MECHTRON 4AA4

Lab #5 – L03

SUBMITTED BY:
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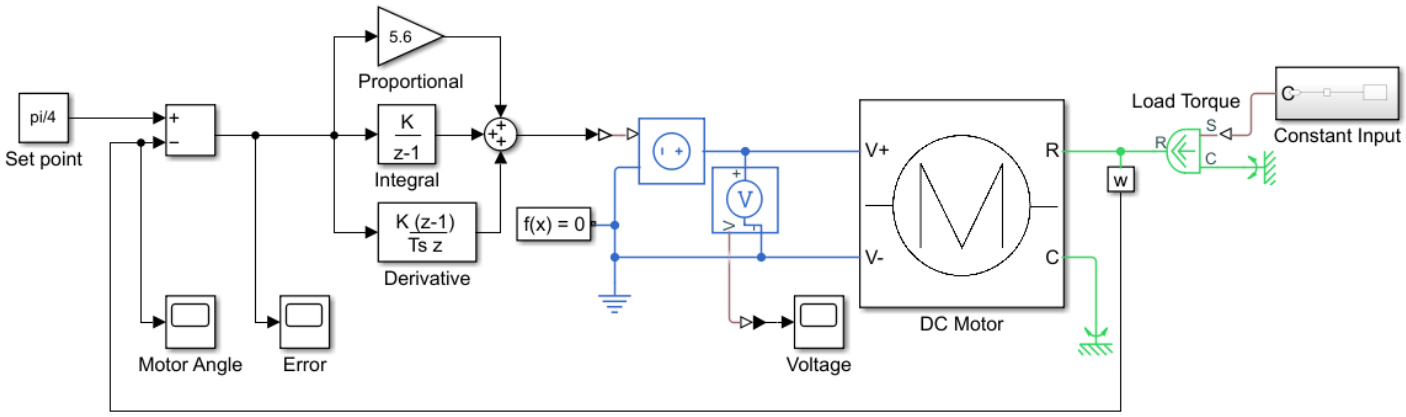
Part 1: Schematic of completed PID controller:



Part 2: Table of Kp, Ki, Kd with overshooting and final value:

#	K_p	K_i	K_d	Overshoot Value	Overshoot Percent [%] (approx.)	Final Value (Steady State Value) at 0.1 second	Stable (Yes/No)
1	**5**	0.0000001	0	1.1700	80.91	0.6536	Yes
2	**5**	0.0001	0	1.1710	80.91	0.6544	Yes
3	**5**	0.01	0	1.2070	65.83	0.7633	Yes
4	**5**	0.1	0	-	-	-	No
5	**9.5**	0.1	0	1.4430	195.60	0.7856	Yes
6	**5**	0.2	0.01	0.8521	8.15	0.7847	Yes
7	**5.5**	0.25	0.02	0.7949	1.53	0.7864	Yes
8	**5.6**	0.275	0.025	0.8080	2.58	0.7848	Yes

Part 3: Final Motor Angle Result:

Final K values used:

K_p	K_i	K_d
5.6	0.275	0.025

Motor Angle plot shown below:

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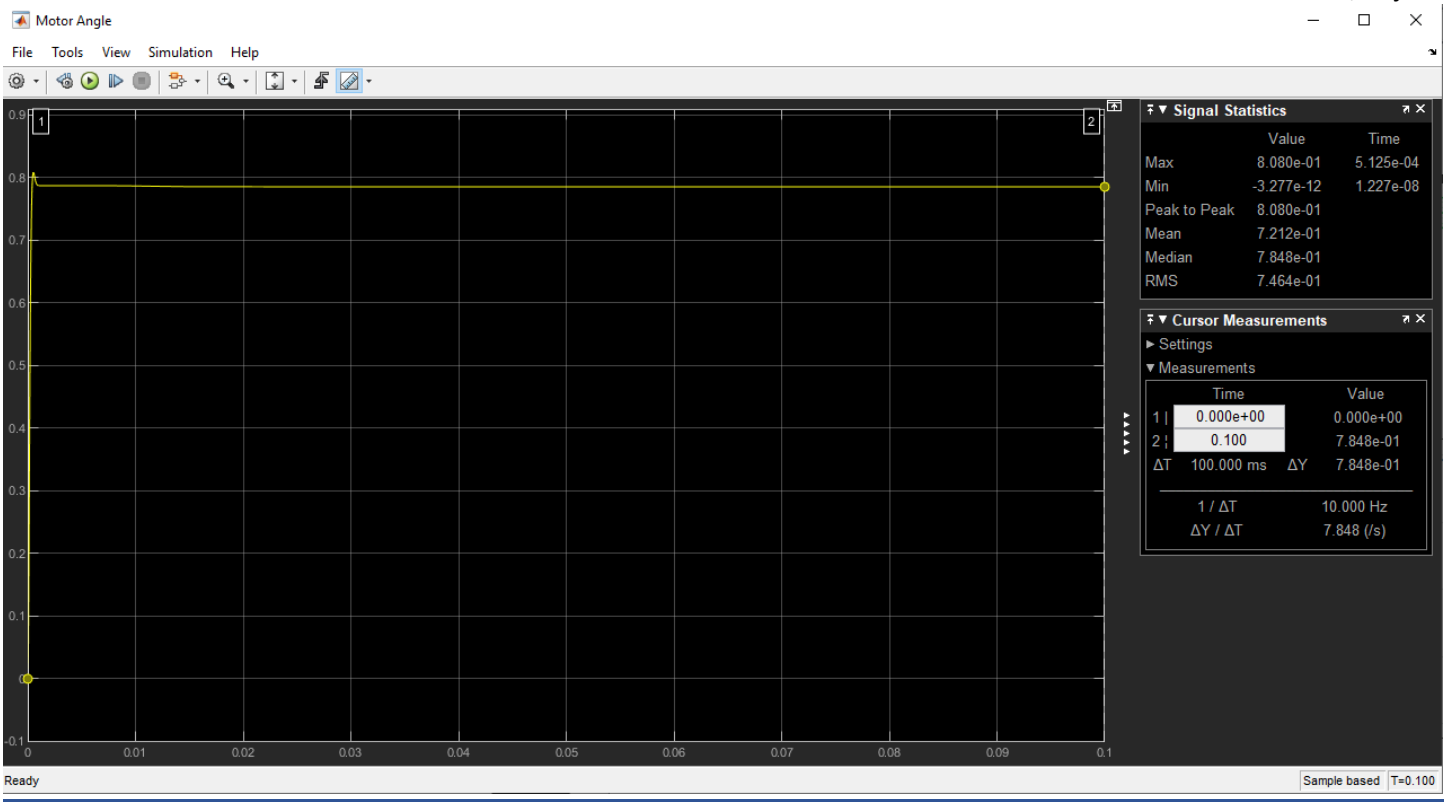

Part 3: Explanation:

#	K_p	K_i	K_d	Explanation
1	**5**	0.0000001	0	With the given default values, the system had steady state error due to the condition of DC gain being equal to zero. Here, integrator value has negligible effect as its value is too small. Only K_p,value influences the system.
2	**5**	0.0001	0	Purpose of adding an integral gain is to diminish the steady state error. However, integral gain value can negatively affect the overshoot percentage. At this integral gain level, system is indistinguishable from system in #1.
3	**5**	0.01	0	With a relatively large value of K_i (in comparison to #1), we start to witness reduction in steady state error. As can be seen from the previous table, this level of integral value significantly improves the steady state error. Care should be taken to as we feed the error value to the system because it negatively affects other performance parameters such as overshoot percent and settling time.
4	**5**	0.1	0	This integral value makes the system unstable because of the integral operation of large error values as the gain is high in this case.
5	**9.5**	0.1	0	In this case, system can be pushed to stability at 0.1 integral gain by raising the K_p value.
6	**5**	0.2	0.01	Adding a derivative also improves the stability factor as integrals' pole affect is canceled by the derivatives' zero if they are close to one another. In this case, derivative gain offers positive change in the system's transient behavior i.e., rising time is improved.
7	**5.5**	0.25	0.02	Now, the proportional, integral and derivative gains bring the system to acceptable conditions by improving settling time, overshoot, and rising time values.

8	**5.6**	0.275	0.025	These values give desired outcome; however, these gain values are not unique.

In essence,

P works on the present value of the system,

I deals with the past error values of the system, and

D predicts the future of the system.