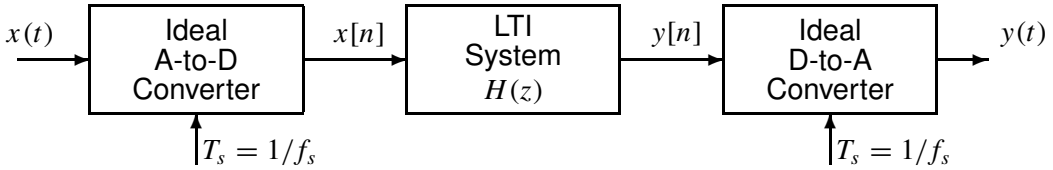
PROBLEM:

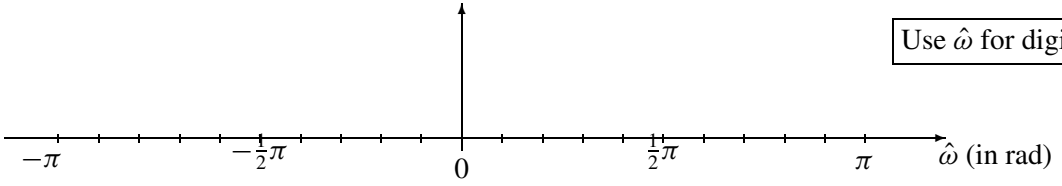
The input to the A-to-D converter in the figure below consists of a single sinusoid. The system function for the LTI system is a digital FIR filter. Since digital filters can be used to null out individual sinusoids, it should be possible to design $H(z)$ so that the output $y(t)$ will be zero.



(a) If the input $x(t)$ is a sinusoid:

$$x(t) = 7\cos(4000\pi t - \pi/5)$$

Determine the spectrum for $x[n]$ when $f_s = 8000$ samples/sec. Make a plot for your answer, but label the frequency, amplitude and phase of each spectral component.



(b) Now you must design the FIR filter: $H(z) = \sum_{k=0}^{M} b_k z^{-k}$. To avoid the all zero solution, make the DC value of the frequency response equal to 1. Since the objective is to make the output zero by filtering $x[n]$, then the FIR filter $H(z)$ can be determined by specifying the locations of its zeros in *either* the z domain or the $\hat{\omega}$ domain. Draw the pole-zero diagram for $H(z)$.