ECE-205

Exam 3

Winter 2009

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

Problem 1 _________/20

Problem 2 _________/20

Problem 3 _________/20

Problem 4 _________/20

Problem 5 _________/20

Total ______________

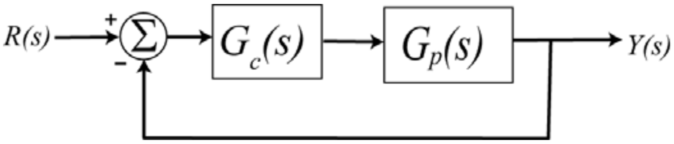
1) (20 points) For the following impulse responses and system inputs, determine the system output using Laplace transforms.

a) $h(t) = e^{-2(t-1)}u(t-1),\ x(t) = u(t-2) - u(t-4)$

b) $h(t) = te^{-3t}u(t),\ x(t) = u(t)$

Do not forget any necessary unit step functions.

2) (20 points) Consider the following simple feedback control block diagram. The plant, the thing we want to control, has the transfer function $G_p(s) = \frac{2}{s+3}$ and the controller is a proportional controller, so $G_c(s) = k_p$.



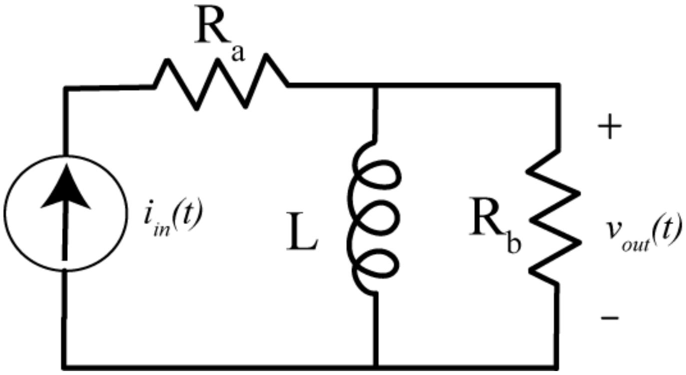
a) Determine the settling time of the plant alone (assuming there is no feedback)

b) Determine the closed loop transfer function, $G_0(s)$

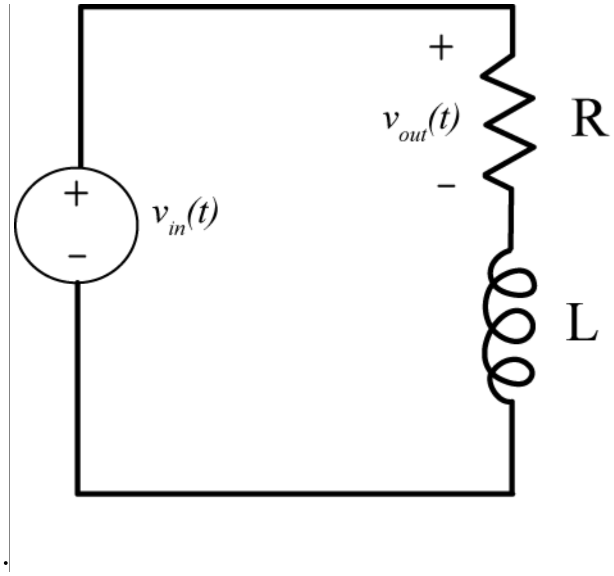
c) Determine the value of k_p so the settling time of the system is 4/25 seconds.

d) Determine the value of k_p so the steady state error of the system for a unit step is 3/23.

3) (20 points) For the following circuit, determine the transfer function and the corresponding impulse response.



4) (20 points) For the following circuit, determine and expression for the output $V_{out}(s)$ in terms of the ZSR and ZIR. Do not assume the initial conditions are zero. Also determine the system transfer function



5) (20 points) Consider the following closed loop system, with plant $G_p(s)$ and controller $G_c(s)$

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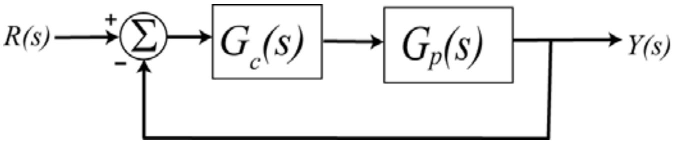

One way to choose the controller is to try and make your closed loop system match a transfer function that you choose (hence the name model matching). Let's assume that our **desired** closed loop transfer function $G_o(s)$, our plant can be written in terms of numerators and denominators as $G_o(s) = \dfrac{N_o(s)}{D_o(s)} \quad G_p(s) = \dfrac{N_p(s)}{D_p(s)}$

Determine an expression for the required controller $G_c(s)$ in terms of $N_o(s), D_o(s), N_p(s), D_p(s)$ For full credit you must simplify your answers as much as possible.

Name ____ Mailbox __________________

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