**Homework – Wall-Following PID**

1. Fill in the blanks (20-points)
2. Adding integral gain improves steady-state accuracy and the expense of \_\_\_\_\_
3. \_\_\_\_\_ gain improves stability at the expense of steady-state accuracy
4. PD gain improves stability \_\_\_\_\_ degrading accuracy much
5. \_\_\_\_\_ improves steady-state accuracy without degrading stability much
6. Type 1 and 2 systems have \_\_\_ error with step response
7. One adds an \_\_\_\_\_ to increase system type
8. One decreases system type by adding a \_\_\_\_\_\_\_\_\_
9. A 10-bit ADC provides decimal values from 0 to \_\_\_\_\_\_
10. \_\_\_\_\_ is the ratio of times when a signal is on and off
11. In DC motors, the back EMF and \_\_\_\_\_ constants are equal
12. Write an NXC program called **wfPidFile1\_0a.nxc** using best practices. The program will save portside-to-wall distance data into a file named “**doma.csv**”. Recall the lab on Wall Following PID; Concept 2 had one capture wall distance data for 4 different proportional gains. Show your NXC code (10-points). You only need to show the code for a single gain case. Generate your own Excel graphs for:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| kP | kI | kD | YouTube URL | Excel Plot |
| 0 | 0 | 0 |  |  |
| 1.5 | 0 | 0 |  |  |
| 5 | 0 | 0 |  |  |
| 15 | 0 | 0 |  |  |

For reference, see the plots in Concept 2 of the lab. Make sure to: (1) title the graph with the correctly (i.e. gain values); (2) label both the horizontal and vertical axes; and (3) add minor gridlines (10-points for each graph; 4 plots total = 40 points). Observe your 4 plots. How does the rise time change and gain kP increases (5-points)? How does the steady-state error change as kP increases (5-points)? Grand total: 10+4\*10+5+5 = 60-points

1. Given below is a typical block diagram of a PID system.



Derive to show that the closed-loop transfer is given by (10-points)

1. Recall that the Final Value Theorem states that. Also, recall that the general form of an open-loop transfer function with is given by



Derive to show that for proportional-only control that a Type 1 system response to a step input is (10-points)