EE 470 – Extra 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) $x_1(t) = \cos(2t) + \sin(3t^2)$
(b) $x_2(t) = [u(t) - u(t-1)]$
(c) $x_3(t) = t\cos(t)$
(d) $x_4(t) = e^{j2t}$
(e) $x_5(t) = \sin(\pi/3)$
(f) $x_6(t) = \sin(2t + 4\pi)$
(g) $x7(t) = e^{j2\pi t} + \cos(5t)$

2. Categorize each of the following signals as a finite energy signal or a finite power signal:

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

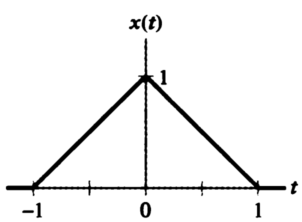
(b) $x[n] = \begin{cases} n, & 0 \le n < 5 \\ 10 - n, & 5 \le n \le 10 \\ 0, & \text{otherwise} \end{cases}$

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

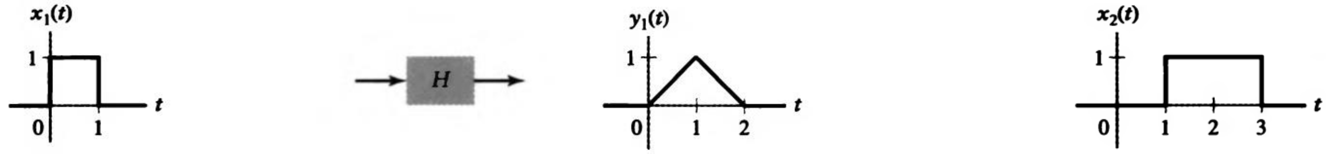
3. For the triangular pulse signal x(t) shown below, sketch each of the following signals derived from x(t):



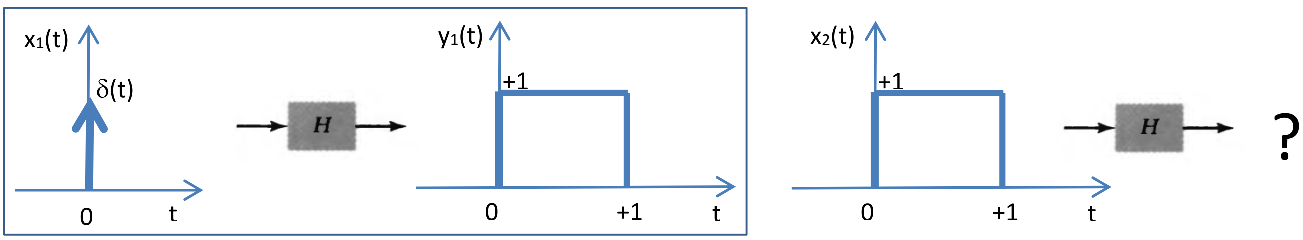
(a) $x(3t)$
(b) $x(3t + 2)$
(c) $x(-2t - 1)$
(d) $x(2(t + 2))$
(e) $x(2(t - 2))$
(f) $x(3t) + x(3t + 2)$

4. For each system, determine whether it is (i) linear, (ii) time invariant, (iii) causal and (iv) BIBO stable:
(a) $y(t) = \frac{dx}{dt} + 2$
(b) $y(t) = x(2t)$
(c) $y(t) = \int_{-\infty}^{\infty} \tau^2 \cdot x(t - \tau) d\tau$
(d) $y(t) = \frac{dx}{dt} + x^{0.5}$
(e) $y(t) = t\, x(t - 1)$
(f) $y(t) = 2\, x(t + 1) + x(t - 1)$
(g) $y(t) = \int_{-\infty}^{\infty} r(\tau) \cdot x(t - \tau) d\tau$ (recall that r(t) is the ramp signal)
(h) $y(t) = \frac{d^2x}{dt^2} + 2x$
(i) $y(t) = x(t^2)$
(j) $y(t) = 2t \cdot x(t + 3)\, \mathrm{u}(t)$

5. For a linear time invariant (LTI) system, if the output of the system $y_1(t)$ is known for a particular input $x_1(t)$ as shown below, compute the output of the same system for an input $x_2(t)$ shown.



6. For a linear time invariant (LTI) system, if the output of the system $y_1(t)$ is known for a particular input $x_1(t)$ as shown below, compute the output of the same system for an input $x_2(t)$ shown.



7. Determine the unilateral Laplace transform of the following signals:

(a) $x(t) = u(t-2)$

(b) $x(t) = u(t+2)$

(c) $x(t) = e^{-2t}u(t+1)$

(d) $x(t) = e^{2t}u(-t+2)$

(e) $x(t) = \sin(\omega_o t)$

(f) $x(t) = u(t) - u(t-2)$

(g) $x(t) = \begin{cases} \sin(\pi t), & 0 < t < 1 \\ 0, & \text{otherwise} \end{cases}$

8. Use the Laplace transform tables and properties to obtain the Laplace transform of the following:

(a) $x(t) = \frac{d}{dt}\{te^{-t}u(t)\}$

(b) $x(t) = tu(t) * \cos(2\pi t)u(t)$

(c) $x(t) = t^3u(t)$

(d) $x(t) = u(t-1) * e^{-2t}u(t-1)$

(e) $x(t) = \int_0^t e^{-3\tau}\cos(2\tau)d\tau$

(f) $x(t) = t\frac{d}{dt}(e^{-t}\cos(t)u(t))$