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ECE-205

Exam 3

Winter 2013

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

Problem 1 __________/15

Problem 2 __________/10

Problem 3 __________/20

Problem 4 __________/15

Problems 5 _________/20

Problems 6 __________/20

Total ________________

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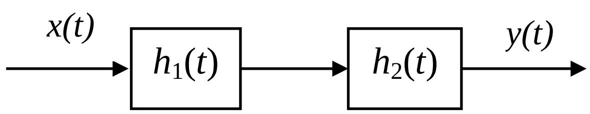
1) **(15 Points)** Consider the LTI systems with the following impulses responses:

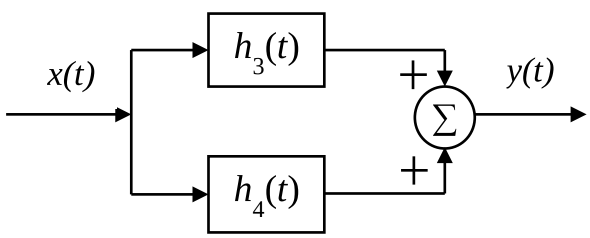
$h_1(t) = \delta(t-2)$, $h_2(t) = \delta(t-1) - 3\delta(t-3)$, $h_3(t) = e^{(t+1)}\delta(t+1)$, $h_4(t) = u(t-2) - \delta(t+1)$

i) Fill in the following table. You do not need to show any work.

	Causal? (Y/N)	BIBO Stable? (Y/N)
$h_1(t) = \delta(t-2)$		
$h_2(t) = \delta(t-1) - 3\delta(t-3)$		
$h_3(t) = e^{(t+1)}\delta(t+1)$		
$h_4(t) = u(t-2) - \delta(t+1)$		

ii) Determine the overall impulse response (the impulse response between input $x(t)$ and output $y(t)$) of the following interconnected systems. You must show your work for a full credit.





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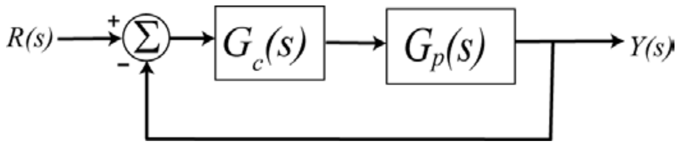
2) (10 points) Consider the following simple feedback control block diagram. The plant, the thing we want to control, has the transfer function $G_p(s) = \frac{2}{s+3}$



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 as much as possible)

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 as much as possible)

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3) (20 points) Determine

a) the *impulse response* of $H(s) = \dfrac{4}{s^2 + 2s + 5}$

b) the *unit step response* of $H(s) = \dfrac{e^{-2s}}{(s+1)^2}$

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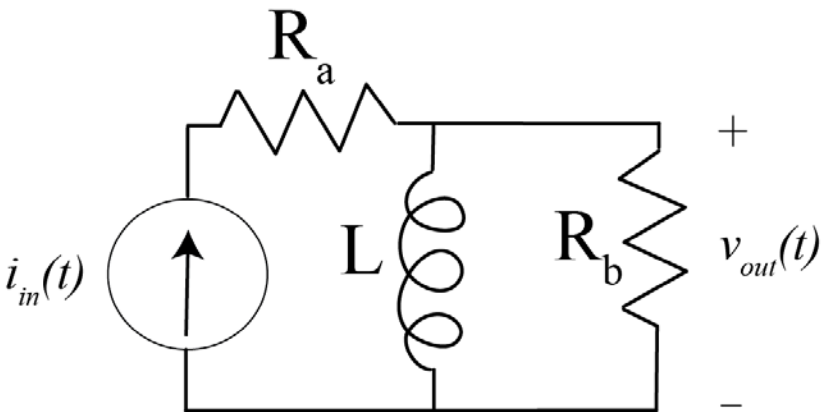
4) (15 points) For the following circuit



- Determine the ZIR
- Determine the ZSR
- Determine the transfer function

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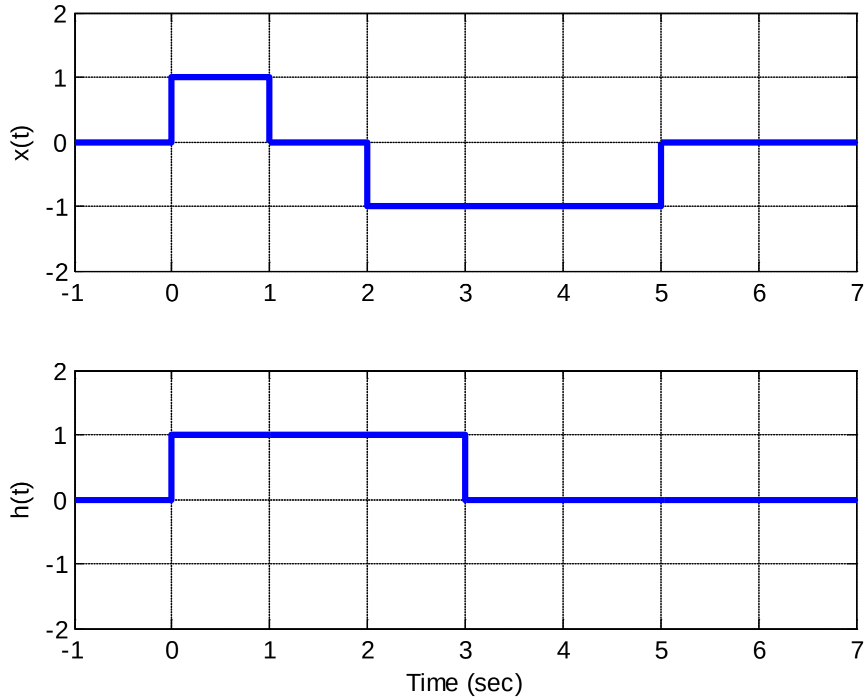
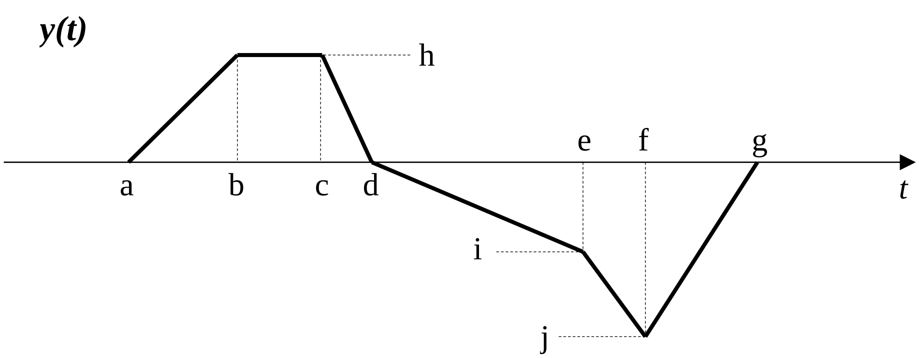
5) (20 Points) An LTI system has input, impulse response, and output as shown below. Determine numerical values for the parameters *a-j*. Note that parameters *a-g* correspond to *times*, and *h-j* correspond to *amplitudes*.

Note that the output graph is only an approximate sketch of the output. Do not try to read values from this sketch.





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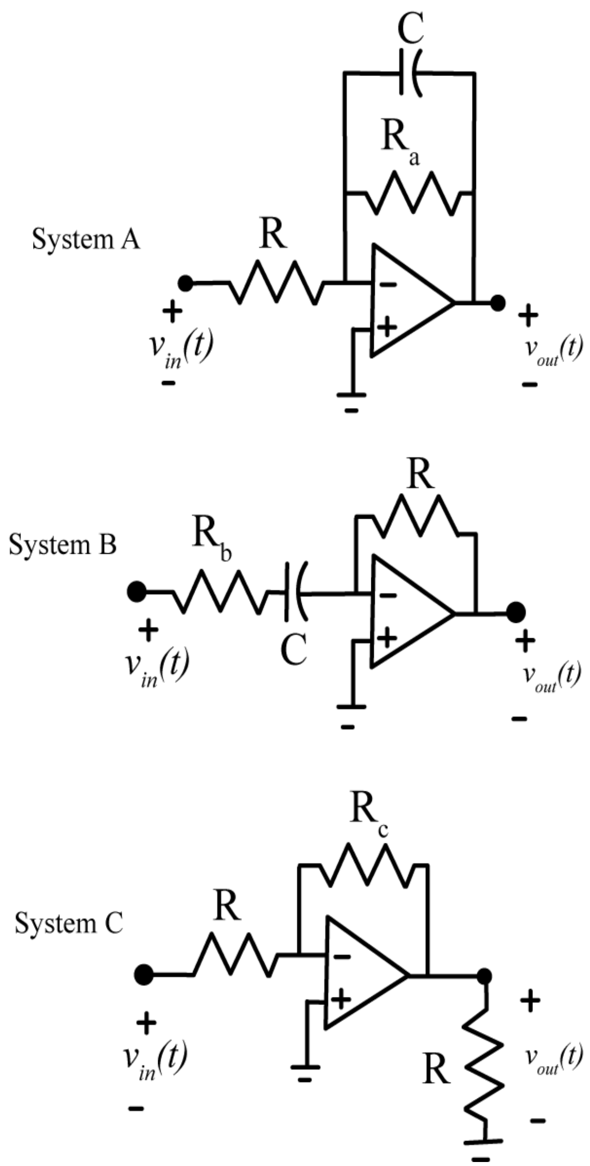
6) (20 points) The following figure shows three different circuits, which are subsystems for a larger system.We can write the transfer functions for these systems as

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

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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