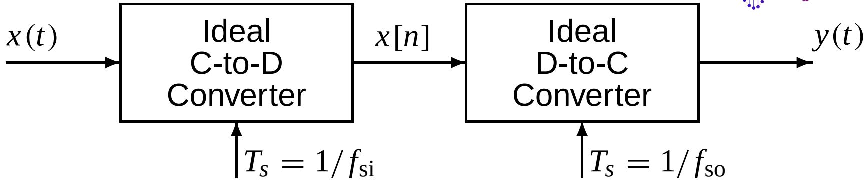
PROBLEM:



(a) Suppose that the input $x(t)$ is given by

$$x(t) = 10 + 10\cos(2\pi(2000)t - \pi) + 8\cos(2\pi(7000)t - 3\pi/4)$$

Determine the spectrum for $x[n]$ when $f_{si} = 10000$ samples/sec. Make a $\boxed{\text{plot}}$ for your answer, making sure to label the frequency, amplitude and phase of each spectral component.

(b) Using the discrete-time spectrum from part (a), determine the analog frequency components in the output $y(t)$ when the sampling rate of the D-to-C converter is $f_{so} = 10000$ Hz.

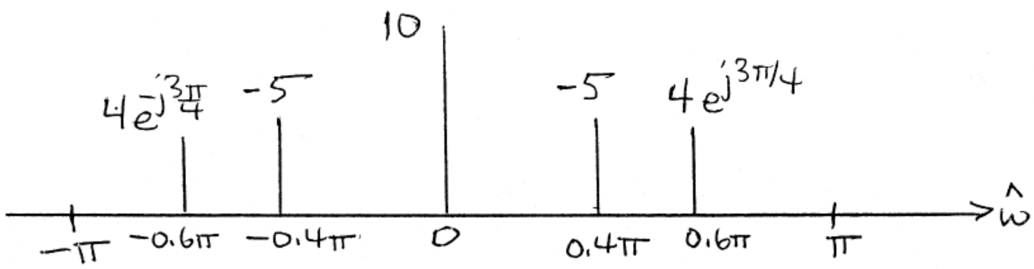
(c) Again using the discrete-time spectrum from part (b), determine the analog frequency components in the output $y(t)$ when the sampling rate of the D-to-C converter is $f_{so} = 20000$ Hz. In other words, the sampling rates of the two converters are different.

McClellan, Schafer and Yoder, *Signal Processing First*, ISBN 0-13-065562-7.

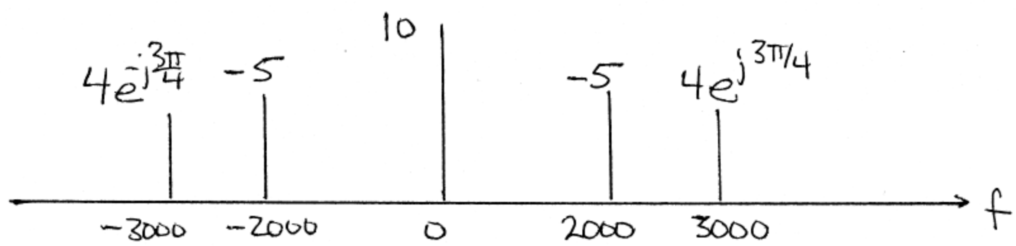
SOLUTION

(a) $x[n] = x\left(\frac{n}{10{,}000}\right) = 10 + 10\cos(0.4\pi n - \pi) + 8\cos(1.4\pi n - 3\pi/4)$

$$= 10 + 10\cos(0.4\pi n - \pi) + 8\cos(0.6\pi n + 3\pi/4)$$



(b) $y(t) = 10 + 10\cos(4000\pi t - \pi) + 8\cos(6000\pi t + 3\pi/4)$



(c) Remember that $f = \hat{f} \cdot f_{so}$

$$\Rightarrow y(t) = 10 + 10\cos(8000\pi t - \pi) + 8\cos(12{,}000\pi t + 3\pi/4)$$