Homework #8: ECE 461/661

Analog Inputs, PID Compensation, Meeting Design Specs

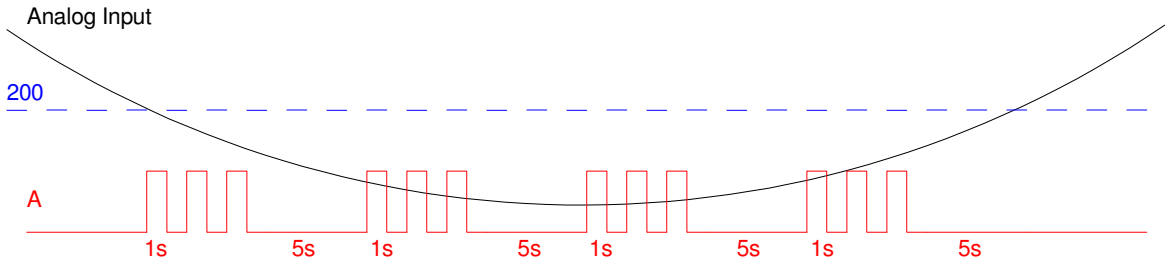
Analog Inputs

Write a ladder-logic program for an irrigation system with an analog input to model a soil-moisture sensor

- If the analog input is more than 200, nothing happens. Soil mosture is high enough.
- If the analog input is less than 200, the soil is too dry. Irrigation A turns on (1s on, 1s off three times)
- It then waits for five seconds.
- If the analog input is still less than 200, the process repeats.

For the analog input

- If using a Micro-810, use the analog inputs (0 = 0V, 1000 = 10V)
- If using PLC-Fiddle, use a number input.



1) Write a ladder logic program using timer blocks to implement this watering system
   - Your pick which program
   - Code Composer Workbench or PLC Fiddle recommended

2) Verify your code's operation
   - Irrigation is off when the analog input is more than 200
   - Irrigation turns on when less than 200

3) Demonstrate your ladder logic program
   - In-person
   - Make a short video
   - Over zoom

Problems 4-9) Assume

$$G(s) = \left(\frac{2}{(s+1)(s+3)(s+7)(s+10)} \right)$$

I Compensation: $K(s) = k\left(\frac{1}{s}\right)$

4) Design an I compensator that results in 20% overshoot for the step response. For this value of k
   - Find the closed-loop poles
   - Plot the step response of the closed-loop system

5) Give an op-amp circuit to implement K(s)

PI Compensation: $K(s) = k\left(\frac{s+b}{s}\right)$

6) Design a PI compensator which results in 20% overshoot for the step response. For this K(s),
   - Find the closed-loop poles
   - Plot the step response of the closed-loop system

7) Give an op-amp circuit to implement K(s)

Meeting Design Specs: $K(s) = any$

8) Design a compensator, K(s), so that the closed-loop system
   - Has no error for a step input,
   - A 2% settling time of 1.5 seconds, and
   - 20% overshoot for the step response.

For this K(s),
   - Find the closed-loop poles
   - Plot the step response of the closed-loop system

9) Give an op-amp circuit to implement K(s)