Digital Signal Processing

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1 QUESTION

Question

Determine whether the following signal is periodic. If it is periodic state the period.

$$x[n] = e^{\frac{jn\pi}{\sqrt{2}}} \tag{1.1}$$

2 SOLUTION

Solution:

$x[n]$ is periodic with period N if $x[n] = x[n+N]$ for some integer N.

$$x[n] = x[n+N] \tag{2.1}$$
$$\implies e^{\frac{jn\pi}{\sqrt{2}}} = e^{\frac{j(n+N)\pi}{\sqrt{2}}} \tag{2.2}$$
$$= e^{\frac{jn\pi}{\sqrt{2}} + \frac{jN\pi}{\sqrt{2}}} \tag{2.3}$$
$$= e^{\frac{jn\pi}{\sqrt{2}} + j2\pi k} \tag{2.4}$$

For integers N,k

$$2\pi k = \frac{N\pi}{\sqrt{2}} \tag{2.5}$$
$$N = 2\sqrt{2}k \tag{2.6}$$

There is no k for which N is an integer

$\therefore$ The given signal is not periodic