**BỘ GIÁO DỤC & ĐÀO TẠO**

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**WEEKLY’S REPORT**

**TOPIC: SIMULATION OF FUZZY CONTROLLER**

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Table of content

[1. Temperature controlling 4](#_Toc99319174)

[1.1 Requirement 4](#_Toc99319175)

[1.2 Solution 4](#_Toc99319176)

[2. Controling the DC motor speed 7](#_Toc99319177)

[2.1 Creating the fuzzy system 7](#_Toc99319178)

[2.1.1 Choose K3=240, K2=0. Vary K1 then survey the POT, settlling time, rise time and steady state error. 9](#_Toc99319179)

[2.1.2 Choose K3=240, K1=1/100. Vary K2 then survey the POT, settlling time, rise time and steady state error. 11](#_Toc99319180)

[2.1.3 Comment about the parameter K1 and K2 13](#_Toc99319181)

[3. Exercise 13](#_Toc99319182)

**Table’s of figure**

[Figure 1: Fuzzy logic controller system 5](#_Toc99318802)

[Figure 2: Input Ti 5](#_Toc99318803)

[Figure 3: Input To 6](#_Toc99318804)

[Figure 4: Output Fan speed 6](#_Toc99318805)

[Figure 5: Block diagram of controling the fan speed using fuzzy control 7](#_Toc99318806)

[Figure 6: Result of the fan speed 7](#_Toc99318807)

[Figure 7: Block diagram of the DC motor using fuzzy control to control 8](#_Toc99318808)

[Figure 8: Input Error 8](#_Toc99318809)

[Figure 9: Input Speed error 8](#_Toc99318810)

[Figure 10: Output U 9](#_Toc99318811)

[Figure 11: Block diagram of an DC motor using fuzzy control 9](#_Toc99318812)

[Figure 12: Output of the system when K1 vary 10](#_Toc99318813)

[Figure 13: Output at K1 when K1 vary 10](#_Toc99318814)

[Figure 14: Error when K1 vary 10](#_Toc99318815)

[Figure 15: Control signal when K1 vary 11](#_Toc99318816)

[Figure 16: Output at K2 when K1 vary 11](#_Toc99318817)

[Figure 17: Block diagram of DC motor when K2 vary 11](#_Toc99318818)

[Figure 18: Output when K2 vary 12](#_Toc99318819)

[Figure 19: Control signal when K2 vary 12](#_Toc99318820)

[Figure 20: Error when k2 vary 12](#_Toc99318821)

[Figure 21: Output K2 12](#_Toc99318822)

[Figure 22: Fuzzy Logic Controller for heat furnace 14](#_Toc99318823)

[Figure 23: Input Error 14](#_Toc99318824)

[Figure 24: Input Error over time 15](#_Toc99318825)

[Figure 25: Output temperature 15](#_Toc99318826)

[Figure 26: Heat furnace graph 16](#_Toc99318827)

# Temperature controlling

## Requirement

To automatically control the air conditioner temperature using fuzzy logic, we used 2 sensor: In the room is a tempature sensor Ti and outside is a temperature sensor To. It will control the room temperature by controlling the fan speed. It given that:

- Temperature: [0oC – 50oC].

- Fan speed: v ∈ [0 – 600 vòng/phút].

- v: {Zero, Slow, Average, Fast, Max) corresponding with{0, 150, 300, 450, 600 rpm}

- Using input variable: Ti, To: {Very cold, Cold, Warm, Hot, Very hot} with the corresponding temperature{15,20,25,30,35}.

- Fan speed: {Zero, Slow, Average, Fast, Max}

Calculate the speed of the fan when: Ti=27oC ; To=32oC

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| To  Ti | Very cold | Cold | Warm | Hot | Very hot |
| Very cold | Zero | Zero | Zero | Slow | Average |
| Cold | Zero | Slow | Slow | Average | Fast |
| Warm | Zero | Slow | Average | Fast | Max |
| Hot | Slow | Average | Fast | Fast | Max |
| Very hot | Average | Fast | Max | Max | Max |

## Solution

Create a fuzzy system that control the speed of the fan with input is the room temperature and the temperature outside and output is the fan speed.

Graphical user interface

Description automatically generated

Figure : Fuzzy logic controller system

* After that, we create the membership function for the 5 cases.

Graphical user interface

Description automatically generated

Figure : Input Ti

Graphical user interface, application

Description automatically generated

Figure : Input To

* Then we create the output Fan\_speed.

Graphical user interface

Description automatically generated

Figure : Output Fan speed

Creating the model in simulink:

Diagram

Description automatically generated

Figure : Block diagram of controling the fan speed using fuzzy control

A screenshot of a computer

Description automatically generated

Figure : Result of the fan speed

* Fan speed: 510 rpm

# Controling the DC motor speed

## Creating the fuzzy system

DC motor’s transfer function with no-load:



Motor with 3.7kW, 240V, 1750 rpm, parameter of the motor:

**

Diagram

Description automatically generated

Figure : Block diagram of the DC motor using fuzzy control to control

Input of the error:

Graphical user interface

Description automatically generated

Figure : Input Error

Graphical user interface

Description automatically generated

Figure : Input Speed error

Graphical user interface

Description automatically generated

Figure : Output U

Fuzzy rule’s:

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| U(t) | | DE(t) | | | | |
| NB | NS | Z | PS | PB |
| E(t) | NB | NB | NB | NS | NS | Z |
| NS | NB | NS | NS | Z | PS |
| Z | NS | NS | Z | PS | PS |
| PS | NS | Z | PS | PS | PB |
| PB | Z | PS | PS | PB | PB |

### Choose K3=240, K2=0. Vary K1 then survey the POT, settlling time, rise time and steady state error.

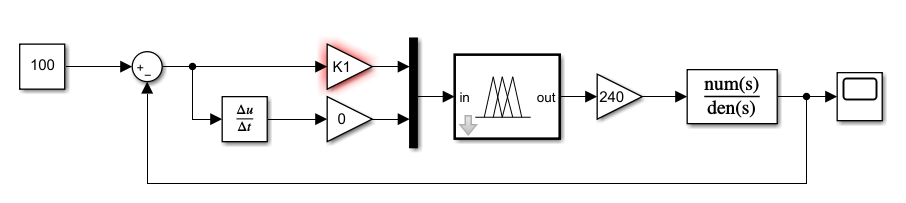


Figure : Block diagram of an DC motor using fuzzy control

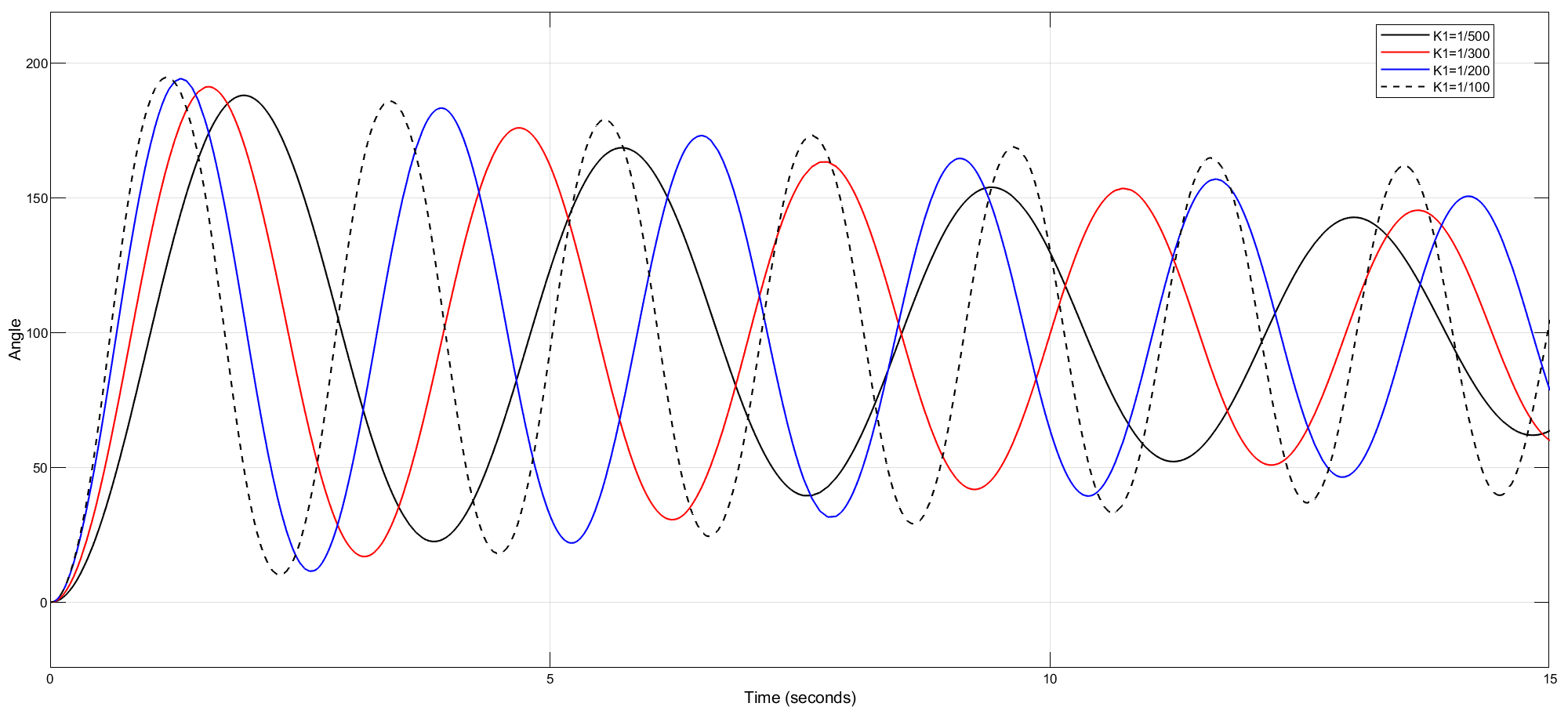


Figure : Output of the system when K1 vary

Chart, line chart

Description automatically generated

Figure :Output at K1 when K1 vary

Chart, line chart

Description automatically generated

Figure : Error when K1 vary

Chart

Description automatically generated

Figure : Control signal when K1 vary

Table

Description automatically generated with medium confidence

Figure : Output at K2 when K1 vary

After simulation, the resulting output:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| K1 | 1/500 | 1/300 | 1/200 | 1/100 |
| POT(%) | 88 | 91.13 | 94.26 | 94.88 |
| Ess | 0 | 0 | 0 | 0 |
| Tr | 0.626 | 0.528 | 0.52 | 0.451 |
| Tss | 102.3 | 102.29 | 102.27 | - |

### Choose K3=240, K1=1/100. Vary K2 then survey the POT, settlling time, rise time and steady state error.

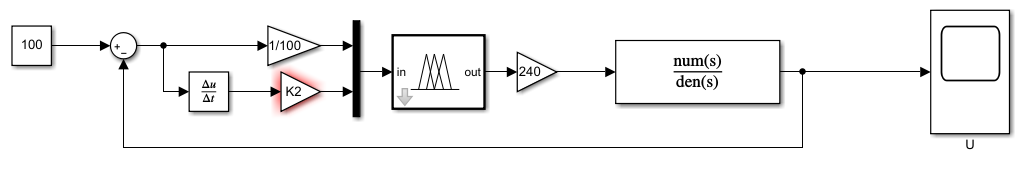


Figure : Block diagram of DC motor when K2 vary

Chart

Description automatically generated

Figure : Output when K2 vary

Chart, scatter chart

Description automatically generated

Figure : Control signal when K2 vary

Chart, scatter chart

Description automatically generated

Figure : Error when K2 vary

Chart

Description automatically generated

Figure : Output K2 when K2 vary

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| K2 | 1/300 | 1/200 | 1/100 | 1/50 |
| POT | 13 | 0.5 | 0 | 0 |
| Ess | 0 | 0 | 0 | 0 |
| Tr | 0.556 | 0.79 | 1.967 | 4.31 |
| Tss | 1.986 | 1.277 | 1.592 | 3.2 |

### Comment about the parameter K1 and K2

Parameter K1 is used to adjust the scale stitch. When increasing K1, the system will increase the overshoot, the rise time will decrease, the setting time will change slightly and the setting error will decrease.

Parameter K2 is used to adjust the system integral to increase overshoot, rise and fall time, constant steady-state error, and increase steady-state time.

# Exercise

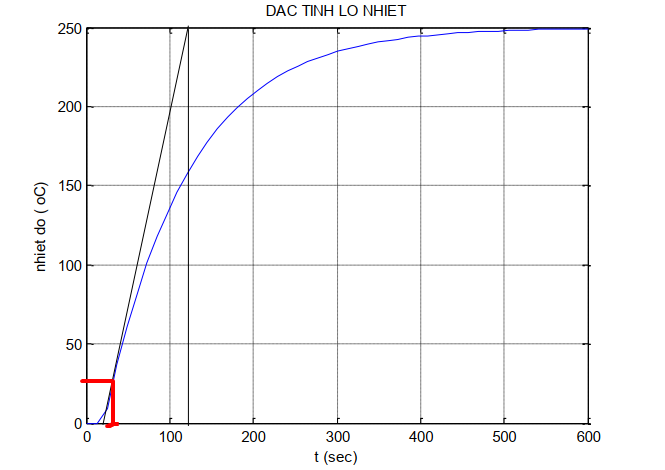


Figure : Characteristic of the heat furncace

With:

* T1 is a delay time
* T2 is a consant time
* T1=30
* T2=120

We have the transfer function:

|  |  |
| --- | --- |
|  | (0.2) |

Given:

Input is a step unit

Output is temperature of the heat furnace

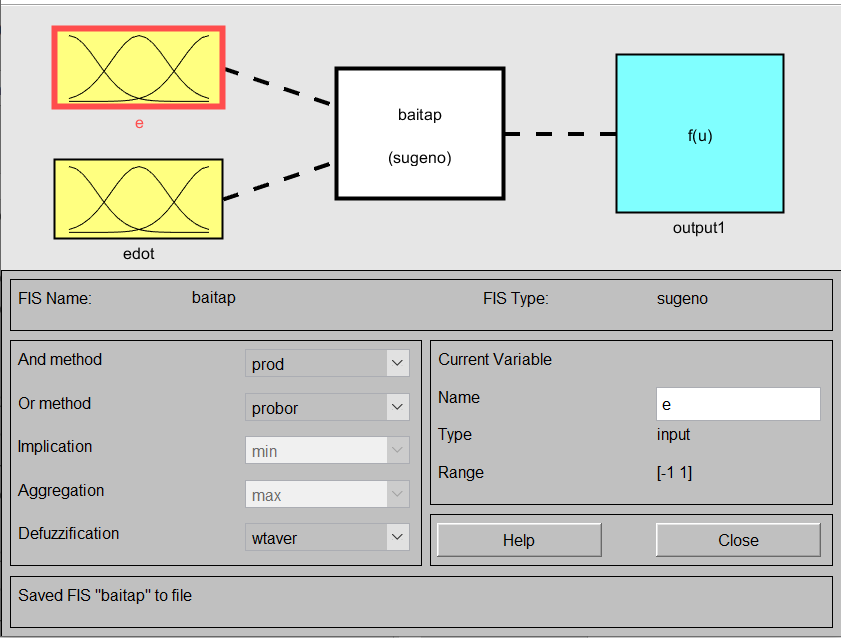


Figure : Fuzzy Logic Controller for heat furnace

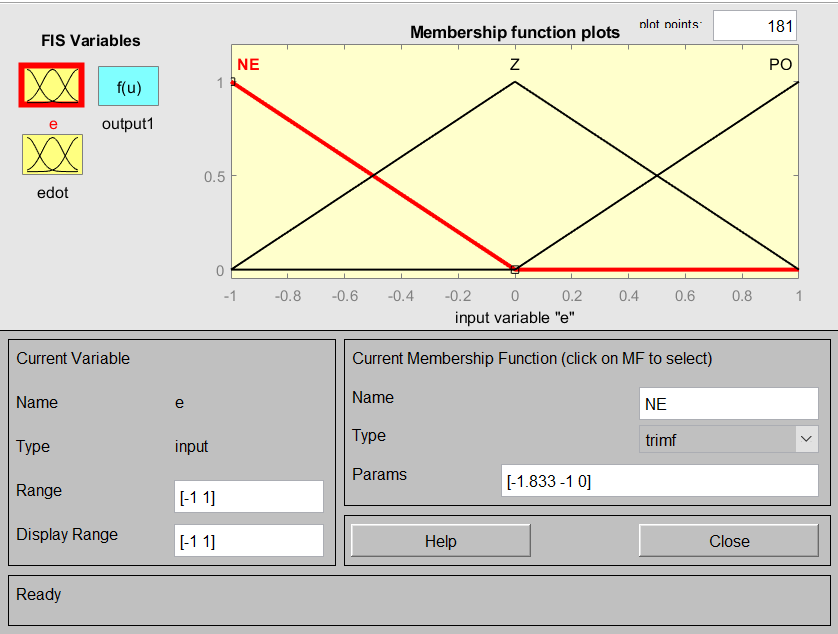


Figure : Input Error

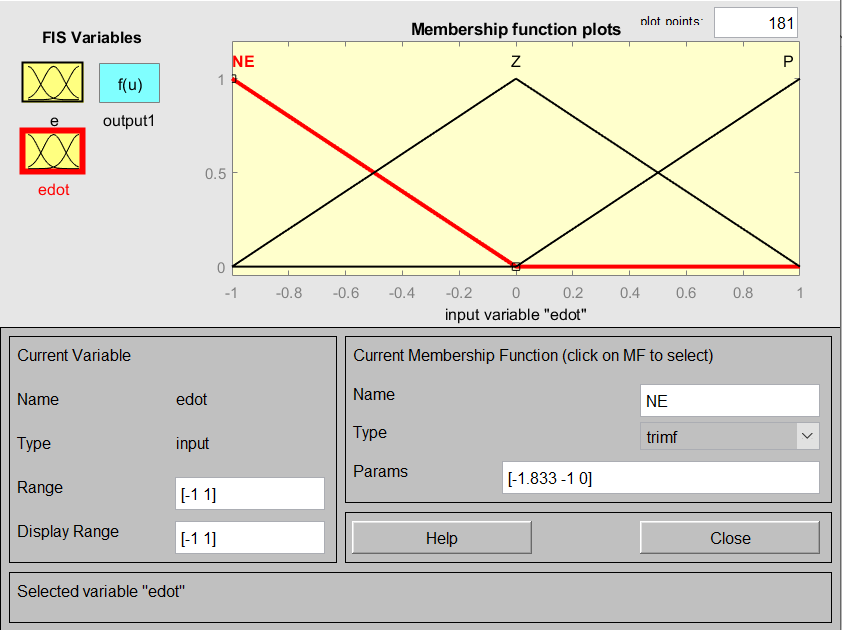


Figure : Input Error over time

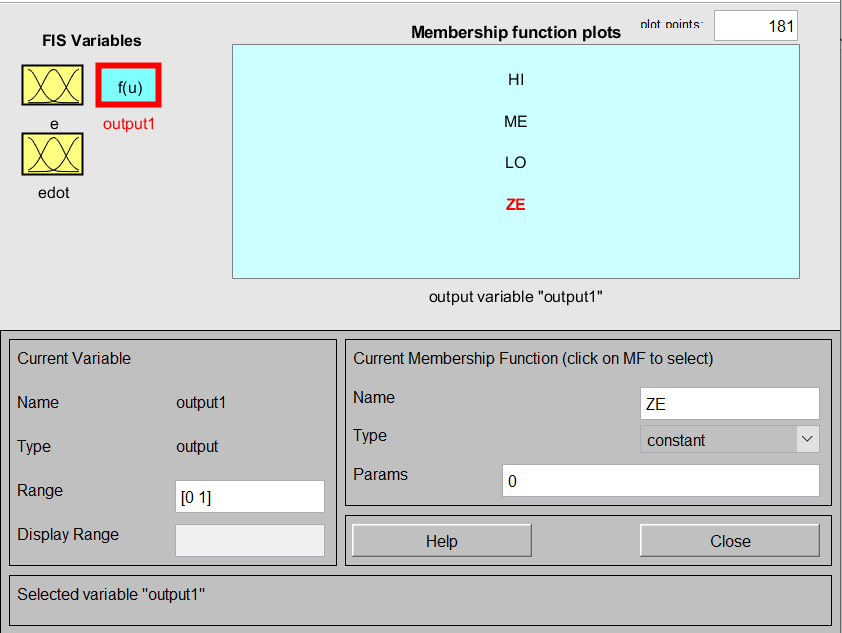


Figure :Output temperature

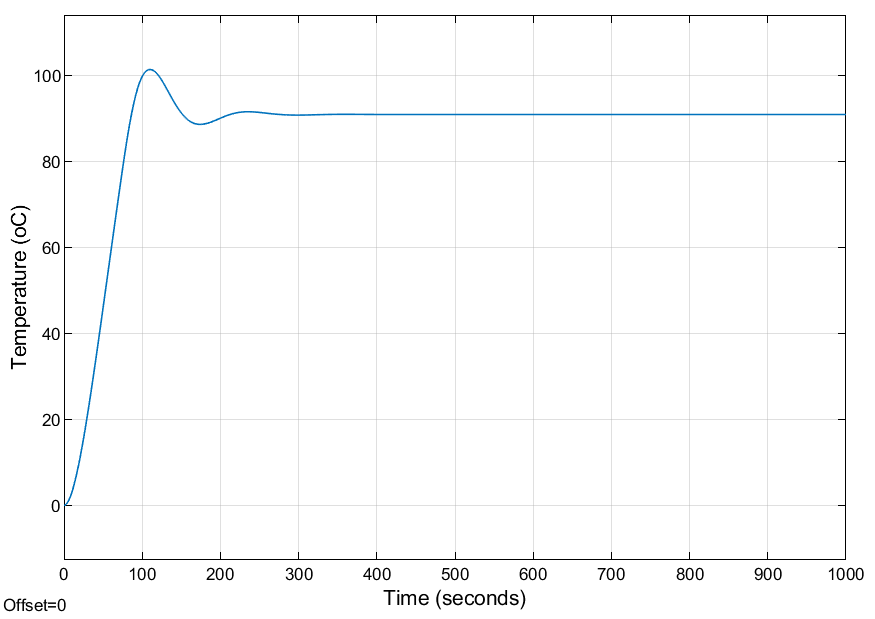


Figure : Heat furnace graph