FACULTY OF ENGINEERING
DEPARTMENT OF ENERGY ENGINEERING

ENE403-Control System Analysis

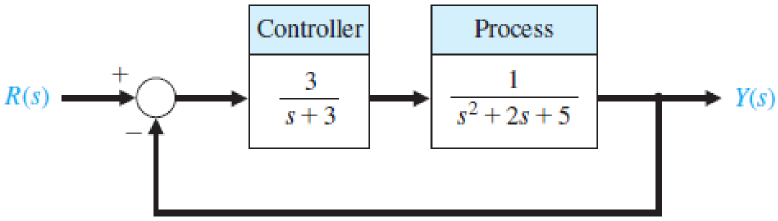
Homework

Deadline:

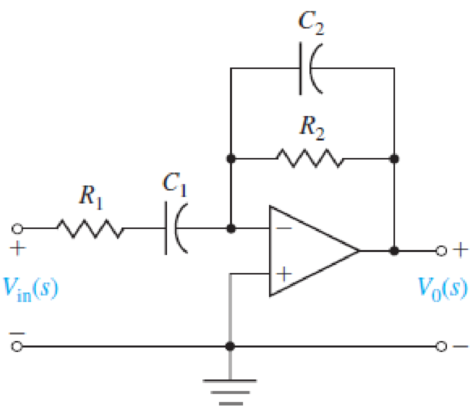
Please use Matlab or Scilab for solve the problems. Submit your homework with source code and plot (if any) of the results. Write your name and the date in the header. Write out the problem number or the problem statement completely, and write your solution below it, leaving space. Clearly indicate where the problem statement ends, and your solution begins. Papers must be stapled (or paper-clipped), nothing loose. Do not tear out pages from a spiral notebook; use clean edged paper. You may consult with your classmates and friends for help on the homeworks, but you may not copy their solutions. You must hand in your own work. You may not show one another your work. Showing one another your work is not discussion/consultation. No late submission, you will get zero grade from homework. You may submit your friend's homework, but late submission will not be accepted.

Use Matlab (or Scilab) to get answers do not solve them on paper!

1.Consider the closed-loop control system in Figure. With the controller and process in state variable form, use the series and feedback functions to compute a closed-loop system representation in state variable form and plot the closed-loop system impulse response.



2. Consider the circuit shown in Figure. Determine the transfer function V0(s)/Vin(s). Assume an ideal op-amp. plot the unit step response with the step function.



3. Consider a unity feedback system with Obtain the step response and determine the percent overshoot. What is the steady-state error?

$$G(s) = \frac{12}{s^2 + 2s + 10}.$$

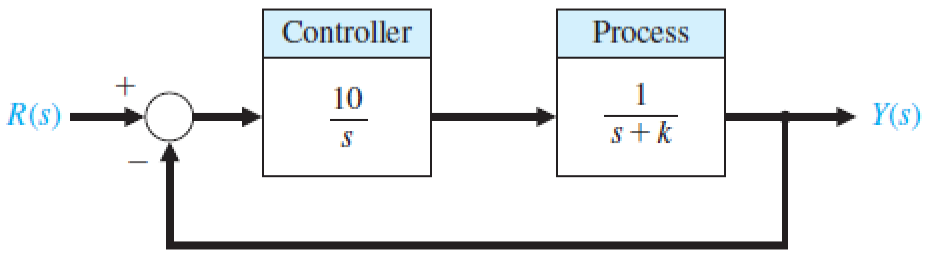
4. Consider the transfer function (without feedback) When the input is a unit step, the desired steady-state value of the output is one. Using the step function, show that the steady-state error to a unit step input is 0.8.

$$G(s) = \frac{4}{s^2 + 2s + 20}.$$

5. Consider the closed-loop transfer function Obtain the family of step responses for K = 10, 200, and 500. Co-plot the responses and develop a table of results that includes the percent overshoot, settling time, and steady-state error.

$$T(s) = \frac{5K}{s^2 + 15s + K}.$$

6. Consider the closed-loop control system shown in Figure. Develop an m-file script to assist in the search for a value of k so that the percent overshoot to a unit step input is P.O. ≤1% but P.O. ≤10%. The script should compute the closed-loop transfer function T(s) = Y(s)/R(s) and generate the step response. Verify graphically that the steady-state error to a unit step input is zero.



7.Consider the nonunity feedback system is depicted in Figure. (a) Determine the closed-loop transfer function T(s) = Y(s)/R(s). (b) For K = 10, 12, and 15, plot the unit step responses. Determine the steady-state errors and the settling times from the plots. For parts (a) and (b), develop an m-file that computes the closed-loop transfer function and generates the plots for varying K.