Signals & Systems Question 1
Student ID Number: _____

Unified Engineering	Fall 2007
Quiz 3	
Wednesday November 7	

Question 1 (15/25 pts)

An RC circuit has an impulse response

$$h(t) = \begin{cases} 0, & t < 0 \\ e^{-t/RC}, & t \geq 0, \end{cases}$$

with $R = \frac{1}{2}$ and $C = \frac{1}{2}$.

(a) [1 pt] What is the time constant of the system?

(b) [2 pt] Sketch the system impulse response, indicating the initial value of the response and the time taken for the transient to decay to 2% of its original value.

(c) [8 pt] Determine $y(t)$, the response of the system to an input

$$u(t) = \sigma(t) - 2\sigma(t-2).$$

(d) [4 pt] Sketch the response computed in part (c), being careful to label the axes. Indicate the steady-state solution on your plot.

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Signals & Systems Question 2
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Question 2 (10/25 pts)

A system has an impulse response

$$h(t) = \begin{cases} 0, & t < 0, \\ e^{-\alpha t} \sin t, & t \geq 0. \end{cases}$$

with $\alpha > 0$.

(a) [7 pt] The system is subjected to a sinusoidal input of frequency ω:

$$u(t) = e^{j\omega t}, \qquad \text{for all } t.$$

Show that the response is given by

$$y(t) \;=\; \frac{e^{j\omega t}}{\alpha^2 + 2j\alpha\omega + 1 - \omega^2}.$$

Hint: Use Euler's formula to express $\sin t$ in terms of complex exponentials.

(b) [3 pt] If $\alpha > 0$, the system is bounded input/bounded output stable. However, in the case that $\alpha = 0$, the system is not bounded input/bounded output stable. Find a bounded input $u(t)$ that results in an unbounded output $y(t)$ when $\alpha = 0$.

Signals & Systems Question 2
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