Problem 1

(10') Determine the energy E_∞ and power P_∞ of those signals. Which are energy signals? Which are power signals?

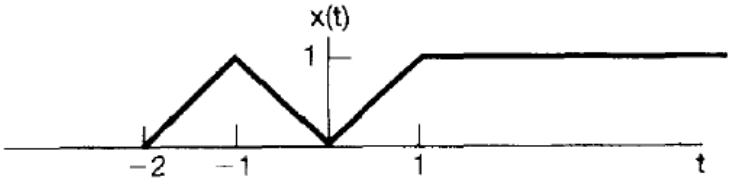
a. $x_1(t) = \cos(t)$

b. $x_2[n] = e^{j(\frac{\pi}{2n}+\frac{\pi}{8})}$

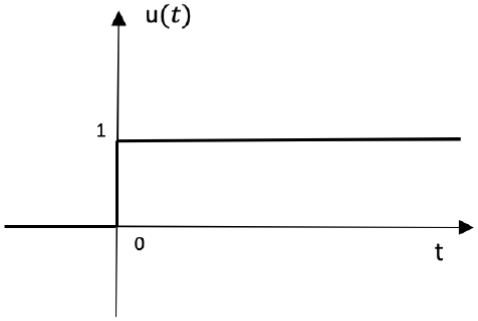
Problem 2

(20') Sketch the signals according to the requirement.

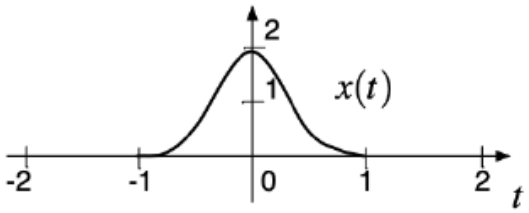
a. Given the signal x(t) shown below, determine and sketch the even part of the signal.



b. Given the signal u(t) shown below, determine and sketch $f(t) = (t-1)u(t-1)$



c. Given the signal x(t) shown below, determine and sketch x(2(t-1)) and x(2t-1)



Problem 3

(15') Determine whether or not each of the following continuous-time signals is periodic. If the signal is periodic, determine its fundamental period.

a. $x_1(t) = \mathrm{j}e^{j10t}$

b. $x_2[n] = e^{j\frac{2\pi}{3}n} + e^{j\frac{3\pi}{4}n}$

c. $x_3(t) = \mathrm{Ev}\{\sin(4\pi t)\mathrm{u}(t)\}$

Problem 4

(36') In this chapter, we introduced a number of general properties of systems. In particular, a system may or may not be

(1) Memoryless

(2) Time invariant

(3) Linear

(4) Causal

(5) Stable

(6) Invertible

Determine which of the properties hold for each of the following continuous-time systems. Justify your answers. In each example, y(t) denotes the system output and x(t) is the system input.

a. $\mathrm{y(t)} = \frac{dx(t)}{dt}$

b. $\mathrm{y[n]} = \mathrm{nx[n]}$

Problem 5

(19') Answer the following questions.

a. Is the following statement true or false? Justify your answer.

The series interconnection of two linear time-invariant systems is itself a linear, time-invariant system.

b. Is the following statement true or false? Justify your answer.

The series interconnection of two nonlinear systems is itself nonlinear.

c. Consider three systems with the following input-output relationships:

$$\text{System 1: } y[n] = \begin{cases} x\left[\frac{n}{2}\right], & n \text{ even} \\ 0, & n \text{ odd} \end{cases}$$

$$\text{System 2: } y[n] = x[n] + \frac{1}{2}x[n-1] + \frac{1}{4}x[n-2]$$

$$\text{System 3: } y[n] = x[2n]$$

Suppose that these systems are connected in series as depicted in Figure below. Find the input-output relationship for the overall interconnected system. Is this system linear? Is it time invariant?