Problem Set #2

1. (a) *(3 pts)*. Give examples of signals that have the listed properties:

   i. A signal with one independent variable that is something other than time,
   ii. A signal (other than image or video) where there is more than one independent variable,
   iii. A signal that is most naturally modeled as analog,
   iv. A signal that is most naturally modeled as digital.

   (b) *(3 pts)*. Determine whether the following signals (a) are continuous-time or discrete-time; (b) take on a continuous or discrete set of values.

   i. Gear of a car in motion (i.e. 2nd gear, 3rd gear, etc.),
   ii. Speed of a car in motion,
   iii. The Hi and Low temperature everyday in the past 10 days.

2. *(3 pts)*. Assume that the signal $x(t)$ is periodic with period T_0, and that $x(t)$ is odd (*i.e.* $x(t) = -x(-t)$). What is the value of $x(T_0)$?

3. *(6 pts)*. Assume that $y(t)$ is an arbitrary periodic signal with fundamental period T_0. Must $x_1(t)$ and $x_2(t)$ both be periodic if:

   (a) $y(t) = x_1(t) + x_2(t)$
   (b) $y(t) = x_1(t) \times x_2(t)$

4. *(4 pts)*. What is the fundamental period of $\cos(2\pi t/T_1) + \cos(2\pi t/T_2)$ if $T_1 = 8$ and $T_2 = 10$? What about if $T_1 = 3$ and $T_2 = \pi$?

5. *Fourier Series (6 pts)*.

   (a) State the fundamental period and Fourier series coefficients of the signal

   $$x(t) = e^{-i\pi t} + e^{2(1+i\pi t)}.$$

   (b) What signal with fundamental period $T_0 = 1$ corresponds to the Fourier series coefficients

   $$c_k = \begin{cases} \frac{1}{2i}, & k = 1 \\ \frac{-1}{2i}, & k = -1 \\ 0, & \text{otherwise} \end{cases},$$

   where c_k is the coefficient of the basis element $e^{i\frac{2\pi}{T_0}kt}$ (please simplify with Euler's formula)?