Assignment-2

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Contents

1 Problem-Oppenheim 2.7-b

1.1 Determine whether the following signal is periodic. If the signal is periodic, state its period.

$$x[n] = e^{j(3\pi n/4)}$$

2 Solution

2.1 **Solution:**
A discrete signal $x[n]$ is said to be periodic when

$$x[n] = x[n+N] \tag{2.1}$$

if discrete signal is periodic then the ration $\frac{\omega_0}{2\pi}$ must be rational i.e., $\frac{m}{N}$ where m = no.of full cycles and N = no. of samples
Now, for the given signal

$$\omega_0 = \frac{3\pi}{4} \tag{2.2}$$

$$\frac{\omega_0}{2\pi} = \frac{3\pi}{4\times 2\pi} \tag{2.3}$$

$$= \frac{3}{8} \qquad (rational) \tag{2.4}$$

Also using the definiton in (2.1), we can write

$$e^{j(3\pi n/4)} = e^{j(3\pi(n+N)/4)} = e^{j(3\pi n/4+2\pi k)} \tag{2.5}$$

$$\implies 2\pi k = \frac{3\pi}{4}N, \text{ for integers k, N} \tag{2.6}$$

$$\implies N = \frac{8}{3}k, \text{ for integers k, N} \tag{2.7}$$

$$\tag{2.8}$$

The smallest k for which both k and N are integers is 3 , resulting in a period of 8.
$\therefore$ The signal is periodic with period 8. We can also verify from the plot (2.1)

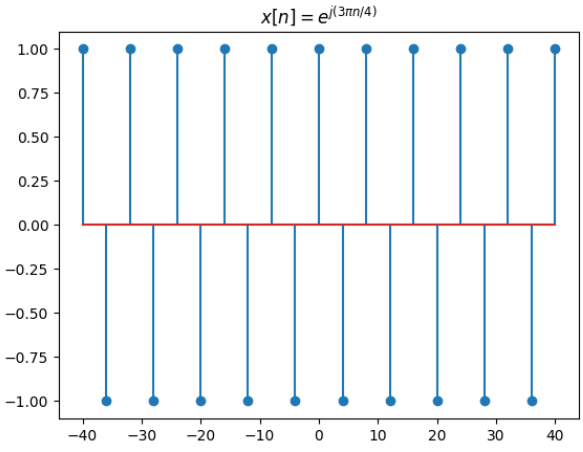

Fig. 2.1: Sketch of $x[n]$