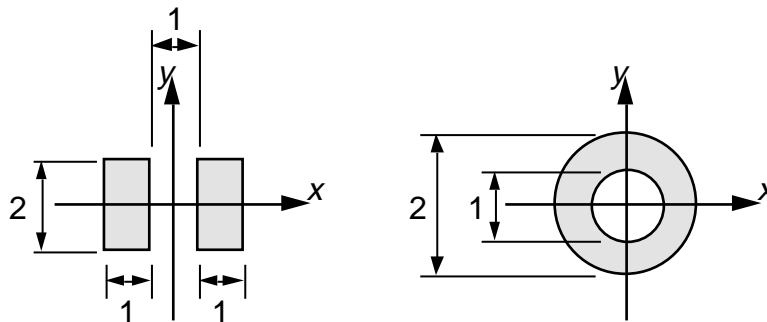


EE 637 Homework #1
Spring 1997
Due 2/3/96

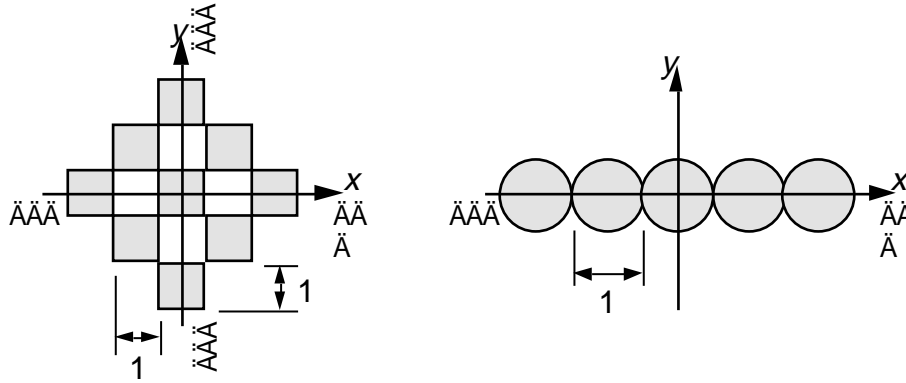
1. Prove the following:
 - i) The convolution property of the CTFT.
 - ii) The separability property of the CSFT.
2. Let $s(n) = x(Tn)$ where $x(t)$ is a continuous time signal and $s(n)$ is its sampled version. Derive the relationship between $X(f)$ and $S(e^{j\omega})$ from the definitions of the DTFT and CTFT.
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 result of problem 2 above.
 - ii) Sketch $x(n)$ and $X(e^{j\omega})$.
 - a) $x(n) = 1$
 - b) $x(n) = \text{pulse}_5(n)$
 - c) $x(n) = \text{sinc}(n/10)$
4. For each of the two functions given below, do the following:
 - i) Express $f(x, y)$ in terms of special functions given in class.
 - ii) Find its CSFT $F(u, v)$ using transform pairs and properties.
 - iii) Sketch $F(u, v)$ in enough detail to show that you know what it looks like. Assume that $f(x, y) = 1$ in shaded regions and $f(x, y) = 0$ elsewhere.



5. For each of the two functions given below, do the following:

Goto: [Course home page](#)

- i) Express $f(x, y)$ in terms of special functions given in class.
- ii) Find its CSFT $F(u, v)$ using transform pairs and properties.
- iii) Sketch $F(u, v)$ in enough detail to show that you know what it looks like. Assume that $f(x, y) = 1$ in shaded regions and $f(x, y) = 0$ elsewhere.



6. Compute the DSFT $X(e^{j\mu}, e^{j\nu})$ of the following functions

- a) $x(n, m) = a^n u(n) \delta(m)$
- b) $x(n, m) = a^{|n|+|m|} u(m)$

7. Let $y(n)$ be a filtered version of $x(n)$ where the filter's impulse response is given by $h(n)$. Furthermore, let $X = (x(1), \dots, x(N-1))$ and $Y = (y(1), \dots, y(N-1))$.

- 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.