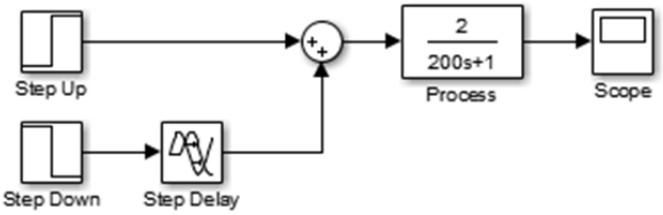
Special Problem 8
ChE 436: Process Dynamics and Control

Purpose: Cause of Oscillations in Control Systems

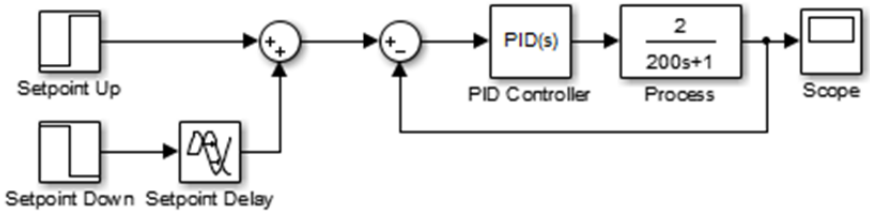
Use a process transfer function in Simulink with $K_p = 2$, $\tau_p = 200$, and $\theta_p = 0$

1. Zero dead time case
   A. Predict the behavior for making a step change in manual mode from 0 to 10 (and back). Then implement it in Simulink with a step input to a transfer function $K_p / (\tau_p s + 1)$



   Explain what happened (offset? oscillations? etc.)

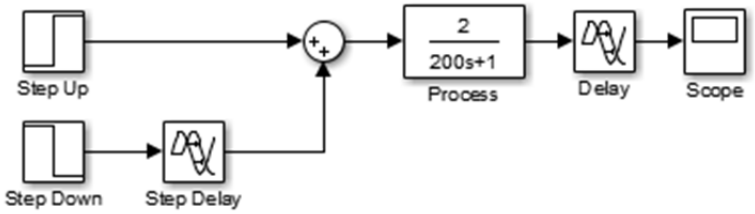
   B. Predict the behavior for using a P-only controller on this system with $K_c = 2$. Then implement the same 0 to 10 (and back) change but in automatic mode (closed-loop) in Simulink and explain what happened.



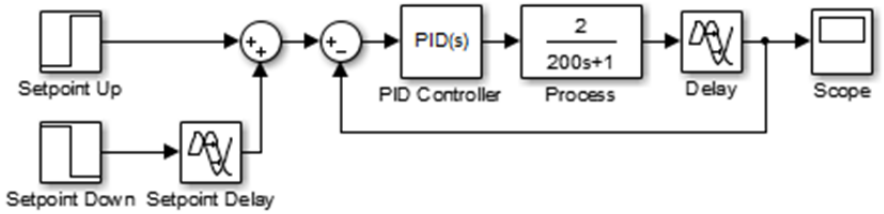
   What happens with increased K_c in terms of offset and oscillation?

   C. Set the controller to PI control, with the controller gain from part B above. Set the reset time (τ_I) as follows and explain what happens and why.
      a. $\tau_I = 200$
      b. $\tau_I = 100$
      c. $\tau_I = 10$

2. Add dead time ($\theta_p = 100$) in Simulink as a transport delay.
   A. Repeat part 1A using this dead time and explain what happens and why.



B. Using P-only control, change the controller gain to (a) K_c = 2 and (b) K_c = 0.5. Explain the results.



C. Using PI control, set τ_I = 200 and explain the results.

3. Summary Questions
   A. Based on the observations in manual mode, is the process stable or unstable
   B. What is the effect of dead time on the control system?
   C. If the process is stable, why can the control system make it unstable?