HW #1

ECE438, Fall 2009

due W 9-09-09 in class or by 5pm in TA's dropbox on Rhea.

1. Use the definition of the CTFT to compute the Fourier transform of the CT signal $x(t) = \text{rect}(x)$, which is defined by

$$\text{rect}(x) = \begin{cases} 1, & |x| < \frac{1}{2} \\ 0, & \text{else} \end{cases}$$

2. Derive the time scaling property of the CTFT

$$x(at) \xrightarrow{\mathcal{F}} ?$$

3. Obtain the CTFT of the CT signal $x(t) = \text{sinc}(3t)$.

4. Recall from the lecture that the CTFT of $e^{j2\pi f_0 t}$ is $\delta(f - f_0)$. Obtain the CTFT of the CT signal $x(t) = \sin(880\pi t)$. and sketch its graph.

5. Recall from the lecture that the DTFT of $e^{j\omega_0 n}$ is $2\pi \text{rep}_{2\pi}\, \delta(\omega - \omega_0)$. Obtain the DTFT of the two following DT signals and sketch their graph.

$$x_1[n] = \sin\left(\frac{880\pi n}{1{,}000}\right)$$

$$x_2[n] = \sin\left(\frac{880\pi n}{400}\right)$$

Compare your answers with the answer to 4.

6. Consider the DT signal

$$x[n] = \alpha^n u[an+b] + \beta^n u[cn+d]$$

for some constants $\alpha, \beta, a, b, c, d$.

Choose some values for these constants.

a) Compute the DTFT of $x[n]$ for these values.
(Use the definition, not a table)

b) Compute the z-transform of $x[n]$ for these values.
(use the definition, not a table)

c) Compare your answers in a) and b).

7. Compute the inverse z-transform of the following functions

a) $X_1(z) = \dfrac{1}{1+2z}$, $|z| < 2$

b) $X_2(z) = \dfrac{1}{1-\frac{1}{2}z}$, $|z| < 2$

c) $X_3(z) = \dfrac{1}{z^2+2z-3}$, $1 < |z| < 3$

d) $X_4(z) = \ln(1+z)$, $-1 < |z| < 1$