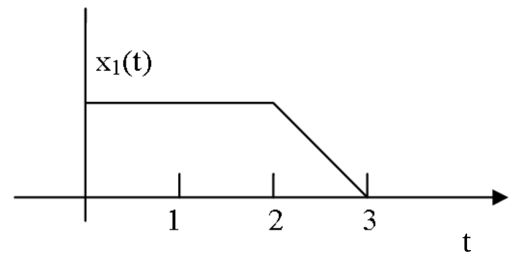
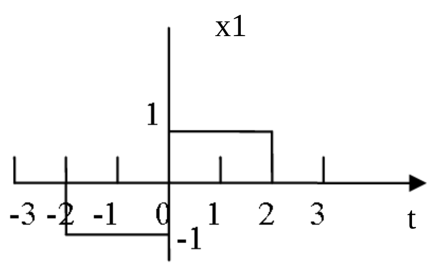
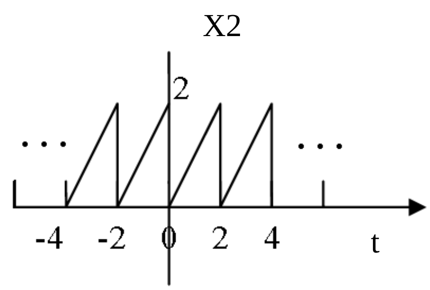
Problem 1.1: Consider the signal $x_1(t)$ shown in the following figure. Plot

a) $x_1(t-1)$
b) $x1(-t+2)$
c) $x_1(t-1)+x_1(-t+2)$
d) $x_1(t-1)-x_1(-t+2)$, and
e) $x_1(t-1)\,x_1(-t+2)$.



Problem 1.2: Express the signals in the following figures in terms of step and ramp functions.





Problem 1.3: Consider a signal $x(t)$. Define

$$x_e(t) = \frac{x(t)+x(-t)}{2} \text{ and } x_o(t) = \frac{x(t)-x(-t)}{2}$$

Show that $x_e(t)$ is even and $x_o(t)$ is odd.
Note: a signal $x(t)$ is even if $x(t)= x(-t)$ and is odd if $x(t)= -x(-t)$.

Problem.1.4: Evaluate the following integrals

a. $\int_0^9 [\cos \pi\tau]\delta(\tau-3)d\tau$

b. $\int_5^9 [\cos \pi\tau]\delta(\tau-3)d\tau$

c. $\int_{-\infty}^{\infty} [\cos(t-\tau)]\delta(\tau+3)d\tau$

d. $\int_0^{\infty} [\cos(t-\tau)]\delta(\tau+3)d\tau$

e. $\int_{-\infty}^{\infty} (1+t^2)\,\dot{\delta}(t-1.5)dt$

Problem 1.5: A system is defined by input x(t) and output y(t) such that $y(t) = 6x(t+2) + 7$. Is this system:

a) Linear?
b) Causal?
c) Dynamic?
d) Fixed?

Problem 1.6:

Determine whether the following signals are energy signals, power signals, or neither.

(a) $x(t) = e^{-at}u(t), \quad a > 0$ (b) $x(t) = A\cos(\omega_0 t + \theta)$

Problem 1.7: Determine whether or not each of the following signals is periodic. If a signal is periodic, determine its fundamental period.

(a) $x(t) = \cos\left(2t + \frac{\pi}{4}\right)$

(b) $x(t) = \cos^2 t$

(c) $x(t) = (\cos 2\pi t)u(t)$

(d) $x(t) = e^{j\pi t}$

Problem 1.8:

Compute the output $y(t)$ for a continuous-time LTI system whose impulse response $h(t)$ and the input $x(t)$ are given by

$$h(t) = e^{-\alpha t}u(t) \qquad x(t) = e^{\alpha t}u(-t) \qquad \alpha > 0$$