**ECE 3512: SignalS – Continuous and Discrete**

# Recitation No. 3: Fourier Series

The goal of this laboratory is to understand how a Fourier series represents a signal in terms of its temporal and frequency domain properties. Use the complex Fourier series for these exercises. **Remember that for all time domain plots, we will plot amplitude versus time in seconds, and for all frequency domain plots we plot magnitude and phase versus frequency in Hz.**

For each of the signals shown:

1. 
2. 
3. 
4. 
5. The audio signal located here:

<http://www.isip.piconepress.com/courses/temple/ece_3512/recitation/2014_fall/rec_01/rec_01_speech.raw>

The tasks to be accomplished in this lab are:

1. For signal no. 1, plot the magnitude and angle (phase) of the Fourier series coefficients for θ = [0, π/4, π/2, 3π/4, π, 3π/2, 2π]. For each case, plot the signal along with the magnitude and phase spectra. Explain what you observe.
2. For signal no. 2, compute the Fourier series coefficients and verify this in MATLAB.
3. For signal no. 3, plot the magnitude spectrum as a function of frequency (in Hz!) for τ=[0.01, 0.1, 1.0]. The duty cycle is defined as  where T = 2. Explain how the spectrum changes as a function of the duty cycle.
4. For signal no 4, replicate the plot in lecture no. 4 slide 7. Plot the reconstructed signal using the first *N* Fourier series coefficients, where N = [1, 2, 4, 8, 16]. Explain your results.
5. For signal no. 5, extract 240 samples from a portion of the signal where the amplitude is the highest and the signal appears most periodic. Using some MATLAB tool, plot the spectrum as a function of frequency and explain what you observe. Note that the signal was sampled at 8 kHz. (Hint: if the signal is somewhat periodic, what should the spectrum look like?)