

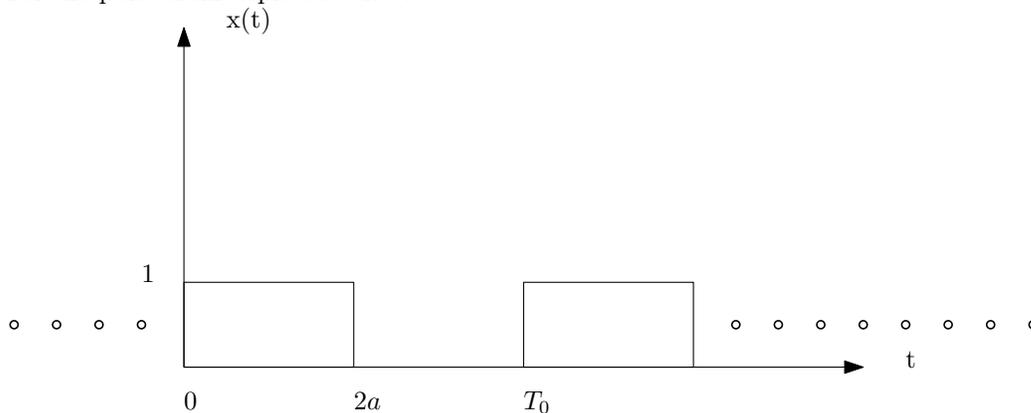
# EE4440 HW#2 Assignment

January 20, 2011

1. Answer the following:

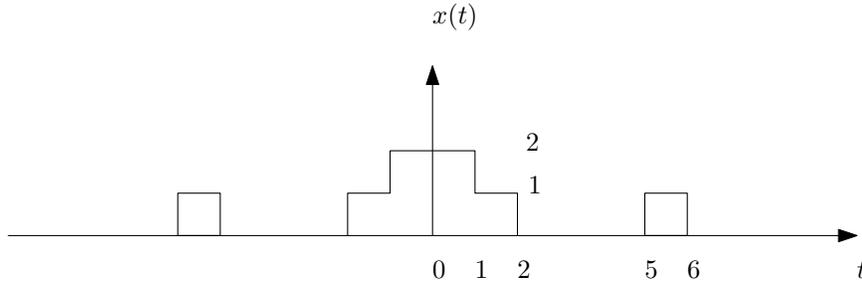
- What kind of spectrum does a periodic signal have?
- What is the procedure (give it step by step with equations) for finding the spectrum of a periodic signal? How does this connect with the Fourier series?

2. For the pulse train depicted below:



- What is the Fourier Transform?
  - What is the duty cycle?
  - What is the approximate bandwidth?
3. If the signal given in problem 2 is shifted so that a pulse is centered on the origin, what happens to the:
- Magnitude spectrum?
  - Phase spectrum?
4. A baseband signal,  $s(t)$  has a bandwidth of 1000 Hz. If  $x(t) = s(t) \cos(2\pi 20,000t)$ :
- Sketch the magnitude spectrum of  $x(t)$ . (Note: I don't care what you decide  $s(t)$ 's spectrum looks like, as long as it has the correct bandwidth)
  - What is the bandwidth of  $x(t)$ ?
  - Given that the power of  $s(t)$  is  $A$ , what is the power of  $x(t)$ ?
5. What is the Fourier Transform of  $\cos(\omega_0 t) + \cos^2(\omega_0 t)$ ? (Hint, if you're integrating you're doing more work than you need to do!)
6. Complete a and b:

- (a) Use Fourier Transform properties to write the Fourier Transform of the below time signal (symmetric about origin):



- (b) Sketch two other signals that would have the same exact magnitude spectrum.

7. A channel has the following transfer function:

$$H(f) = \text{rect}\left(\frac{f}{100} - 4.5\right) \cdot \left(160 - \left(\frac{f - 500}{8}\right)^2\right) e^{-2\pi f(0.5)}$$

- (a) What is the bandwidth of this channel?  
 (b) Does this channel have linear phase? If so, what is the delay through the channel?  
 (c) Is this channel linear?  
 (d) Is this channel distortion free? If not, what is the source of the distortion?  
 (e) Plot or sketch the magnitude response of this channel.

8. Given that  $x(t) = \text{rect}(t)$ :

- (a) Find the ESD via a product of Fourier Transforms.  
 (b) Find the autocorrelation function  $\Psi_x(\tau)$ .  
 (c) Using  $\Psi_x(\tau)$  verify the ESD you found in part a.