

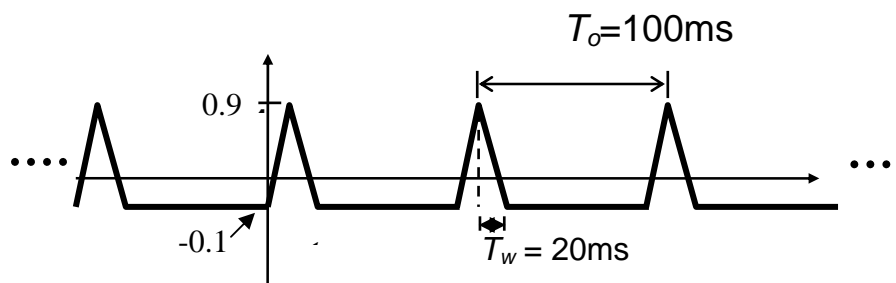
# 2704: Signals and Systems

## Quiz #5

March 15, 2006

OPEN BOOK, OPEN NOTES

Determine the Fourier Series  $X[k]$  of the following signal



From the plot we can write an equation for  $x(t)$  as

$$x(t) = \sum_{n=-\infty}^{\infty} \text{tri}\left(\frac{t - nT_o - t_o}{T_w}\right) - 0.1$$

where  $T_o = 0.1$ ,  $t_o = T_w = 0.02$ . We can use the property of linearity to write

$$X[k] = X_1[k] + X_2[k]$$

where

$$x_1(t) = \sum_{n=-\infty}^{\infty} \text{tri}\left(\frac{t - nT_o - t_o}{T_w}\right)$$

$$x_2(t) = -0.1$$

Now we can use the following relationships from our knowledge of the Fourier Series:

$$1 \stackrel{FS}{\leftrightarrow} \delta[k]$$

$$\sum_{n=-\infty}^{\infty} \text{tri}\left(\frac{t - nT_o - t_o}{T_w}\right) \stackrel{FS}{\leftrightarrow} e^{-j2\pi k f_o t_o} f_o T_w \text{sinc}^2(k f_o T_w)$$

*Thus, we can write:*

$$\begin{aligned} X[k] &= e^{-j2\pi k f_o t_o} f_o T_w \text{sinc}^2(k f_o T_w) - 0.1\delta[k] \\ &= 0.2e^{-j2\pi k/5} \text{sinc}^2(0.2k) - 0.1\delta[k] \end{aligned}$$