CE-103 Thermal Process Control- Problem Statement

CE103 Thermal Process Control Apparatus models the industrial situation commonly found in air conditioning plant where temperature control is achieved through a combination of either,

1. Varying the heat energy input to the system
2. Varying the speed of a circulating fan
3. Restricting the actual flow channel using a remotely controlled vane mounted in the flow path
4. Any combination of a, b or c.

Read chapter 1 and section 2.2.1 to 2.2.4 before starting the experiment.

System Identification and modelling

1. To familiarize with the thermal system.

   The objective of this experiment is to familiarize with the various controllers and the outputs on the thermal process control apparatus CE103.

   Connect the system so that the heater, fan and shutter can be supplies a voltage of 0 and +10V.

   - Monitor the input voltage of the heater using digital voltmeter.
   - Observe the operation of the fan as the input voltage is changed.
   - Calibrate the shutter position with the input voltage.

2. Determine the transfer function

   The system is connected so that the heater is supplied with a voltage between 0 and +10V. Set the fan and shutter voltage to some value as shown in the table. Give the heater the input voltage of 4V and let it stabilize for some time (5-7min) and then give a +1V step input to the heater. Now using CRO observe the temp output parameters T1 and T2 with respect to time. Repeat above process with different values of fan and shutter as shown in table and save the step response for every give step input.

From the plots find the DC gain and time constant of the system, with respect to T1 and T2 and generate the two transfer functions for T1 and T2.
Comment on the difference between the two transfer functions.

(Caution: Have patience, the process is very slow. For each reading it takes approximately 10 min or even more.)

Table:

Heater input (step)	Fan input (V)	Shutter input (V)	Temp diff (Δt1)	DC gain (k1)	Time constant (τ 1)	Temp diff (Δt2)	DC gain (k2)	Time constant (τ 2)
1, 5, 9	1	1						
1, 5, 9		5						
1, 5, 9		9						
1, 5, 9	1	1						
1, 5, 9		5						
1, 5, 9		9						
1, 5, 9	1	1						
1, 5, 9		5						
1, 5, 9		9						

3. Matlab Simulation

Using the above transfer functions and the MATLAB/SIMULINK, generate the simulated response of the system to the inputs given in the experiment and compare the two. Also, tune the DC gain and the constants so that differences between the simulated and the actual time responses are minimized.