Homework #5: ECE 461/661

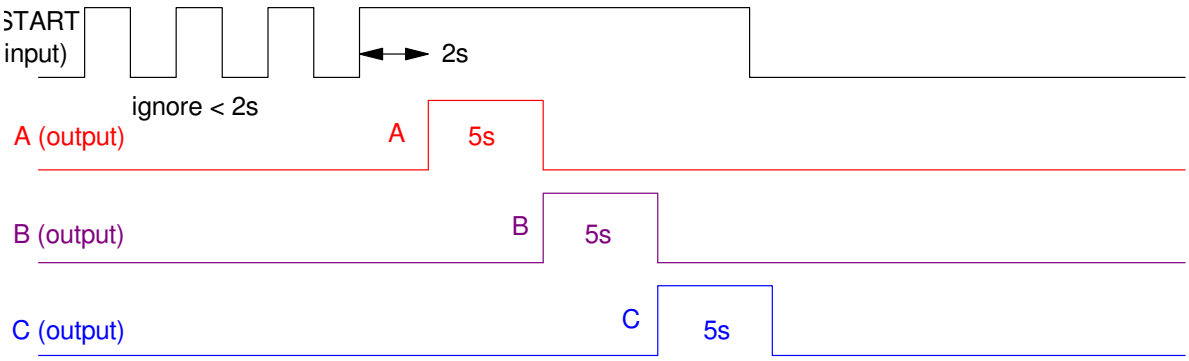
Timer Blocks, Error Constants, and Routh Criteria

Ladder Logic & Timer Blocks

Write a ladder-logic program which uses timer blocks to implement a watering system

- In order to start operation, the START button has to be held down for 2 seconds.
- Once started, sprinkler A turns on for 5 seconds then turns off.
- When A turns off, sprinkler B turns on for 5 seconds then turns off.
- When B turns off, sprinkler C turns on for 5 seconds then turns off.

Once C turns off, the process ends and it waits for the START button to be pressed.



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
   - Button presses less than 2 seconds are ignored
   - Once started, the process continues turning on all three outputs, one at a time

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

Error Constants

4) Determine the system type, the error constants, and the steady-state error for the following systems

G(s)	System Type	Kp	Kv	Steady-State Error for a Step Input
$\left(\frac{10}{(s+3)(s+5)}\right)$				
$\left(\frac{10}{s(s+3)(s+5)}\right)$				
$\left(\frac{10(s+1)}{s^2(s+3)(s+5)}\right)$				
$\left(\frac{10}{(s-1)(s+5)}\right)$				

Routh Criteria

5) Set up a Routh table and determine the range of k that results in a stable system (i.e. a negative definite polynomial)

$$(s+1)(s+3)(s+7)(s+10)+2k=0$$

6) Set up a Routh table and determine the range of k that results in a stable system (i.e. a negative definite polynomial)

$$(s-1)(s+2)(s+5)(s+7)+2(s+1)k=0$$