Homework 7
EECS 360

1. Find the complex exponential Fourier series and then plot the double sided amplitude and phase spectra for the following signals. Hints: $\sin(\theta)=\cos(\theta-\frac{\pi}{2})$ and $-\sin(\theta)=\cos(\theta+\frac{\pi}{2})$.

a) $x(t)=8\cos(\pi 300t)$

b) $x(t)=8\cos(\pi 300t-\frac{\pi}{3})$

c) $x(t)=8\sin(\pi 300t-\frac{\pi}{4})$

d) $x(t)=8\cos(\pi 300t)-4\sin(\pi 600t)$

e) $x(t)=\sin^2(\pi 2000t)$

2.

a) Find the complex exponential Fourier series for x(t) below and then plot the double sided amplitude spectrum for $|f|\le 20kHz$. Carefully label the axis.

$$x(t)=\sum_{k=-\infty}^{\infty}\text{rect}(\frac{t-kT_0}{\tau}) \quad \text{with } T_0=.5ms \text{ and } \tau=0.125ms$$

b) What is the total power in x(t)?
c) What is the power in the 2rd harmonic?
d) What is the power in the 5rd harmonic?
e) What is the % power in the frequency range $|f|\le 20kHz$?

3. Find the complex exponential Fourier series for x(t) below and then plot the double sided amplitude spectrum for $|f|\le 20kHz$. Carefully label the axis.

$$x(t)=\sum_{k=-\infty}^{\infty}\text{rect}(\frac{t-kT_0}{\tau}) \quad \text{with } T_0=1ms \text{ and } \tau=0.125ms$$

4. Find the complex exponential Fourier series for x(t) below and then plot the double sided amplitude spectrum for $|f|\le 20kHz$. Carefully label the axis.

$$x(t)=\sum_{k=-\infty}^{\infty}\text{rect}(\frac{t-kT_0}{\tau}) \quad \text{with } T_0=.5ms \text{ and } \tau=0.0625ms$$

5. Examine the results of problems 2- 4.

a) Describe how changing T_o changes the double sided amplitude spectra.
b) Describe how changing τ changes the double sided amplitude spectra.
Confirm your observations using Fourier Series Coefficients of a Rectangular Pulse Signal (http://demonstrations.wolfram.com/FourierSeriesCoefficientsOfARectangularPulseSignal/

Class 6. a) Find the complex exponential Fourier series X_n for y(t) for $|f| \le 12kHz$ and then plot the double sided phase spectrum for $|f| \le 12kHz$. Hint: use the result from problem 2. Carefully label the axis.

$$y(t) = \sum_{k=-\infty}^{\infty} \text{rect}\left(\frac{t - kT_0 - d}{\tau}\right) \quad \text{with } T_0 = .5ms \text{ and } \tau = 0.125ms \text{ and } d = 0.04ms$$

b) What is the difference between the amplitude spectrum of y(t) above and x(t) in problem 2?
c) What is the difference between the phase spectrum of y(t) above and x(t) in problem 2?