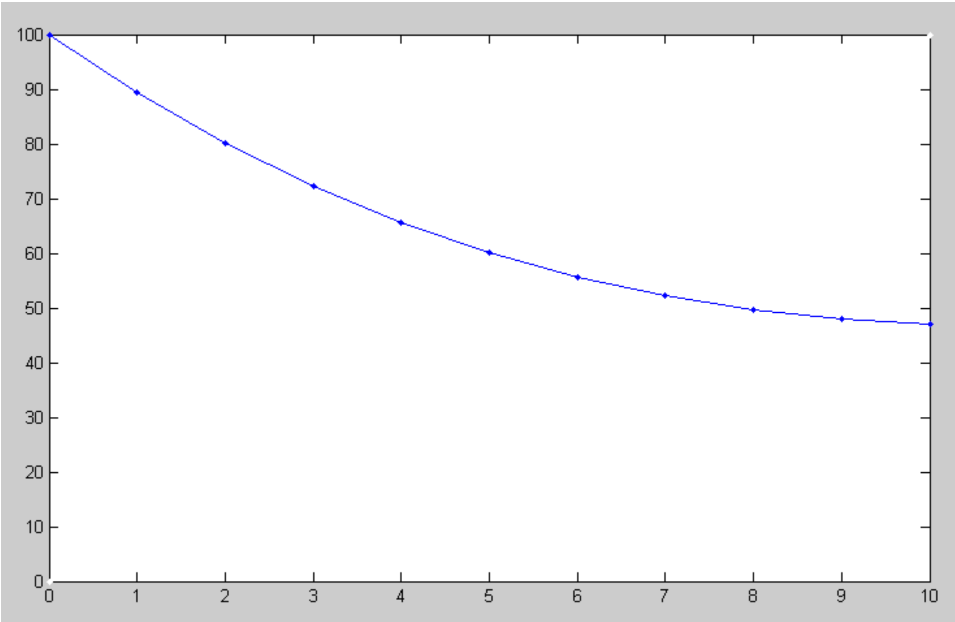
Homework #9: ECE 461

Gain, Lead, PID Compensation. Due Monday, October 30th

A 3rd-order approxiamtion for 10-stage heat equation from homework set #5 is

$$G(s) = \left(\frac{0.2796}{(s+0.195)(s+1.074)(s+2.753)} \right)$$



Problem 1: Assume

$$G(s) = \left(\frac{0.2796}{(s+0.195)(s+1.074)(s+2.753)} \right)$$

a) Design a compensator, K(s), which results in

- No error for a step input
- A 2% settling time of 4 seconds, and
- 20% overshoot for a step input.

b) Find the step response of the closed-loop system using Matlab or VisSim (or similar program)

c) Give a circuit to implement K(s).

Problem 2: A better model includes a delay to approximate the neglected poles. Assume

$$G(s) = \left(\frac{0.2796}{(s+0.195)(s+1.074)(s+2.753)} \right) \cdot e^{-0.65s}$$

a) Design a compensator, K(s), which results in

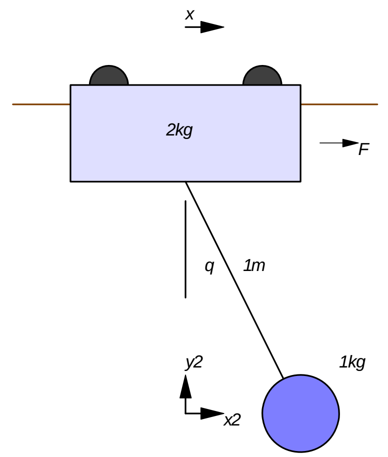
- No error for a step input
- A 2% settling time of 10 seconds, and (change from 4 seconds)
- 20% overshoot for a step input.

b) Find the step response of the closed-loop system using Matlab or VisSim (or similar program)

c) Give a circuit to implement K(s).

Problem 3: A gantry system has the following dynamics:

$$\theta = \left(\frac{0.5}{s^2+14.7}\right)X$$



a) Design a compensator, K(s), which results in

- No error for a step input, and
- A 2% settling time less than 20 seconds

b) Find the step response of the closed-loop system using Matlab or VisSim (or similar program)

Problem 4: The dynamics of an inverted pendulum where the input is the position of the base (X) is

$$\theta = \left(\frac{-1}{(s+3.13)(s-3.13)}\right)X$$

a) Design a compensator, K(s), which results in

- A stable closed-loop system, with
- 20% overshoot for a step input, and
- A 2% settling time less of 4 seconds

b) Find the step response of the closed-loop system using Matlab or VisSim (or similar program)