OPTI 330   Homework 5   Spring 2015

1. Show that the two-dimensional Fourier transform of a separable
function $f(x, y) = h(x)g(y)$ is the product of the one-dimensional Fourier
transforms: $F(\xi, \eta) = H(\xi)G(\eta)$ where $H(\xi) = \mathcal{F}(\mathrm{h(x)})$ and
$G(\eta) = \mathcal{F}(\mathrm{g(y)})$.

[15 points]

2. *Calculate* (purely via integration i.e. not graphical convolution) the
following two-dimensional convolutions:
a. $f(x, y) = \mathrm{rect}(x, y) \otimes \mathrm{rect}(x, y)$
b. $g(x, y) = \mathrm{tri}(x, y) \otimes \delta(x, y)$

[40 points]

3. *Calculate* the following two-dimensional Fourier transforms:
a. $f(x, y) = \sin(2\pi\xi_o x) + \sin(2\pi\xi_o y)$
b. $g(x, y) = \cos(2\pi\xi_o x) \times \sin(2\pi\eta_o y)$
c. $h(x, y) = \delta(x) \times \sin(2\pi\eta_o y)$

[45 points]