

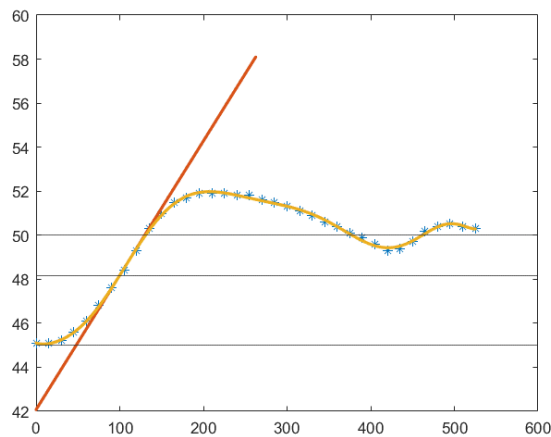
Dynamics of thermal systems under P/PI/PID control, as studied on Siemens SCADA

TIME CONSTANT AND DELAY OF THERMAL SYSTEM

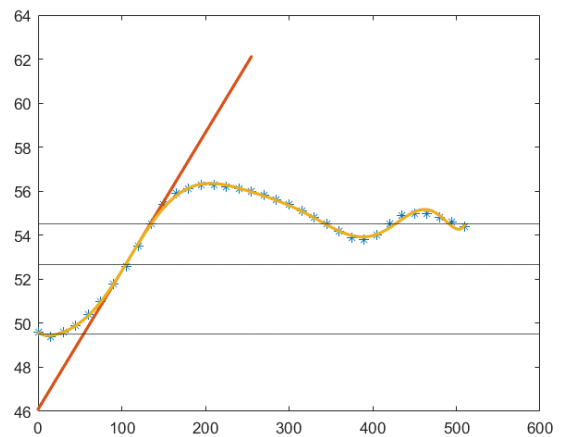
Since the system was in closed loop with a PID controller therefore to find out system's time constant and delay, K_p was kept to be at minimum as well as T_i and T_d for the PID were given values to make subsequent terms zero.

The value of K_p used was 0.1 and 0.3 and required values were obtained from solving the closed loop system formed. The time at which the variable reaches 63.2% of Set Value gives the value for time constant and with a tangent drawn at maximum slope we can get the value of T_d (delay).

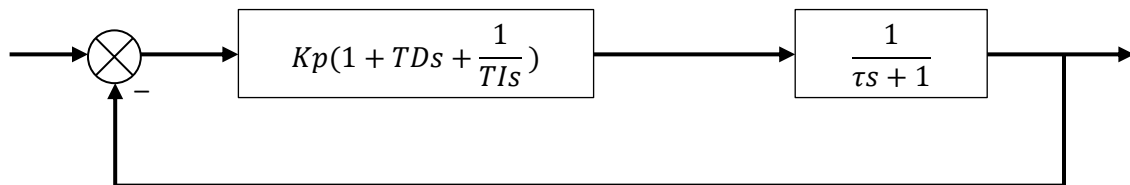
Time response of the thermal system for different K_p 's



$K_p = 0.1$



$K_p = 0.3$



Block Diagram of Thermal Heater operated in a closed loop

Solving this transfer function as per required values of K_p , T_i and T_d and comparing with the experimental values gives the values as tabulated below:

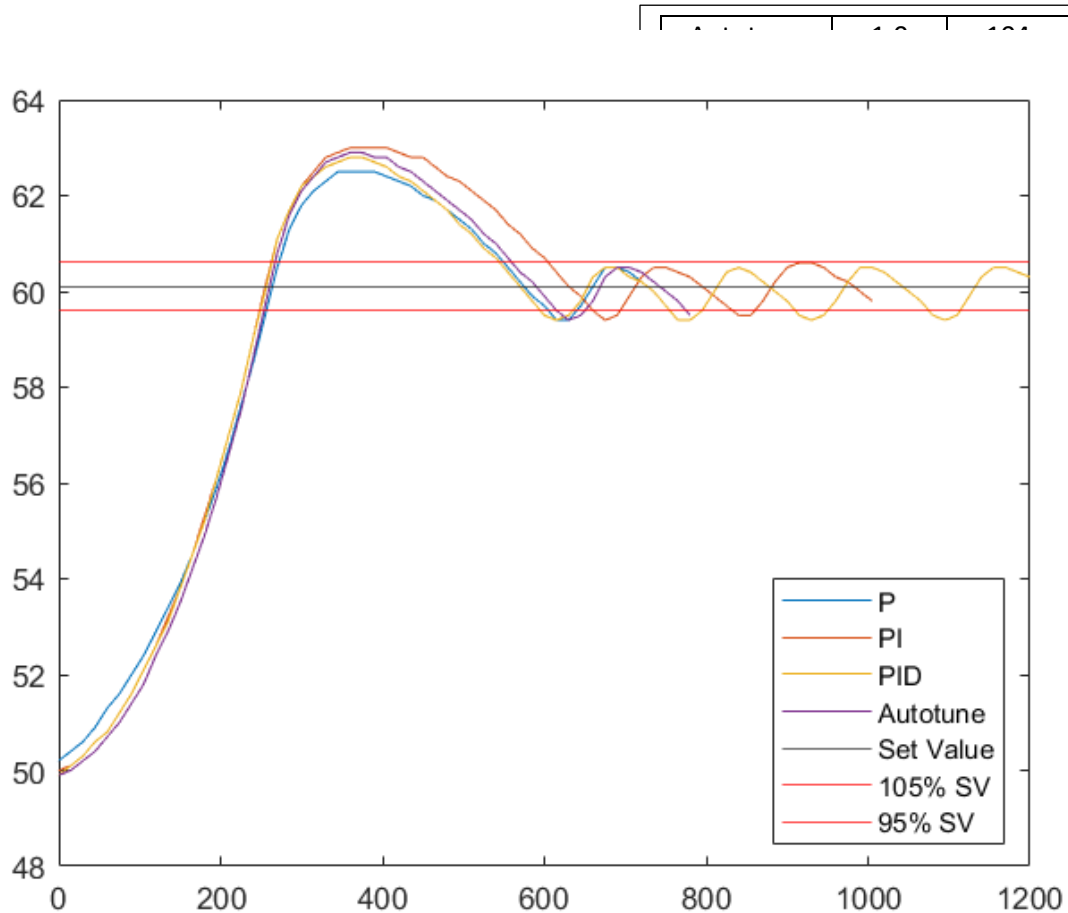
K_p	T_d (Delay)	T (Time constant)
0.1	48 sec	56.87 sec
0.3	54.3 sec	65.39 sec

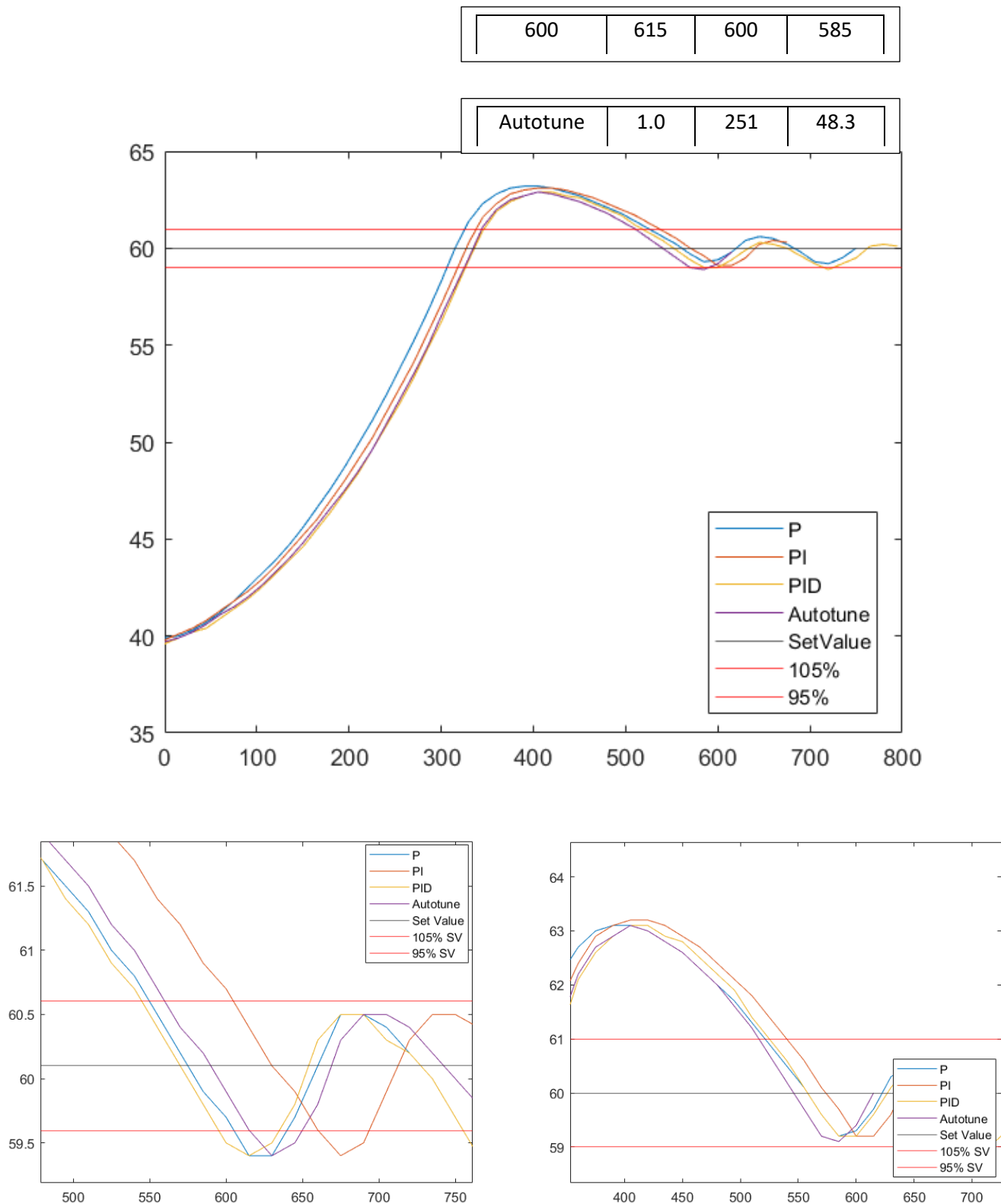
Averaging out the values results in $T_d = 51.15\text{sec}$ and $T = 61.13\text{ sec}$.

P, PI AND PID CONTROLLER SETTINGS USING ZIEGLER NICHOLAS RULES

The values for the K_p , T_I and T_D were calculated using ZN rules. The values are tabulated below. Apart from that the autotune values for PID are included as well.

	K_p	T_I	T_D				
P	1.2	∞	0				
PI	1.1	169	0				
PID	1.4	102		605	660	595	615





As could be seen in the time response of the thermal system, it is not much susceptible to the control settings. However, it is worth mentioning that PI controller shows the highest overshoot and has the highest settling time. As for others, P controller has the smallest overshoot.

As well as the decay of Temperature is slowest in PI therefore affects the settling time directly. Followed by Autotuned controller with P and PI only with a slightly better performance.

The settling error remains constant for all the controllers while lies in a range close to 5% of Set Value.

One of the reasons could be the way the thermal system cools down as its control is no