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ECE-205

Exam 2

Winter 2009

Calculators and computers are not allowed. You must show your work to receive credit.

Problem 1 __________/20

Problem 2 __________/15

Problem 3 __________/20

Problem 4 __________/25

Problem 5-9 ________/20

Total ______________

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1) (20 points) Fill in the following table with a Y (yes) or N (no) for each of the system models given. Assume $-\infty < t < \infty$ for all of the systems and all initial conditions are zero.

System	System Model	Linear?	Time-Invariant?	Causal?	Memoryless?
1	$y(t) = e^{t+1}\cos(t)x(t)$				
2	$y(t) = \lvert x(t-1) \rvert$				
3	$y(t) = x(1-t)$				
4	$\dot{y}(t) + y(t) = e^{-t}x(t+1)$				
5	$y(t) = \int_{-\infty}^{t} e^{-(t-\lambda)}x(\lambda+1)d\lambda$				

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2) (15 points) Determine the impulse responses for the following systems

a) $y(t) = x(t-1) + \int_{-\infty}^{t-1} e^{-(t-\lambda-2)} x(\lambda+2)\, d\lambda$

b) $\tau \dot{y}(t) + y(t) = Kx(t)$

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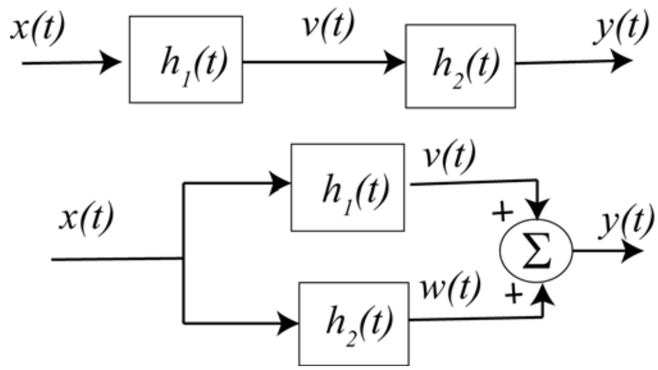
3) (20 points) For the following interconnected systems,

i) determine the overall impulse response (the impulse response between input *x(t)* and output *y(t)*) and

ii) determine if the system is causal.



a) $h_1(t) = u(t-1),\ h_2(t) = u(t+1)$

b) $h_1(t) = e^{-(t-1)}u(t-1),\ h_2(t) = \delta(t-2)$

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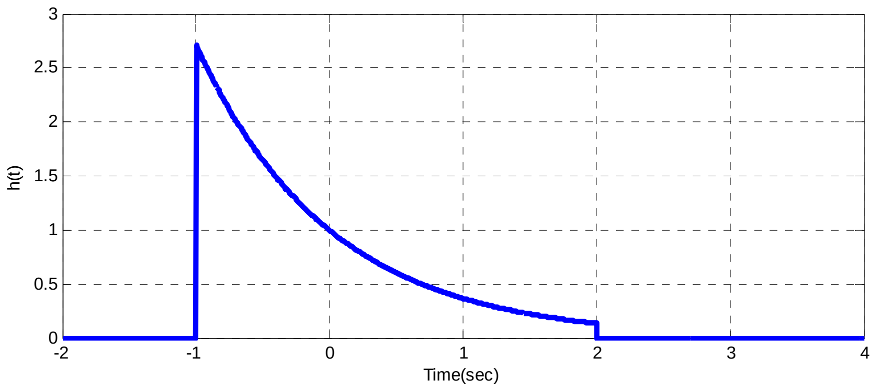
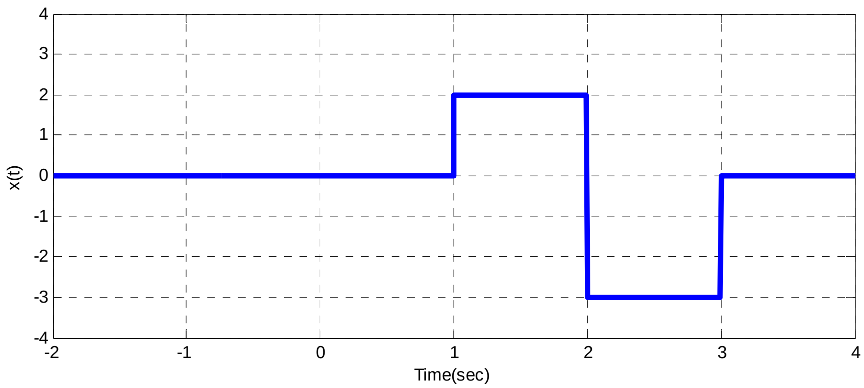
4) (25 points) Consider a noncausal linear time invariant system with impulse response given by

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

The input to the system is given by

$$x(t) = 2u(t-1) - 5u(t-2) + 3u(t-3)$$





Using ***graphical convolution***, determine the output $y(t)$ Specifically, you must

- Flip and slide $h(t)$, ***NOT*** $x(t)$
- Show graphs displaying both $h(t-\lambda)$ and $x(\lambda)$ for each region of interest
- Determine the range of t for which each part of your solution is valid
- Set up any necessary integrals to compute $y(t)$. Your integrals must be complete, in that they cannot contain the symbols $x(\lambda)$ or $h(t-\lambda)$ but must contain the actual functions.
- Your integrals cannot contain any unit step functions
- ***DO NOT EVALUATE THE INTEGRALS!!***

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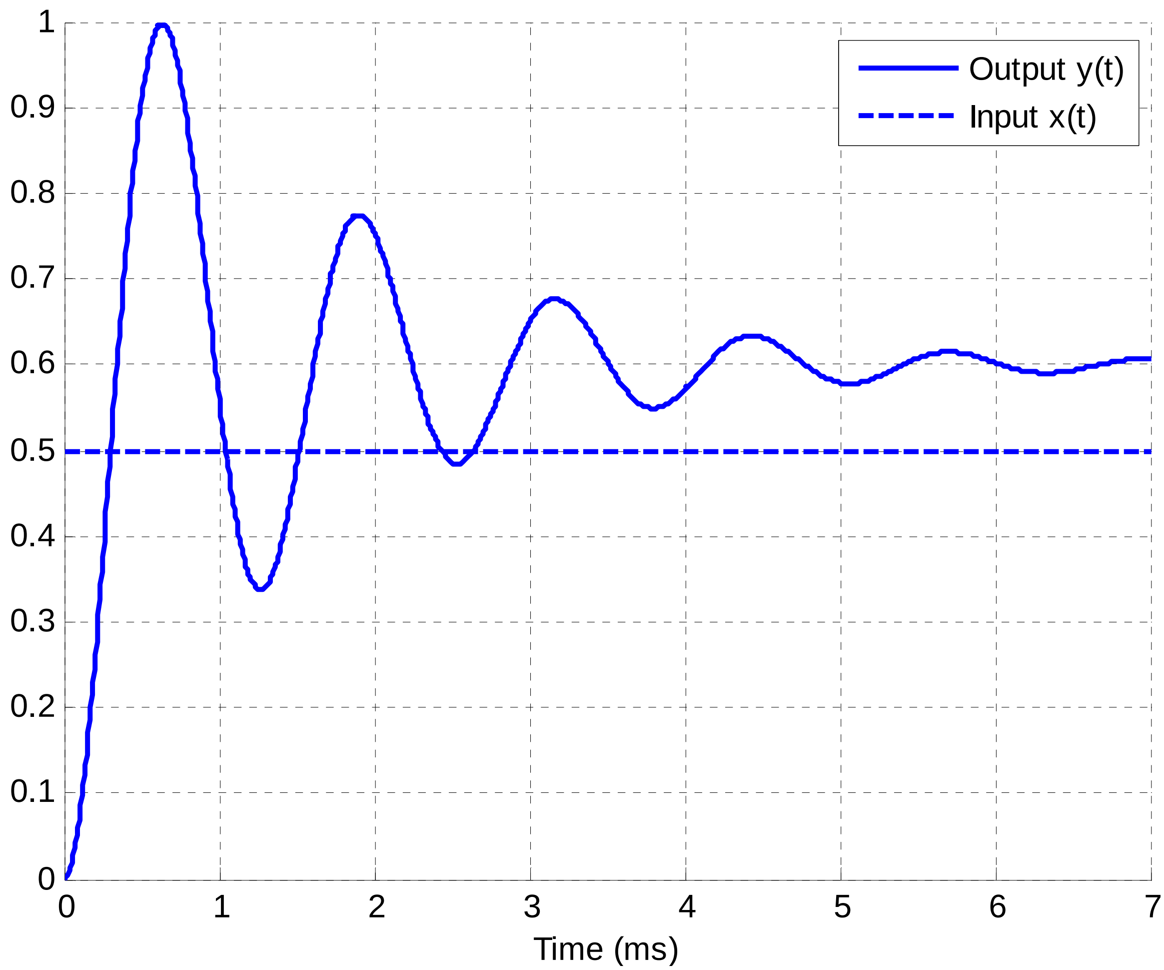
Multiple Choice Problems (4 points each)

5) Assume we have a first order system in standard form, and the input is a step. The usual form used to compute the response of the system is

a) $y(t) = [y(0) - y(\infty)]e^{-t/\tau} + y(0)$ b) $y(t) = [y(\infty) - y(0)]e^{-t/\tau} + y(0)$

c) $y(t) = [y(\infty) - y(0)]e^{-t/\tau} + y(\infty)$ d) $y(t) = [y(0) - y(\infty)]e^{-t/\tau} + y(\infty)$

Problems 6 and 7 refer the following graph showing the response of a second order system to a step input.



6) The percent overshoot for this system is best estimated as

a) 200 %   b) 150 %   c) 100%   d) 67 %   e) 50 %   f) 33%

7) The static gain for this system is best estimated as

a) 0.1   b) 0.5   c) 1.0   d) 1.2   e) 1.5   d) 2.0

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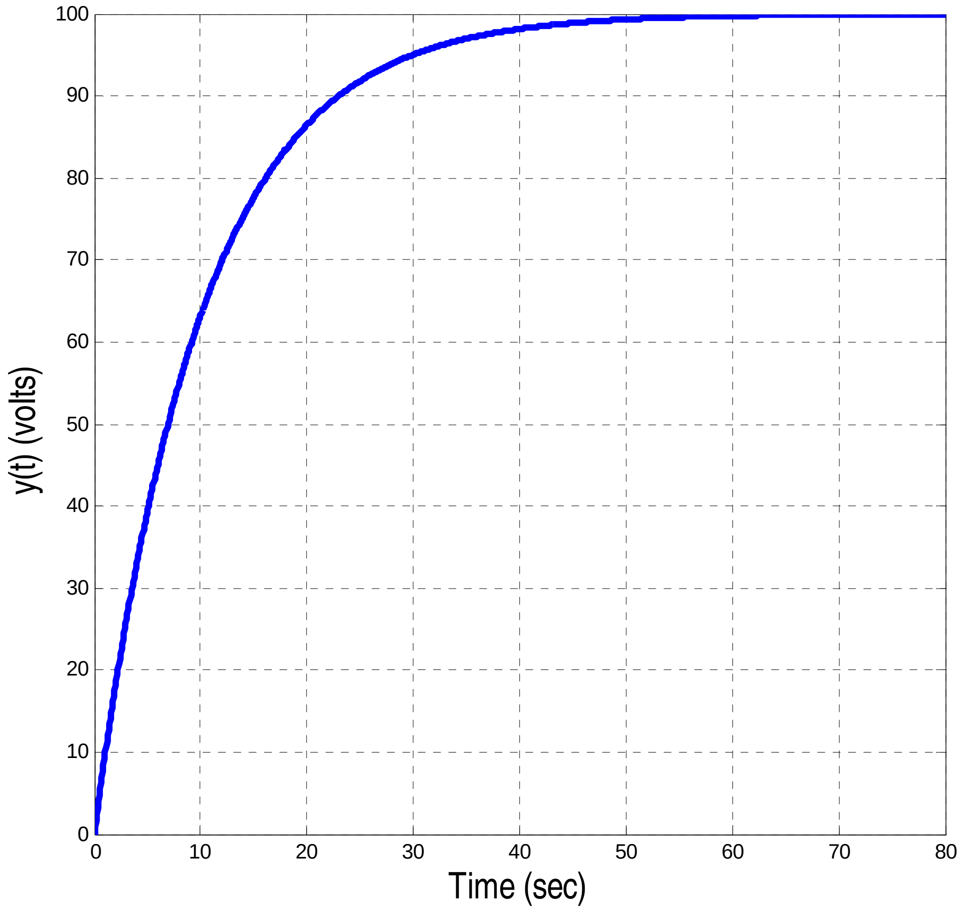
8) The following figure shows a capacitor charging.



Based on this figure, the best estimate of the **time constant** for this system is

a) 5 sec   b) 10 sec   c) 15 sec   d) 20 sec   e) 30 sec   f) 40 sec

9) For the second order equation $\ddot{y}(t) + 4\dot{y}(t) + 5y(t) = x(t)$ with an input $x(t) = u(t)$, we should look for a solution of the form

a) $y(t) = ce^{-2t}\sin(t+\theta)+1$ b) $y(t) = ce^{-t}\sin(2t+\theta)+1$ c) $y(t) = ce^{-t}\sin(2t+\theta)+5$

d) $y(t) = ce^{-2t}\sin(t+\theta)+5$ e) $y(t) = ce^{2t}\sin(t+\theta)+5$ f) none of these

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