SIGNALS AND SYSTEMS

BASIC PROBLEMS :- (P-59)

1.21.

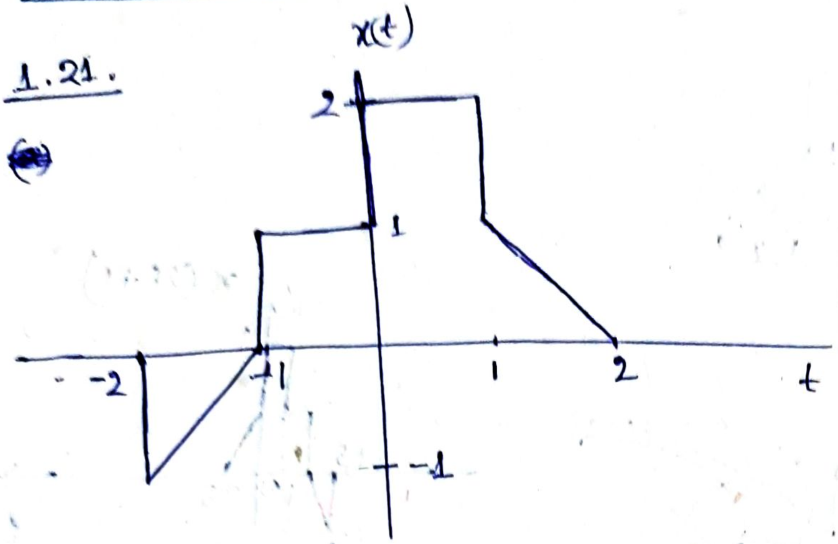
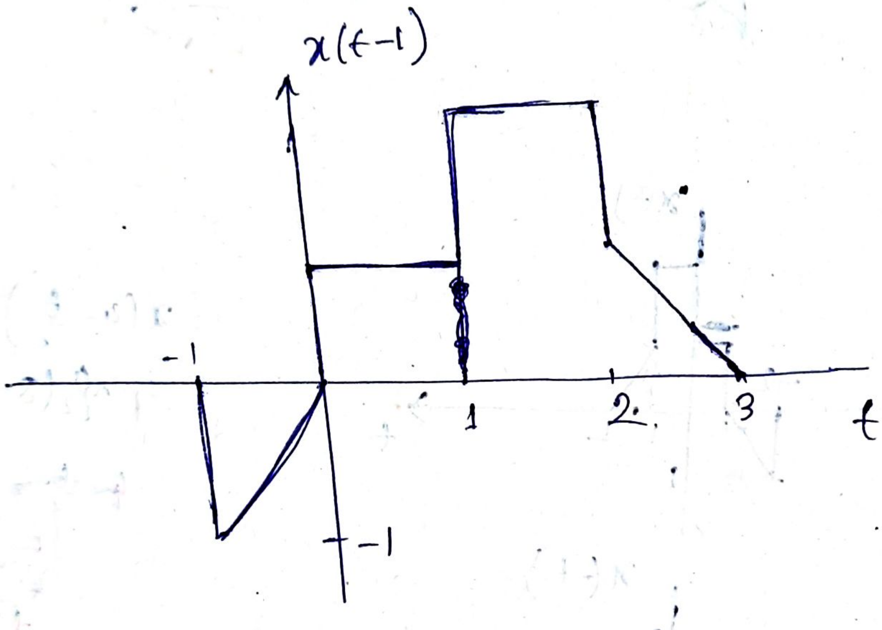
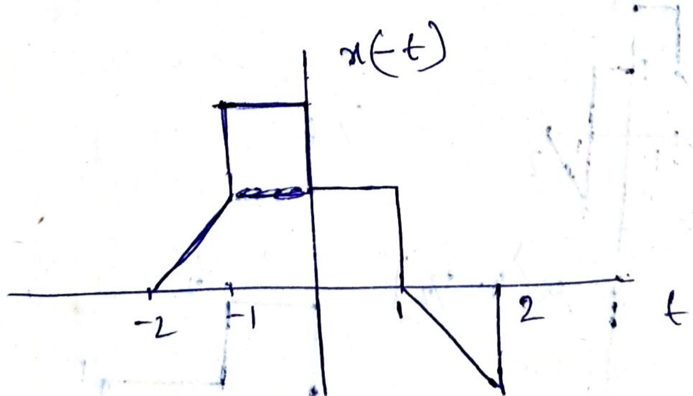


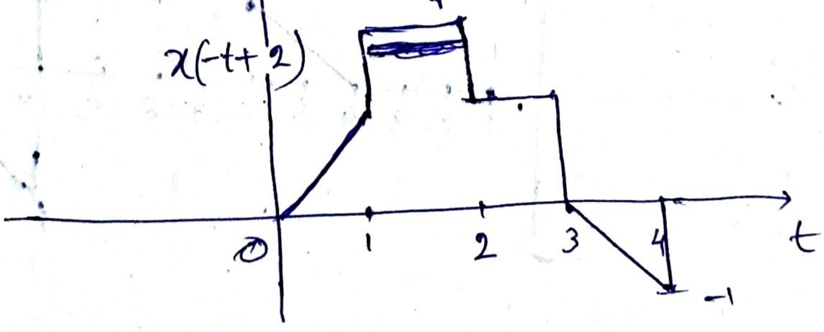
Figure P1.21

(a)



(b)





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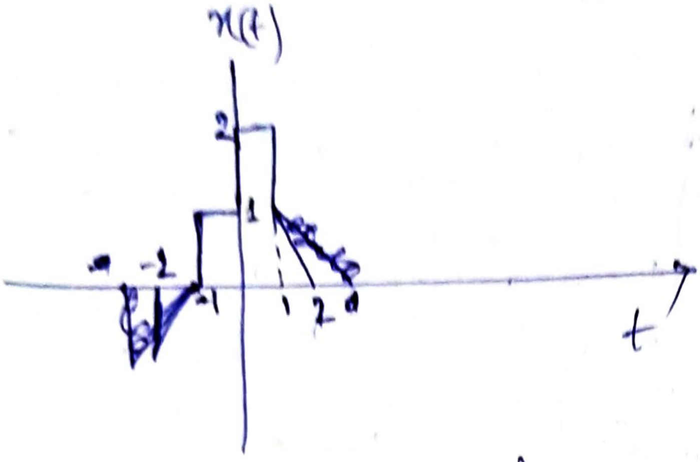
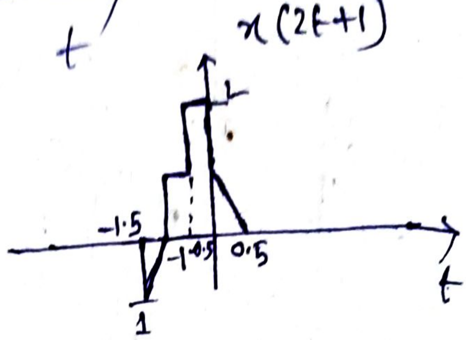
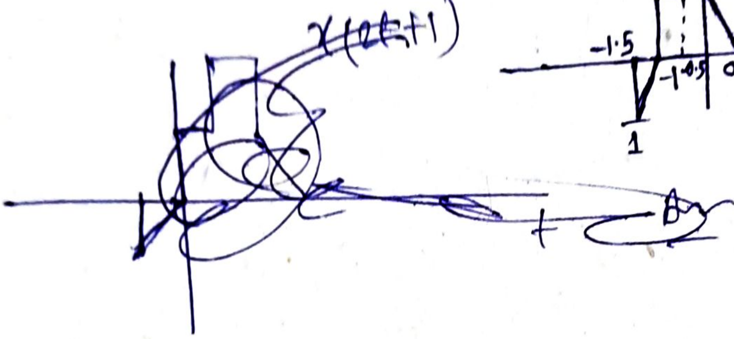
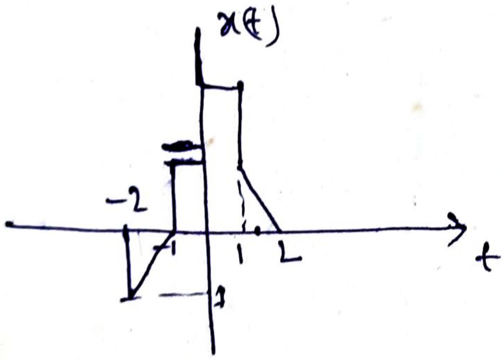
(c) $x(2t+1)$





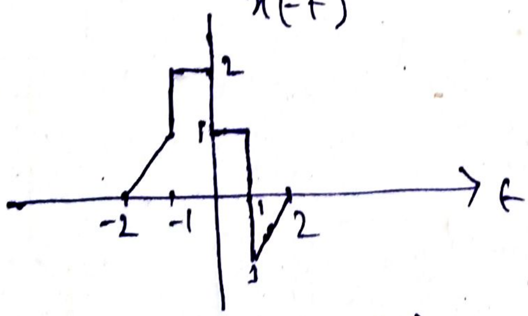


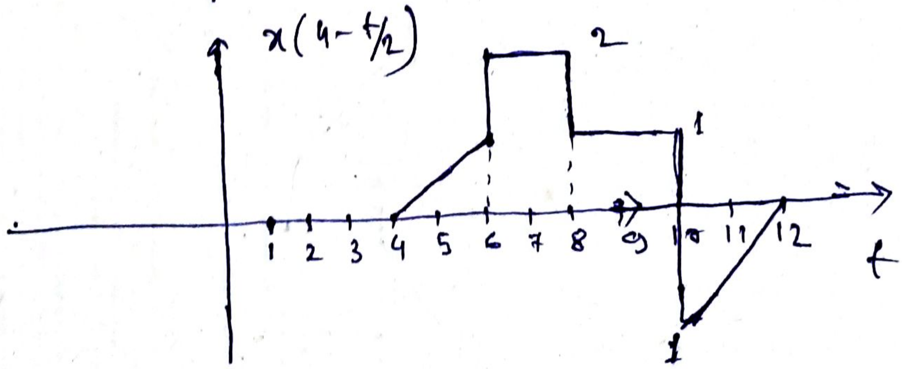
(d)



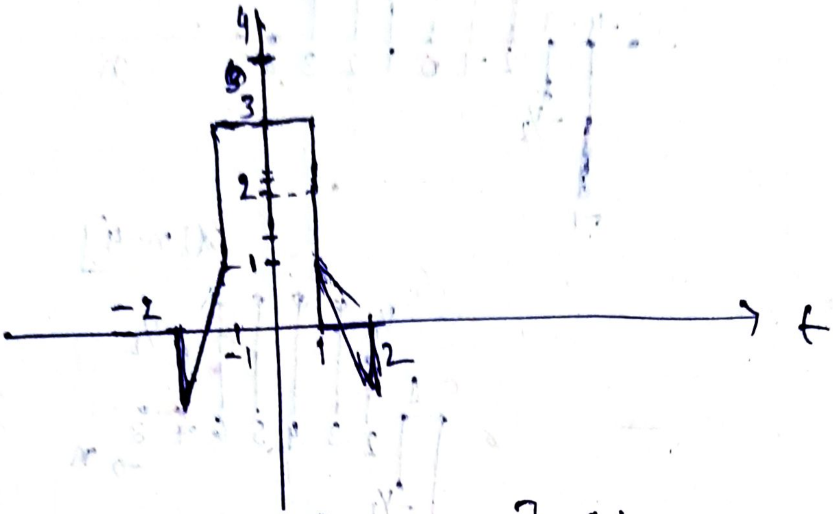
$$x\left(4-\frac{t}{2}\right) = x\left\{\frac{1}{2}(8-t)\right\} = x\left\{-\left[\frac{1}{2}(t-8)\right]\right\}$$

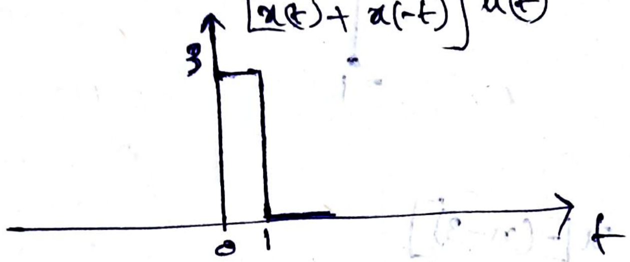
$t \in 8$





(e) $[x(t) + x(-t)]\, u(t)$





(f) $x(t)\left[\delta\left(t+\frac{3}{2}\right) - \delta\left(t-\frac{3}{2}\right)\right]$

$= x(t)\,\delta\left(t+\frac{3}{2}\right) - \delta\left(t-\frac{3}{2}\right) x(t)$

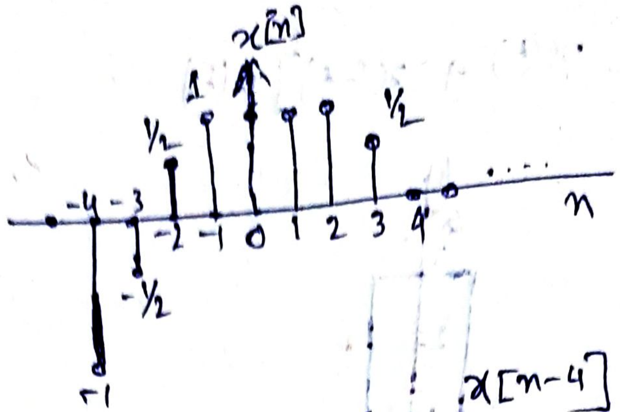
$= x\left(-\frac{3}{2}\right) - x\left(\frac{3}{2}\right)$

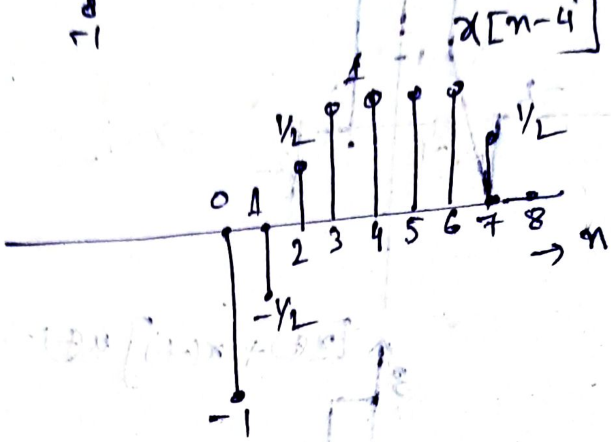
$= x(-1.5) - x(1.5)$

$= -1.5 - 1.5 = -3$

1.22.

(a) $x[n-4]$





(b) $x[3-n] = x[-(n-3)]$

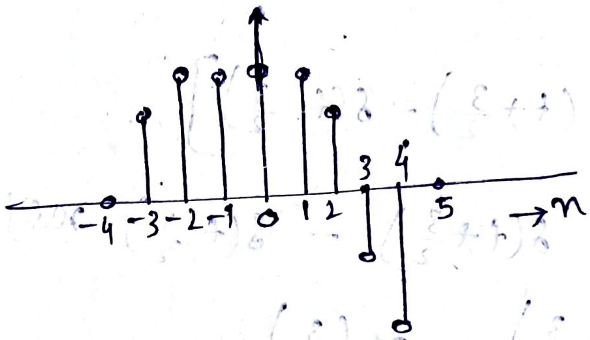


Fig:- $x[n]$

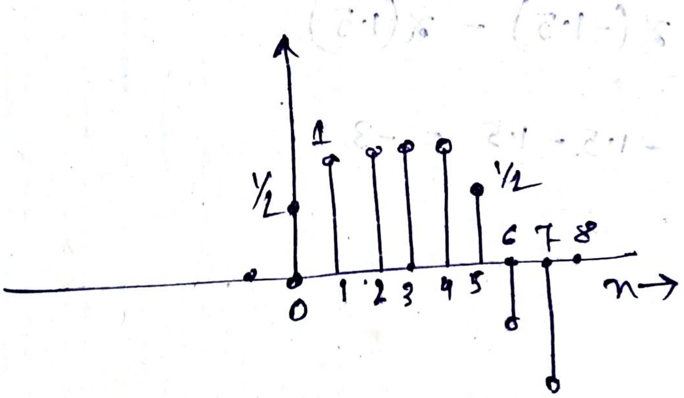
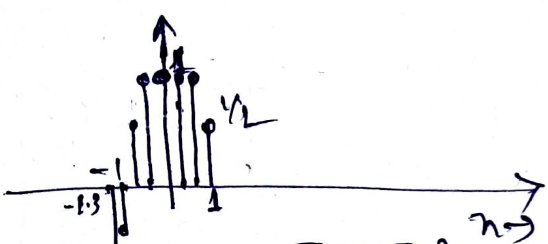


Fig: $x[3-n]$

(c) $x[3n]$



$\frac{1}{3}=3.3$

Fig $x[3n]$

(d) $x[3n+1]$

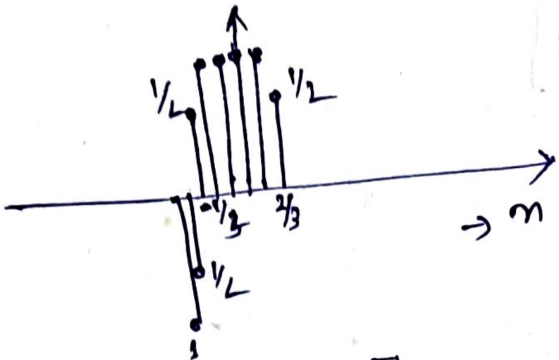
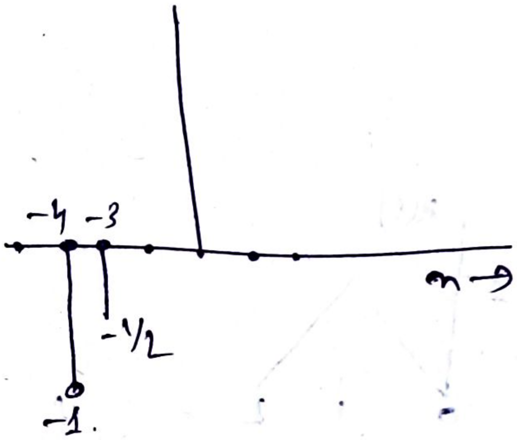


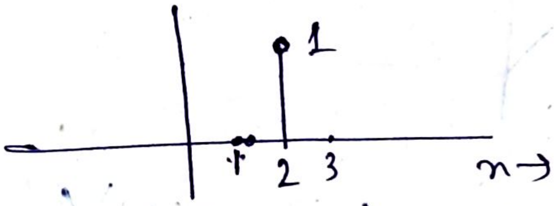
Fig: $x[3n+1]$

(e) $x[n]\,u[3-n]$

$= x[n]\,u[-(n-3)]$



(f) $x[n-2]\,\delta[n-2]$



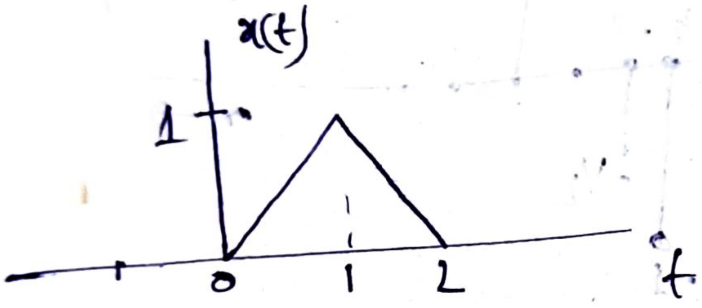
(g) when $n =$ odd $= 1, 3, 5$ etc

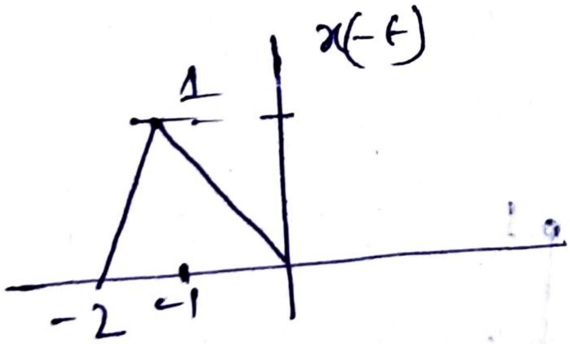
$\frac{1}{2}x[n] - \frac{1}{2}x[n] = 0$

when $n =$ even ie $n = 2, 4, 6, 8$ etc,

$\frac{1}{2}x[n] + \frac{1}{2}x[n] = x[n]$ Ans

(a)





$\therefore Ev\{x(t)\} = (x(t) + x(-t))/2$

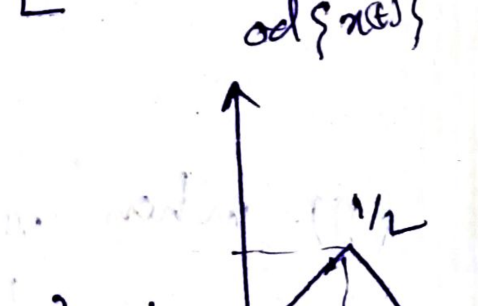
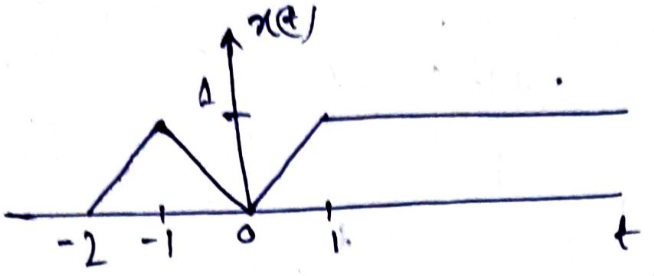
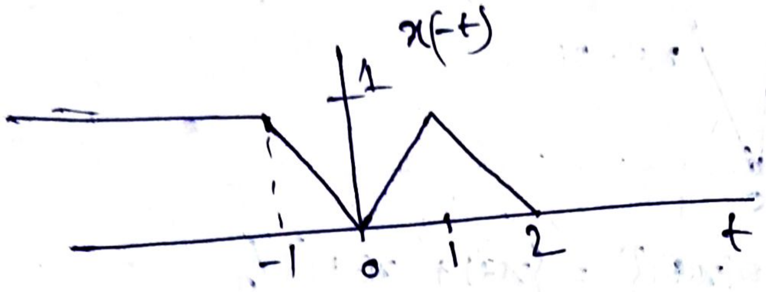


Fig: Ev{x(t)}

(b)





$$\therefore \; Ev\{x(t)\} = \frac{1}{2}\left[x(t) + x(-t)\right]$$

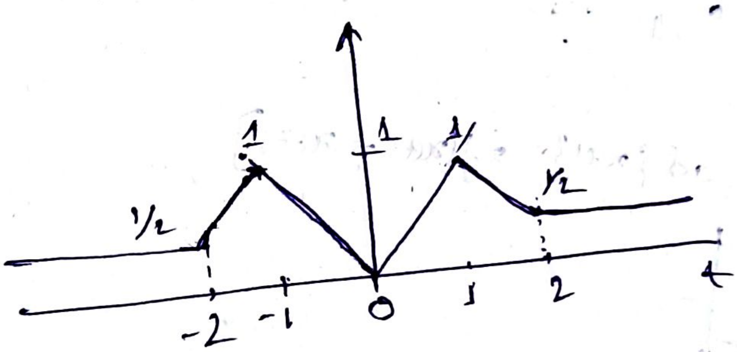


Fig:- Ev{x(t)}.

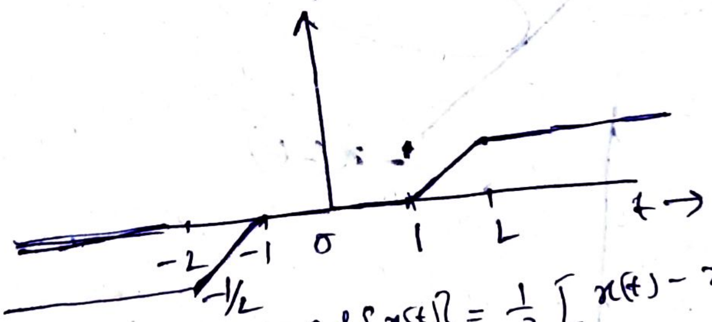
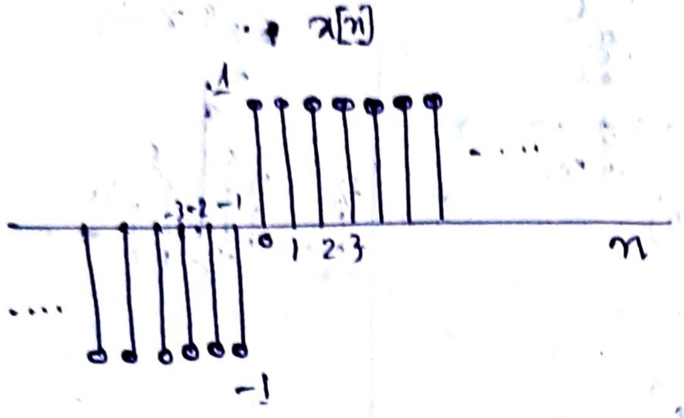
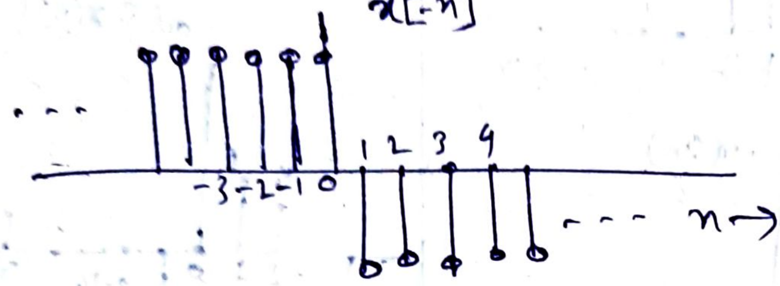


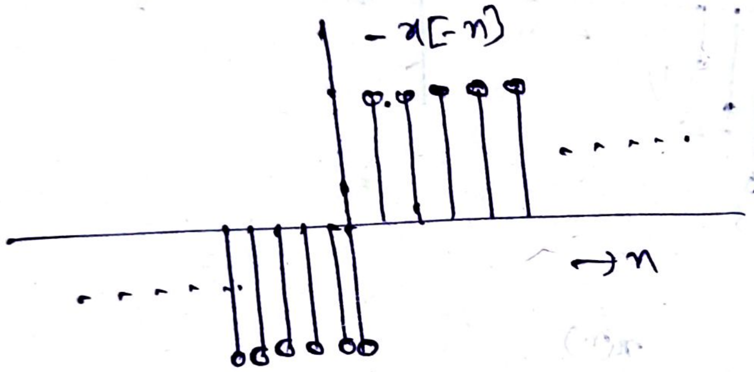
Fig:- $Od\{x(t)\} = \frac{1}{2}\left[x(t) - x(-t)\right]$

1.24.

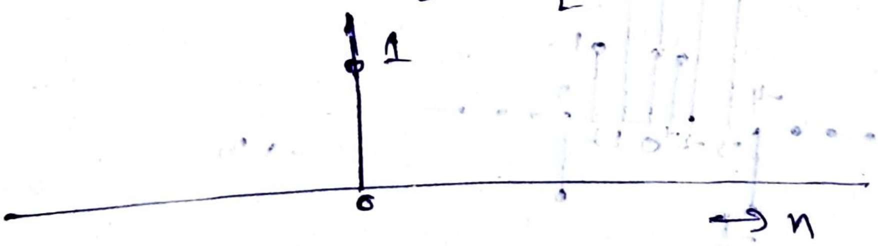
(a)



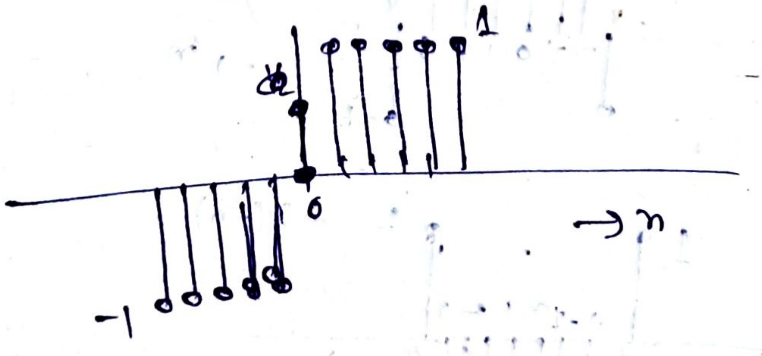




$$\frac{x[n] + x[-n]}{2} = Ev\{x[n]\}.$$



$$Od\{x[n]\} = \frac{x(n) - x(-n)}{2}$$



(c) 2(a)

$$x(t) = \left[\cos\left(2t - \frac{\pi}{3}\right)\right]^2$$

$$= \cos^2\left(2t - \frac{\pi}{3}\right)$$

$$= \frac{1}{2}\left[1 + \cos\left(4t - \frac{2\pi}{3}\right)\right]$$

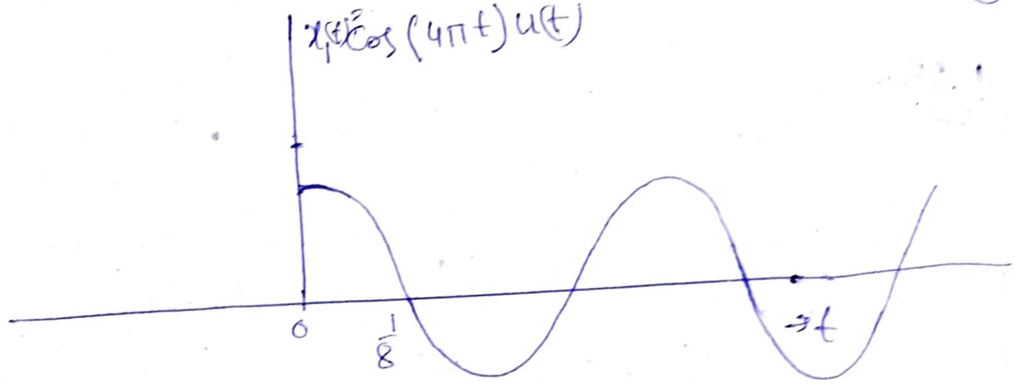
$$= \frac{1}{2} + \frac{1}{2}\cos\left(4t - \frac{2\pi}{3}\right)$$

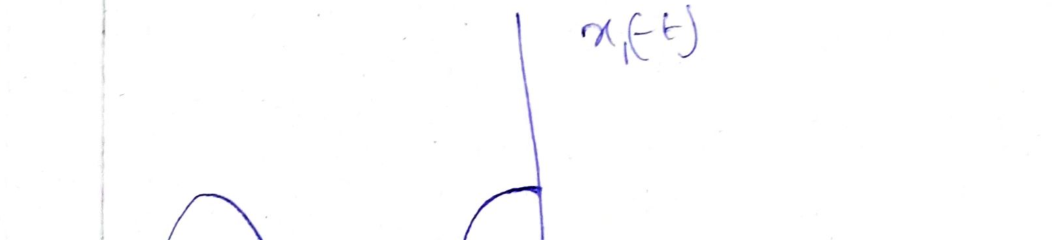
It is periodic with fundamental period

$$T_0 = \frac{2\pi}{\omega_0} = \frac{2\pi}{4} = \frac{\pi}{2}. \quad \underline{\text{Ans}}$$

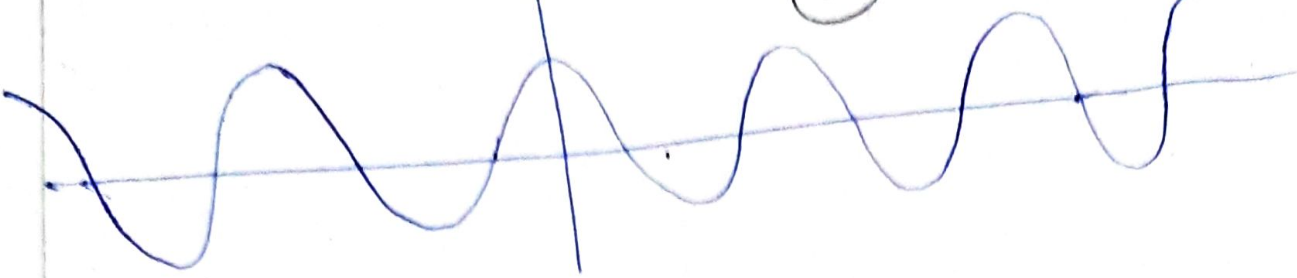
(d) $x(t) = \mathcal{E}v\{\cos(4\pi t)\, u(t)\}$

$\frac{1}{8}$





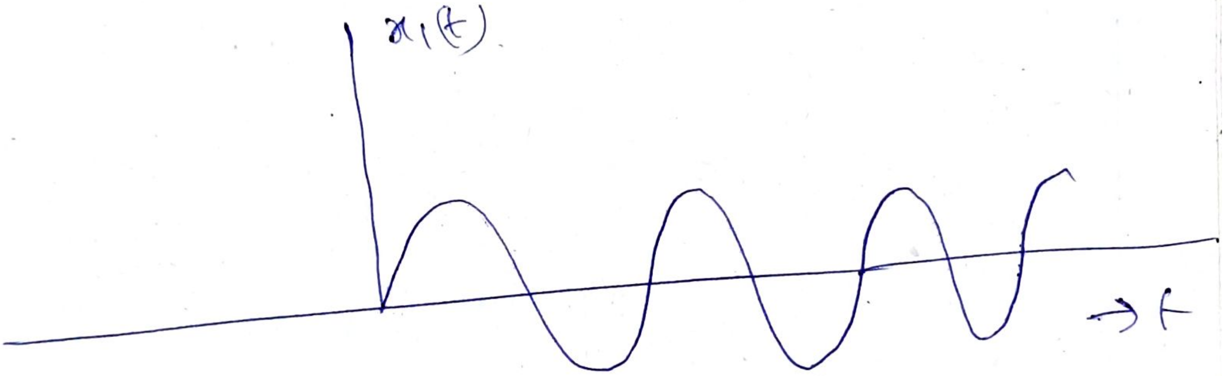
$$x(t) = \mathcal{E}v\{x_1(t)\} = \frac{x_1(t) + x_1(-t)}{2}$$

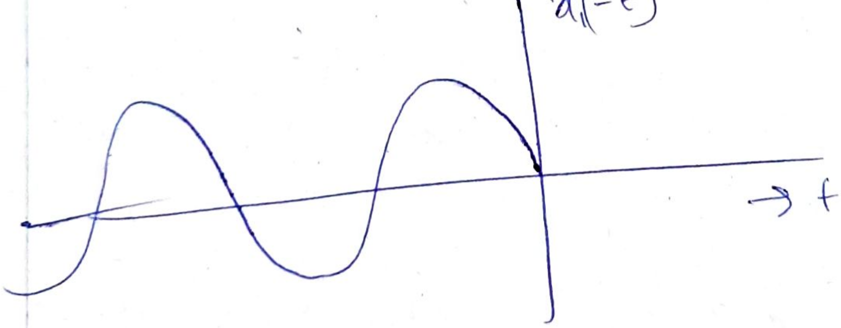


So $x(t)$ is periodic
with fundamental period $= T_0 = \frac{2\pi}{\omega_0} = \frac{2\pi}{4\pi}$
$= \frac{1}{2}$

Ans

(e) $x(t) = Ev\{\sin(4\pi t)\, u(t)\}$
$= Ev\{x_1(t)\}$





$\therefore Ev\{x_1(t)\} = \dfrac{x_1(t) + x_1(-t)}{2}$

There is discontinuity at $t=0$, so it is not periodic

(22)

(f) $x(t) = \sum_{n=-\infty}^{\infty} e^{-(2t-n)}$

It is periodic with period $= T_0 = \frac{2\pi}{\omega_0} = \frac{2\pi}{2}$

$= \pi$ ...

1.26

(a) $x[n] = \sin\left(\frac{6\pi}{7}n + 1\right)$

$= \sin\left[\left(\frac{2\pi}{7}\right)3n + 1\right]$

$\therefore$ Here $\omega_0 = \frac{2\pi}{7}$ or, $N_0 = \frac{2\pi}{\omega_0} = \frac{2\pi}{\frac{2\pi}{7}} = 7$ Ans

(b) $x[n] = \cos\left(\frac{n}{8} - \pi\right)$

$= \cos\left[\left(\frac{2\pi}{8\times 2\pi}\right)n - \pi\right]$

Here $\omega_0 = \frac{2\pi}{8\times 2\pi}$ $\therefore N_0 = \frac{2\pi}{\omega_0} = \frac{2\pi}{\frac{2\pi}{8\times 2\pi}}$

$= 8\times 2\pi$

Since N_0 is fraction no it is not periodic.

(c) $x[n] = \cos\left(\frac{\pi}{8} n^2\right)$ (23)

It is not periodic

(d) $x[n] = \cos\left(\frac{\pi}{2} n\right) \cos\left(\frac{\pi}{4} n\right)$

$\cos\left(\frac{\pi}{2} n\right)$ is a periodic signal with fundamental period $= N_0 = \frac{2\pi}{\omega_0}$

$= \frac{2\pi}{\frac{2\pi}{4}} = 4$

$\cos\left(\frac{\pi}{4} n\right)$ is also periodic with fundamental period $N_0 = \frac{2\pi}{\omega_0} = \frac{2\pi}{\frac{2\pi}{8}} = 8$