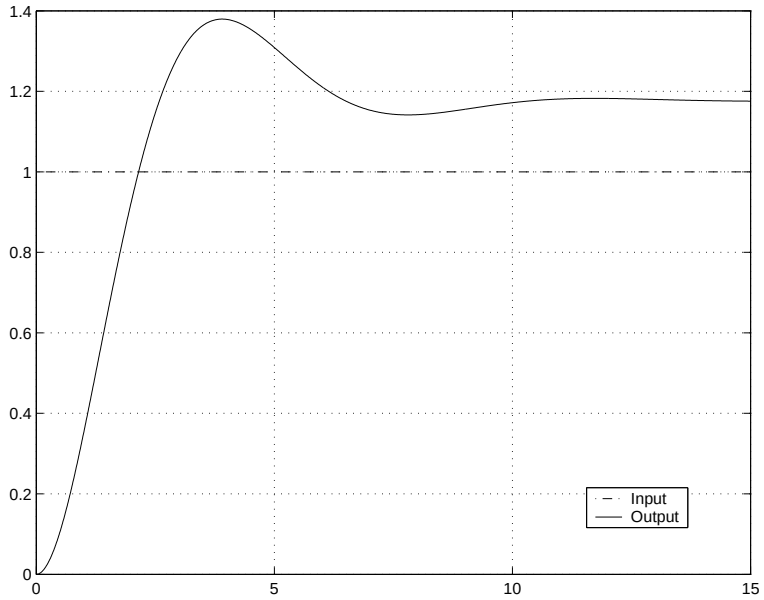
ECE-320 Linear Control Systems
Fall 2004, Exam 1

You must show all work and justify your answers!

1 (15 points) The unit step response of a system is given below.

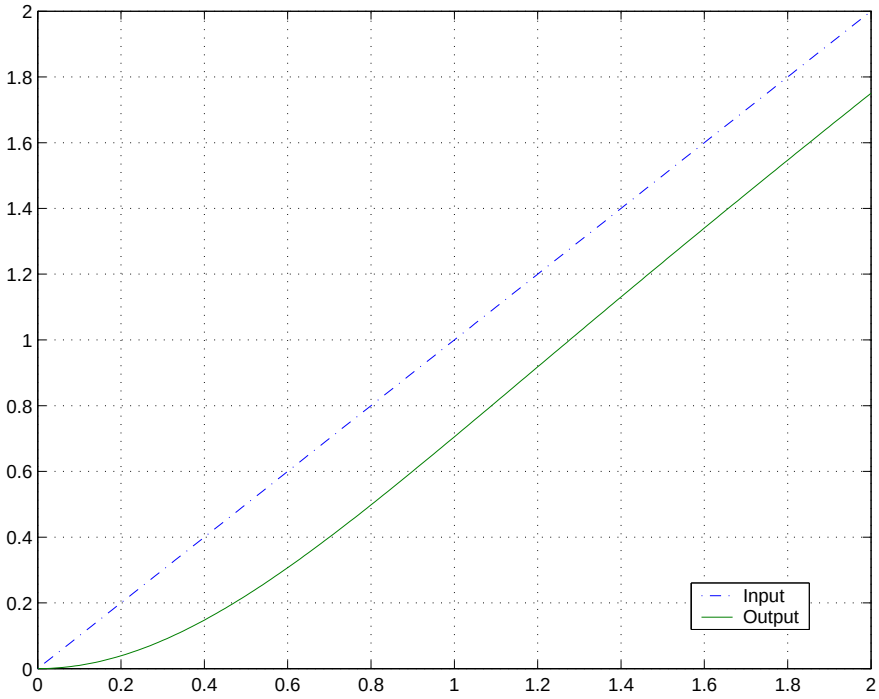


a) Determine the steady state error for this system, and show on the graph this error.

b) Determine the steady state error for a unit ramp input for this system. If you do not have enough information indicate this.

c) Estimate the percent overshoot for this system. (You can leave your answer as a fraction.)

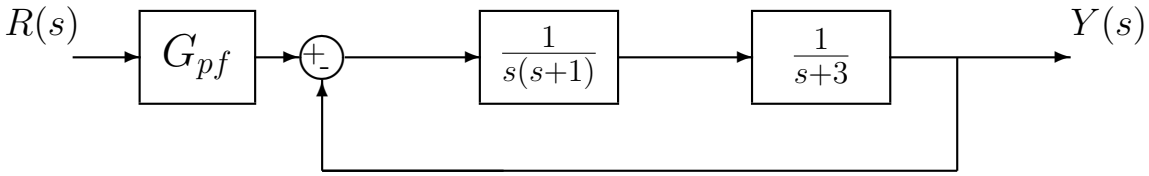
2 (10 points) The unit ramp response for a system is given below (this is not the same system as in problem 1!).

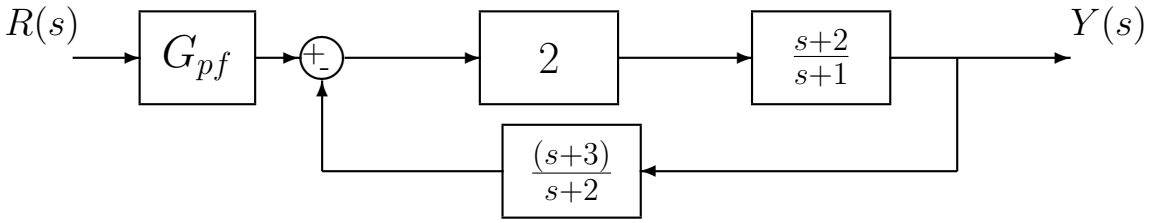


a) Determine the steady state error for this system, and show on the graph this error.

b) Determine the steady state error for a unit step input for this system. If you do not have enough information indicate this.

3 (20 points) For the following systems, determine the values of G_{pf} so the steady state error for a step input is zero.





4 (20 points) For a system with the following transfer function

$$G_0(s) = \frac{1}{(s+4)^2(s+2)(s^2+2s+2)}$$

a) Determine the characteristic equation.

b) Determine the characteristic modes.

c) Determine the form of the impulse response (do not solve for the unknown coefficients!).

d) Is the system stable, unstable, or marginally stable?

e) What is the (2%) settling time of the system?

f) What is/are the dominant poles of the system?

5 (15 points) For a system with plant

$$G_p(s) \;=\; \frac{1}{2s+2}$$

determine the optimal quadratic closed loop transfer function $G_0(s)$ when $q = 12$.

6 (20 points) For the system with the following transfer function

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

a) Determine, using Laplace transforms, the unit step response in the time domain.

b) Determine the steady state error for a unit step input (any method/way you want).