PROBLEM:

Circle the correct answer to each of these short answer questions (3 pts. each):

1. A signal $x(t)$ is defined by: $x(t) = \cos(1000\pi t - 1.3\pi)$. Its shortest period ($T$) is

   (a) $T = 1000$ sec.

   (b) $T = 1$ sec.

   (c) $T = 10^{-3}$ sec.

   (d) $T = 2 \times 10^{-3}$ sec.

   (e) none of the above

2. A signal $x(t)$ is defined by: $x(t) = 7\sin(3\pi t - \frac{1}{2}\pi)$. A valid complex exponential representation for $x(t)$ is:

   (a) $x(t) = \Re e\{14e^{-j\pi}e^{j3\pi t}\}$

   (b) $x(t) = \Re e\{7e^{j\pi}e^{j3\pi t}\}$

   (c) $x(t) = \Re e\{7e^{-j0.5\pi}e^{j3\pi t}\}$

   (d) $x(t) = \Re e\{7e^{j3\pi}e^{j\pi t}\}$

   (e) none of the above

3. When the following two sinusoids are combined: $\cos(6t + \pi/3) + \cos(6t - \pi/3)$, determine the amplitude (A) and phase (ϕ) of the resulting sinusoid.

   (a) $A = 1$ and $\phi = 0$.

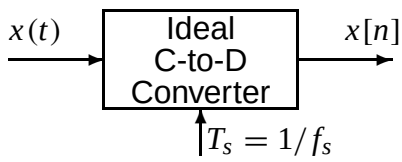
   (b) $A = 1$ and $\phi = \pi/3$.

   (c) $A = 1$ and $\phi = -\pi/3$.

   (d) $A = \sqrt{3}$ and $\phi = 0$.

   (e) none of the above

4. If the input to an ideal C/D converter is a sinusoid with frequency of 2500 Hz, and the output is the discrete-time sinusoid: $x[n] = 4\cos(\frac{1}{2}\pi n)$, then

   determine the possible value(s) of the sampling frequency f_s:

   (a) $f_s = 10,000$ Hz

   (b) $f_s = 2000$ Hz

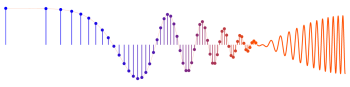
   (c) $f_s = 400$ Hz

   (d) all of the above

   (e) none of the above

McClellan, Schafer and Yoder, *Signal Processing First*, ISBN 0-13-065562-7.
Prentice Hall, Upper Saddle River, NJ 07458.

SOLUTION



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   (c) $T = 10^{-3}$ sec.
   (d) $T = 2 \times 10^{-3}$ sec.
   (e) none of the above

$f_0 = 1000\pi/2\pi = 500\text{Hz}$

$T = 1/f_0 = 1/500 = 2\times10^{-3}\text{ sec}$

2. A signal $x(t)$ is defined by: $x(t) = 7\sin(3\pi t - \frac{1}{2}\pi)$. A valid complex exponential representation for $x(t)$ is:

   (a) $x(t) = \Re e\{14e^{-j\pi}e^{j3\pi t}\}$
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   (e) none of the above

$x(t) = 7\cos(3\pi t - \pi/2 - \pi/2)$

$= 7\cos(3\pi t - \pi)$ $\quad e^{-j\pi} = e^{j\pi}$

$= \text{Re}\{7e^{j(3\pi t-\pi)}\} = \text{Re}\{7e^{j\pi}e^{j3\pi t}\}$

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   (a) $A = 1$ and $\phi = 0$.
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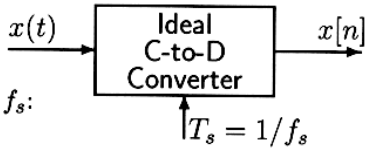
Phasors (Complex Amplitude)

$1e^{j\pi/3} + 1e^{-j\pi/3} = 2\cos(\pi/3) = 2(1/2) = 1e^{j0}$

4. If the input to an ideal C/D converter is a sinusoid with frequency of 2500 Hz, and the output is the discrete-time sinusoid: $x[n] = 4\cos(\frac{1}{2}\pi n)$, then



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   (b) $f_s = 2000$ Hz
   (c) $f_s = 400$ Hz
   (d) all of the above
   (e) none of the above

$x[n] = A\cos(2\pi(2500)n/f_s)$

$\Rightarrow \frac{2\pi(2500)}{f_s} = \frac{\pi}{2} + 2\pi\ell = 2\pi(\frac{1}{4} + \ell)$

$f_s = \frac{2500}{\ell + 1/4}$

$\ell = 0 \Rightarrow f_s = 10,000\text{Hz}$

$\ell = 1 \Rightarrow f_s = 2500/5/4 = 2000\text{Hz}$

$\ell = 6 \Rightarrow f_s = 2500/25/4 = 400\text{Hz}$

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