EE 380 **EXAM II** **3 November 2011**

Last Name (Print): Solutions

First Name (Print): _____

ID number (Last 4 digits): _____

Section: ___

DO NOT TURN THIS PAGE UNTIL YOU ARE TOLD TO DO SO

Problem	Weight	Score
1	25	
2	25	
3	25	
4	25	
Total	100	

INSTRUCTIONS

1. You have 2 hours to complete this exam.
2. This is a closed book exam. You may use one 8.5" × 11" note sheet.
3. Calculators are allowed.
4. Solve each part of the problem in the space following the question. If you need more space, continue your solution on the reverse side labeling the page with the question number; for example, **Problem 1.2 Continued. NO** credit will be given to solutions that do not meet this requirement.
5. **DO NOT REMOVE ANY PAGES FROM THIS EXAM.** Loose papers will not be accepted and a grade of **ZERO** will be assigned.
6. The quality of your analysis and evaluation is as important as your answers. Your reasoning must be precise and clear; your complete English sentences should convey what you are doing. **To receive credit, you must show your work.**

Problem 1: (25 Points)

1. (13 points) Consider the feedback control system in Figure 1.

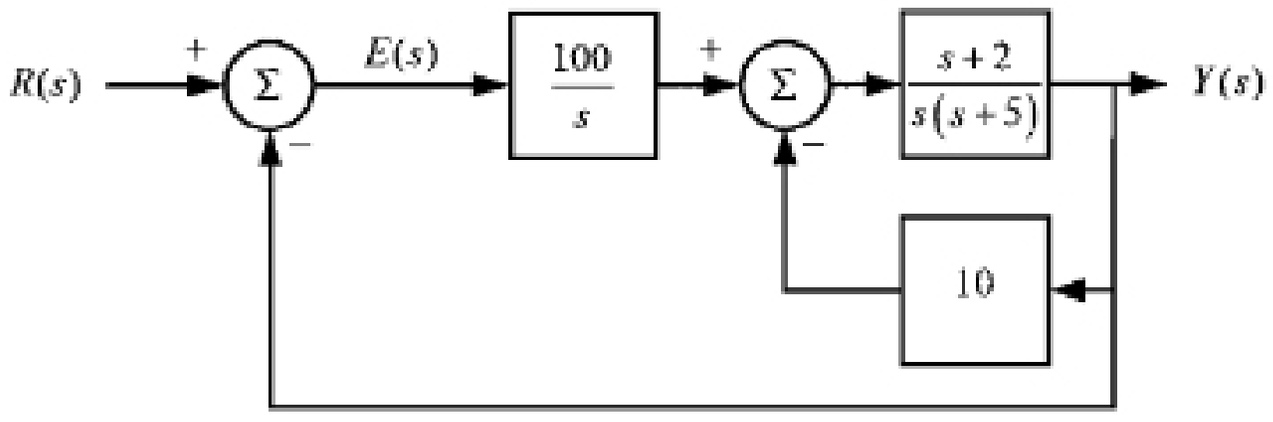
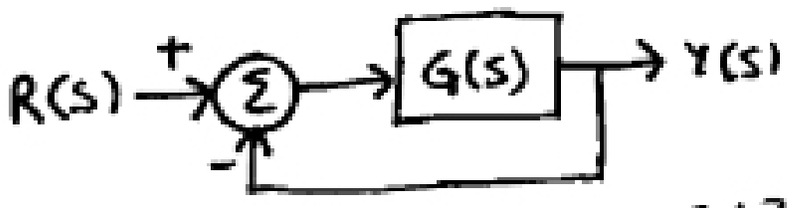


Figure 1: Feedback control system.

(a) (7 points) Determine the system type.



$$G(s) = \frac{\frac{100}{s}\,\frac{\frac{s+2}{s^2+5s}}{1+\frac{10s+20}{s^2+5s}}}{} = \frac{100(s+2)}{s(s^2+15s+20)}$$

Because G(s) has a single pole at the origin the system type is 1.

(b) (3 points) Determine the position, velocity, and acceleration error constants.

$$K_p = \lim_{s\to 0} G(s) = \infty$$

$$K_v = \lim_{s\to 0} sG(s) = \frac{200}{20} = 10$$

$$K_a = \lim_{s\to 0} s^2 G(s) = 0$$

(c) (3 points) For each of the following command inputs, determine the steady-state value of $e(t)$:

- $r_1(t) = 10\, u_o(t)$
- $r_2(t) = 10\, t\, u_o(t)$
- $r_3(t) = 10\, \frac{t^2}{2}\, u_o(t)$.

$r_1(t) = 10\, u_o(t) \rightarrow e_{ss1} = \frac{10}{1 + K_p} = 0$

$r_2(t) = 10\, t\, u_o(t) \rightarrow e_{ss2} = \frac{10}{K_V} = 1$

$r_3(t) = 10\, \frac{t^2}{2} u_o(t) \rightarrow e_{ss3} = \frac{10}{K_A} = \infty$