Control Systems Engineering Chapter 1: Introduction
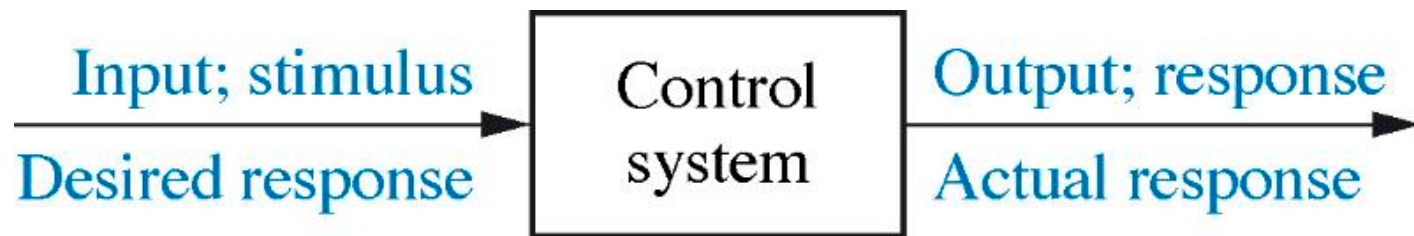
Dr.-Ing. Witthawas Pongyart

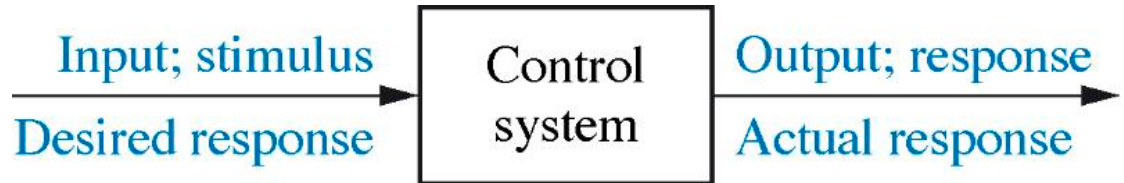# Introduction to Control System

- **What is Control System ?**

  A control system consists of *subsystems and processes (or plants) assembled for the* purpose of obtaining a desired *output with desired performance, given a specified input.*
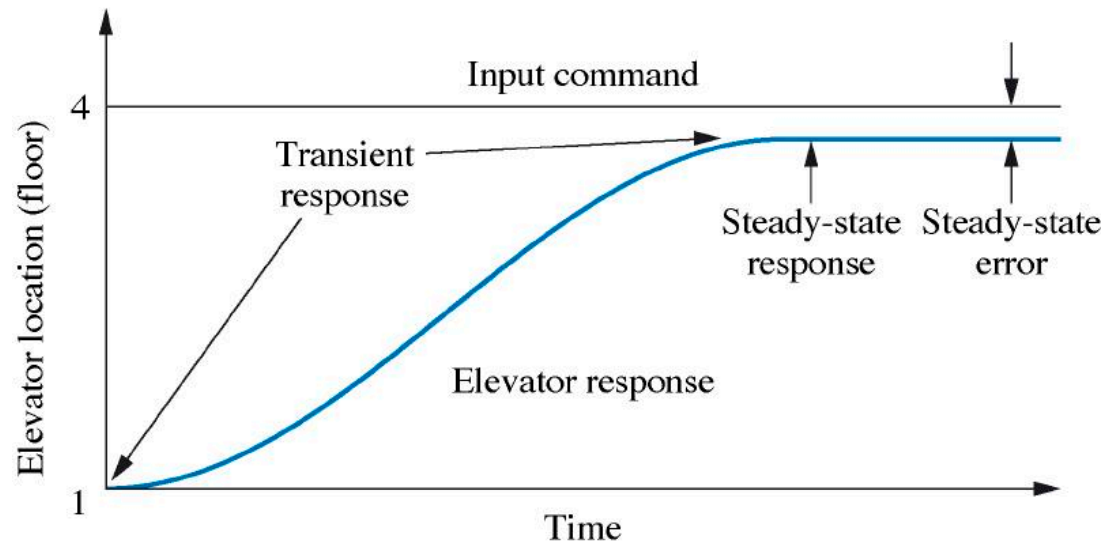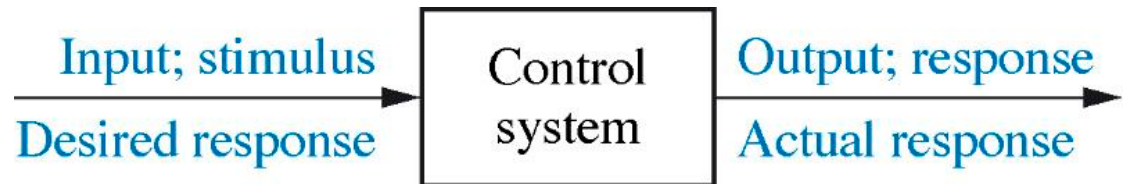
Introduction to Control System

- **Example of a control system: Elevator**

Input; stimulus
Desired response → Control system → Output; response
Actual response

When the fourth-floor button is pressed on the first floor, the elevator rises to the fourth floor with a speed and floor-leveling accuracy designed for passenger comfort.

Introduction to Control System

- **Example of a control system: Elevator**

Input; stimulus / Desired response → Control system → Output; response / Actual response

Elevator location (floor) vs Time: Input command (4), Transient response, Elevator response, Steady-state response, Steady-state error
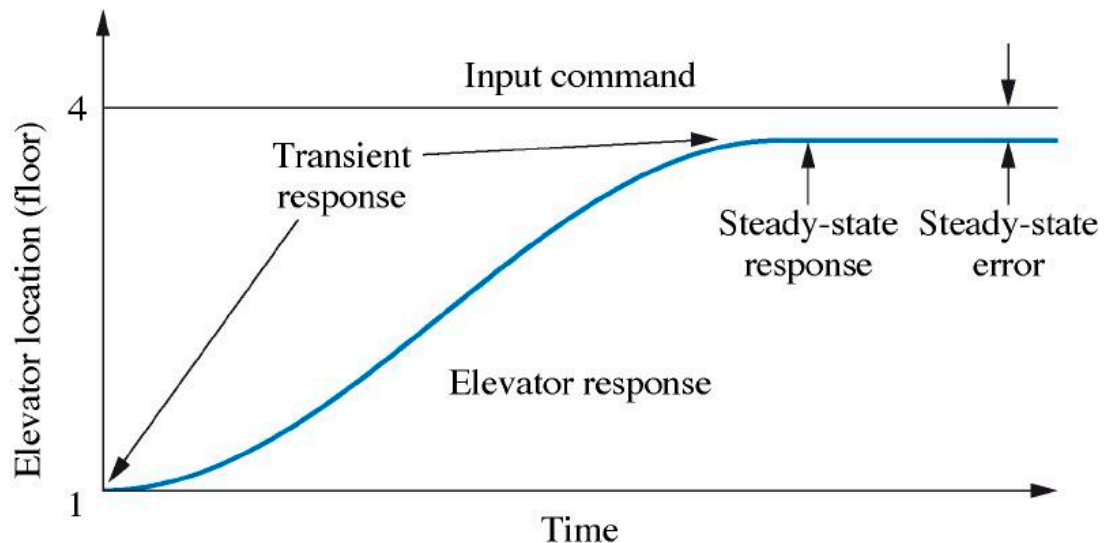
Introduction to Control System

- **Example of a control system: Elevator**

Two major measures of performance:
(1) the transient response
(2) the steady-state error.

Introduction to Control System
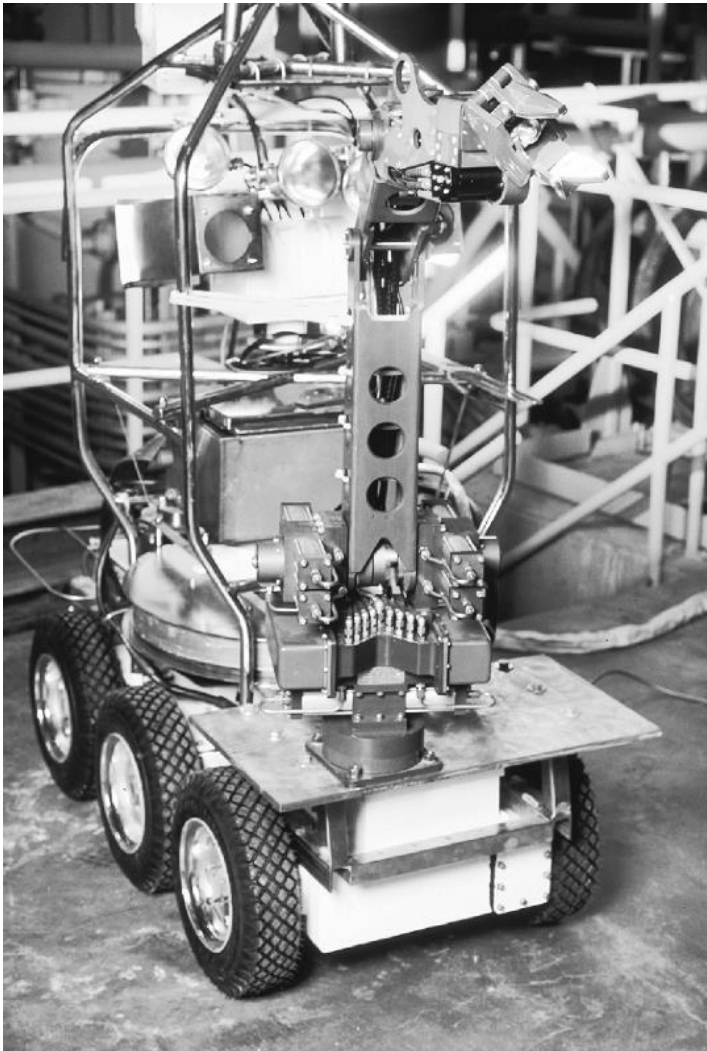
- **Advantages of Control Systems**

We build control systems for four primary reasons:

1. Power amplification
2. Remote control
3. Convenience of input form
4. Compensation for disturbances

Introduction to Control System

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Introduction to Control System

- **System Configurations**

    We discuss two major configurations of control systems: **open loop** and **<u>closed loop</u>**.

    We can consider these configurations to be the internal architecture of the total system shown in Figure 1.1.

    Finally, we show how a digital computer forms part of a control system's configuration.
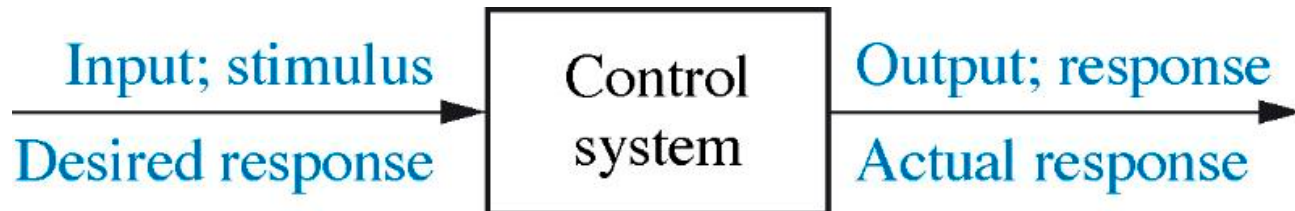
Introduction to Control System
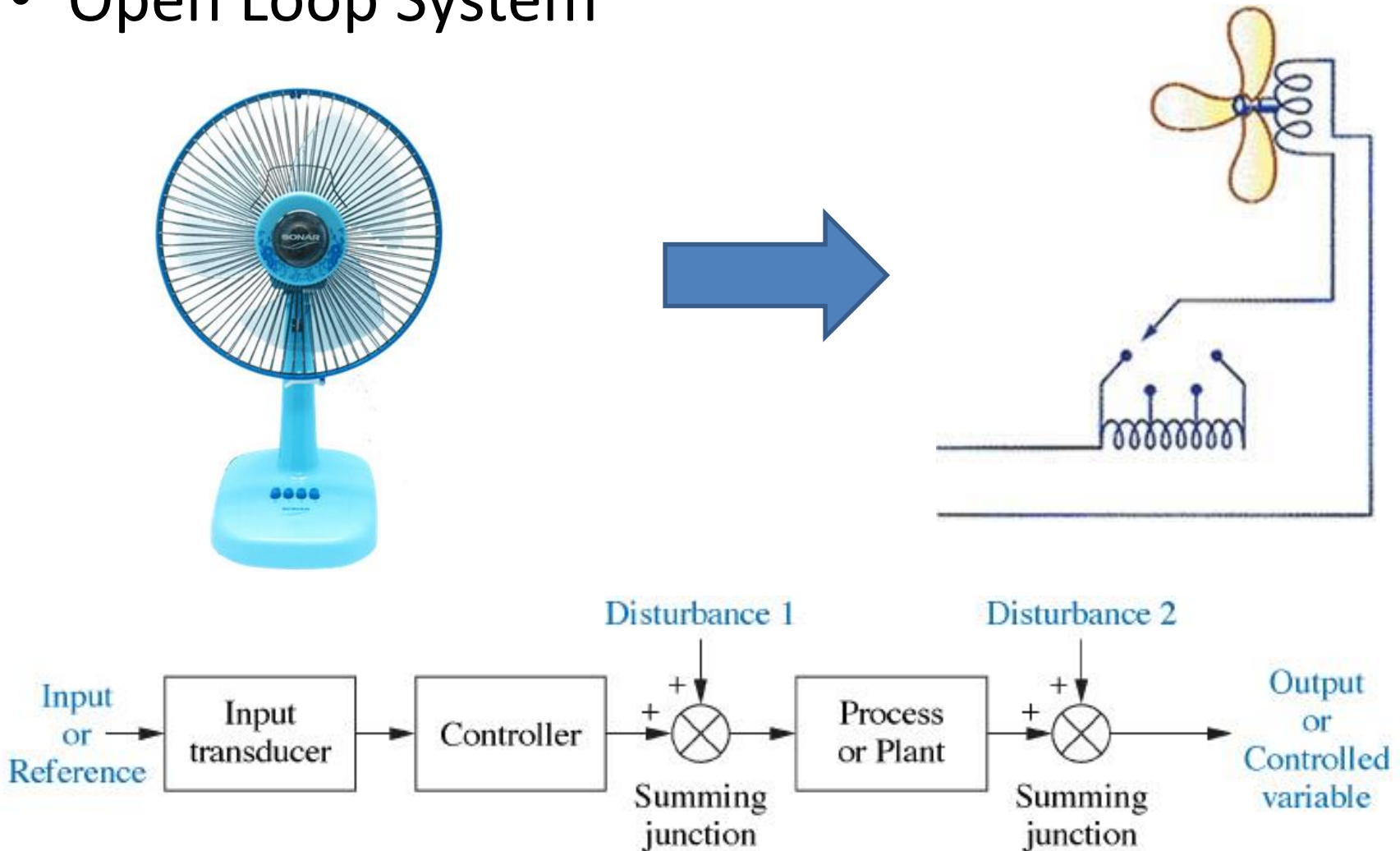
- Open Loop System

Figure 1.6 (a)

Introduction to Control System

- ## Open Loop System
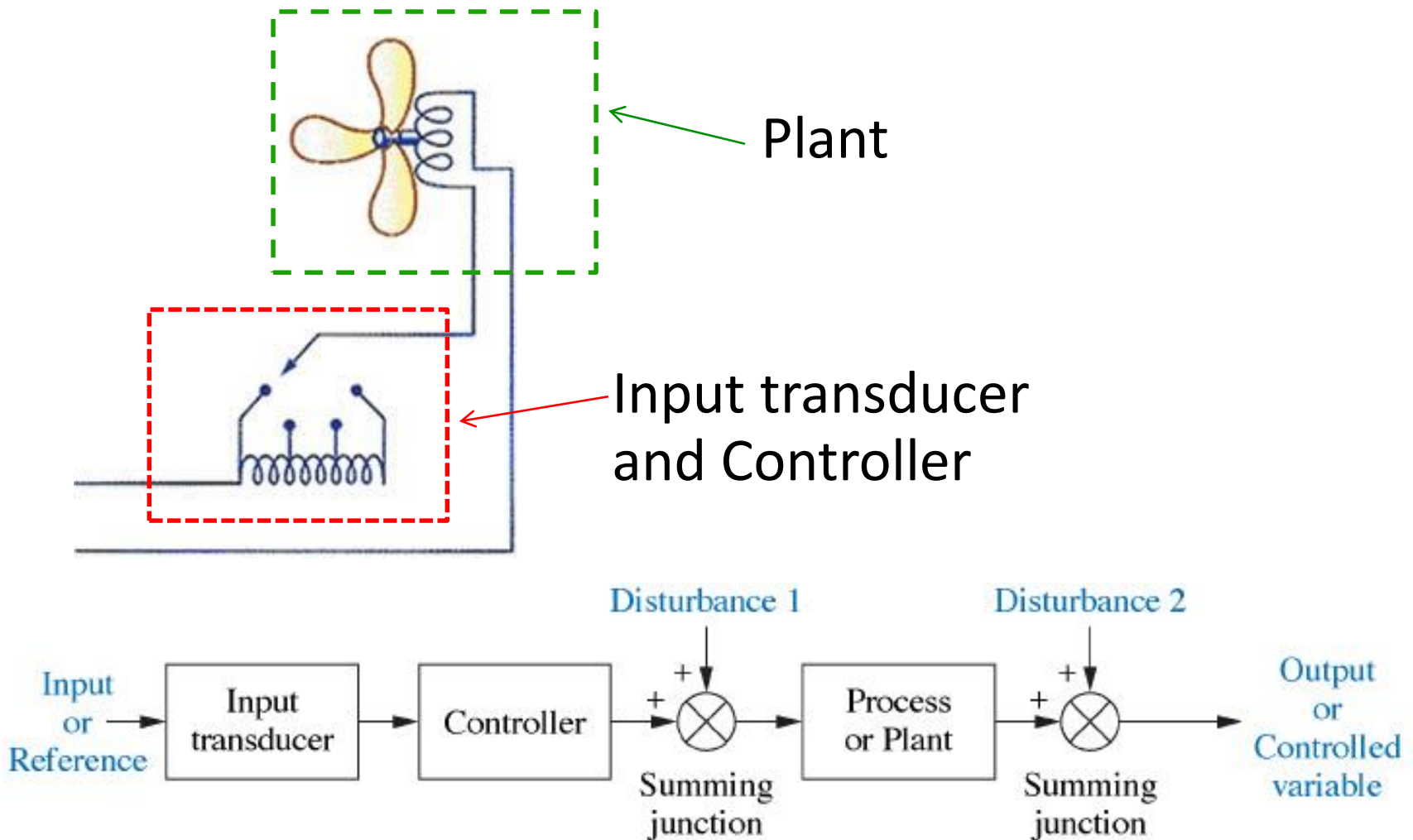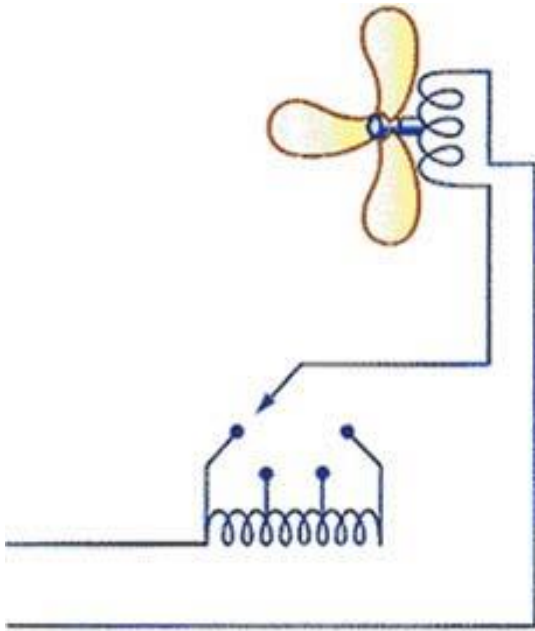

Plant

Input transducer and Controller

Figure 1.6 (a)

Introduction to Control System

- Open Loop System

The distinguishing characteristic of an open-loop system is that it cannot compensate for any disturbances that add to the controller's driving signal
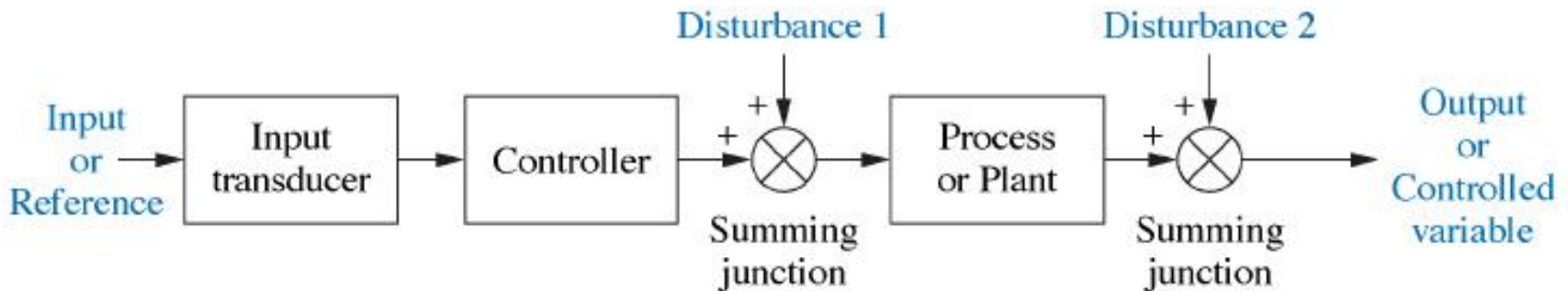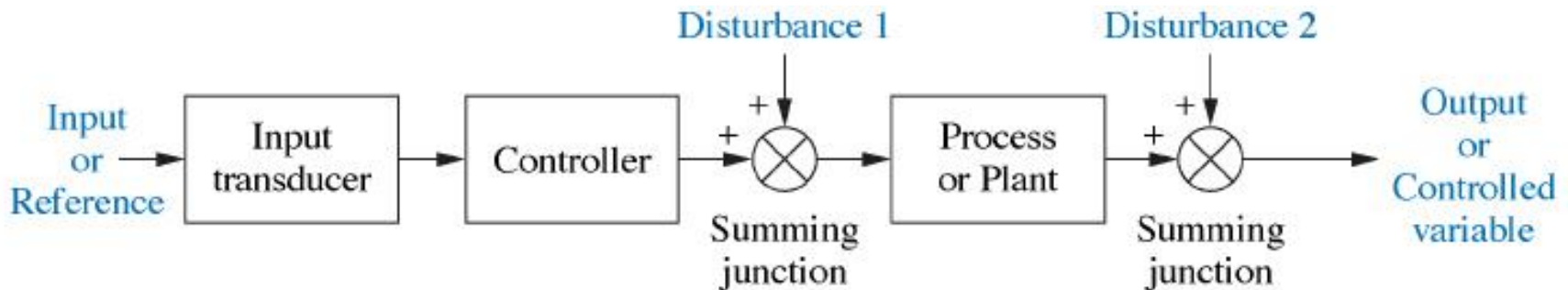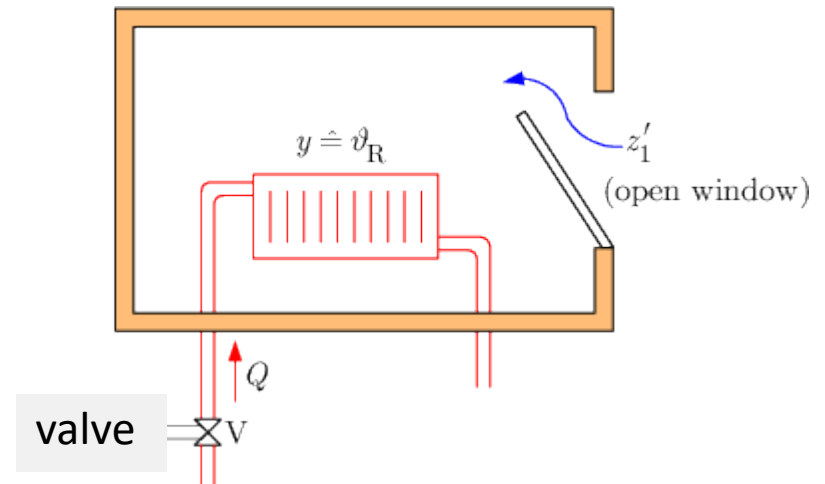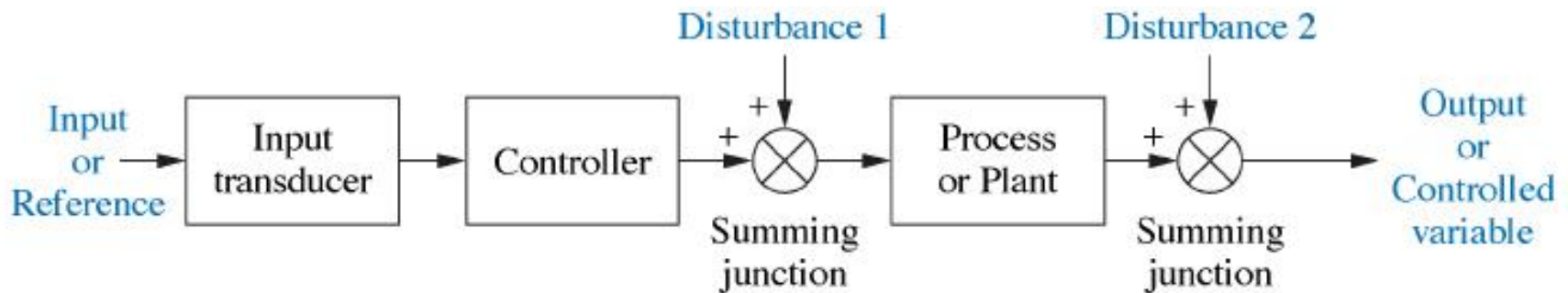

Figure 1.6 (a)

Introduction to Control System

- Open Loop System

$y \doteq \vartheta_R$

z_1' (open window)

Q

valve

V

| Input or Reference | → | Input transducer | → | Controller | → | + Summing junction | → | Process or Plant | → | + Summing junction | → | Output or Controlled variable |

Disturbance 1 → Summing junction (+)

Disturbance 2 → Summing junction (+)

Introduction to Control System

- Open Loop System

Figure 1.6 (a)

Introduction to Control System

- Open loop System

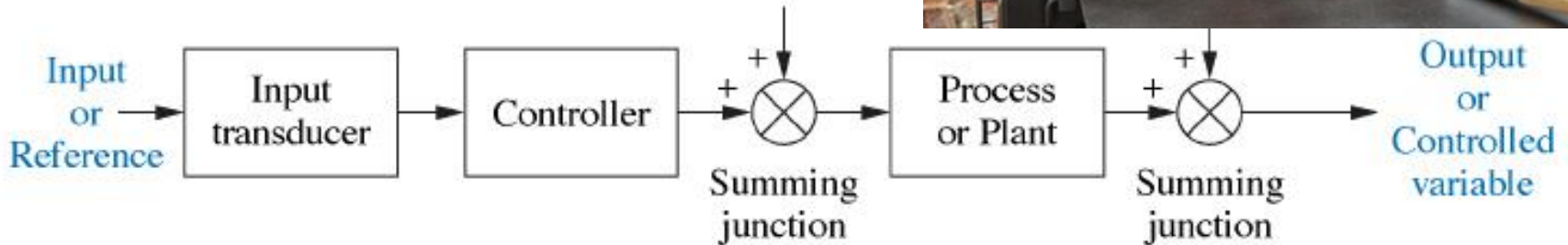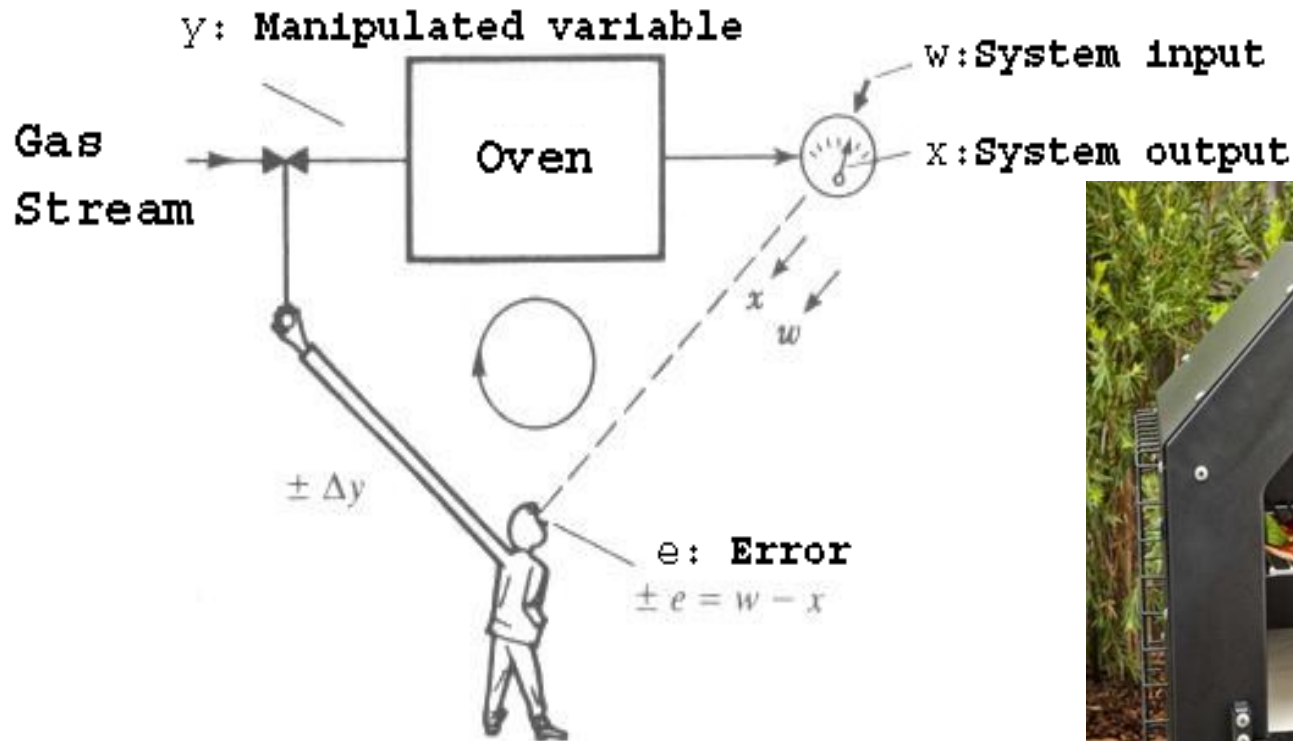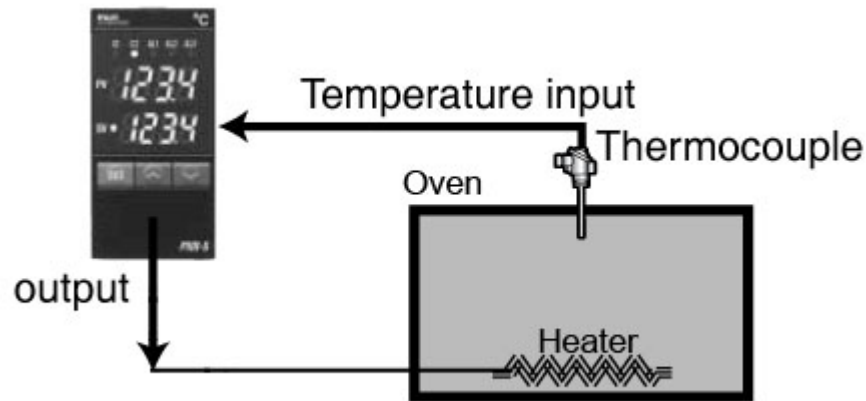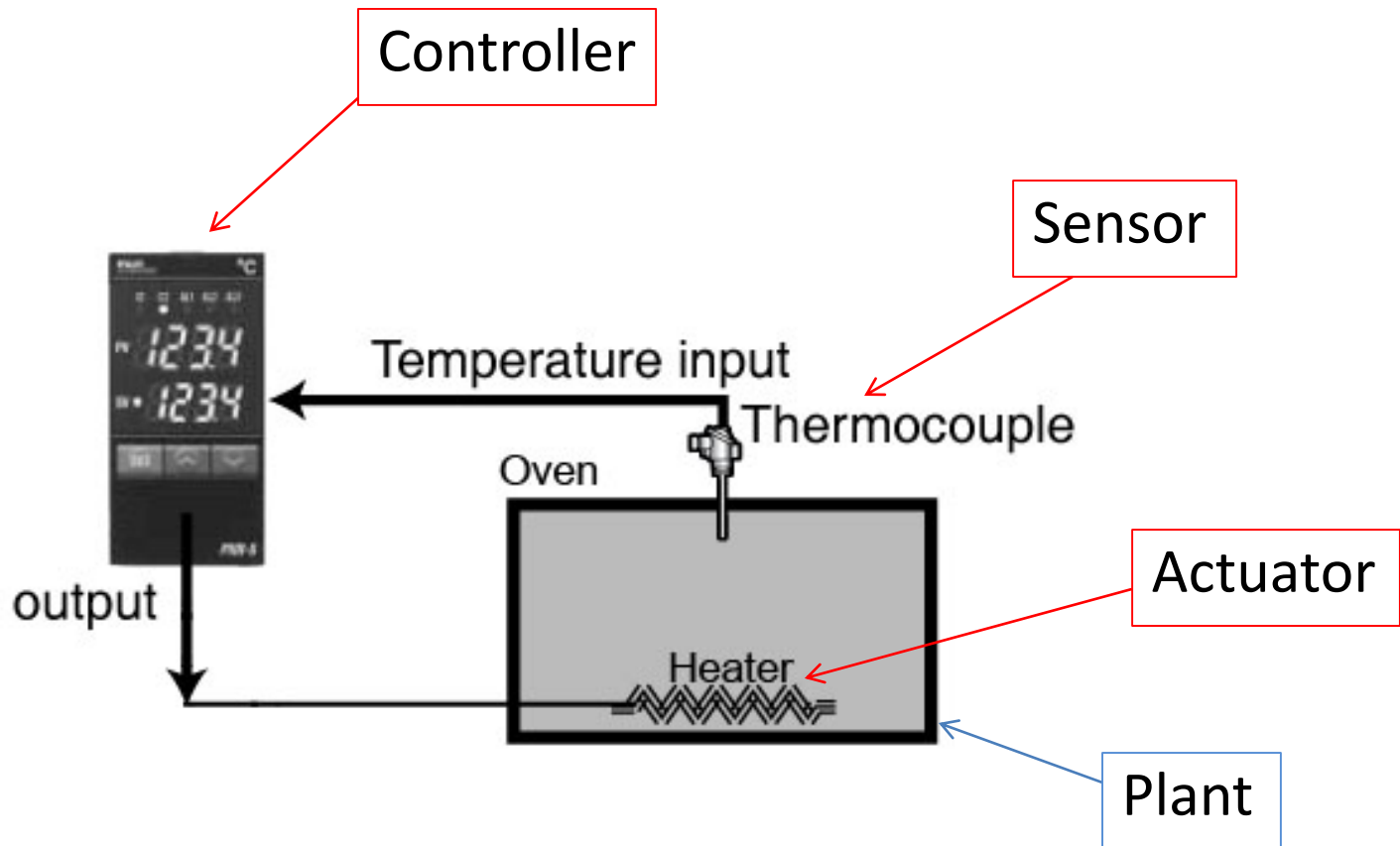
Figure 1.6 (a)

Introduction to Control System

- Closed Loop System

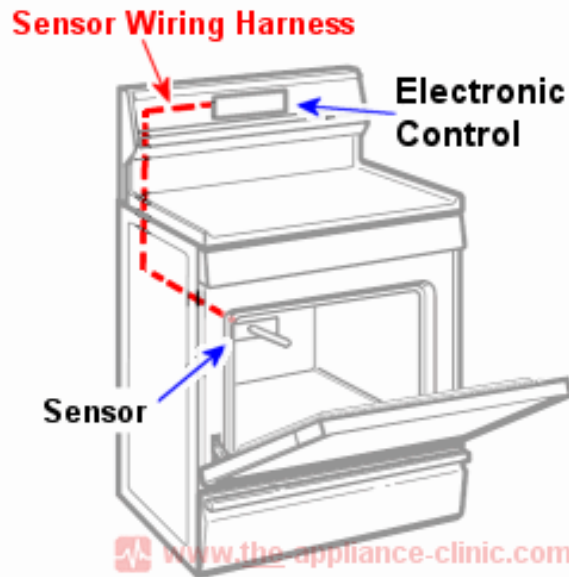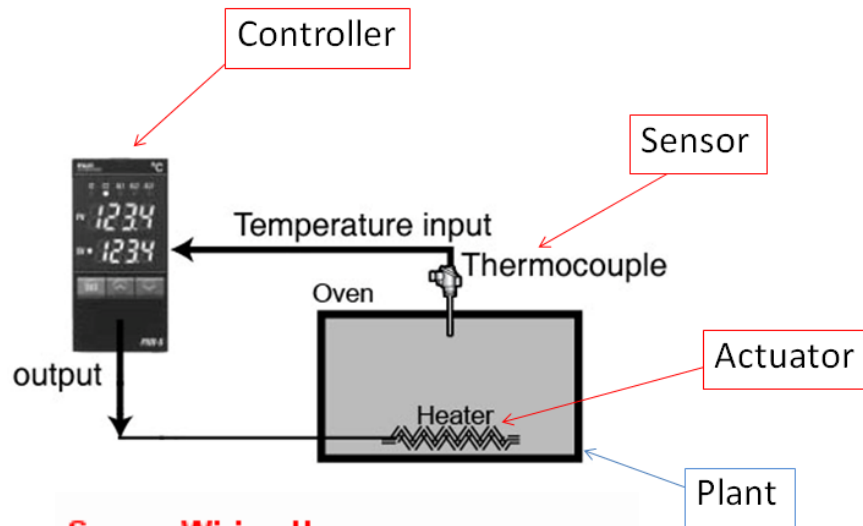# Introduction to Control System

- Closed Loop System (Feedback control)

Introduction to Control System

- Closed Loop System (Feedback control)

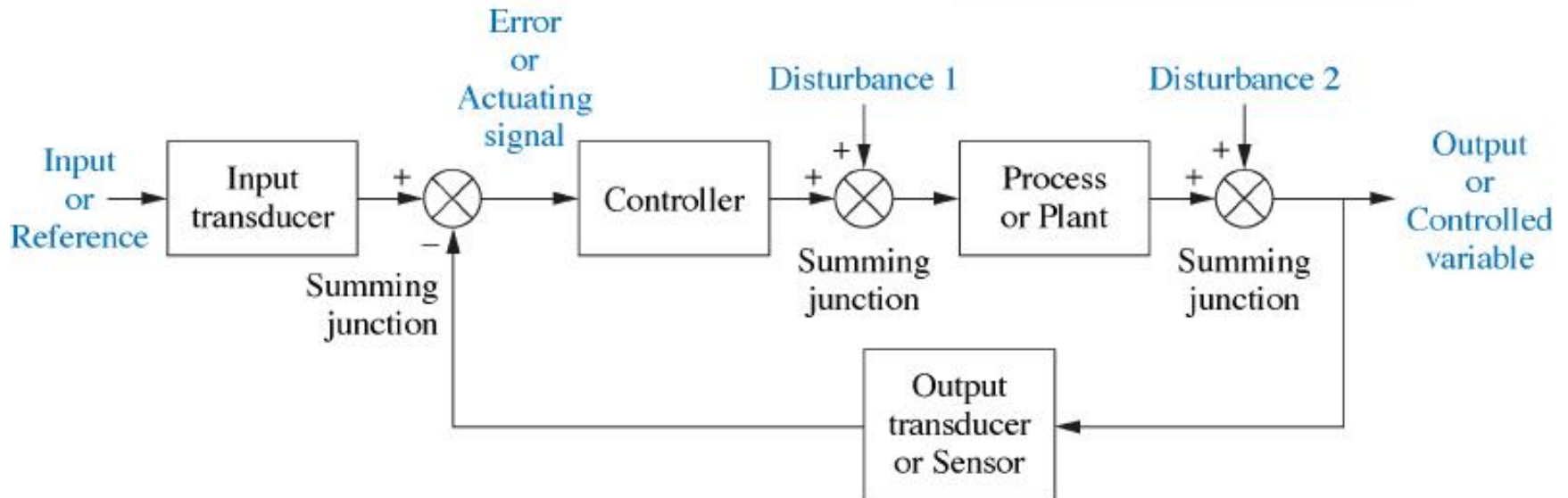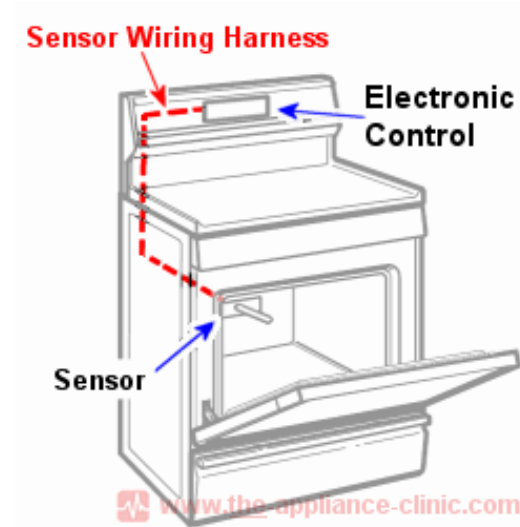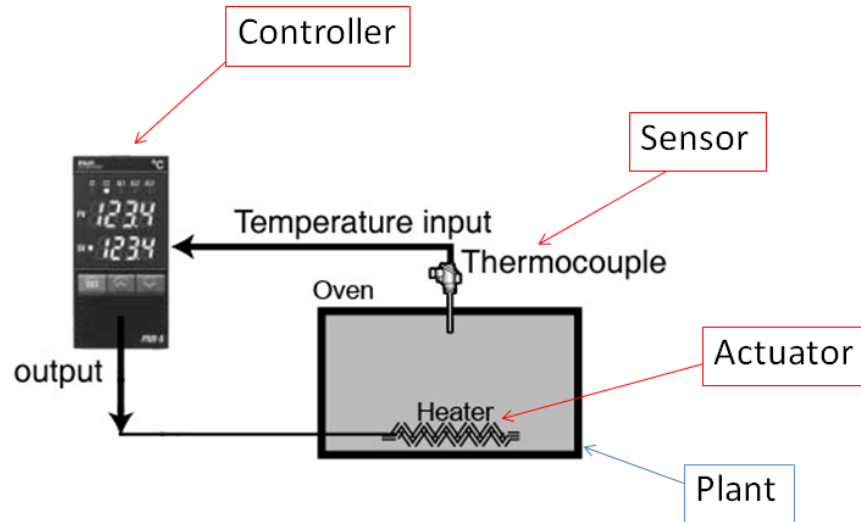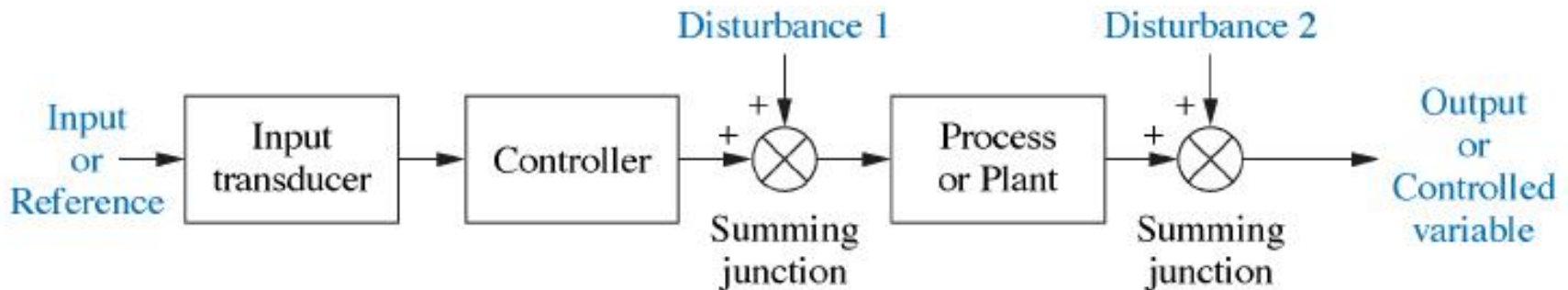# Introduction to Control System

- Closed Loop System (Feedback control)

Introduction to Control System

- Open Loop System

valve

$y \doteq \vartheta_R$

z_1' (open window)

Q

V

		Disturbance 1		Disturbance 2	
Input or Reference	Input transducer → Controller → + Summing junction		Process or Plant	+ Summing junction	Output or Controlled variable

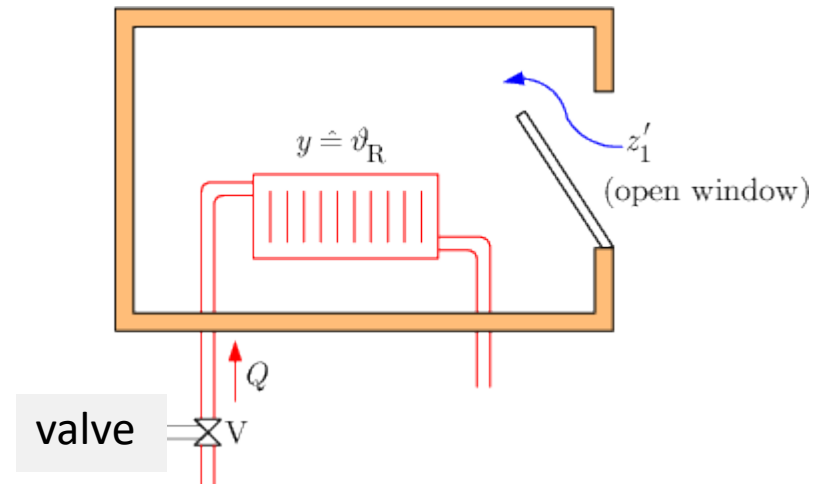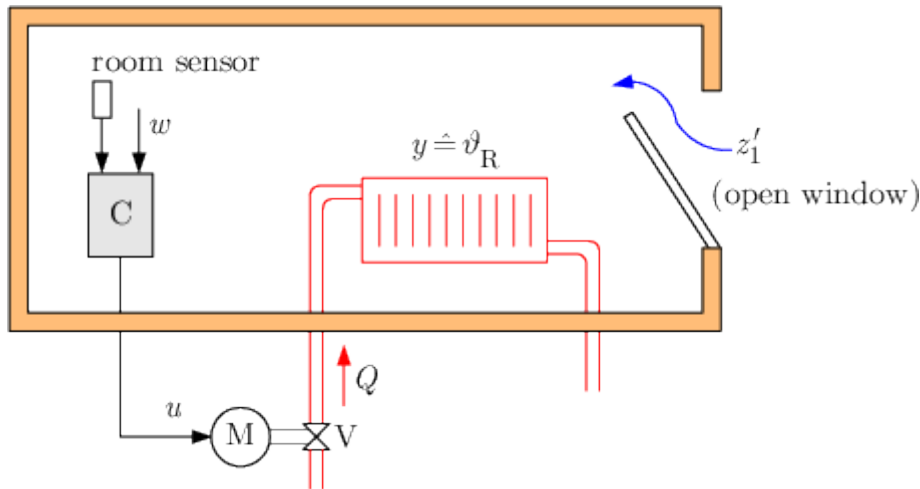# Introduction to Control System

- Closed Loop System (Feedback control)

room sensor

w

$y \,\hat{=}\, \vartheta_R$

z_1'

(open window)

C

u

Q

M ⊠V

Error or Actuating signal

Disturbance 1

Disturbance 2

Input or Reference

Input transducer

+ − Summing junction

Controller

+ + Summing junction

Process or Plant

+ + Summing junction

Output or Controlled variable

Output transducer or Sensor

Introduction to Control System

- Control System