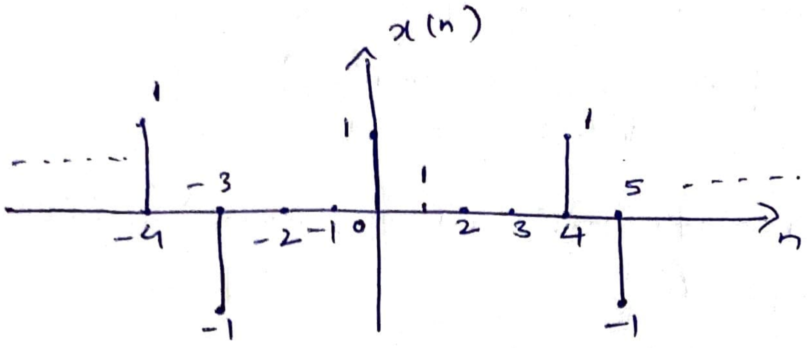
Assignment - I Solutions

(1)
(a)



Therefore, it is Periodic with a fundamental Period of 4.

(1)
(b)

Period of the first term $N_1 = 1$

Period of the second term $N_2 = \left(\frac{2\pi}{4\pi/7}\right)m = 7$ (where $m=2$)

Period of the third term $N_3 = \left(\frac{2\pi}{2\pi/5}\right)m = 5$ (where $m=1$)

$\frac{N_1}{N_2}, \frac{N_1}{N_3} \rightarrow$ Rational number

overall period of the signal $\} N = N_1 \times \text{Lcm}(N_2, N_3)$

$= 35$

(1)
(c)

Period of the first term $T_1 = \frac{2\pi}{10} = \frac{\pi}{5}$

Period of the second term $T_2 = \frac{2\pi}{4} = \frac{\pi}{2}$

$\frac{T_1}{T_2} \rightarrow$ Rational number

$\therefore$ $x(t)$ is Periodic with fundamental Period $T = \text{Lcm}(T_1, T_2) = \pi$

(2)

$$x(n) = 1 - \sum_{k=3}^{\infty} \delta(n-1-k)$$
$$= 1 - [\delta(n-4) + \delta(n-5) + \delta(n-6) + \cdots]$$
$$= 1 - [u(n-3)]$$
$$= u(-n+3)$$

This implies that $M=-1$, $n_0=-3$

(3)

(a) $E = \int_0^{\infty} e^{-4t}\,dt = \frac{1}{4}$; $P=0$, because $E < \infty$

(b) $x_2(t) = e^{j(2t+\frac{\pi}{4})}$; $|x_2(t)| = 1$, $E = \int_{-\infty}^{\infty} |x_2(t)|^2 dt$
$= \infty$

$$P = \lim_{T\to\infty} \frac{1}{2T} \int_{-T}^{T} |x_2(t)|^2 dt = 1$$

(c) $E = \int_{-\infty}^{\infty} \cos^2(t)\,dt = \infty$

$P = \lim_{T\to\infty} \frac{1}{2T} \int_{-\infty}^{\infty} \cos^2(t)\,dt = \lim_{T\to\infty} \frac{1}{2T} \int_{-T}^{T} \frac{1+\cos(2t)}{2}\,dt$
$= \frac{1}{2}$

(d) $E = \sum_{n=0}^{\infty} \left(\frac{1}{4}\right)^n = \frac{4}{3}$, $P = \infty$

(e) $E = \infty$, $P = 0$

(f) $E = \sum_{n=-\infty}^{\infty} \cos^2\left(\frac{\pi}{4}n\right) = \infty$, $P = \lim_{N\to\infty} \frac{1}{2N+1} \sum_{n=-N}^{N} \cos^2\left(\frac{\pi}{4}n\right)$
$= \lim_{N\to\infty} \frac{1}{2N+1} \sum_{n=-N}^{N} \left(\frac{1}{2} + \frac{\cos(\frac{\pi}{2}n)}{2}\right)$
$= \frac{1}{2}$