Lab 4

Procedure:

1.5 points Consider the open-loop transfer function

$$H(s) = \frac{s+2}{(s^2+2s+2)(s^2+2s+10)}$$

(a) Find the maximum gain k_{max} for which closed-loop system $G(s)$ is stable.

(b) Show how different values of the parameter k affects the unit step response of $G(s)$. Comment on the nature of the step response as k increases.

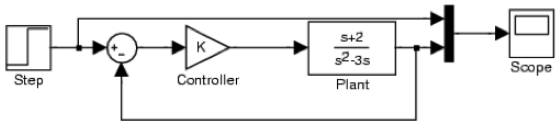
(c) Find the poles of $G(s)$ when $k = k_{max}$. What is the mean of the result?

0.5 points Consider the open-loop system with transfer function

$$H(s) = \frac{s-1}{s^2+2s+17}$$

This system is called non-minimum-phase because it has a zero in the right half plane. This zero will attract a pole in the root locus diagram, and therefore the closed-loop system will become unstable for some value of k. Solve for this value of k. Plot some step responses for k ranging from 0 to the maximum value for stability.

3 points Consider the following system



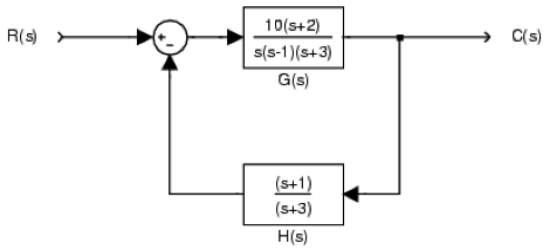
(a) What are the poles and zeroes of the open loop system? Is the open loop system stable? Can the open loop system track a step input? Show the process.

(b) Now with the system in close-loop, replace the variable k with a values in the range $1 \leq k \leq 10$. Show the response of the system. Is the output stable? For what values of k is the system stable? For roughly what value of k is the system completely oscillatory?

(c) Can you make the system stable for all values of K? For what values of K is the system completely oscillatory?For what values of K is the system stable?

(d) Now, change the gain to 8, and replace the step input with a ramp input. Re-run the simulation.

(e) What is the closed-loop transfer function for this system? What is the characteristic equation? What are the locations of the poles (i.e. $s =?$) Leave k as a variable in the characteristic equation and pole locations. Also, evaluate the expression for the pole locations for any value of $k =$unstable, $k =$oscillatory and $k =$stable.



1 point Consider the following system

(a) Find the transfer function of the system. Show the process.

(b) Print the step response, frequency response (specify the gain and phase margins), and root locus for this system.

Note: Remember that the report **MUST** include conclusions.

- Detailed procedure.
- Answer to all questions.
- Send an email with the Notebook that you used.
- Conclusions.
- References.

0.1 References

1. Franklin, Gene F., Powell, David J. and Emami-Naeini Abbas. Feedback Control of Dynamic Systems. 5th Edition. 2006, Prentice-Hall Inc.
2. EE128 Fall 2007 Lab 1 guide. University of California, Bekerly. Online at http://inst.eecs.berkeley.edu/ ee128/fa07
3. Control tutorial for Matlab and Simulink. Online at: http://www.library.cmu.edu/ctms/ctms/basic/basic.htm