

**PHYS 306 Spring 2010**  
**Wave Motion and Electromagnetic Radiation**

**Homework Assignment**

HW#3

Assignment Date: Feb. 9, 2010

Due Date: Feb. 16, 2010

1. (Adopted from Example 9.2 in Ghatak book). For a rectangle function given as

$$f(x) = \text{rect}\left(\frac{x}{a}\right) = \begin{cases} +1 & \text{for } |x| < \frac{1}{2}a \\ 0 & \text{for } |x| > \frac{1}{2}a \end{cases}$$

(1) show that its Fourier transform is

$$F(k) = \sqrt{\frac{2}{\pi}} \frac{\sin(ka/2)}{k}$$

(2) make a schematic plot of  $f(x)$  and  $F(k)$  respectively (hand drawing is acceptable). In the drawing, indicate the approximate (or characteristic) width of the function.

2. (Adopted from Example 10.4 in Ghatak book). Given the Gaussian pulse described as

$$E(t) = E_0 e^{-t^2/\tau_0^2} e^{+i\omega_0 t}$$

(1) show that its Fourier transform is

$$E(\omega) = \frac{E_0 \tau_0}{2\sqrt{\pi}} \exp\left[-\frac{1}{4}(\omega - \omega_0)^2 \tau_0^2\right]$$

(2) make a schematic plot of  $E(t)$  and  $E(\omega)$  respectively (hand drawing is acceptable).