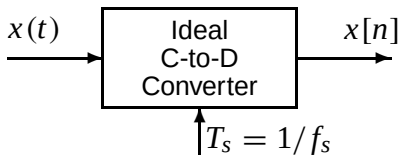
PROBLEM:

For each short question, pick a correct frequency[1] and enter the number in the answer box[2]:

Question

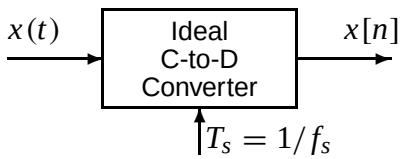
(a) If the output from an ideal C/D converter is $x[n] = 33\cos(0.5\pi n)$, and the sampling rate is 2000 samples/sec, then determine one possible value of the input frequency of $x(t)$:

ANS =



(b) If the output from an ideal C/D converter is $x[n] = 33\cos(0.5\pi n)$, and the the input signal $x(t)$ defined by: $x(t) = 33\cos(3000\pi t)$ then determine one possible value of the sampling frequency of the the C-to-D converter:

ANS =



(c) Determine the Nyquist rate for sampling the signal $x(t)$ defined by: $x(t) = \Re e\{e^{j1200\pi t} + e^{j2000\pi t}\}$.

ANS =

Frequency

1. 8000 Hz
2. 4000 Hz
3. 2000 Hz
4. 1600 Hz
5. 1200 Hz
6. 1000 Hz
7. 800 Hz
8. 500 Hz
9. 400 Hz

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

SOLUTION

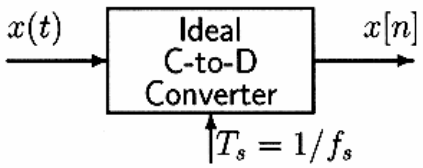
[1] Some questions have more than one answer, but you only need to pick one correct answer.

[2] It is possible to use an answer more than once.

For each short question, pick a correct frequency and enter the number in the answer box:

Question

(a) If the output from an ideal C/D converter is $x[n] = 33\cos(0.5\pi n)$, and the sampling rate is 2000 samples/sec, then determine one possible value of the input frequency of $x(t)$:



ANS = 8

$\hat{\omega} = \omega/f_s \pm 2\pi\ell$

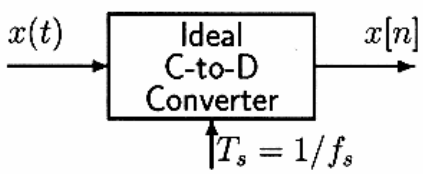
$\omega = f_s(\hat{\omega} \pm 2\pi\ell)$

$= 2000(\frac{\pi}{2} \pm 2\pi\ell)$ → $1000\pi \pm 4000\pi\ell$ → 500 Hz.

Frequency

1. 8000 Hz
2. 4000 Hz
3. 2000 Hz
4. 1600 Hz
5. 1200 Hz
6. 1000 Hz
7. 800 Hz
8. 500 Hz
9. 400 Hz

(b) If the output from an ideal C/D converter is $x[n] = 33\cos(0.5\pi n)$, and the the input signal $x(t)$ defined by: $x(t) = 33\cos(3000\pi t)$ then determine one possible value of the sampling frequency of the the C-to-D converter:



ANS = 5

$\hat{\omega} = \frac{\omega}{f_s} \pm 2\pi\ell$

$f_s = \frac{\omega}{\hat{\omega} \pm 2\pi\ell} = \frac{3000\pi}{\frac{\pi}{2} \pm 2\pi\ell} = \frac{6000}{1 \pm 4\ell}$

$\ell = 0 \Rightarrow f_s = 6000\text{Hz}$ $\quad \ell = -1 \Rightarrow f_s = 1200\text{ Hz}$

(c) Determine the Nyquist rate for sampling the signal $x(t)$ defined by: $x(t) = \Re e\{e^{j1200\pi t} + e^{j2000\pi t}\}$.

ANS = 3

x(t) has two freqs: 600Hz & 1000Hz

$f_s \geq 2f_{MAX} = 2000\text{ Hz}.$