ECE 598 **Prof. Douglas L. Jones** **Spring 2010**

Homework # 2
Due February 17, 2010

1. Calculate the Fourier transform of the signal

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

2. Plot the function $x(t)$ above. Now plot the functions $u(t)$, $u(t-1)$ and $g(t) = u(t) - u(t-1)$ and show that $g(t)$ and $x(t)$ are the same.

3. Calculate the Fourier transform of the signal

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

(Hints: show that the derivative of $x(t)$ is

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

Now use linearity, your result from above, the transform of the δ function, and the shift and differentiation properties to get your answer without having to do any additional calculations!)

4. Compute the Fourier transform of $x(t) = \sin(4\pi t)$. (Hint: use Euler's relationships and the fact that $\delta(f - f_o)$ has the inverse transform $x(t) = \exp(j2\pi f_o t)$ to find this transform without having to do integrals!)

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