

Digital Communications
Homework #1
Due 8/31/2007

- (a) Determine the convolution of a sinc function with an impulse. What is the spectrum?
(b) Use Matlab to *generate and plot* this result. (Use the `conv()` function.)
- Convolve the two square pulses (in the time domain) of width T , $\Pi(t/T)$. Plot the time waveform and the spectrum. You can use either analysis or Matlab. *Be sure to label all axes.*
- Let $x(t) = \text{sinc}(2Wt)$ and $y(t) = t$. If $z(t) = x(t)y(t)$, what is $Z(f)$?
- Determine whether each of the following signals is an energy signal or a power signal, and evaluate the normalized energy or power as appropriate:
 - $w(t) = \Pi(t/T_0)$
 - $w(t) = \Pi(t/T_0)\cos(\omega_0 t)$
 - $w(t) = \cos^2(\omega_0 t)$
- Using the convolution property, find the spectrum for

$$w(t) = \sin(2\pi f_1 t) \cos(2\pi f_2 t)$$

- The signal $x(t) = \cos(10t)$ is input to a linear system that has an impulse response

$$h(t) = \begin{cases} e^{-t/10} & t > 0 \\ 0 & t < 0 \end{cases}$$

- What is the output time signal?
- Due to interference, the signal $z(t) = \cos(15t + \pi/8)$ is added to the input signal prior to entering the system. Provide the impulse response $h(t)$ of a brick-wall (rectangular pulse in frequency) filter that eliminates the interferer but not effect signal of interest.