Practice Problem Set #1

1. For each of the following signals, determine whether it is periodic, and if it is, find the fundamental period:

(a) $x(t) = \cos^2(2\pi t)$
(b) $x(t) = \sin^3(2t)$
(c) $x(t) = e^{-2t}\cos(2\pi t)$
(d) $x[n] = (-1)^n$
(e) $x[n] = (-1)^{n^2}$
(f) $x[n] = \cos(2n)$
(g) $x[n] = \cos(2\pi n)$

2. Categorize each of the following signals as a finite energy signal or a finite power signal, and find the energy or time-averaged power of the signal:

(a) $x(t) = \begin{cases} t, & 0 \le t \le 1 \\ 2 - t, & 1 \le t \le 2 \\ 0, & \text{otherwise} \end{cases}$

(b) $x[n] = \begin{cases} n, & 0 \le n < 5 \\ 10 - n, & 5 \le n \le 10 \\ 0, & \text{otherwise} \end{cases}$

(c) $x(t) = 5\cos(\pi t) + \sin(5\pi t), -\infty < t < \infty$

(d) $x(t) = \begin{cases} 5\cos(\pi t), & -1 \le t \le 1 \\ 0, & \text{otherwise} \end{cases}$

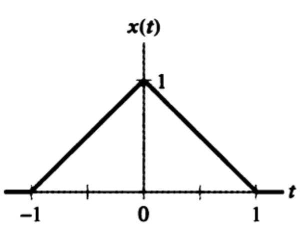
(e) $x(t) = \begin{cases} 5\cos(\pi t), & -0.5 \le t \le 0.5 \\ 0, & \text{otherwise} \end{cases}$

(f) $x[n] = \begin{cases} \sin(\pi n), & -4 \le n \le 4 \\ 0, & \text{otherwise} \end{cases}$

(g) $x[n] = \begin{cases} \cos(\pi n), & -4 \le n \le 4 \\ 0, & \text{otherwise} \end{cases}$

(h) $x[n] = \begin{cases} \cos(\pi n), & n \ge 0 \\ 0, & \text{otherwise} \end{cases}$

3. For the triangular pulse signal x(t) shown below, sketch each of the following signals derived from x(t):



(a) $x(3t)$
(b) $x(3t + 2)$
(c) $x(-2t - 1)$
(d) $x(2(t + 2))$
(e) $x(2(t - 2))$
(f) $x(3t) + x(3t + 2)$

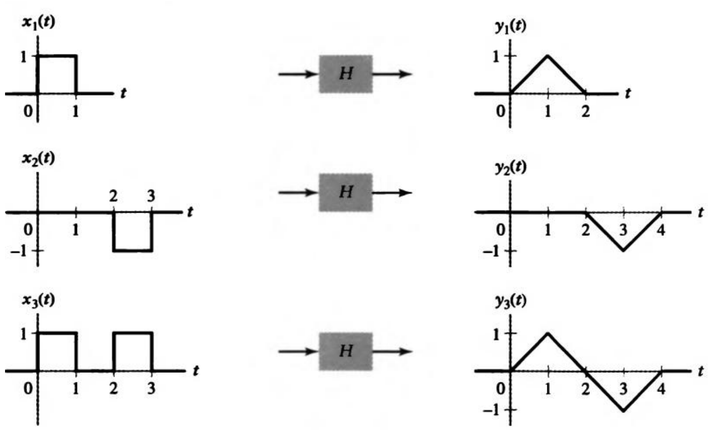
4. For the following sinusoidal signals, find if each signal is periodic and determine its period:

(a) $x[n] = 5\sin[2n]$
(b) $x[n] = 5\cos[0.2\pi n]$
(c) $x[n] = 5\cos[6\pi n]$
(d) $x[n] = 5\sin[6\pi n/35]$

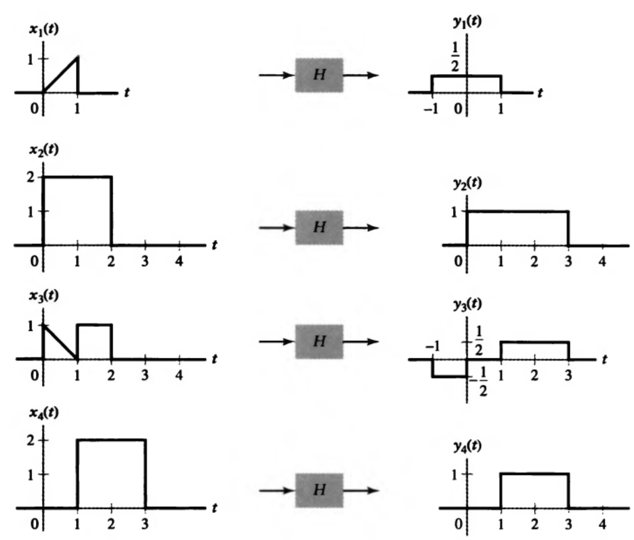
5. The systems that follow have input x(t) or x[n] and output y(t) or y[n]. For each system, determine whether it is (i) memoryless, (ii) stable, (iii) causal, (iv) linear, and (v) time invariant.

(a) $y(t) = \cos(x(t))$
(b) $y[n] = 2x[n]u[n]$
(c) $y[n] = \log_{10}(|x[n]|)$
(d) $y(t) = \int_{-\infty}^{t/2} x(\tau)\, d\tau$
(e) $y[n] = \sum_{k=-\infty}^{n} x[k+2]$
(f) $y(t) = \frac{d}{dt}x(t)$
(g) $y[n] = \cos(2\pi x[n+1]) + x[n]$
(h) $y(t) = \frac{d}{dt}\{e^{-t}x(t)\}$
(i) $y(t) = x(2-t)$
(j) $y[n] = x[n]\sum_{k=-\infty}^{\infty}\delta[n-2k]$
(k) $y(t) = x(t/2)$
(l) $y[n] = 2x[2^n]$

6. A system H has its input-output pairs given. Determine whether the system could be memoryless, causal, linear, and time invariant for systems (a) and (b) signals shown below. For all cases, justify your answers.



(a)



(b)