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SECTION: B

PAPER: DSP

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Q1. Determine if the following sinusoidal signals are periodic or aperiodic. In case signal is periodic, find its fundamental period N.

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

Solution:

$U = 8$, $T = 5$

$x[n] = 2\sin\left(\frac{1}{8}\pi n + \frac{\pi}{3}\right)$

we know that if a Discrete signal is periodic, the ratio of $\frac{\omega_0}{2\pi}$ must be a rational number.

so

$$\frac{\pi/8}{2\pi} = \frac{1}{16}$$

so it is a periodic signal because $\frac{1}{16}$ is a rational number.

Fundamental Period $N = 16$.

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(iii) $x[n] = 3\cos\left(\frac{1}{T}n + \pi/2\right)$

solution:

$T = 5$

$x[n] = 3\cos\left(\frac{1}{5}n + \pi/2\right)$

signal is periodic if $\frac{\omega_0}{2\pi}$ is rational

$\frac{1/5}{2\pi} \Rightarrow \frac{1}{10\pi}$

Here $\frac{1}{10\pi}$ is not a rational number so it is not periodic signal.

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(PART 2)

Solution:

$$x[n] = \{U, T, H, T_h\}$$

$$h[n] = \{T_h, H, T, U\}$$

$U = 8$, $T = 5$, $H = 6$, $T_h = 1$

we know that

$$y[n] = \sum_{k=-\infty}^{\infty} x[k]h[n-k]$$

For $n = 0$:

$$y[0] = \sum_{k=-\infty}^{\infty} x[k]h[-k]$$

$$= (6\times8)+(1\times5)+(0\times6)+(0\times1)$$

$$= 48+5+0+0$$

$$y[0] = 53$$

For $n = 1$:

$$y[1] = \sum_{k=-\infty}^{\infty} x[k]h[1-k]$$

$$= (5\times0)+(1\times8)+(0\times5)$$

$$y[1] = 8$$

For $n = 2$

$$y[2] = \sum_{k=-\infty}^{\infty} x[k]h[2-k]$$

$$= (0\times5)+(0\times8)+0\times\ldots$$

$$y[2] = 0$$

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For $n=-1$:

$$y[-1] = \sum_{k=-\infty}^{\infty} x[k]h[-1-k]$$

$$= (5\times8)+(6\times5)+(1\times6)+(0\times1)$$

$$= 40+30+6$$

$$y[-1] = 76$$

For $n=-2$:

$$y[-2] = \sum_{k=-\infty}^{\infty} x[k]h[-2-k]$$

$$= (8\times8)+(5\times5)+(6\times6)+(1\times1)$$

$$= 64+25+36+1$$

$$y[-2] = 126$$

For $n=-3$:

$$y[-3] = \sum_{k=-\infty}^{\infty} x[k]h[-3-k]$$

$$= (5\times8)+(6\times5)+(1\times6)+(0\times1)$$

$$= 40+30+6$$

$$y[-3] = 76$$

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For $n=-4$:

$$y[-4] = \sum_{k=-\infty}^{\infty} x[k]\,h[-4-k]$$

$$= (8\times 6) + (5\times 1) + (6\times 0)$$

$$= 48+5$$

$$\Rightarrow \boxed{y[-4] = 53}$$

For $n=-5$:-

$$y[-5] = \sum_{k=-\infty}^{\infty} x[k]\,h[-5-k]$$

$$= 8\times 1$$

$$\Rightarrow \boxed{y[-5] = 8}$$