GEORGIA INSTITUTE OF TECHNOLOGY
School of Electrical and Computer Engineering

EE3230
Problem Set No. 4

**Date Assigned:** April 24, 1998
**Date Due:** May 1, 1998

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**Reading Assignment:** In Oppenheim and Willsky, read all of Chapter 4 and read pp. 516-534 and 583-597 in Chapter 8.

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**Homework Assignment:** Problems 4.1 - 4.5 were assigned last quarter. You can find their solutions on the web. I will not be publishing solutions on these. Hand in for grading only Problems 4.1* and 4.2*.

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**Practice Problems:**

(a) Work Problem 4.23 in O & W. (See solution to Problem 4.3, winter 98.)

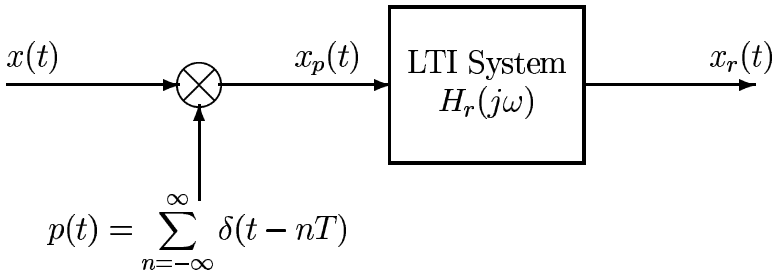
(b) Work Problem 4.26(b) in O & W. (See solution to Problem 4.4, winter 98.)

(c) Work Problem 4.28(a) and 4.28(b-ii) and (b-viii) in O & W. (See solution to Problem 4.5, winter 98.)

(d) Work Problem 8.22 in O & W. (See solution to Problem 5.4, winter 98.)

(e) Work Problem 8.22 in O & W. (See solution to Problem 6.1, winter 98.)

**Problem 4.1***




The input signal for the above sampling/reconstruction system is

$$x(t) = 2\cos(100\pi t) + \cos(200\pi t + \pi/3) \qquad -\infty < t < \infty$$

and the frequency response of the lowpass reconstruction filter is

$$H_r(j\omega) = \begin{cases} T & |\omega| < \pi/T \\ 0 & |\omega| > \pi/T \end{cases}$$

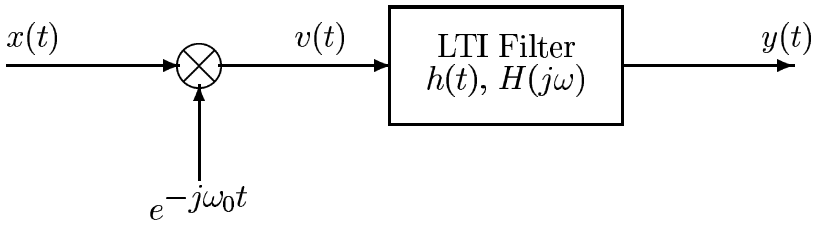
where $T$ is the sampling period.

(a) Sketch the Fourier transform $X_p(j\omega)$ for $-2\pi/T < \omega < 2\pi/T$ for the case where $2\pi/T > 400\pi$. Carefully label your sketch to receive full credit.

(b) Now assume that $\omega_s = 2\pi/T = 200\pi$. Determine an equation for the output $x_r(t)$.

**Problem 4.2*:**

Consider the following modulation/filtering system:




The impulse response of the LTI system is: $h(t) = \begin{cases} 1/T & |t| < T/2 \\ 0 & |t| > T/2 \end{cases}$

(a) Determine the frequency response of the LTI system and plot it.

(b) Suppose that $\omega_0 = 2\pi/T$ and the input signal is the periodic function

$$x(t) = A_0 + A_1\cos(\omega_0 t + \phi_1) + A_2\cos(2\omega_0 t + \phi_2)$$

Determine expressions for the Fourier transforms of $x(t)$ and $v(t)$. Plot the Fourier transform $V(j\omega)$ on the same axes as your plot of $H(j\omega)$.

(c) Determine the output $y(t)$ for the input $x(t)$ in part (b).

(d) Describe how you could use a system of this type to determine $A_0$, $A_1$, $A_2$, $\phi_1$, and $\phi_2$ for the given input signal.