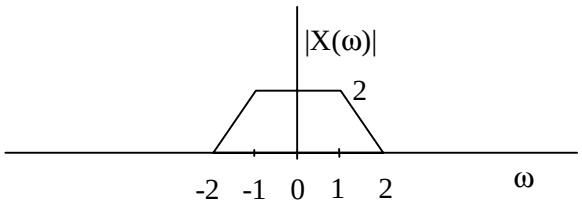
Sampling and Reconstruction:

1. Draw $|X_s(\omega)|$ for the following cases if $x_s(t)=x(t)p(t)$ with sampling period T.

$$p(t) = \sum_{n=-\infty}^{n=\infty} \delta(t - nT)$$

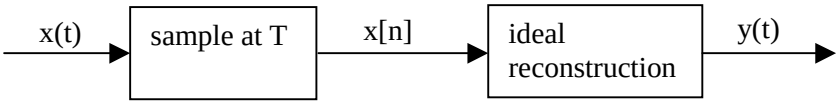



a) T = π/4 sec
b) T = π/2 sec
c) T = 2π/3 sec

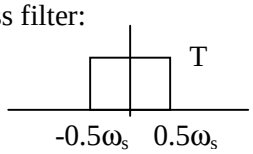
2. Repeat Problem 1 where $x(t) = e^{-t/4}\cos(t)u(t)$
(You can either sketch the plots by hand or use MATLAB for a more accurate plot.)

In order to examine the effects of aliasing in the time domain, plot x(t) for each of the sampling times for t=0 to 15 sec. In MATLAB, this is done by defining your time vector with the time increment set to the desired sampling period. MATLAB then "reconstructs" the signal by connecting the sampled points with straight lines (this is known as a linear interpolation). Compare your sampled/reconstructed signals with a signal that is more accurate, one that is created by using a very small sampling period (such as T = 0.05 sec) by plotting them on the same graph.

3. Consider the following sampling and reconstruction configuration:




The output y(t) of the ideal reconstruction can be found by sending the sampled signal $x_s(t) = x(t)p(t)$ through an ideal lowpass filter:



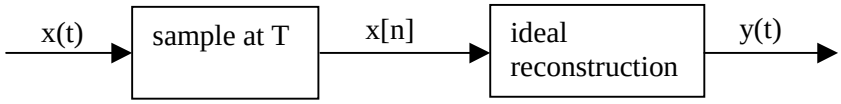

Let $x(t) = 2 + \cos(50\pi t)$ and T = 0.01 sec.

a) Draw $|X_s(\omega)|$ where $x_s(t) = x(t)p(t)$. Determine if aliasing occurs.
b) Determine the expression for y(t).
c) Determine an expression for x[n].

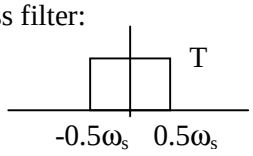
4. Repeat Problem 3 for $x(t) = 2 + \cos(50\pi t)$ and T = 0.025 sec.

5. Repeat Problem 3 for $x(t) = 1 + \cos(20\pi t) + \cos(60\pi t)$ and T = 0.01 sec.

6. Consider the following sampling and reconstruction configuration:




The output y(t) of the ideal reconstruction can be found by sending the sampled signal $x_s(t) = x(t)p(t)$ through an ideal lowpass filter:




a) Let $x(t) = 1 + \cos(15\pi t)$ and T = 0.1 sec. Draw $|X_s(\omega)|$ where $x_s(t) = x(t)p(t)$. Determine the expression for y(t).

b) Let $X(\omega) = 1/(j\omega+1)$ and T = 1 sec. Draw $|X_s(\omega)|$ where $x_s(t) = x(t)p(t)$. Does aliasing occur? (Justify your answer.)