UCLA
Dept. of Electrical Engineering
EE113: Digital Signal Processing
Problem Set 1
Due: 10/15/1998

Reading Assignment:
Chapter 1: 1-1.2, 1.2.2-1.4.3, 1.4.5-end of Chapter 1.
Chapter 2: 2.1-2.3

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1. Are the following signals one or multi-dimensional? Are they continuous-time or discrete-time? If discrete-time, specify whether or not the signal is a digital signal. Explain your answers briefly.

   (a) Closing stock prices on the New York Exchange.

   (b) A color movie.

   (c) Weight and height measurements of a child taken every month.

2. Sketch the following functions and determine whether or not they are periodic. If they are periodic, find the period:

   (a) $x(n) = cos(6.5n\pi + \frac{\pi}{3})$

   (b) $x(n) = e^{cos(\frac{\pi n}{8})}$

   (c) $x_k(n) = e^{\frac{j2\pi kn}{N}} \quad k = 0, 1, ... \quad and \;\; N = 7$

3. For each of the following systems, determine whether the system is 1) BIBO stable, 2) causal, 3) linear, 4) time-invariant. $y(n)$ denotes the output and $x(n)$ the input. Explain your reasoning carefully.

   (a) $y(n) = 2x(n) + 3$

   (b) $y(n) = x(n) + 3u(n + 1)$

   (c) $y(n) = \sum_{k=n_0}^{n} x(k)$

(d) $y(n) = x(n - n_o)$

4. An analog signal composed of a sum of three sinusoids is given by:

$$y(t) = 2\ cos(1000\pi t) + 5\ sin(2500\pi t + \frac{\pi}{6}) - 15.9\ sin(6000\pi t)$$

   (a) What range of sampling frequencies will allow perfect reconstruction of the signal? Why?

   (b) If the signal is sampled at 2000Hz, what is the discrete-time signal obtained after sampling?

   (c) If ideal interpolation is used at the sampled signal, what is the reconstructed analog signal?

5. Let $x(n)$ represent the input to a LTI system with impulse response $h(n)$. Determine the output $y(n)$ and sketch your answer.

$$x(n) = \alpha^n u(n), \quad 0 < \alpha < 1$$

$$h(n) = \beta^n u(n), \quad 0 < \beta < 1, \quad \beta \neq \alpha$$