4.39. The system shown in Figure P4.39-1 approximately interpolates the sequence $x[n]$ by a factor L. Suppose that the linear filter has impulse response $h[n]$ such that $h[n] = h[-n]$ and $h[n] = 0$ for $|n| > (RL-1)$, where R and L are integers; i.e., the impulse response is symmetric and of length $(2RL-1)$ samples.

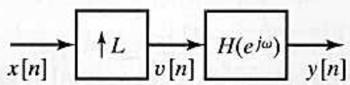


Figure P4.39-1

(a) In answering the following, do not be concerned about the causality of the system; it can be made causal by including some delay. Specifically, how much delay must be inserted to make the system causal?

(b) What conditions must be satisfied by $h[n]$ in order that $y[n] = x[n/L]$ for $n = 0, \pm L, \pm 2L, \pm 3L, \ldots$?

(c) By exploiting the symmetry of the impulse response, show that each sample of $y[n]$ can be computed with no more than RL multiplications.

(d) By taking advantage of the fact that multiplications by zero need not be done, show that only $2R$ multiplications per output sample are required.

4.40. In the system of Figure P4.40-1,

$$X_c(j\Omega) = 0, \qquad |\Omega| \geq \pi/T,$$

and

$$H(e^{j\omega}) = \begin{cases} e^{-j\omega}, & |\omega| < \pi/L, \\ 0, & \pi/L < |\omega| \leq \pi. \end{cases}$$

How is $y[n]$ related to the input signal $x_c(t)$?

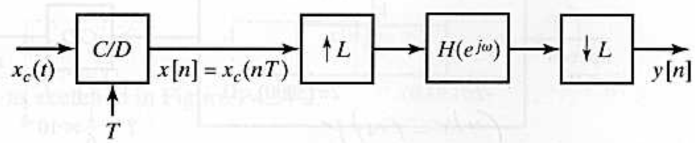


Figure P4.40-1

4.41. Consider the system shown in Figure P4.41-1. The input to this system is the bandlimited signal whose Fourier transform is shown in Figure P4.20-1 with $\Omega_0 = \pi/T$. The discrete-time LTI system in Figure P4.41-1 has the frequency response shown in Figure P4.41-2.

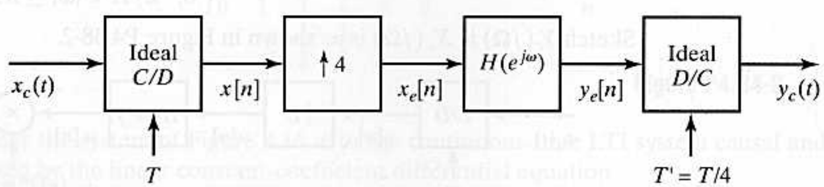
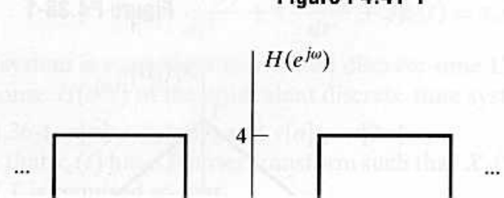


Figure P4.41-1



(a) Sketch the Fourier transforms $X(e$

(b) For the general case when $X_c(j\Omega$ $X_c(j\Omega)$. Also, give a general expre limited in this manner.

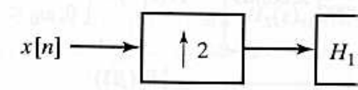
4.42. Let $x_c(t)$ be a real-valued continuous ans/second. Furthermore, let $y_c(t) = x_c$

(a) If $x[n] = x_c(n/500)$, is it theoretical answer.

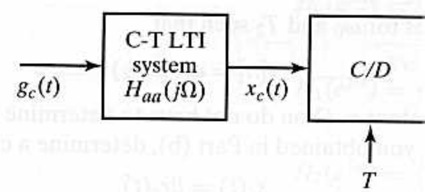
(b) If $y[n] = y_c(n/500)$, is it theoretical answer.

(c) Is it possible to obtain $y[n]$ from $x[n]$ $H_1(e^{j\omega})$.

(d) It is also possible to obtain $y[n]$ fro using a single LTI system with frequ



4.43. Consider the system shown in Figure P4. time input signal $g_c(t)$. The input signal Fourier transforms of $f_c(t)$ and $e_c(t)$ are not bandlimited, a continuous-time ant the frequency response for $H_{aa}(j\Omega)$ is s the antialiasing filter is $\angle H_{aa}(j\Omega) = -\Omega$



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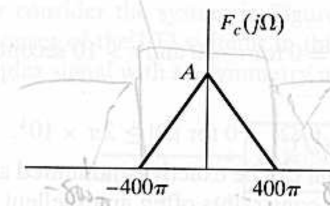

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