Problem 2a

Kp = 5

Diagram

Description automatically generated

Kp = 15

Diagram

Description automatically generated

Kp = 50

Diagram

Description automatically generated

Here we see that the proportional control is not sufficient to have h stabilize and instead it continuously oscillates around the set point.

Problem 2b

Diagram

Description automatically generated

We can see that the system is underdamped here as h overshoots the setpoint before stabilizing. But because we did add the differential portion of control we do see some stabilization.

Problem 2c

Diagram

Description automatically generated

Here we again see that the system eventually stabilized but is overdamped as h gradually approaches the set point.

Problem 2d

Without Ki:

Diagram

Description automatically generated with medium confidence

With Ki:

Diagram

Description automatically generated

Here the function without Ki given some improper assumption for u shows that the control for the system can become greatly skewed. Thus, in order to resolve issues where uncertainty is a factor the integral part helps mediate this and allow for stabilization.

Problem 3k

Lyapunav:

Chart

Description automatically generated

Code: Graphical user interface, text, application, email

Description automatically generated

Indicator:

Chart

Description automatically generated

Code:Graphical user interface, text, application, email

Description automatically generated