UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN
Department of Electrical and Computer Engineering

ECE 498DJ Principles of Signal Analysis

Problem Set 2

Fall 2011

Assigned: 9/9/2011 **Due:** 9/16/2011

Problem 2.1

Calculate the Fourier transform of the signal

$$x(t) = \begin{cases} 1, & 0 \le t < 1 \\ 0, & \text{elsewhere} \end{cases}$$

Problem 2.2

Plot the signal $x(t)$ above, and then plot the following signal:

$$y(t) = \begin{cases} -1, & -1 \le t < 0 \\ 1, & 0 \le t < 1 \\ 0, & \text{elsewhere} \end{cases}$$

Compute the Fourier transform of $y(t)$. (Hint: use the linearity and time-shift properties of the Fourier transform, so that you can get the answer without doing any new integrals.)

Problem 2.3

Plot the signal $z(t)$, given as:

$$z(t) = \begin{cases} 1 - |t|, & -1 \le t \le 1 \\ 0, & \text{otherwise} \end{cases}$$

Find the Fourier transform of $z(t)$. (Hint: use the differentiation property of the Fourier transform in order to avoid having to compute any new integrals).

Problem 2.4

Compute the Fourier transform of $x(t) = \sin(\pi t/5)$. (Hint: use Euler's formula and the fact that $\delta(\omega - \omega_0)$ has the inverse transform $x(t) = \exp(j\omega_0 t)$ in order to find this transform without having to do any integrals).

Problem 2.5

For $x_c(t) = 2 + 3\cos(2\pi t) + \sin(5\pi t) + \cos(8\pi t) + 2\cos(12\pi t) + \sin(21\pi t) + \cos(22\pi t)$ and a sampling period of $T_s = 0.1$sec, find the discrete-time sampled signal $x[n] = x_c(nT_s)$. Simplify any discrete-time (aliased) frequencies to the range $0 \le \omega < 2\pi$.