

# Fourier Optics EOP513

## Assignment 3

1. With  $(f(x), F(x))$  an arbitrary Fourier transform pair, and with  $x_0$ ,  $\xi_0$ , and  $b$  real constants, show that:

(a)  $\text{FT}\{\delta(\frac{x-x_0}{b})\} = |b|e^{-j2\pi x_0\xi}$

(b)  $\text{FT}\{f(x) * \delta(\frac{x-x_0}{b})\} = |b|F(\xi)e^{-j2\pi x_0\xi}$

(c)  $\text{FT}\{f(x)\delta(x-x_0)\} = f(x_0)e^{-j2\pi x_0\xi}$

(d)  $f(x) * e^{j2\pi\xi_0x} = F(\xi_0)e^{j2\pi\xi_0x}$

2. Find the Fourier transforms of the following functions. Also use Matlab to find the transform and plot the original and transformed functions:

(a)  $f(x) = \text{rect}(\frac{x}{2})$

(b)  $g(x) = \text{rect}(x-1)$

(c)  $h(x) = \text{rect}(\frac{x-1}{2})$

(d)  $p(x) = \text{rect}(x-2)e^{j2\pi x}$

(e)  $r(x) = 0.5\text{rect}(0.5x) + \text{tri}(x)$

(f)  $s(x) = \text{rect}(0.5x) - \text{tri}(x)$

(g)  $u(x) = 3\text{sinc}(3x) - \text{sinc}(x)$

3. Find the Fourier transforms of the following functions. Also use Matlab to find the transform and plot the original and transformed functions:

(a)  $f(x) = \text{rect}(x) * \text{rect}(x-1)$

(b)  $g(x) = 2\text{sinc}(2x) * \text{sinc}(x)$

(c)  $h(x) = \text{rect}(\frac{x}{3})\text{rect}(\frac{x+3}{5})$

(d)  $p(x) = \cos(2\pi x)\text{gaus}(\frac{x}{5})$

(e)  $r(x) = \text{gaus}(\frac{x}{5}) * \text{gaus}(\frac{x}{4})$

(f)  $s(x) = \frac{2}{1+(2\pi x)^2} * \frac{2}{1+(2\pi x)^2}$