Laboratory Assignment 1

PID Control Through Simulations

A SISO process model is given to you. Develop a Simulink simulation to control the output using a standard PID controller.

P Control

Take a P controller and obtain the closed loop response as the controller gain, K_C, is increased from low to large values. Plot the closed loop servo response for appropriately chosen K_C values on the same plot for an at-a-glance appreciation of the effect of K_C on the closed loop dynamic response.

Obtain the P controller gain, $K_C = K_U$, that results in sustained oscillations. Note the period of sustained oscillations, P_U. Adjust K_C for a 5% overshoot. This is the recommended tuning of the P controller.

PI Control

Now lets obtain the response of a PI controller. Set $K_C = K_U/2.5$. Obtain the closed loop servo response as the integral time (τ_I) is reduced from very large values (say 10 P_U) to small values (say 0.1 P_U). Plot the servo response for appropriately chosen τ_I values on the same plot for an at-a-glance appreciation of the effect of τ_I on the closed loop dynamic response.

Now set $\tau_I = P_U$ and adjust K_C for a closed loop response with 5% overshoot. This is the recommended tuning of the PI controller.

PID Control

Now lets obtain the servo response for PID control. Set $\tau_I = P_U$. Vary τ_D from $0P_U$ till $0.5P_U$ in small steps. At each value of τ_D, adjust K_C for a servo response with 5% overshoot. Plot the variation of the obtained K_C with τ_D. From the plot, obtain the value of τ_D that maximizes K_C. This is the recommended tuning of the PID controller.

Plot the servo and regulator responses for the recommended tuning of the P, PI and PID controllers. The servo responses should be on a single plot and the regulator responses should be on another single plot. Comment on the quality of the responses.

You can also tune the controllers using the Zeigler Nichols (ZN) or Tyreus Luyben (TL) tuning, which express K_C in terms of K_U, and τ_I and τ_D in terms of P_U. Compare the servo and regulator responses for P, PI and PID controllers with ZN or TL tuning.

Submit a short and crisp report on the above exercise.

Note: The plots should be for the output and also for the input.