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ECE-205

Exam 3

Winter 2016

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

Problem 1 _____/15

Problem 2 _____/20

Problem 3 _____/20

Problem 4 _____/23

Problem 5 _____/22

Total _____

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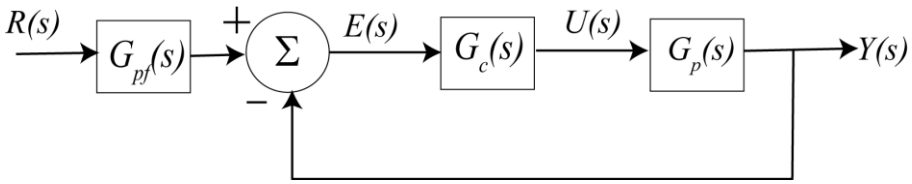
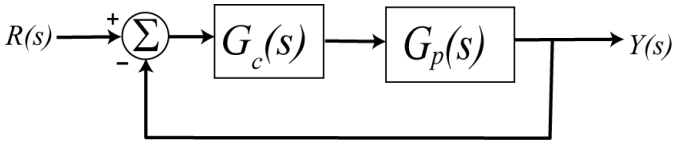
1) (15 points)

For the following problems, the closed loop transfer function for the following feedback system is

$$\frac{Y(s)}{R(s)} = G_o(s) = \frac{G_{pf}(s)G_c(s)G_p(s)}{1+G_c(s)G_p(s)}$$



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)

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)

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2) (20 points)

a) For transfer function $H(s) = \dfrac{2}{(s+1)^2 + 2^2}$ and input $X(s) = \dfrac{1}{s+3}$, determine $y(t)$ where $Y(s) = H(s)X(s)$

b) For impulse response $h(t) = e^{-3(t-2)}u(t-2)$ and input $x(t) = e^{-2(t-1)}u(t-1)$, determine the output $y(t)$ using Laplace transforms. *You will not receive credit if you solve this problem in the time domain.*

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3) (20 points) Simplify the following as much as possible. Be sure to include any necessary step functions. Note that $*$ denotes convolution integral.

a) $\int_{-\infty}^{\infty} \delta(\lambda+2)u(\lambda)d\lambda$

b) $\delta(t-1)*\delta(t-3)$

c) $\int_{-\infty}^{t-1} u(\lambda+1)\delta(\lambda-1)d\lambda$

d) $\int_{t-1}^{t+1} \delta(\lambda)d\lambda$

e) $\int_{-\infty}^{t+1} u(\lambda+t)\delta(t-\lambda)d\lambda$

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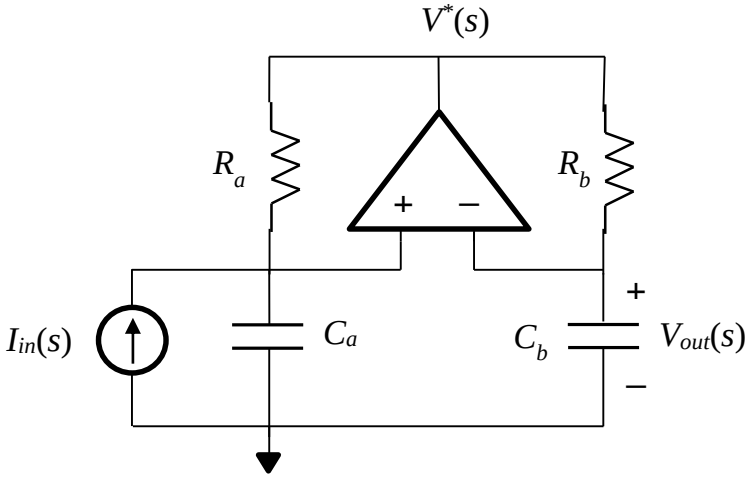
4) (23 points) Determine the transfer function $H(s) = \frac{V_{out}(s)}{I_{in}(s)}$ of the following circuit.



Hint: Define the node voltage $V^*(s)$ at the output of the op-amp as an intermediate variable.

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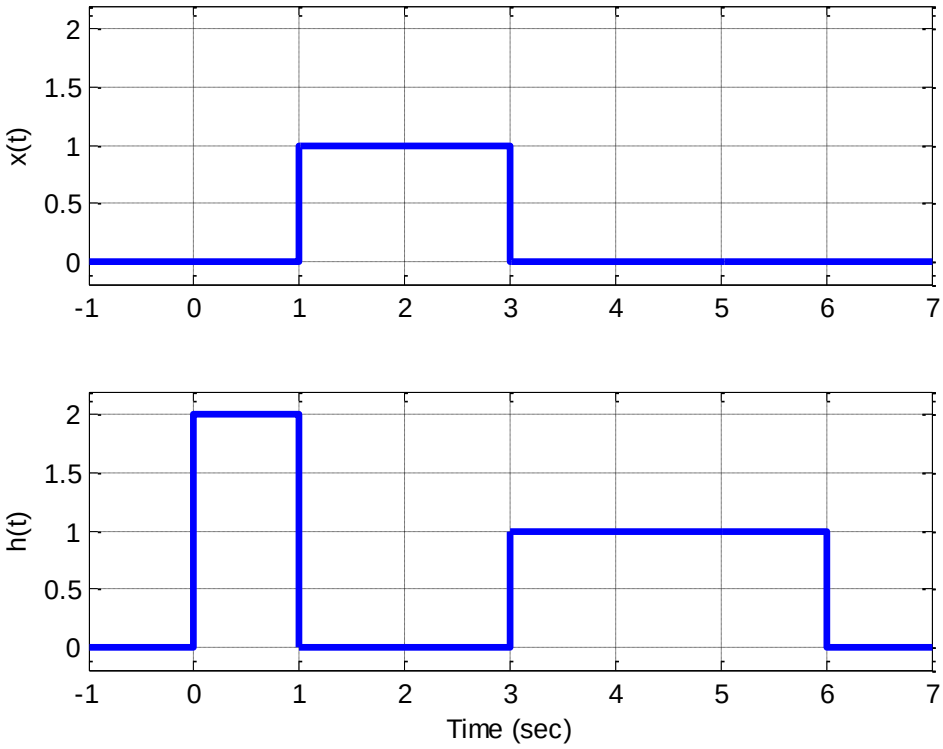
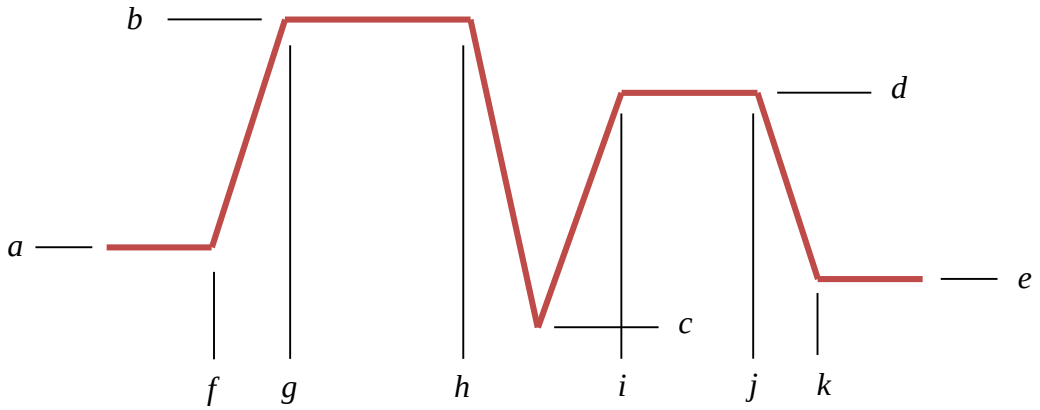
5) (22 points)

Below are functions for $x(t)$ and $h(t)$ for a system and the result of the convolution. Provide values for the specified artifacts in the convolution. Note that *a-e* are values while *f-k* are times. *The convolution diagram is a rough sketch and not to scale!*





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