GEORGIA INSTITUTE OF TECHNOLOGY
School of Electrical and Computer Engineering

EE3230
Quiz No. 1
April 20, 1998

Name: _____

1. The exam is closed book. You may use one 8.5" by 11" sheet of notes and a calculator if you need it.
2. Do all work in the space provided. If you need more room, use the *back* of the *previous* page.
3. Indicate your answer clearly by circling it or drawing a box around it.
4. Think carefully about the the problem before you begin to write. Move on to the next problem if you cannot come up with a plan for the solution.
5. If you want to receive partial credit, you should clearly indicate your reasoning and method of attack on the problem.

Problem	**Points**	**Score**
1	20	
2	20	
3	20	
4	20	
5	20	
TOTAL	100	

Problem Q1:Sp98-1: (20 %)

A linear time-invariant system has impulse response:

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

(a) Plot $h(t)$ in the space below.

(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 $x(t) = u_1(t) = \dfrac{d\delta(t)}{dt}$.

Problem Q1:Sp98-2: (20 %)

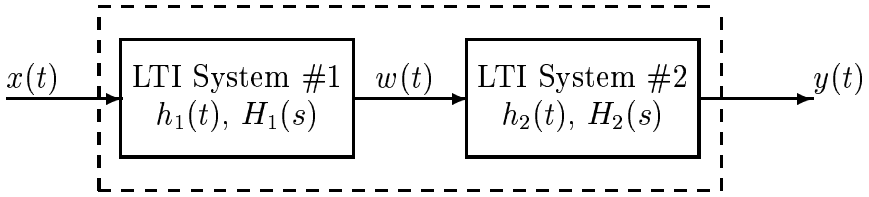
A linear time-invariant system has impulse response

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

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

(b) Plot $y(t)$ below.

Problem Q1:Sp98-3: (20 %)



In the above cascade system, the second system is the *inverse* of the first system; i.e., $y(t) = x(t)$ for all inputs $x(t)$.

(a) If $y(t) = x(t)$, the overall impulse response (from input $x(t)$ to output $y(t)$) is $h(t) = \delta(t)$. Express $h(t)$ in terms of $h_1(t)$ and $h_2(t)$.

(b) If $y(t) = x(t)$, the overall system function (from input $x(t)$ to output $y(t)$) is $H(s) = 1$. Express $H(s)$ in terms of $H_1(s)$ and $H_2(s)$.

(c) What is the impulse response of the second system if the impulse response of the first system is $h_1(t) = u(t)$, where $u(t)$ denotes the unit step.

(d) Now consider the case where $w(t) = x(t-3)$. What is the the system function of the second system if it is the inverse system for system #1?

Problem Q1:Sp98-4: (20 %)

A linear time-invariant system has impulse response

$$h(t) = u(t) - u(t-2) = \begin{cases} 1 & 0 < t < 2 \\ 0 & \text{otherwise,} \end{cases}$$

where $u(t)$ is the unit step, and frequency response

$$H(j\omega) = \frac{2\sin(\omega)}{\omega} e^{-j\omega}.$$

(Recall that $H(0) = 2$ for this frequency response.)

Use superposition to find the output due to the input

$$x(t) = 10 + 10\cos(\pi t/2) + 5\cos(\pi t) + 5\delta(t-3) \qquad -\infty < t < \infty$$

HINT: The input has four parts. Each part of the output is easy to find if you use the right method.

Problem Q1:Sp98-5: (20 %)

The periodic input $x(t)$ to an LTI system can be expressed in the form

$$x(t) = \sum_{k=-\infty}^{\infty} e^{jk\omega_0 t}$$

where the fundamental frequency is $\omega_0 = 2\pi$. The frequency response of the LTI system is

$$H(j\omega) = \frac{2\sin(\omega/4)}{\omega}.$$

(a)What is the period T of the input signal?

(b) Plot the spectrum of the input signal below for $-5\omega_0 \leq \omega < 5\omega_0$.

(c) Using the given frequency response of the system, determine the Fourier series coefficients b_k in following expression for the output:

$$y(t) = \sum_{k=-\infty}^{\infty} b_k e^{jk\omega_0 t}.$$

(d) Plot the spectrum of the output signal below for $-5\omega_0 \leq \omega < 5\omega_0$.