Problem: 1.3, 1.6

1.3. Determine the values of $P_\infty$ and $E_\infty$ for each of the following signals:
   
   (a) $x_1(t) = e^{-2t}u(t)$
   (b) $x_2(t) = e^{j(2t+\pi/4)}$
   (c) $x_3(t) = \cos(t)$
   (d) $x_1[n] = (\frac{1}{2})^nu[n]$
   (e) $x_2[n] = e^{j(\pi/2n+\pi/8)}$
   (f) $x_3[n] = \cos(\frac{\pi}{4}n)$

1.6. Determine whether or not each of the following signals is periodic:
   
   (a) $x_1(t) = 2e^{j(t+\pi/4)}u(t)$
   (b) $x_2[n] = u[n] + u[-n]$
   (c) $x_3[n] = \sum_{k=-\infty}^{\infty} \delta[n - 4k] - \delta[n - 1 - 4k]$
Problem: 1.21, 1.22

1.21. A continuous-time signal $x(t)$ is shown in Figure P1.21. Sketch and label carefully each of the following signals:

(a) $x(t - 1)$  
(b) $x(2 - t)$  
(c) $x(2t + 1)$  
(d) $x(4 - \frac{1}{2})$  
(e) $[x(t) + x(-t)]u(t)$  
(f) $x(t)[\delta(t + \frac{3}{2}) - \delta(t - \frac{3}{2})]$

Figure P1.22

1.22. A discrete-time signal is shown in Figure P1.22. Sketch and label carefully each of the following signals:

(a) $x[n - 4]$  
(b) $x[3 - n]$  
(c) $x[3n]$  
(d) $x[3n + 1]$  
(e) $x[n]u[3 - n]$  
(f) $x[n - 2]\delta[n - 2]$  
(g) $\frac{1}{2}x[n] + \frac{1}{2}(-1)^nx[n]$  
(h) $x[(n - 1)^2]$

Problem: 1.23, 1.24

1.23. Determine and sketch the even and odd parts of the signals depicted in Figure P1.23. Label your sketches carefully.

1.24. Determine and sketch the even and odd parts of the signals depicted in Figure P1.24. Label your sketches carefully.
2. [12] Determine whether or not the each of the following signals are periodic. Please justify your answer.

(a) \( x[n] = \cos\left(\frac{\pi}{8} n^2\right) \) \[6\]

(b) \( x(t) = \cos(4\pi t)u(t) \) \[6\]

2. (8 %) Consider a periodic signal \( x(t) \) with period 1 and \( x(t) = 1/\sqrt{t} \) for \( 0 \leq t < 1 \). Show that the signal is absolutely integrable in one period but has infinite average power \( P_r = \frac{1}{T} \int_0^T |x(t)|^2 \, dt \) over one period.

Midterm: 2010-1, 2010-2, 2010-3

1. Find the even and odd components of the following signals.

(a) [3] \( x(t) = 1 + t \cos(t) + t^2 \sin(t) + t^3 \sin(t) \cos(t) \)

(b) [3] \( x(t) = 5 \cos(3t) + \sin(3t - \frac{\pi}{2}) \)

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

(a) [2] \( x(t) = \sin^3(2t) \)

(b) [2] \( x[n] = \cos(2n) \)

(c) [2] \( x(t) = e^{jt0t} \)

(d) [2] \( x(t) = e^{-j10t} + e^{j5t} \)

(e) [2] \( x[n] = \cos(\frac{\pi}{4} n^2) \)

3. [5] Assume that an real-valued continuous-time signal is expressed as

\[
x(t) = x_e(t) + x_o(t),
\]

where \( x_e(t) \) and \( x_o(t) \) are, respectively, the even and odd components of \( x(t) \).

Show that the energy of the signal \( x(t) \) is equal to the sum of the energy of the even component \( x_e(t) \), and the energy of the odd component \( x_o(t) \). That is, show that

\[
\int_{-\infty}^{\infty} x^2(t) dt = \int_{-\infty}^{\infty} x_e^2(t) dt + \int_{-\infty}^{\infty} x_o^2(t) dt
\]