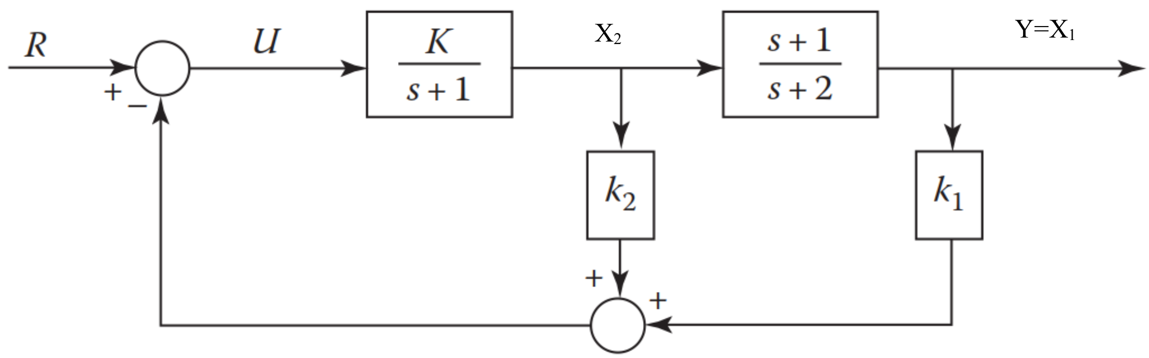
Elec341 - Systems and Control - Project assignment

Part I

A cascade/series block with gain K is inserted before the plant, and a state-feedback control, with parameters k1 and k2, is shown below:

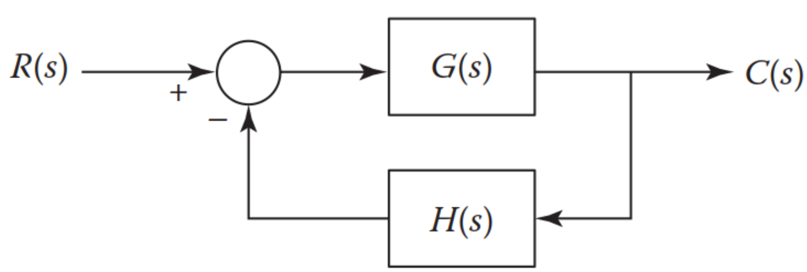


1. Compute (analytically) the closed-loop transfer function Y(s)/R(s)
2. Choose some numerical values for K, k1 and k2. Use Matlab tf() or zpk() to define the blocks used in the system, and for defining the total transfer function T(s)=Y(s)/R(s) . Plot the unit step response of the system (hint: check command step()). Include the Matlab source code and the plot.
3. Determine the condition for the closed-loop system to follow a step input with no steady-state error. Choose test values for k1, k2 and K so that they satisfy the zero steady-state error to an input step condition. Introduce the system in Matlab and plot again the response to the unit step, to compare with the unit response you got in (2) . Include the Matlab code and the plot result in your report.
4. Determine the poles of the closed-loop system. Can the parameters k1 and k2 be used to control the position of the both poles?

Part II

The following non-unity negative feedback system has the forward path gain $G(s)=\dfrac{K_1}{s\left(\dfrac{s^2}{2600}+\dfrac{s}{26}+1\right)}$, with

K1 as gain parameter, and the feedback gain $H(s)=\dfrac{1}{0.04s+1}$



5) compute the closed loop transfer function
6) define the transfer function G(s) and H(s) in Matlab for K1=1. Use model interconnect Matlab functions (series(), parallel(), feedback()) to generate the resulting transfer function. Simulate and plot the unit step response. Include the matlab code and the plots in your report.
7) implement the block diagram in Simulink for the same gain value K1=1. Simulate and plot the unit step response.

Comment the the Matlab vs. Simulink implementations - which one seems easier or more comfortable for you?
8) use Matlab to plot the root locus, and determine the range of values of K1 for which the closed loop system is stable.
9) Find C(s)/R(s) with $\zeta = 0.5$ (normalized damping) for the dominant roots (roots closest to the imaginary axis) - using the interactive root locus graph in Matlab determine the value of K1 for this condition, the values of the dominant roots and of the remaining roots.
10) use Matlab to compute and plot the unit step response of the system for the value of K1 determined in (9)