

**American University of Beirut**  
**Department of Electrical and Computer Engineering**

EECE 440 Signals and Systems

Homework 1: Due Tuesday July 4, 2006

**Part I**

1. For each of the following signals, determine the energy, the mean value, the average power, and the rms value of the following signals.

$$\text{a. } x_1(t) = \begin{cases} \cos\left(\frac{2\pi t}{T_0}\right) & t \geq 0 \\ 0 & \text{Otherwise} \end{cases}$$

$$\text{b. } x_2(t) = \begin{cases} 1 & 0 < t < 1 \\ 1 - |t - 5| & |t - 5| \leq 1 \\ 0 & \text{Otherwise} \end{cases}$$

$$\text{c. } x_3(t) = \begin{cases} \cos^2\left(\frac{2\pi t}{T_0}\right) & 0 \leq t \leq T_0 \\ 0 & \text{Otherwise} \end{cases}$$

$$\text{d. } x_4(t) = 7 + 3e^{-2|t|}$$

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

$$\text{a. } x(t) = \cos\left(4t + \frac{\pi}{3}\right)$$

$$\text{b. } x(t) = e^{j(\pi t - 1)}$$

$$\text{c. } x(t) = \left[ \cos\left(2t - \frac{\pi}{3}\right) \right]^2$$

3. In Chapter 1, we introduced a number of general properties of systems.

In particular, a system may or may not be:

- a. Memoryless
- b. Time invariant
- c. Linear
- d. Causal
- e. Stable

Determine which of these properties hold and which do not 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.  $y(t) = x(t - 2) + x(2 - t)$

b.  $y(t) = (\cos 3t)x(t)$

c.  $y(t) = \int_{-\infty}^t x(\tau) d\tau$

d.  $y(t) = \begin{cases} 0 & t < 0 \\ x(t) - x(t - 2) & t \geq 0 \end{cases}$

e.  $y(t) = x(t/3)$

## **Part II**

1. An exponentially damped sinusoidal signal is defined by:

$$x(t) = 20\sin(2\pi \times 1000t - \pi/3)e^{-at}$$

Where the exponential parameter  $a$  is variable, taking on the set of values  $a=500, 750,$  and  $1000$ . Using MATLAB, investigate the effect of varying  $a$  on the signal  $x(t)$  for  $-2 \leq t \leq 2$  milliseconds.