University of Kentucky
Department of Electrical and Computer Engineering

EE421G: Signals and Systems I – Fall 2007

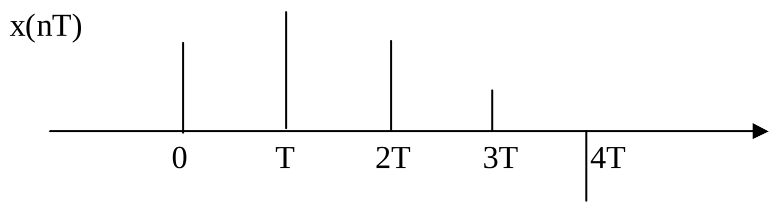
Problem Set 10

Issued: November 7, 2007 Due: November 16, 2007 (In class)

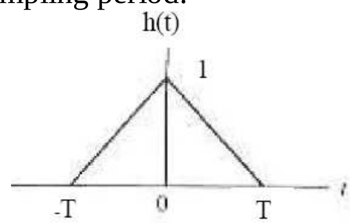
Reading Assignments:
Read Chapter 6.1-6.6 of Chen

Paper and Pencil Assignments:

1. Given the following discrete-time input x(nT), sketch the outputs reconstructed continuous signal y(t) using Sample-And-Hold and Linear Interpolation.



2. Show that the impulse response for the low-pass filter used in linear interpolation is as follows, where T is the sampling period:



3. Show that the discrete-time complex exponentials $u[n] = e^{j\omega nT}$ is an eigen-signal for any discrete-time LTI system L, i.e. the following statement is true:
$$L\left[e^{j\omega nT}\right] = H(\omega)e^{j\omega nT}$$
Show that H(ω) is in fact the Discrete-Time Fourier Transform $H_d(\omega)$. Use this fact to show the DTFT of convolution x[n]*y[n] is the product of their respective DTFT $X_d(\omega)Y_d(\omega)$.

4. During lecture, we discussed the Discrete Fourier transform pair:
$$X_k = \sum_{n=0}^{N-1} x(nT)e^{-j\frac{2\pi k}{N}n}, \quad k = 0,1,..,N-1$$
$$x(nT) = \frac{1}{N}\sum_{k=0}^{N-1} X_k e^{j\frac{2\pi k}{N}n}, \quad n = 0,1,...,N-1$$
You are given the discrete-time signal x[n] = [1 2 1], starting at n=0. Compute the four-point DFT (N=4) and its inverse. Do you get back the original signal? Now repeat the process for a two-point DFT (N=2).

5. Problem 6.2
6. Problem 6.3
7. Problem 6.4
8. Problem 6.6
9. Problem 6.8
10. Problem 6.10
11. Problem 6.14