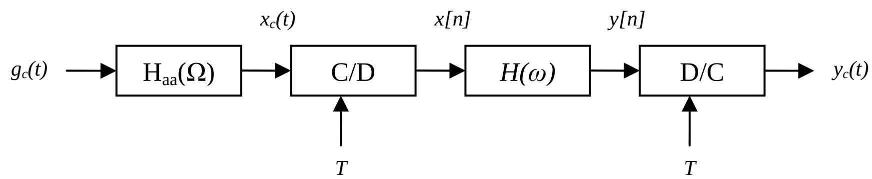
University of California, Berkeley
Department of Electrical Engineering and Computer Sciences
EE123: DIGITAL SIGNAL PROCESSING

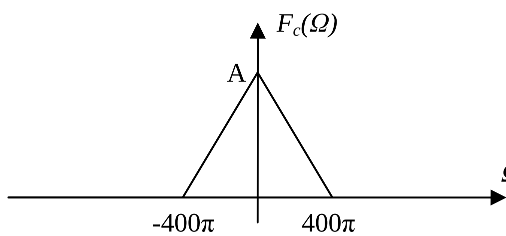
Fall 2006

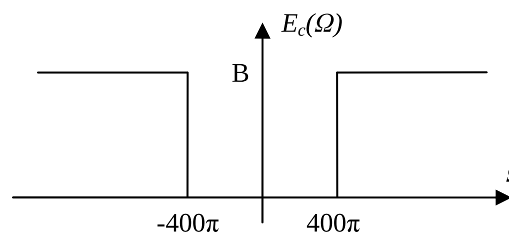
Discussion #13

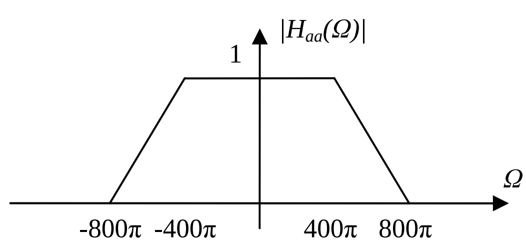
1. Consider the following system:



The input signal is $g_c(t)=f_c(t)+e_c(t)$, where the Fourier transforms of $f_c(t)$ and $e_c(t)$ are shown below. Since the input signal is not band-limited, a continuous-time anti-aliasing filter $H_{aa}(\Omega)$ is used. The magnitude of the frequency response for $H_{aa}(\Omega)$ is as shown below, and the phase response is $arg[H_{aa}(\Omega)]=-\Omega^3$.



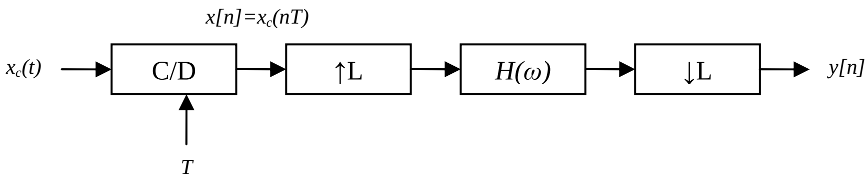




(a) If the sampling rate is $2\pi/T = 1600\pi$, determine the magnitude and phase of $H(\omega)$ such that the output is $y_c(t)=f_c(t)$.

(b) Is it possible that $y_c(t)=f_c(t)$ if $2\pi/T < 1600\pi$? If so, what is the *minimum* value of $2\pi/T$? Determine $H(\omega)$ for this choice of $2\pi/T$.

2. Consider the system below:



We also know that:

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

and:

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

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