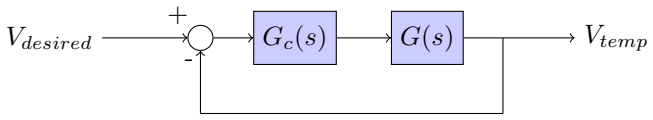
EEE 151 Experiment 2: Feedback Implementation and Error Signals

At the end of this exercise, each student must have been able to model a closed-loop system of the plant developed in experiment 1. Each group must also be able to observe the error response to variable controller values. Consider ambient temperature to be 27° C.

Part 1: Closing the loop

1. With the original circuit from experiment 1 as the plant, with modelled transfer function, $G(s)$, implement it in a closed loop system as shown below



2. $V_{desired} = 0.8 * (VTemp_{max})$, where $VTemp_{max}$ is the steady state condition reached in the experiment 1 data. The system, therefore, aims to regulate the bulb temperature to this $V_{desired}$ value.
3. The summing block is a difference amplifier circuit with unity gain.
4. $G_c(s)$ is a controller whose configuration will be varied throughout the experiment.
5. The experimental data gathered has been provided in the second data set.

Part 2: Proportional Controllers

1. Proportional controllers with values $k_p = 1, 2, 5$ are used and their respective data have been recorded in the first 3 columns of the data set.
2. Investigate the behavior of each of the proportional controllers.
3. For each of the controller variations, plot temperature vs. timeand Δtemp vs. time.
4. Take note of and record the steady-state error observed.

Part 3: Integral Controller

1. Finally, an integral controller with gain, $K_i = 1$, is implemented. The corresponding data set demonstrating the behavior of the system with it is in the 4th column of the data provided.
2. Investigate the behavior of the integral controller.
3. Plot temperature vs. time. Plot Δtemp vs. time.
4. Record the steady-state error observed.
5. Make a comparison of the steady-state errors from Parts 2 and 3. Make your conclusions.

Additional Requirements for the Lab Report

1. Plot the error results of the Proportional controllers in one graph. Make sure each plot is easily distinguished from the others.
2. Plot the error results of the Integral controller.
3. For the integral controller, solve for the theoretical error response, indicating pertinent values of the system. Plot this response against the actual results.
4. Make a theoretical analysis of the experiment using the model you derived in experiment 1. Clearly show your analysis.
5. What are your step responses? Plot them.
6. Compare your analytical results withthe data gathered from the experiment.
7. Include all other answers obtained in Parts 2 and 3.
8. Include schematics of the circuits implemented.

Important Note

Cheating will not be tolerated. Note that copying any part of another student's work is considered cheating.