Tutorials

1 Determine whether or not each of following signals are periodic

(a) $x_1(t) = 1 + je^{j5t}$

(b) $x_2(t) = e^{j(2-3t)}$

(c) $x_3[n] = e^{j3\pi n}$

(d) $x_4[n] = e^{j4n}$

2. Let $x(t)$ be a signal with $x(t) = 0$ for $t < 4$. For given signals below they determine for which value of t they are guaranteed to be zero

(a) $x(t-1)$

(b) $x(t-3) + x(2-3t)$

(c) $x(t-1)\, x(2-t)$

(d) $x(4t)$

3. Define the signal $\delta_\Delta(t)$ as

$$\delta_\Delta(t) = \begin{cases} \frac{1}{\Delta} & 0 < t < \Delta \\ 0 & \text{else} \end{cases}$$

and
$$U_\Delta(t) = \begin{cases} \frac{t}{\Delta} & 0 < t < \Delta \\ 1 & t > \Delta \\ 0 & t < 0. \end{cases}$$

~~as~~ Given $U_\Delta(t) = \int_{-\infty}^{t} \delta_\Delta(\tau)\,d\tau$

Show that $U(t) = \int_{-\infty}^{t} \delta(\tau)\,d\tau$

here $\delta(t) = \lim_{\Delta \to 0} \delta_\Delta(t)$

$$U(t) = \lim_{\Delta \to 0} U_\Delta(t)$$

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Problems

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

Periodic?

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

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

here $\omega_0 = 4$.

A: Yes.

Fun. Period $= T_0 = \frac{2\pi}{4} = \frac{\pi}{2}$.

(2) $x(t) = Ev\{\cos 4\pi t \cdot u(t)\}$.

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

$$\therefore x(t) = \begin{cases} \frac{1}{2}\cos 4\pi t. & t > 0 \\ 1. & t = 0 \\ \frac{1}{2}\cos 4\pi t. & t < 0. \end{cases}$$

Not periodic.

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

$$= \sin\left(\frac{6\pi}{7}n\right) \cdot \cos(1) + \cos\left(\frac{6\pi}{7}n\right)\sin(1).$$

$$\frac{m}{N} 2\pi = \frac{6\pi}{7}. \Rightarrow N = \frac{7}{3}m.$$

$\therefore N_1 = 7$. for $m = 3$.

4..

(1.36)

$$x[n] = x(nT) = e^{j\omega_0 nT}$$ → Sampled signal of $e^{j\omega_0 t}$.

$$\boxed{\omega_0 = \frac{2\pi}{T_0}}$$

periodicity.

$$x[n+N] = x[n].$$

$$e^{j\omega_0 (n+N)T} = e^{j\omega_0 nT}.$$

$$\therefore e^{j\omega_0 NT} = 1.$$

$$\omega_0 NT = 2\pi m.$$

$$\omega_0 = \frac{2\pi}{T_0}. \quad \therefore \frac{1}{T_0} . T N = m.$$

$$\therefore \boxed{\frac{m}{N} = \frac{T}{T_0}} \rightarrow [mT_0 = NT].$$

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