Due 28 March 1997 at 5:00 PM

EE 438 Assignment No. 7 Spring 1997

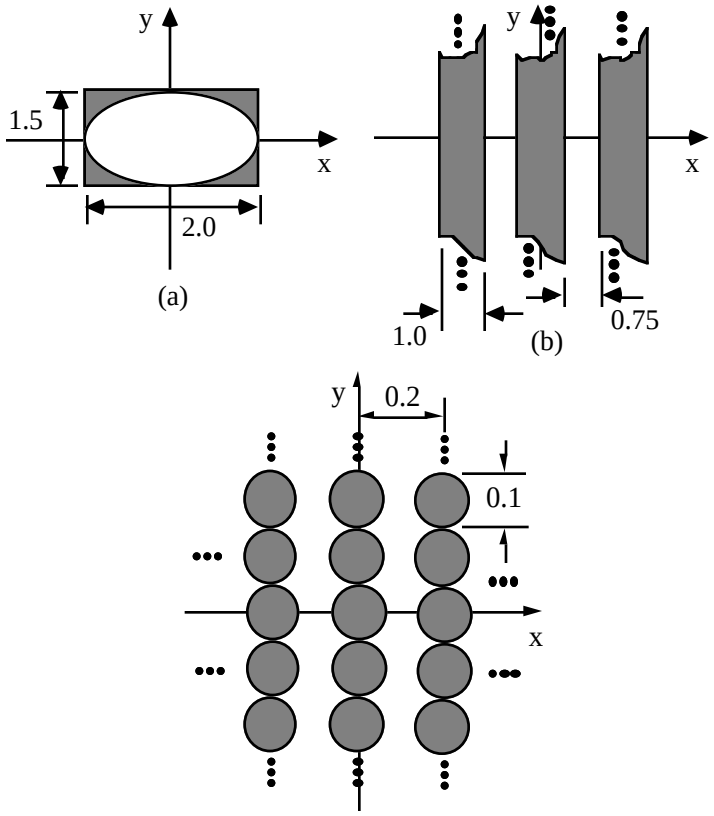
1. For each function given below, do the following:

   i. Express $f(x,y)$ in terms of the 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.



2. Consider the function $f(x,y)$ defined below:

$$f(x,y)=\begin{cases}0.5+0.5\cos[2\pi(x/X+y/Y)], & |x|<A/2 \text{ and } |y|<B/2,\\ 0, & \text{else.}\end{cases}$$

   For each case below, do the following:

   i. Carefully sketch $f(x,y)$.

   ii. Find its CSFT $F(u,v)$ using transform pairs and properties. Do **not** use Matlab.

   iii. Sketch $F(u,v)$ in enough detail to show that you know what it looks like.

   a. $X=0.5, Y=100, A=10, B=1$

   b. $X=2, Y=2, A=4, B=4$

3. An imaging system has point spread function $h(x,y) = 20\,\text{rect}(\text{x} / 0.1,\ \text{y} / 0.5)$ and magnification $M = 5$. Calculate and carefully sketch the image $g(x,y)$ of the object $f(x,y) = \text{rect}(\text{x} - 1, \text{y} - 1)$. Be sure to fully dimension your sketch.

4. The signal $f(x,y) = \cos[2\pi(100x + 10y)]$ is multiplied by a grating with transmittance described by

$$g(x,y) = \sum_n rect\left[300(x - n/150),\ 300y\right]$$

The product $d(x,y) = f(x,y)\,g(x,y)$ is then filtered with an ideal low-pass filter with point spread function $h(x,y) = \text{sinc}(150x, 150y)$ to yield the final output $c(x,y)$. Calculate and sketch the following functions

a. $f(x,y)$ b. $F(u,v)$

c. $g(x,y)$ d. $G(u,v)$

e $D(u,v)$ f. $d(x,y)$

g. $h(x,y)$ h. $H(u,v)$

i. $C(u,v)$ j. $c(x,y)$