GEORGIA INSTITUTE OF TECHNOLOGY
School of Electrical and Computer Engineering

EE3230
Problem Set No. 1

Date Assigned: September 25, 1998
Date Due: October 2, 1998

Reading Assignment: In Oppenheim and Willsky, read pp. 7-56 and pp. 90-116.

Homework Assignment: In all problems, write some explanation of your approach to the solution, i.e., give more than the answer. Turn in for grading only the starred problems: 1.1*, 1.2*, 1.3*, 1.5*, 1.6*.

Review Problems:
Take a look at Problems 1.1, 1.2, and 1.52 in Oppenheim and Willsky.

Optional Problems:
Look at the problems in Problem Set # for Winter 98 and Spring 98. These problems all relate to what we will study this week.

Problem 1.1*:
For each of the following systems, determine whether or not the system is (1) Memoryless, (2) Time-invariant, (3) Linear, (4) Causal, and (5) Stable.

a) $y(t) = 1/x(t)$.

(b) $y(t) = \int_{-\infty}^{2t} x(\tau)d\tau$

(c) $y(t) = \cos(2000\pi t)x(t)$

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

Problem 1.2*:
Work Problem 2.44(a) in O$W.

Problem 1.3*:

A linear time-invariant system has impulse response:

$$h(t) = e^{-2t}u(t+1)$$

(a) Plot $h(t)$ and plot $h(t-\tau)$ as a function of τ for $t = 3$.

(b) Is the system stable? Justify your answer.

(c) Is the system causal? Justify your answer.

(d) Find the output $y(t)$ when the input is $x(t) = \delta(t-1)$

(e) Find the output $y(t)$ when the input is $x(t) = u_1(t) = \dfrac{d\delta(t)}{dt}$.

(f) Find the output $y(t)$ when the input is $x(t) = \begin{cases} 1 & -1 < t < 2 \\ 0 & \text{otherwise} \end{cases}$.

Problem 1.4:

A linear time-invariant system has impulse response

$$h(t) = \begin{cases} e^t & 2 < t < 4 \\ 0 & \text{otherwise} \end{cases}$$

The input to this system is $x(t) = u(t-1)$. Find and plot the output $y(t)$ for $-\infty < t < \infty$.

Problem 1.5*:

A linear time-invariant system has impulse response

$$h(t) = \begin{cases} e^t & 0 < t < 4 \\ 0 & \text{otherwise} \end{cases}$$

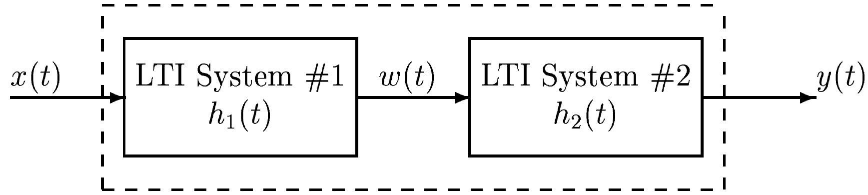
The input to this system is

$$x(t) = \begin{cases} 1 & 1 < t < 2 \\ 0 & \text{otherwise} \end{cases}$$

(a) For what values of t is it true that $y(t) = 0$? *Draw a carefully labelled sketch to help solve this problem.*

(b) Determine $y(t)$ for all t and plot it.

Problem 1.6*:



The first system is described by the input/output relation

$$w(t) = \frac{dx(t)}{dt}$$

and the second system has impulse response

$$h_2(t) = u(t-5) - u(t-10)$$

(a) Find the impulse response of the overall system; i.e., find the output $y(t) = h(t)$ when the input is $x(t) = \delta(t)$.

(b) Give a general expression for $y(t)$ in terms of $x(t)$ that holds for any input signal.