EE 637 Homework #1
Spring 2000
Due 1/26/98

1. Prove the following:

    (a) The convolution property of the CTFT.

    (b) The modulation property of the CTFT.

    (c) The separability property of the CSFT.

    (d) The rotation property of the CSFT.

2. Compute the CSFT of the following functions

    (a) $\text{rep}_{2,4}\{\delta(x, y)\} * \text{rect}(4x, 4y)$

    (b) $f(x, y) * \text{rect}(x/a, y/a)$

    (c) $(\Lambda(x/3)\text{sinc}(y)) * \text{sinc}(x/2, y/2)$

3. For each of the following D-T signals x(n):

    i) Compute its DTFT using only the transform equation, the known properties of the DTFT, and the sampling equations.

    ii) Sketch $x(n)$ and $X(e^{j\omega})$.

    (a) $x(n) = 1$

    (b) $x(n) = \text{pulse}_5(n)$

    (c) $x(n) = \text{sinc}(n/10)$

    (d) $x(n) = \text{sinc}((n - 4)/4)\text{pulse}_9(n)$

4. Let $y(n)$ be a filtered version of $x(n)$ where the filter's impulse response is given by $h(n)$. Futhermore, let $X = [x(0), \cdots, x(N - 1)]^t$ and $Y = [y(0), \cdots, y(N - 1)]^t$ and assume that $x(n) = 0$ for $n < 0$ and $n \geq N$.

    (a) Give a formula for $y(n)$ in terms of $x(n)$ and $h(n)$.

    (b) Find a matrix $\mathbf{A}$ so that $Y = \mathbf{A}X$. Give a precise expression for the elements of $\mathbf{A}$.

    (c) Write out the matrix $\mathbf{A}$ for $N = 5$.

    (d) Show that $\mathbf{A}$ is a Toeplitz matrix.