

- 4.23.** Figure P4.23-1 shows a continuous-time filter that is implemented using an LTI discrete-time filter ideal lowpass filter with frequency response over $-\pi \leq \omega \leq \pi$ as

$$H(e^{j\omega}) = \begin{cases} 1 & |\omega| < \omega_c \\ 0 & \omega_c < |\omega| \leq \pi. \end{cases}$$

- (a) If the continuous-time Fourier transform of $x_c(t)$, namely $X_c(j\Omega)$, is as shown in Figure P4.23-2 and $\omega_c = \frac{\pi}{5}$, sketch and label $X(e^{j\omega})$, $Y(e^{j\omega})$ and $Y_c(j\Omega)$ for each of the following cases:
- (i) $1/T_1 = 1/T_2 = 2 \times 10^4$
 - (ii) $1/T_1 = 4 \times 10^4$, $1/T_2 = 10^4$
 - (iii) $1/T_1 = 10^4$, $1/T_2 = 3 \times 10^4$.
- (b) For $1/T_1 = 1/T_2 = 6 \times 10^3$, and for input signals $x_c(t)$ whose spectra are bandlimited to $|\Omega| < 2\pi \times 5 \times 10^3$ (but otherwise unconstrained), what is the maximum choice of the cutoff frequency ω_c of the filter $H(e^{j\omega})$ for which the overall system is LTI? For this maximum choice of ω_c , specify $H_c(j\Omega)$.

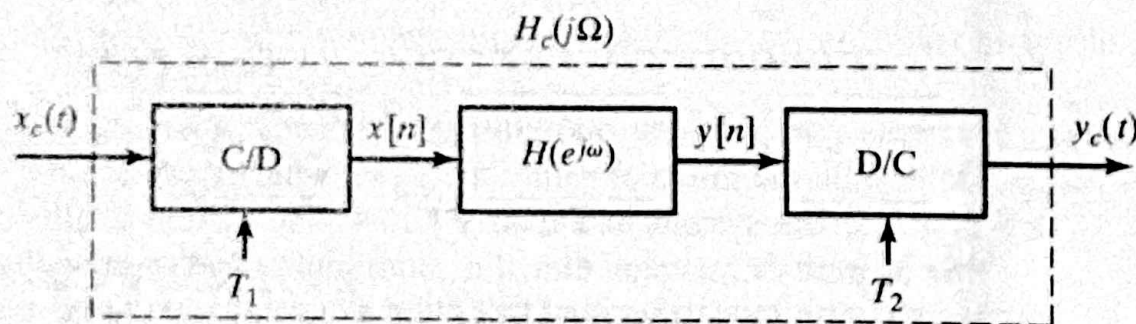


Figure P4.23-1

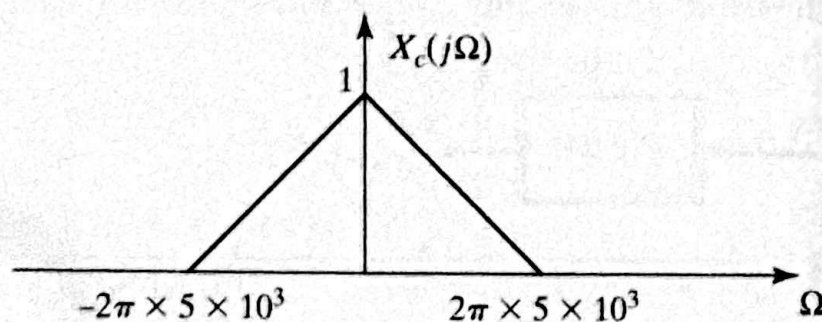


Figure P4.23-2