ELEN3801 - Fall 2009
Homework 6

Due Thursday October 29th at the **beginning** of class
(Mudd 227 9:10am)[1]

Carefully justify ALL your answers

6.1 - We have seen in class that signals with "nice" symmetries have some interesting properties in the Fourier series representation. In this problem we consider a special case. If the two halves of one period of a periodic signal are of identical shape, except that one is the negation of the other, the periodic signal is said to have a *half-wave symmetry*. Formally, if $f(t)$ is a periodic signal with period T_0 then f has half-wave symmetry if

$$f(t - T_0/2) = -f(t) \ ,$$

for all $t \in \mathbb{R}$. See Figure P3.4-7 for examples of such signals (page 230 of the textbook).

Show that the Fourier series representation of such signals has no even-numbered harmonics. In other words if

$$f(t) = \sum_{k=-\infty}^{\infty} D_k e^{j\frac{2\pi}{T_0}kt}$$

is the Fourier series representation of $f(t)$ then $D_k = 0$ for all k even. Furthermore show that for odd k

$$D_k = \frac{2}{T_0}\int_0^{T_0/2} f(t)e^{-j\frac{2\pi}{T_0}kt}dt \ .$$

Taking this into account write the Fourier series representation for the signals in Figure P3.4-7.

6.2 - Solve problem 3.4-8 of the textbook, parts (a) and (b), but **consider instead** the signal $f(t) = t^2$. ***Note:*** *For part (a) the terms in the Fourier series representation should be of the form* $\cos(\omega_0 kt)$*, and for part (b) of the form* $\sin(\omega_0 kt)$*.*

6.3 - Problem 3.5-1, part (d).

6.4 - Read Sections 3.1-3.3 of the book. Based on this solve problem 3.1-2 of the book.

6.5 - *Optional:* Use MATLAB to check the answer of problem 6.2.

[1] You can always hand-in the homework earlier if you so desire - just give it to me or to one of the TAs, or leave it in **my** mailbox (in the EE office on the 13th floor of Mudd).