ECE 300
Signals and Systems
Homework 5

Due Date: Thursday October 6 at 1 PM

Reading: K & H, pp. 145-161.

Problems:

1. Simplify each of the following into the form $c_k = \alpha(k)e^{-j\beta(k)}\text{sinc}(\lambda k)$

a) $c_k = \dfrac{e^{j7k\pi} - e^{-j2k\pi}}{k\pi j}$

b) $c_k = \dfrac{e^{-j2\pi k} - e^{-j5\pi k}}{jk}$

c) $c_k = \dfrac{e^{j5k} - e^{j2k}}{k}$

Scrambled Answers $c_k = 3\pi e^{-\frac{7\pi k}{2}}\text{sinc}\left(\frac{3\text{k}}{2}\right)$, $c_k = 3e^{j(\frac{7}{2}k+\frac{\pi}{2})}\text{sinc}\left(\frac{3k}{2\pi}\right)$,

$c_k = 9e^{j\frac{5}{2}k\pi}\text{sinc}\left(k\frac{9}{2}\right)$

2. Find the Fourier series representation for the signal indicated using hand analysis. Clearly indicate the values of ω_0 and the c_k. Hint: Draw the signal, and then use the sifting property to calculate the c_k. *Hint: If you understand how to do this, there is very little work involved.*

$$x(t) = \sum_{p=-\infty}^{\infty} \delta(t - 3p)$$

3. For the periodic square wave $x(t)$ with period $T_o = 0.5$ and

$$x(t)\begin{cases} 1 & 0 \le t < 0.25 \\ -1 & 0.25 \le t < 0.5 \end{cases}$$

show that the Fourier series coefficients are given by

$$c_k = \begin{cases} \dfrac{-2j}{k\pi} & k \quad odd \\ 0 & k \quad even \end{cases}$$

where $x(t)=\sum_k c_k e^{jk4\pi t}$

4. Assume periodic function $x(t)$ has the Fourier series representation

$$x(t)=1+\sum_{k=-\infty}^{k=\infty}\frac{2}{1-jk}e^{j3kt}$$

a) What is the period T_o of $x(t)$?

b) What is the average (DC) value of $x(t)$?

5. K & H, Problem 4.9. For part **c** you should get $c_k^v=c_{k-1}^x$, use Euler's identity for part **d**.

6. K & H, Problem 4.12 parts **a** and **b** only. Write the integral as the sum of two integrals (with zero as the midpoint). Change variables to make the limits on the integrals the same.

7. Show that and function $x(t)$ can be written in terms of and even function and an odd function, i.e. $x(t)=x_e(t)+x_o(t)$, where $x_e(t)$ is an even function, and $x_o(t)$ is an odd function. Determine expressions for $x_e(t)$ and $x_o(t)$ in terms of $x(t)$ (if you can do this than you have shown that $x(t)=x_e(t)+x_o(t)$).