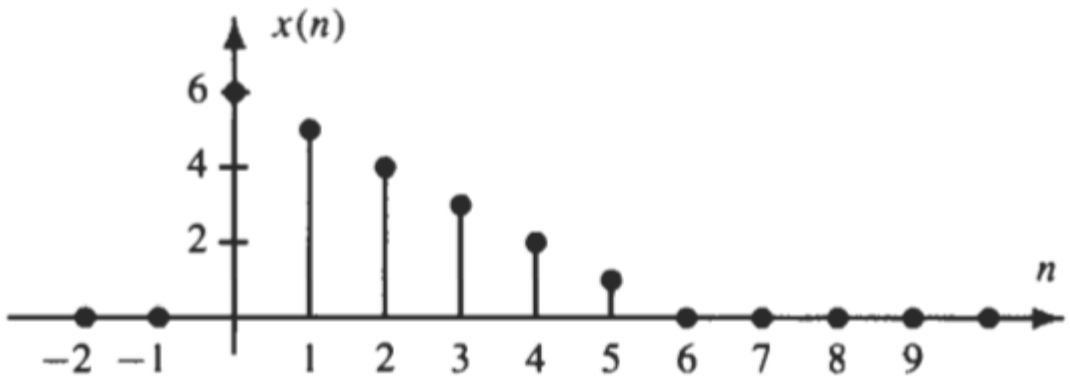


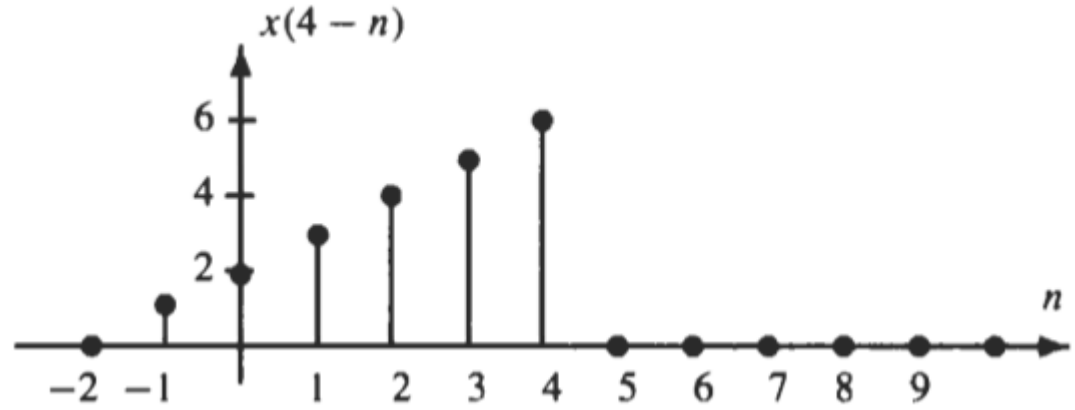

Sinyal Step Satuan u[n]
x[n]
n [Indeks Waktu]
1.5
1
0.5
0
-0.5
-2
0
2
4
6
8
10

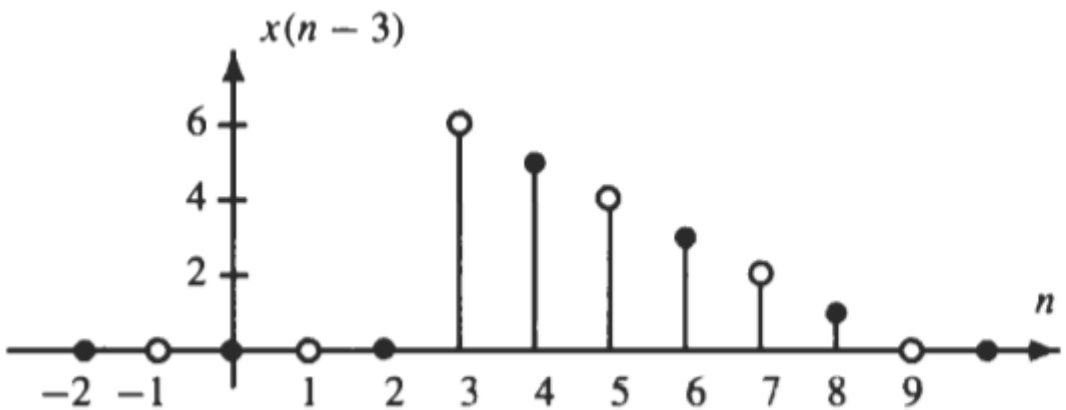

Sinyal Step Satuan digeser 3 cuplikan kekanan: u[n-3]
x[n]
n [Indeks Waktu]
1.5
1
0.5
0
-0.5
-2
0
2
4
6
8
10

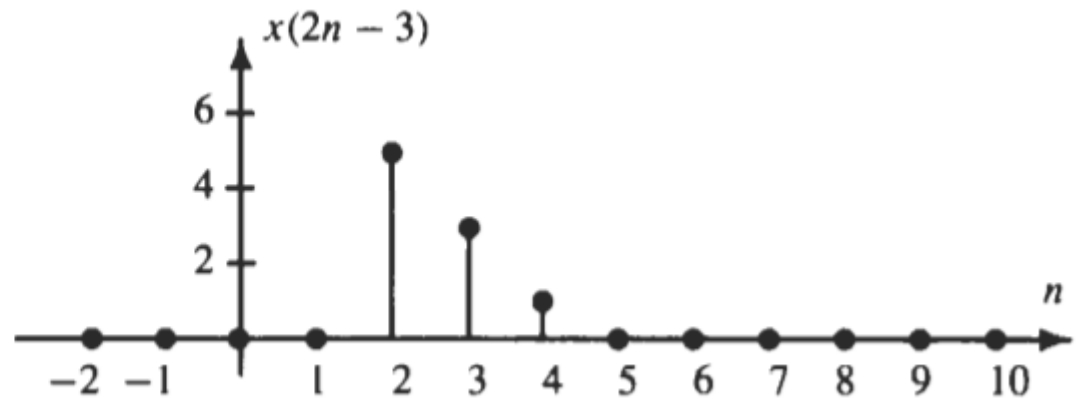
Given the sequence $x(n) = (6 - n)[u(n) - u(n - 6)]$, make a sketch of

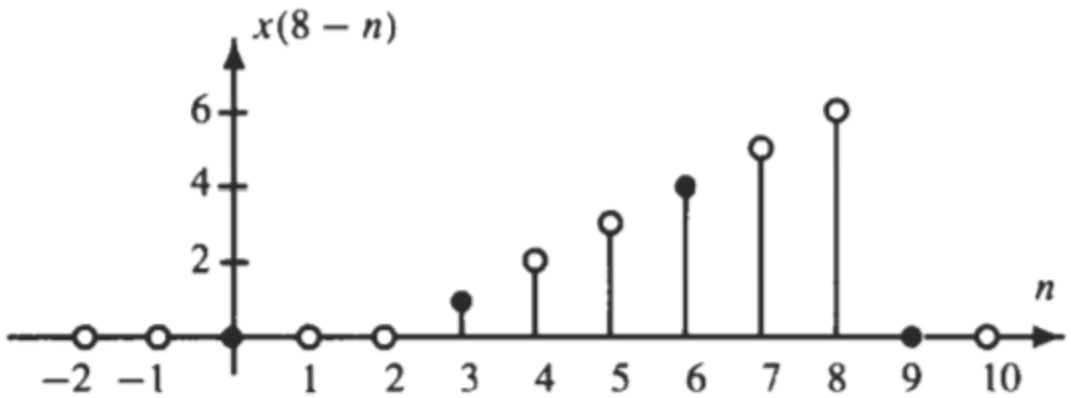
(*a*) $y_1(n) = x(4 - n)$ (*b*) $y_2(n) = x(2n - 3)$ (*c*) $y_3(n) = x(8 - 3n)$

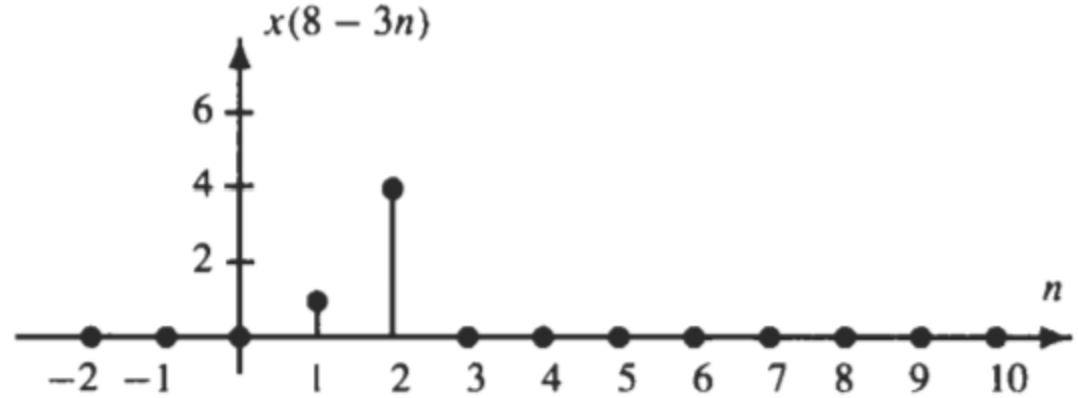






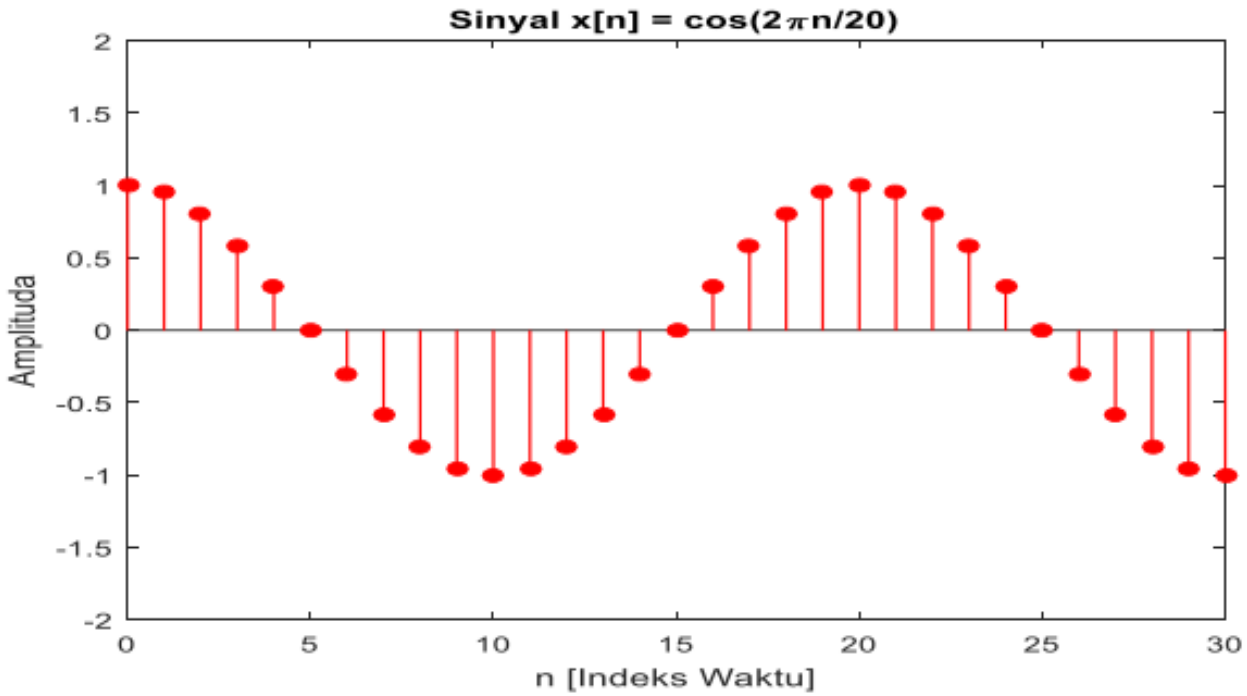



x(8 − n)
6
4
2
n
−2 −1 1 2 3 4 5 6 7 8 9 10

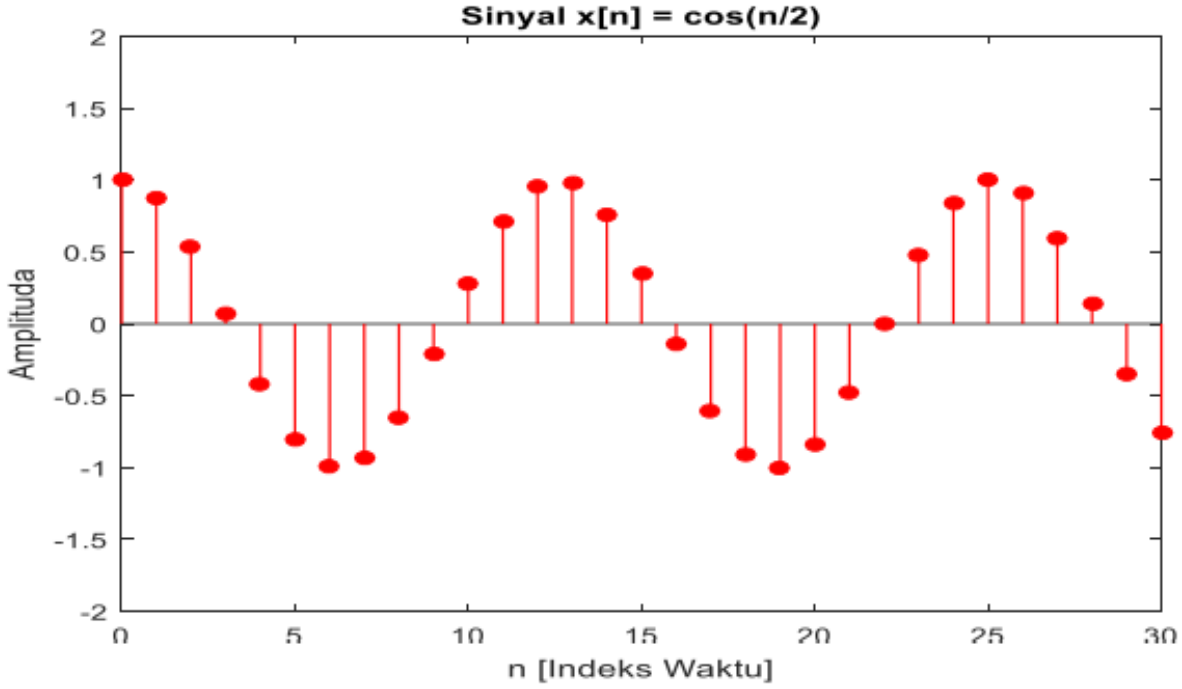

x(8 − 3n)
6
4
2
n
−2 −1 1 2 3 4 5 6 7 8 9 10

Contoh sinyal sinusoidal waktu diskrit

$x[n] = \cos\left(\frac{2\pi}{20}n\right) = \cos\left(\frac{\pi}{10}n\right)$, Sinyal periodik



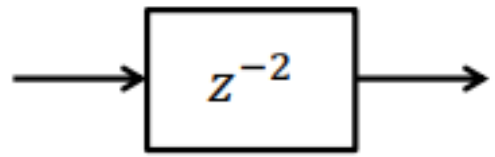
$x[n] = \cos\left(\frac{n}{2}\right)$, bukan sinyal periodik

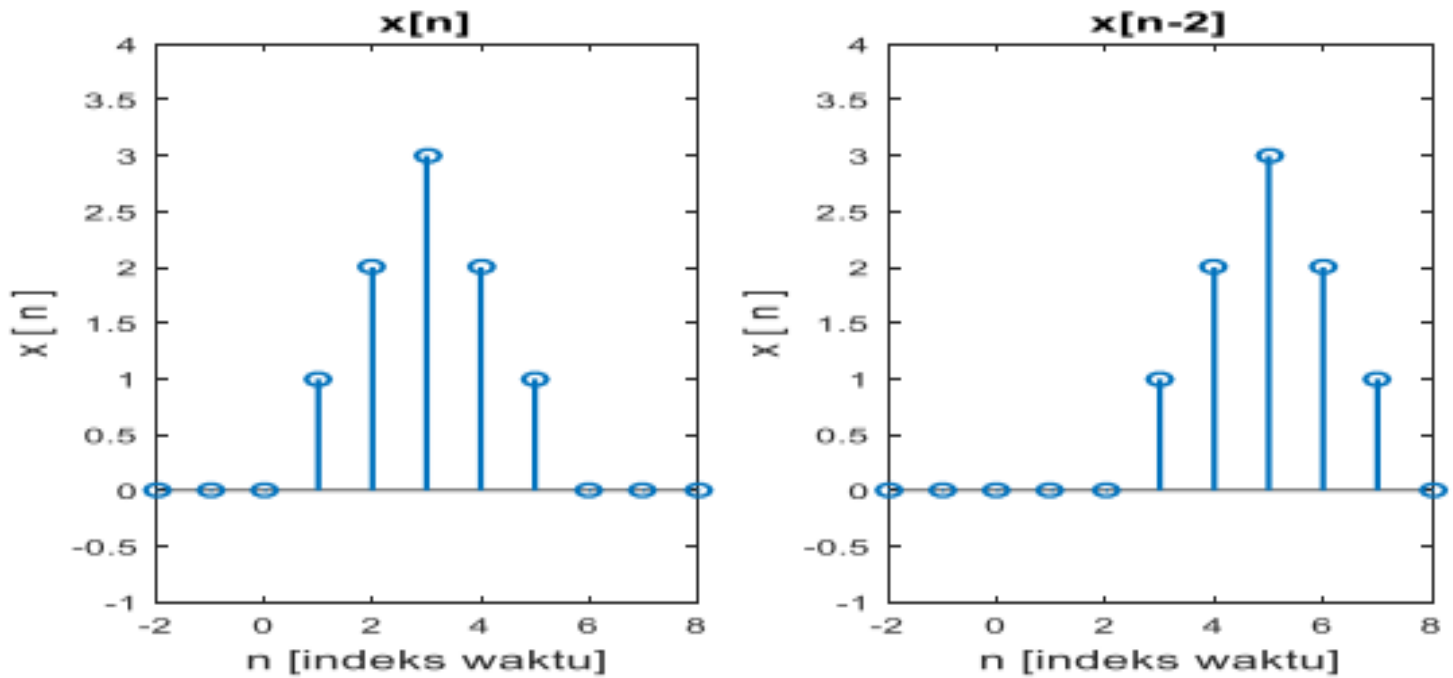


Operasi Terhadap Sinyal Waktu Diskrit

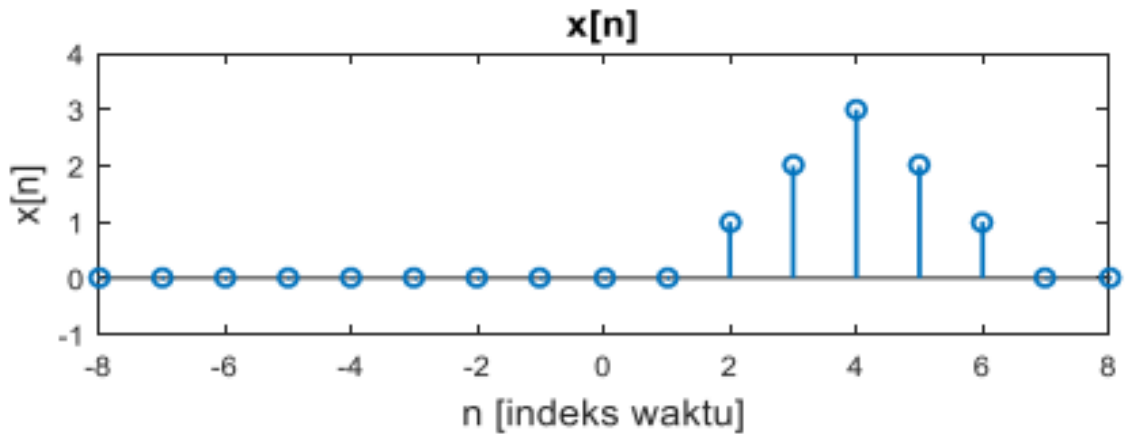
- **Transformasi terhadap peubah bebas:**
  - Shifting
  - Reversal
  - Time Scaling
- **Transformasi Amplitudo Sinyal:**
  - Addition
  - Multiplication
  - Scaling
- **Konvolusi**
- **Korelasi**

- **Contoh**: $f(n) = n - n_0$
- $y[n] = x[n-2]$, digeser kekanan sebesar 2 cuplikan.

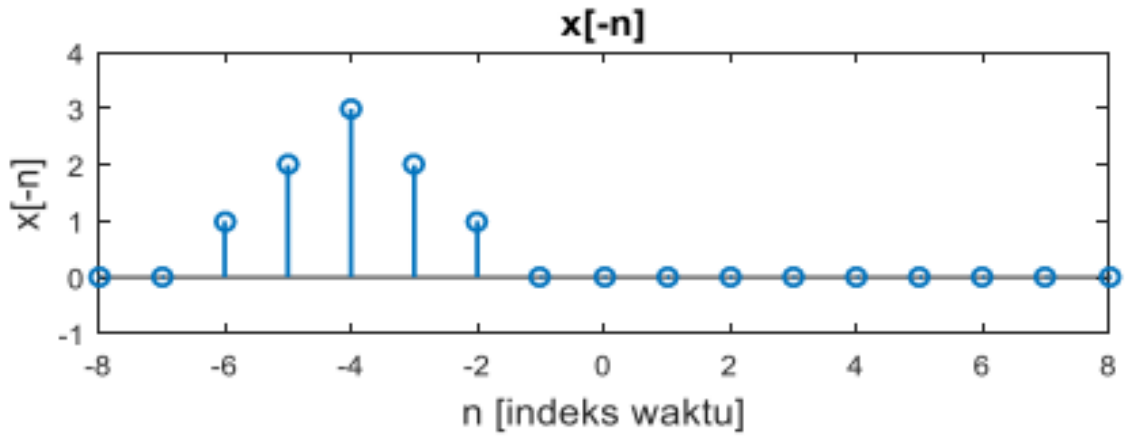




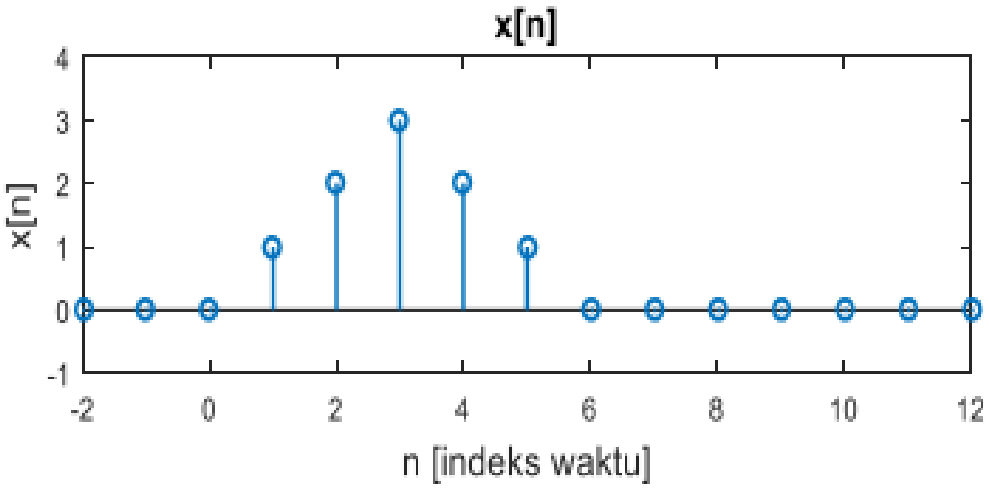
- **Reversal**: $f(n) = -n$
- Deretan dibalik dengan referensi $n = 0$

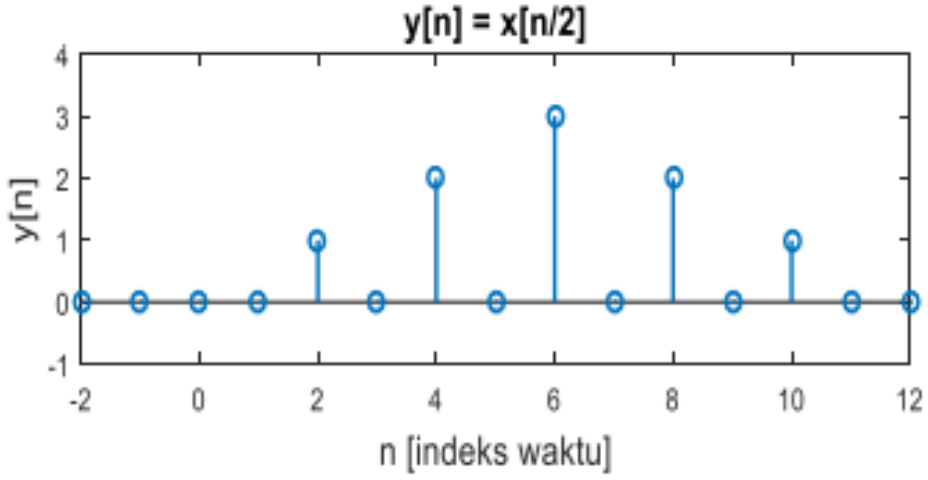


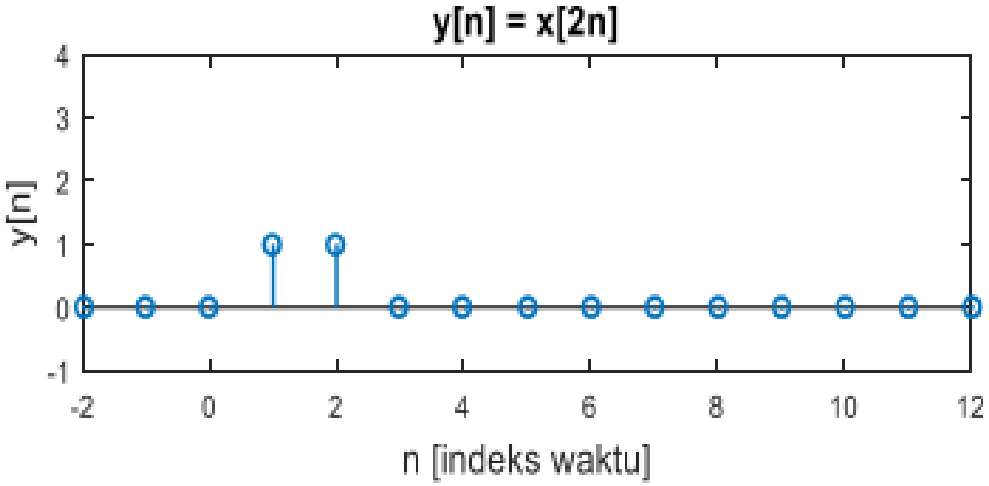
- $y[n] = x[-n]$



- **Time Scaling**: $f(n) = Mn$ atau $f(n) = \frac{n}{N}$
- $f(n) = Mn$: Down sampling
- $y[n] = x[2n]$
- Dimampatkan





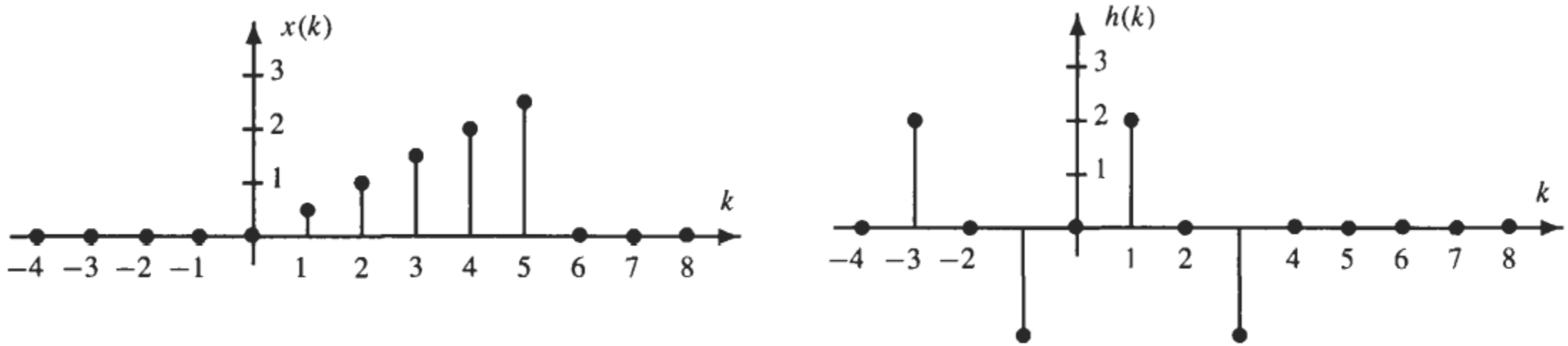


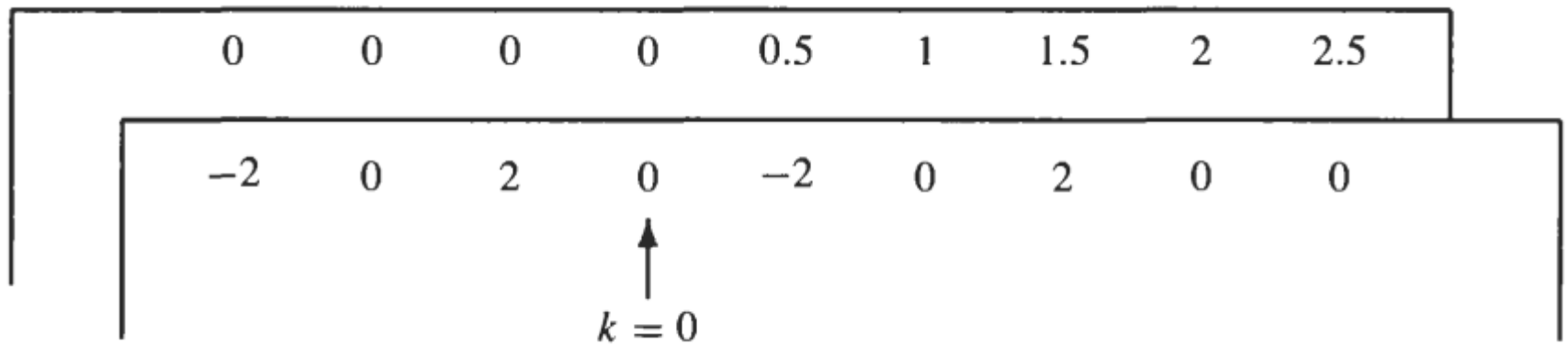
1.26 Find the convolution of the two finite-length sequences:

$$x(n) = 0.5n[u(n) - u(n-6)]$$

$$h(n) = 2\sin\left(\frac{n\pi}{2}\right)[u(n+3) - u(n-4)]$$

Shown in the figure below are the sequences $x(k)$ and $h(k)$.





y(n) for n > 0,

$$y(1) = 2 \qquad y(2) = 3 \qquad y(3) = -2 \qquad y(4) = -3$$
$$y(5) = 2 \qquad y(6) = 2 \qquad y(7) = -4 \qquad y(8) = -5$$