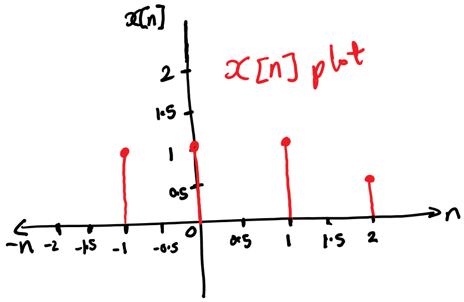
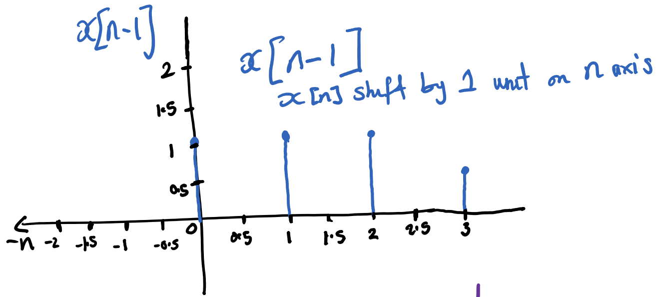
9.1

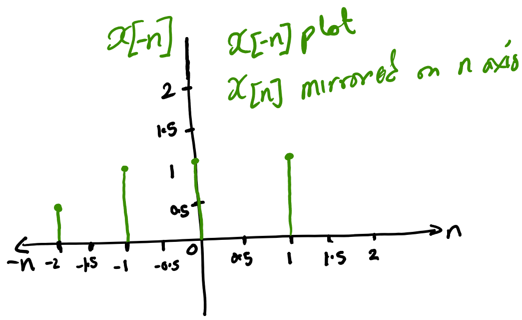
Saturday, November 18, 2023 11:32 AM

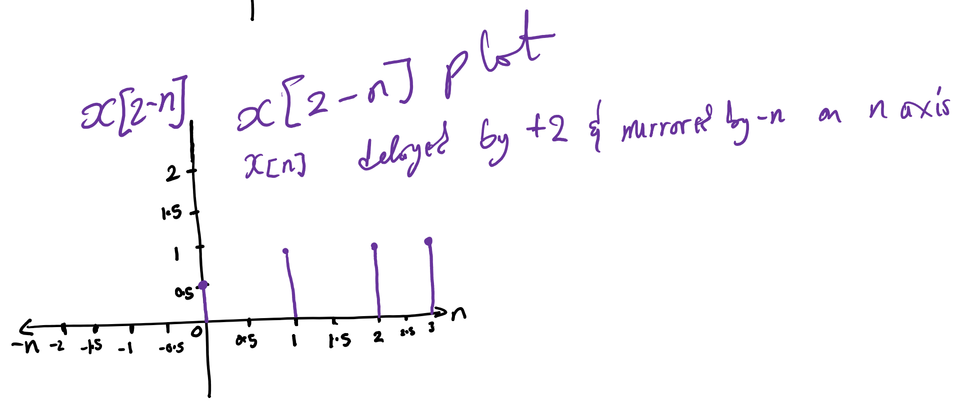
a)

$$x[n] = \begin{cases} 1 & n = -1, 0, 1 \\ 0.5 & n = 2 \\ 0 & \text{otherwise} \end{cases}$$









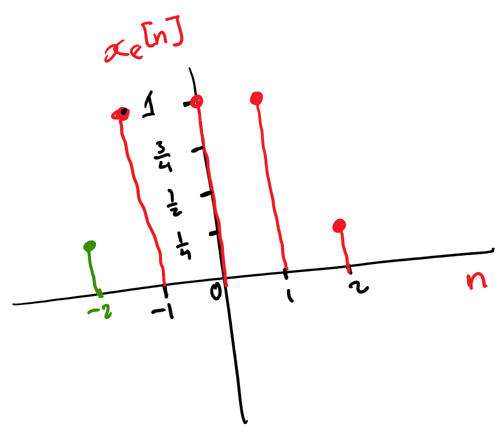
b)

Even Component

$$x_e[n] = \frac{1}{2}\left[x[n] + x[-n]\right]$$

$$x[n] = \begin{cases} 1 & n = -1, 0, 1 \\ 0.5 & n = 2 \\ 0 & \text{otherwise} \end{cases}$$

n	$x_e[n]$
-1	$\frac{1}{2}\left[x[-1] + x[1]\right] = \frac{1}{2}[1+1] = 1$
0	$\frac{1}{2}\left[x[0] + x[0]\right] = \frac{1}{2}[1+1] = 1$
1	$\frac{1}{2}\left[x[1] + x[-1]\right] = \frac{1}{2}[1+1] = 1$
2	$\frac{1}{2}\left[x[2] + x[-2]\right] = \frac{1}{2}\left[\frac{1}{2}+0\right] = \frac{1}{4}$
-2	$\frac{1}{2}\left[x[-2] + x[2]\right] = \frac{1}{2}\left[0+\frac{1}{2}\right] = \frac{1}{4}$

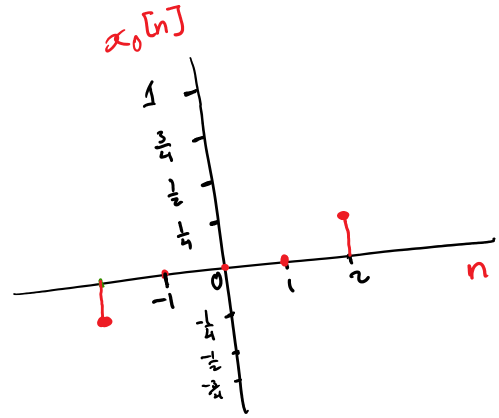


c) Odd Component

$$x_o[n] = \frac{1}{2}\left[x[n] - x[-n]\right]$$

$$x[n] = \begin{cases} 1 & n = -1, 0, 1 \\ 0.5 & n = 2 \\ 0 & \text{otherwise} \end{cases}$$

n	$x_o[n]$
-1	$\frac{1}{2}\left[x[-1] - x[1]\right] = \frac{1}{2}\left[1-1\right] = 0$
0	$\frac{1}{2}\left[x[0] - x[0]\right] = \frac{1}{2}\left[1-1\right] = 0$
1	$\frac{1}{2}\left[x[1] - x[-1]\right] = \frac{1}{2}\left[1-1\right] = 0$
2	$\frac{1}{2}\left[x[2] - x[-2]\right] = \frac{1}{2}\left[\frac{1}{2}-0\right] = \frac{1}{4}$
-2	$\frac{1}{2}\left[x[-2] - x[2]\right] = \frac{1}{2}\left[0-\frac{1}{2}\right] = -\frac{1}{4}$



9.2

Saturday, November 18, 2023 1:38 PM

a)

$$x[n] = \cos(0.7\pi n)$$

$$\omega_0 = \frac{2\pi}{T_0} = \frac{2\pi m}{N}$$

$$\frac{m}{N_0} = \frac{\omega_0}{2\pi}$$ | ω_0 = rational number for periodic signal

$$\frac{m}{N_0} = \frac{0.7\cancel{\pi}}{2\cancel{\pi}} = \frac{0.7 \times 10}{2 \times 10}$$

$$\frac{m}{N_0} = \frac{7}{20} \qquad \boxed{\therefore N_0 = 20}$$

b) $x(t) = \cos(\pi t)$ $T_s = 0.7$

Nyquist theorem $f_s \geq 2f$

f_s ↓ Sampling freq. f ↓ freq. of signal

$\omega = 2\pi f$

for $x(t)$ $\omega = \pi$

$$f = \frac{\omega}{2\pi} = \frac{\pi}{2\pi} = \frac{1}{2}\text{ Hz}$$

$$f_s = \frac{1}{T_s} = \frac{1}{0.7} = 1.4\text{ Hz}$$

$$f_s \geq 2f$$

$$= 2\left(\frac{1}{2}\right)\text{Hz}$$

$1.4\,Hz \geq$

$1.4\,Hz \geq 1\,Hz$

Since $f_s \geq 2f$ $\therefore T_s$ @ 0.7 satisfies the Nyquist condition

$x[n] = \cos(0.7\pi n)$

$x(t) = \cos(\pi t)$

$T_s = 0.7$

$x[n] = x(T_s n) = \cos(T_s \pi n)$

9.4

Saturday, November 18, 2023 2:39 PM

a)

$$x[n] = e^{j(n-8)/8}$$

$$x[n] = e^{j(\underbrace{\tfrac{1}{8}}_{\omega_0} n - \underbrace{1}_{\theta})}$$

$$\omega_0 = \frac{2\pi m}{N}$$

$$\frac{1}{8} = \frac{2\pi m}{N}$$

$$\frac{m}{N} = \frac{\frac{1}{8}}{2\pi} = \frac{1}{16\pi}$$

$\boxed{N = 16\pi \text{ is irrational integer} \therefore x[n] \text{ is not periodic}}$

$$x_1[n] = e^{j(n-8)\pi/8}$$

$$x_1[n] = e^{j(\underbrace{\tfrac{\pi}{8}}_{\omega_0} n - \underbrace{\pi}_{\theta})}$$

$$\omega_0 = \frac{2\pi m}{N}$$

$$\frac{\pi}{8} = 2\pi \frac{m}{N}$$

$$\frac{m}{N} = \frac{\frac{\cancel{\pi}}{8}}{2\cancel{\pi}} = \frac{1}{16}$$

$\boxed{N = 16 \text{ is a rational number} \therefore x_1[n] \text{ is periodic}}$

9.29

Saturday, November 18, 2023 4:01 PM

$x[n] = x[n-1] + x[n-3] \quad n \geq 3$

$x[0] = 0$
$x[1] = 1$
$x[2] = 2$

$x[3] = x[2] + x[0]$
$x[3] = 2 + 0$
$x[3] = 2$

$x[4] = x[3] + x[1]$
$= 2 + 1$
$= 3$

$x(3+1) = x(3-2) + x(3)$
$x(4) = x(1) + x(3)$
$x[i] = x(i-1) + x[i-3]$
$x[i] = x[2] + x[0]$

9.34c

Sunday, November 19, 2023 4:42 PM

$$x(t) = \cos(2\pi t)$$

$$x[n] = x(nT_s)$$

$$x[n] = \cos[2\pi(nT_s)]$$

$$z[n] = x[2n]$$

$$Z[n] = \cos[2\pi(2nT_s)]$$

$$Z[n] = \cos[4\pi n T_s]$$

$$Z[n] = \cos\left[\frac{4\pi n}{7}\right]$$

$$\cancel{2\pi}\,\cancel{n}\,T_s = \frac{\overset{2}{\cancel{4}}\,\cancel{\pi}\,\cancel{n}}{7}$$

$$\boxed{T_s = \frac{2}{7} \text{ for } Z[n]}$$

$$y[n] = x\left[\frac{n}{2}\right]$$

$$y[n] = \cos\left[\cancel{2}\pi\left(\frac{n}{\cancel{2}}T_s\right)\right]$$

$$y[n] = \cos\left(\pi n T_s\right)$$

$$y[n] = \cos\left(\frac{\pi n}{7}\right)$$

$$\cancel{2}\cancel{\pi}\cancel{n}T_s = \frac{\cancel{\pi}\cancel{n}}{7} \times \frac{1}{2}$$

$$\boxed{T_s = \frac{1}{14} \text{ for } y[n]}$$