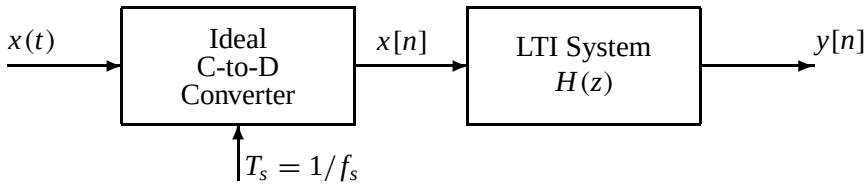
PROBLEM:



The input to the C-to-D converter in the above system is

$$x(t) = 2 - 3\cos(500\pi t + \pi/3)$$

The sampling frequency is $f_s = 1000$ samples/second.

(a) Determine a system function $H(z)$ for the LTI system such that $y[n] = A$ for $-\infty < n < \infty$, where A is a constant.

(b) Determine the value of the constant A for your system in part (a).

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

SOLUTION

$$x(t) = 2 - 3\cos(500\pi t + \pi/3)$$

$$x[n] = 2 - 3\cos\left(\frac{500\pi n}{1000} + \frac{\pi}{3}\right)$$

$$= 2 - 3\cos\left(\frac{\pi}{2}n + \pi/3\right)$$

(a) We want $y[n] = A$ = constant so we need zeros of $H(z)$ at $z = e^{\pm j\pi/2}$ so that $H(e^{j\hat{\omega}})\Big|_{\hat{\omega} = \pm\frac{\pi}{2}} = 0$. Thus

$$H(z) = (1 - e^{j\frac{\pi}{2}}z^{-1})(1 - e^{-j\pi/2}z^{-1})$$ will do it

(b) The output will be

$$y[n] = 2\,H(e^{j0}) = 2(1 - e^{j\frac{\pi}{2}})(1 - e^{-j\pi/2})$$

$$= 2(1+1) = \underline{\underline{4}}$$