Name _____ Mailbox _____

ECE-320 Linear Control Systems

Winter 2013, Exam 2

You may only use your computer on the sisotool problem.

You may only use Matlab on this problem.

Problem 1	**_____/25**
Problem 2	**_____/25**
Problem 3-9	**_____/21**
Problem 10	**_____/29**
Total	**_____/100**

Name _____ Mailbox _____

1) (25 points) For impulse response $h(n)=\left(\frac{1}{2}\right)^{n-1}u(n+1)$ and input $x(n)=\left(\frac{1}{4}\right)^{n+1}u(n-1)$, determine the system output by evaluating the convolution sum $y(n)=\sum_{k=-\infty}^{\infty}h(n-k)x(k)$

Note: you do not have to simplify your answer, but you must remove all sums and include a unit step function of some sort.

Name _____ Mailbox _____

2) (25 points) For impulse response $h(n)=\left(\frac{1}{2}\right)^{n-1}u(n)$ and input $x(n)=\left(\frac{1}{3}\right)^{n+1}u(n-1)$,

a) determine the z-transform of $h(n)$, $H(z)$

b) determine the z-transform of $x(n)$, $X(z)$

c) determine $y(n)$

Hint: Assume $Y(z)=z^{-2}G(z)$, determine $g(n)$ and then $y(n)$

Name _____ Mailbox _____

Problem 3-9, 3 points each

3) Is the following system ***controllable***? $G(s) = \dfrac{G_{pf}}{(s - k_1 k_2)^2}$

a) Yes b) No c) impossible to determine

4) Is the following system ***controllable***? $G(s) = \dfrac{8G_{pf}}{s^2 + 12s + (k_1 + k_2 + 20)}$

a) Yes b) No c) impossible to determine

5) Is the following system **controllable**? $G(s) = \dfrac{G_{pf}}{s^2 + (k_2 + k_1 - 1)s + (k_2 + 2)}$

a) Yes b) No c) impossible to determine

6) Consider a plant that is unstable but is a controllable system. Is it possible to use state variable feedback to make this system stable?

a) Yes b) No

7) Is it possible for a system with state variable feedback to change the zeros of the plant (other than by pole-zero cancellation) ?

a) Yes b) No

8) Is it possible for a system with state variable feedback to introduce zeros into the closed loop system?

a) Yes b) No

9) If a plant has *n* poles, then a system with state variable feedback with no pole-zero cancellations will have

a) more than *n* poles b) less than *n* poles c) n poles d) it is not possible to tell

Name _____ Mailbox _____

10) (29 points) ***(sisotool problem)***

Consider the plant

$$G_p(s) = \frac{50}{s^2 + 10s + 100}$$

Design a PID controller using *sisotool* with ***complex conjugate zeros*** so that

$$\begin{aligned} T_s &\leq 2.0\,\text{sec} \\ P.O. &\leq 10\% \end{aligned}$$

In addition, your controller must be designed so that

$$\begin{aligned} k_p &\leq 1.0 \\ k_i &\leq 5 \\ k_d &\leq 0.05 \end{aligned}$$

Write your final values for k_p, k_i, k_d, and the transfer function of the controller in the space below.

Name ______________________________________ Mailbox ____________