Problem Set 6

EECS123: Digital Signal Processing

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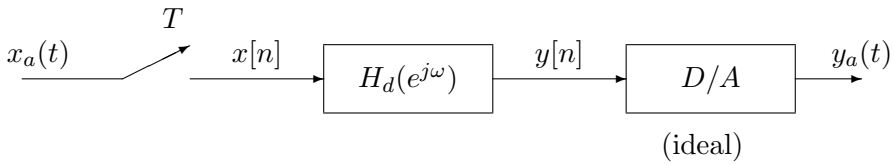
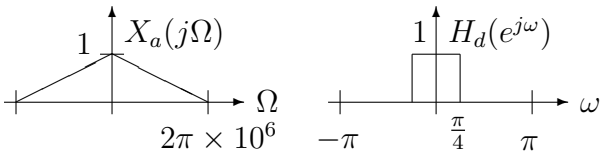
1.



For the digital system pictured above, let $T = \frac{1}{4\times 10^6}$ with



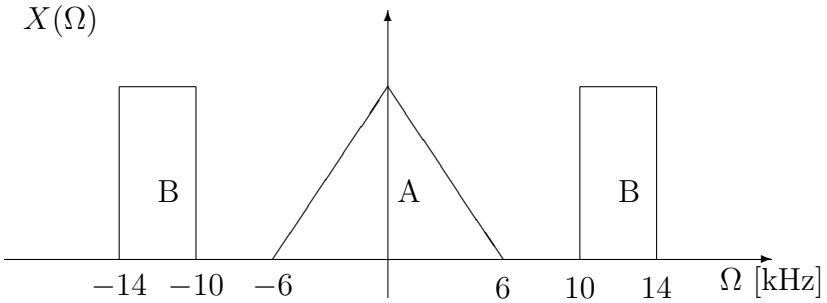
(a) Sketch $X_d(e^{j\omega})$, $Y_d(e^{j\omega})$, and $Y_a(j\Omega)$.

(b) Now, suppose that the ideal D/A is mismatched to the true sampling period. Suppose it uses a period $T/2$ instead of T and simply reads in every element of the y_n sequence twice in a row. That is, the D/A, in effect, uses the input $w[n] = \{\ldots, y[0], y[0], y[1], y[1], y[2], y[2], \ldots\}$. Sketch both $W_d(e^{j\omega})$ and the resulting $Y_a(j\Omega)$.

2. The spectrum of an analog signal is shown below. We wish to extract portions of the signal using a digital filter. This will be accomplished using an ideal ADC and DAC (with no analog antialiasing filter).

(a) If we wish to extract the portion of the signal contained in A, what is the minimum sufficient sampling rate? Sketch the magnitude response of the digital filter needed at this sampling rate.

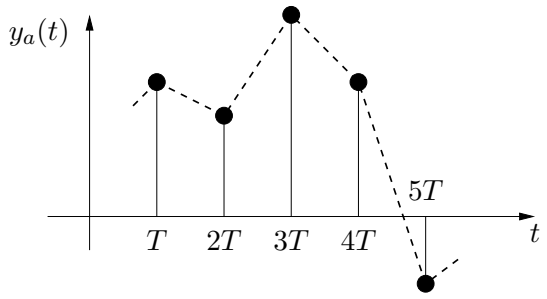
(b) Repeat for the portion of the signal contained in B.



3. Problem 4.38 from Oppenheim, Schafer, and Buck.

4. Problem 4.42 from Oppenheim, Schafer, and Buck.

5. A first order hold (FOH) D/A converter outputs a linear interpolation between successive samples as shown in the figure below:



This D/A is given by:

$$y_a(t) = \sum_{n=-\infty}^{\infty} y(n) g_a(t - nT)$$

(i) Find $g_a(t)$ for the FOH.

(ii) The FOH can be followed with an appropriate filter to form an ideal D/A. Find the frequency response of this analog filter.

(iii) How does the frequency reponse of the filter in part (ii) compare with that of the filter needed to follow a zero order hold (ZOH).