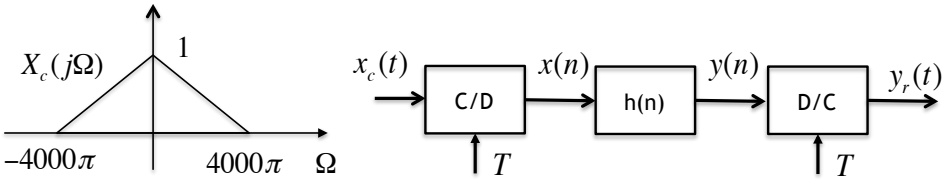
DSP/YPL

Homework 3

1. Consider the following system. Let $T = 1/4000$ sec. and the input is as given in the figure.



   (a) Plot $X_s(j\Omega)$, where $X_s(j\Omega)$ is the Fourier transform of $x_s(t) = x_c(t)\sum_n \delta_c(t-nT)$ is the signal in the conceptual representation of C/D converter.

   (b) Plot $X(e^{j\omega})$.

   (c) Suppose $h(n) = \delta(n)$. Plot $Y_s(j\Omega)$ and $Y_r(j\Omega)$.

   (d) Plot $Y_r(j\Omega)$ and $Y_s(j\Omega)$ when $h(n)$ is an ideal lowpass filter with cutoff frequency $\pi/2$.

   (e) Consider a general $h(n)$. Is the system from $x_c(t)$ to $y_r(t)$ always an LTI system when there is no aliasing? Determine the frequency response of the system in terms of $H(e^{j\omega})$ and T if it is.

   (f) Suppose the input is changed to $x_c(t) = \cos(500\pi t) + \cos(2000\pi t)$ and $T = 1/1000$ sec. Determine $Y_r(j\Omega)$ when $h(n)$ is as in (e).

   (g) Can we find a value of T for the $x_c(t)$ in (g) so that $x(n)$ is a sinusoid instead of the sum of two sinusoids?

   (h) Suppose the input is $x_c(t) = \cos(1000\pi t)$ and $T = 1/1000$ sec. Plot $X_s(j\Omega)$ and $X(e^{j\omega})$.

2. Consider the following system with $T = 1/4000$ sec. and input $x_c(t) = \cos(1000\pi t)$. Determine $x_c'(t)$ and plot $X_c'(j\Omega)$ for the following cases.

   (a) $T' = 2T$.

   (b) $T' = T/2$.