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ECE-205

Exam 3

Fall 2012

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

Problem 1 __________/20

Problem 2 __________/15

Problem 3 __________/15

Problem 4 __________/20

Problems 5 _________/30

Total ________________

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1) (20 points) For the following transfer functions, determine the *unit step response* of the system. *Do not forget any necessary unit step functions.*

a) $H(s) = \dfrac{e^{-2s}}{s}$

b) $H(s) = \dfrac{1}{(s+1)^2}$

c) $H(s) = \dfrac{1}{s^2 + 2s + 5}$

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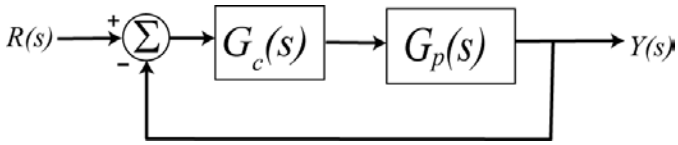
2) (15 points) Consider the following simple feedback control block diagram. The plant, the thing we want to control, has the transfer function $G_p(s) = \dfrac{5}{s+3}$



a) Determine the settling time of the plant alone (assuming there is no feedback)

b) Determine the steady state error for plant alone assuming the input is a unit step (simplify your answer)

c) For a proportional controller, $G_c(s) = k_p$, determine the closed loop transfer function $G_0(s)$

d) Determine the settling time of the closed loop system , in terms of k_p

e) Determine the steady state error of the closed loop system for a unit step, in terms of k_p (simplify your answer)

f) For and integral controller, $G_c(s) = \dfrac{k_i}{s}$, determine the closed loop transfer function $G_0(s)$ and the steady state error for a unit step in terms of k_i

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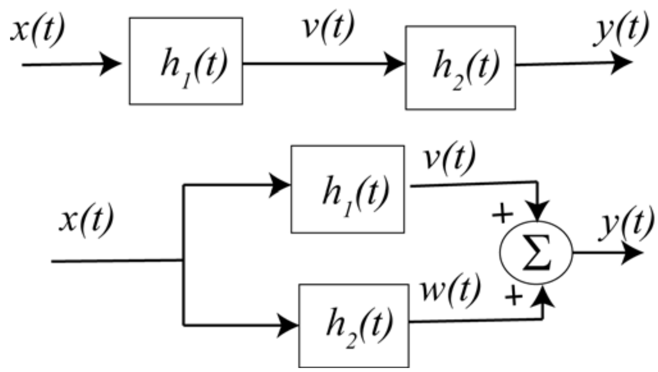
3) (15 points) For the following block diagram

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) $h_1(t) = \delta(t-2),\ h_2(t) = \delta(t+1)$

b) $h_1(t) = u(t+1),\ h_2(t) = u(t-2) + \delta(t-2)$

Series Connections:

Parallel Connections:

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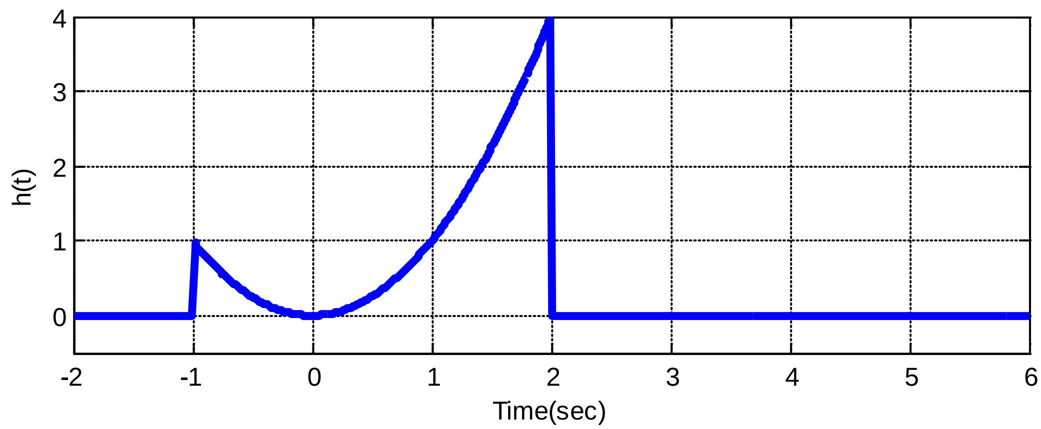
4) (20 points) Consider a linear time invariant system with impulse response given by

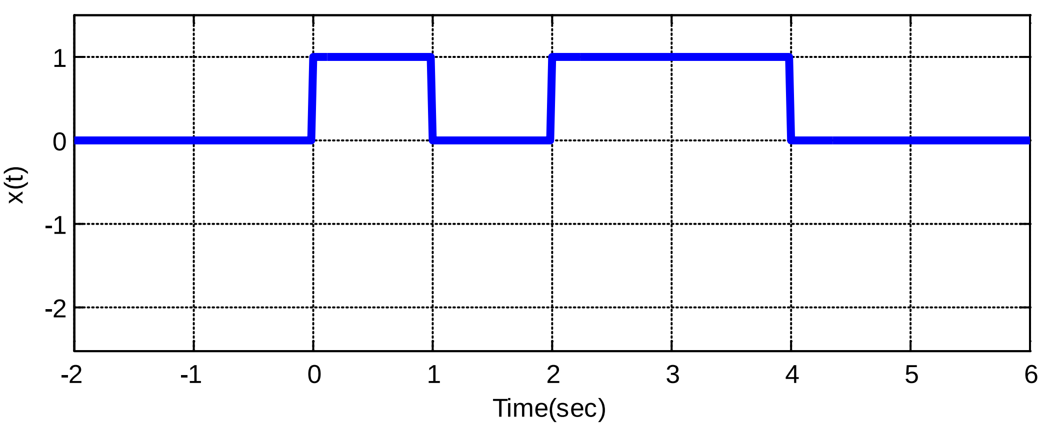
$$h(t) = t^2[u(t+1) - u(t-2)]$$

The input to the system is given by

$$x(t) = [u(t) - u(t-1)] + [u(t-2) - u(t-4)]$$

The impulse response and input are shown below:





Using ***graphical evaluation***, 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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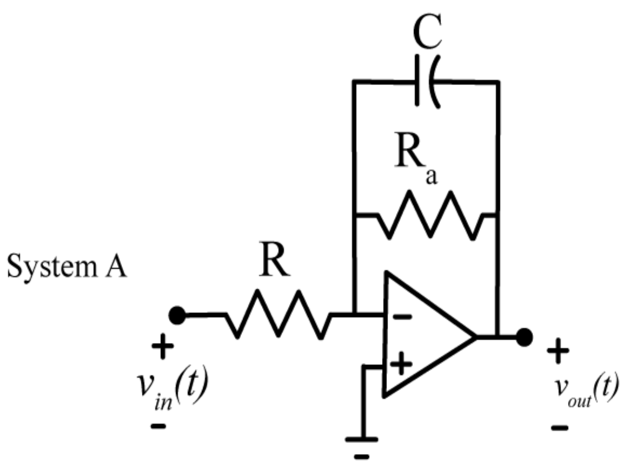
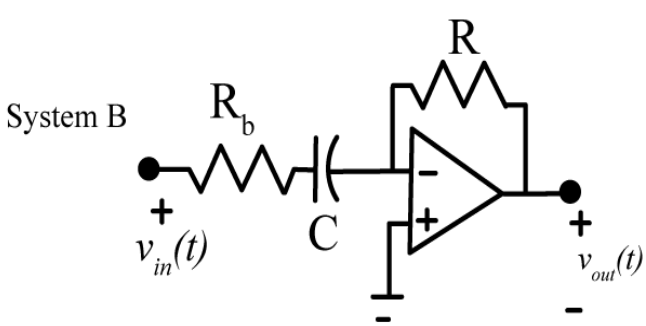
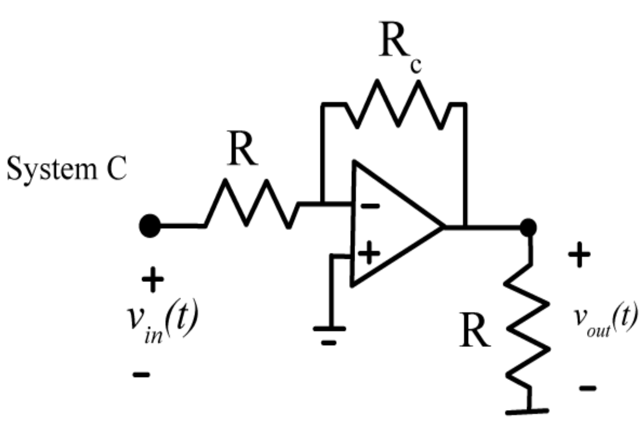
5) (30 points) The following figure shows three different circuits, which are subsystems for a larger system.We can write the transfer functions for these systems as

$$G_a(s) = \frac{-K_{low}\omega_{low}}{s+\omega_{low}} \qquad G_b(s) = \frac{-K_{high}s}{s+\omega_{high}} \qquad G_c(s) = -K_{ap}$$

Determine the parameters $K_{low}, \omega_{low}, K_{high}, \omega_{high}$, and K_{ap} in terms of the parameters given (the resistors and capacitors).







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