دانشگاه سمنان
Semnan University
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دانشکده مهندسی مکانیک

دانشکده مهندسی مکانیک

# درس مکاترونیک ۱

# MECHATRONICS 1

Section 1:

## Introduction to Mechatronics

**Reference:**

**Mechatronics**

**Electronic control systems in mechanical and electrical engineering**

6th Edition

William Bolton

Chapter 1 - Introducing mechatronics

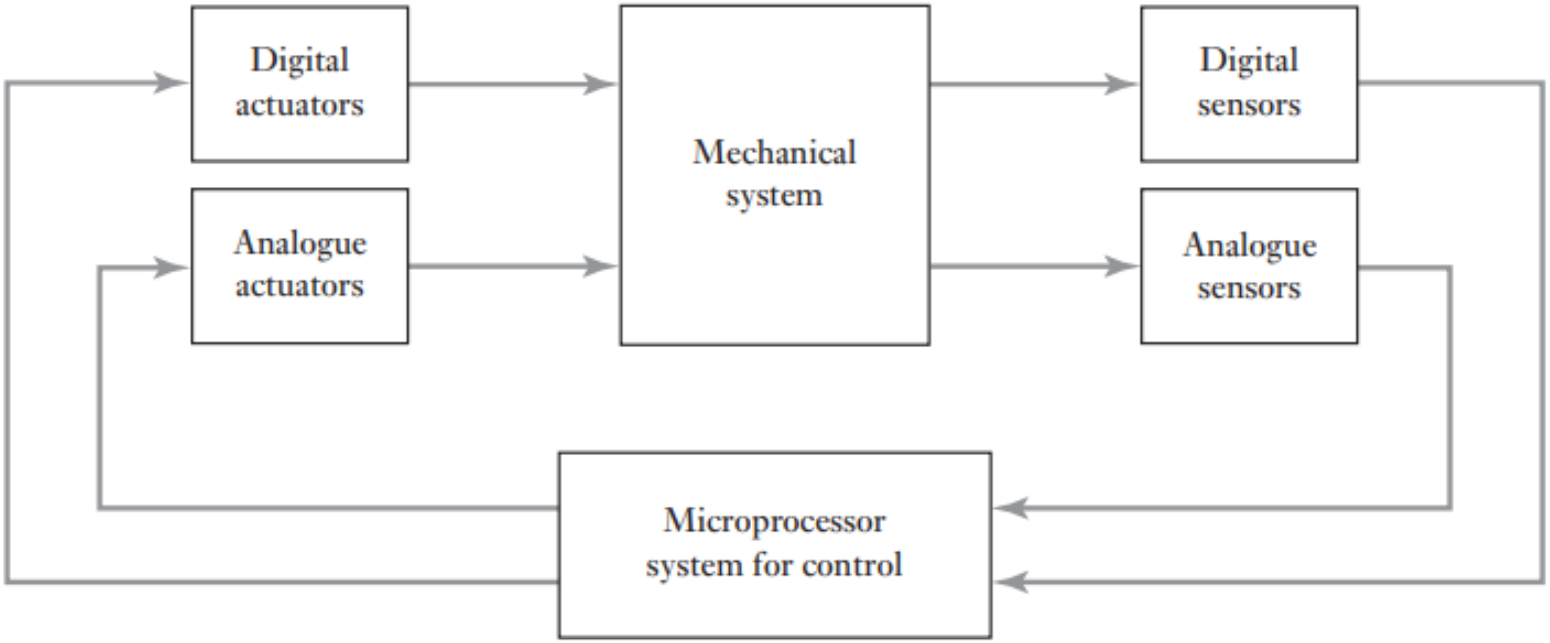
## 1.1 What is mechatronics?

- The term mechatronics was ‘invented’ by a Japanese engineer in 1969, as a combination of ‘mecha’ from mechanisms and ‘tronics’ from electronics.
  - Integration of mechanical engineering with electronics and intelligent computer control in the design and manufacture of products and processes.

- As a result, mechatronic products have many mechanical functions replaced with electronic ones. This results in much greater flexibility, easy redesign and reprogramming, and the ability to carry out automated data collection and reporting.

## 1.1 What is mechatronics?

- Mechatronics brings together areas of technology involving sensors and measurement systems, drive and actuation systems, and microprocessor systems, together with the analysis of the behavior of systems and control systems.

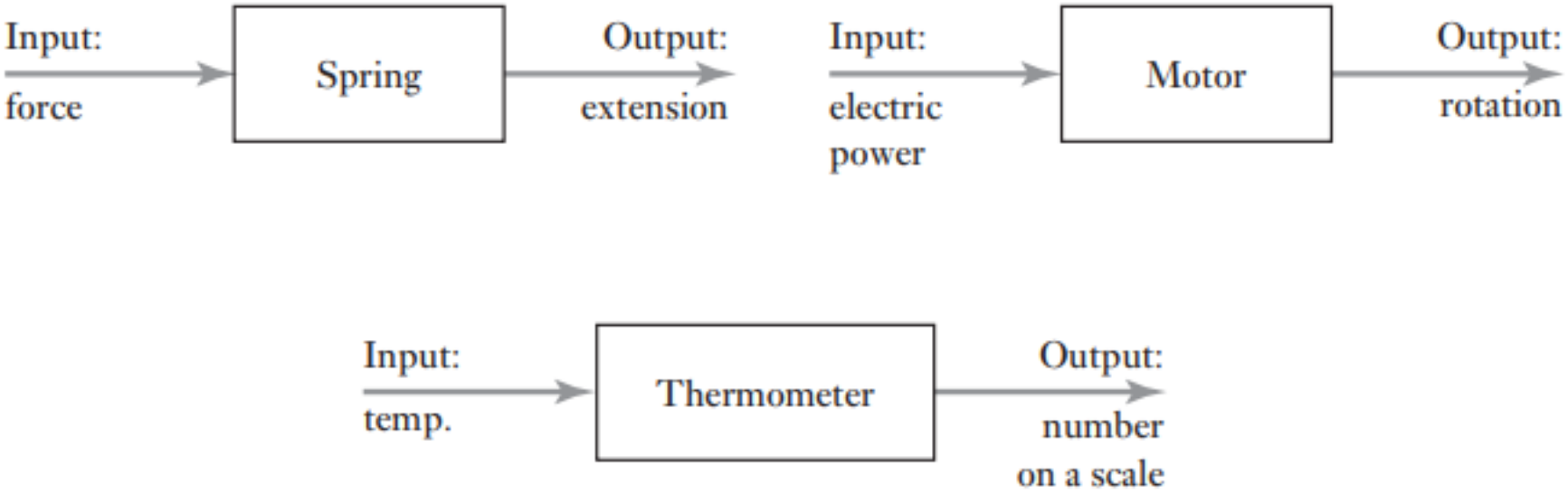


## 1.2 The design process

- The design process:
  1) The need
  2) Analysis of the problem
  3) Preparation of a specification
  4) Generation of possible solution
  5) Selections of a suitable solution
  6) Production of a detailed design
  7) Production of working drawings

## 1.3 Systems

- In designing mechatronic systems, one of the steps involved is the creation of a model of the system so that predictions can be made regarding its behavior when inputs occur.

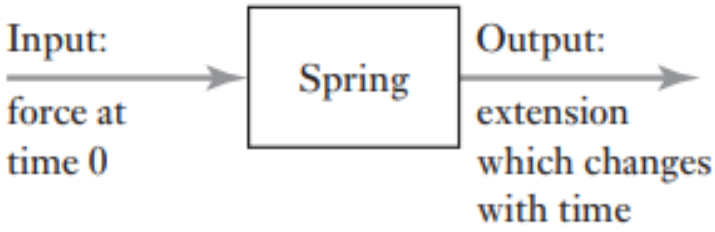


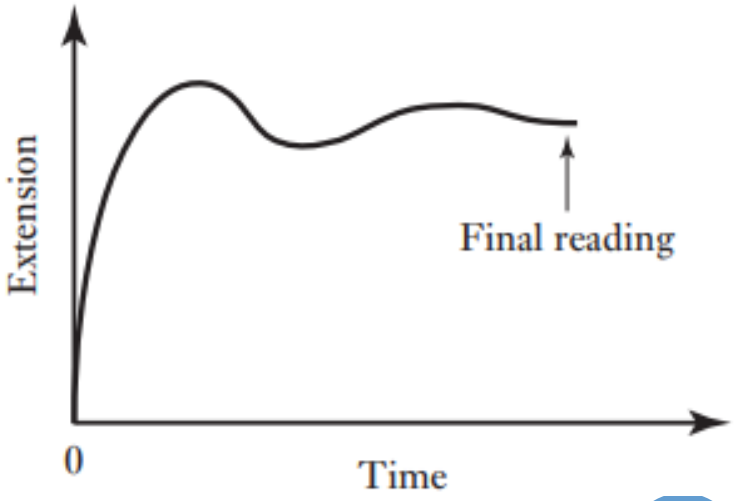
## 1.2 The design process

- The term modelling is used when we represent the behavior of a real system by mathematical equations, such equations representing the relationship between the inputs and outputs from the system.

- The response of any system to an input is not instantaneous.

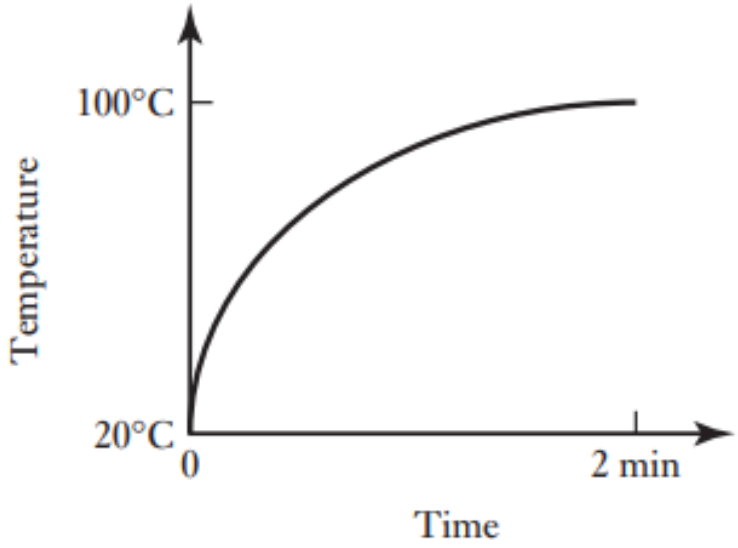
- Spring System



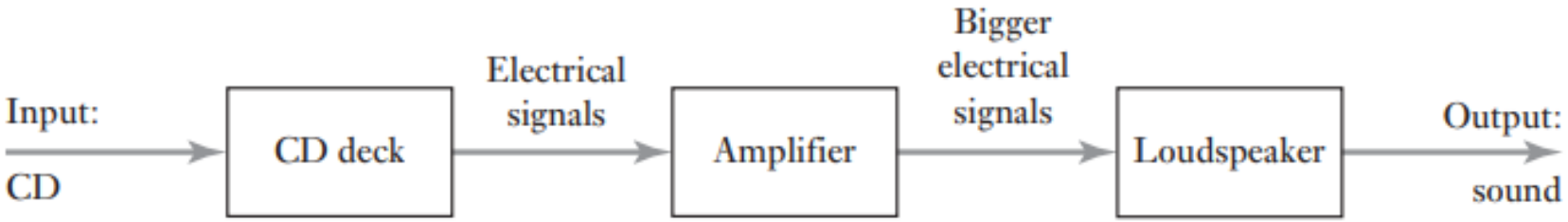



## 1.2 The design process

- Kettle system

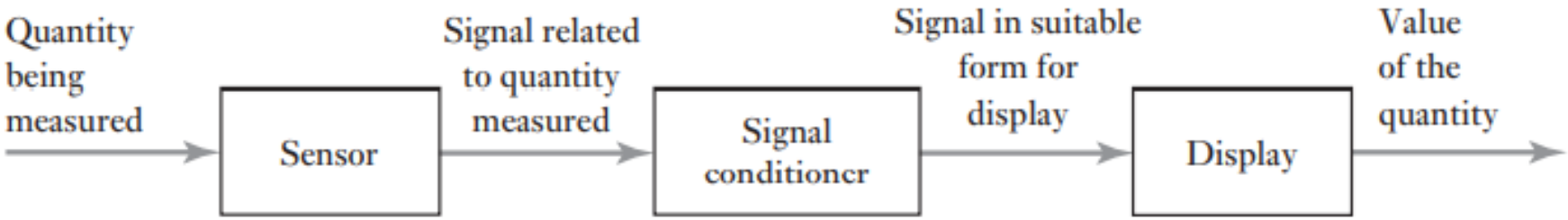




- CD Player



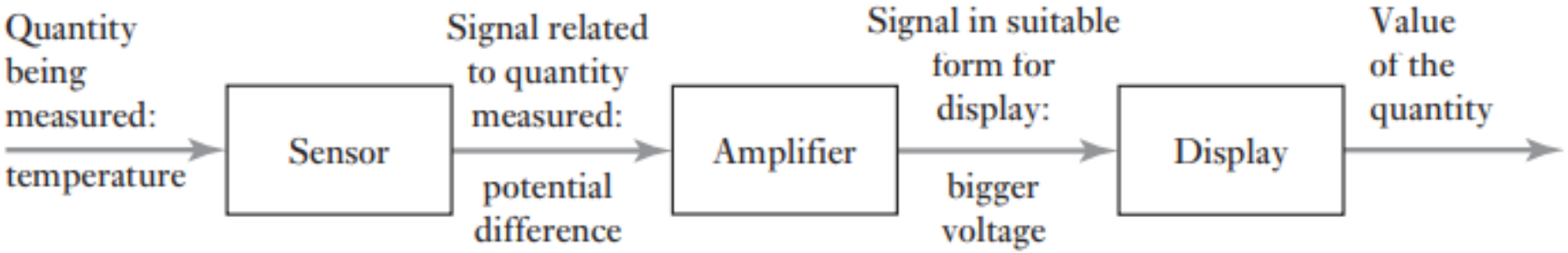
## 1.4 Measurement systems

- Measurement systems can, in general, be considered to be made up of three basic elements:
  1) A sensor
  2) A signal conditioner
  3) A display system



## 1.4 Measurement systems

- A digital thermometer system

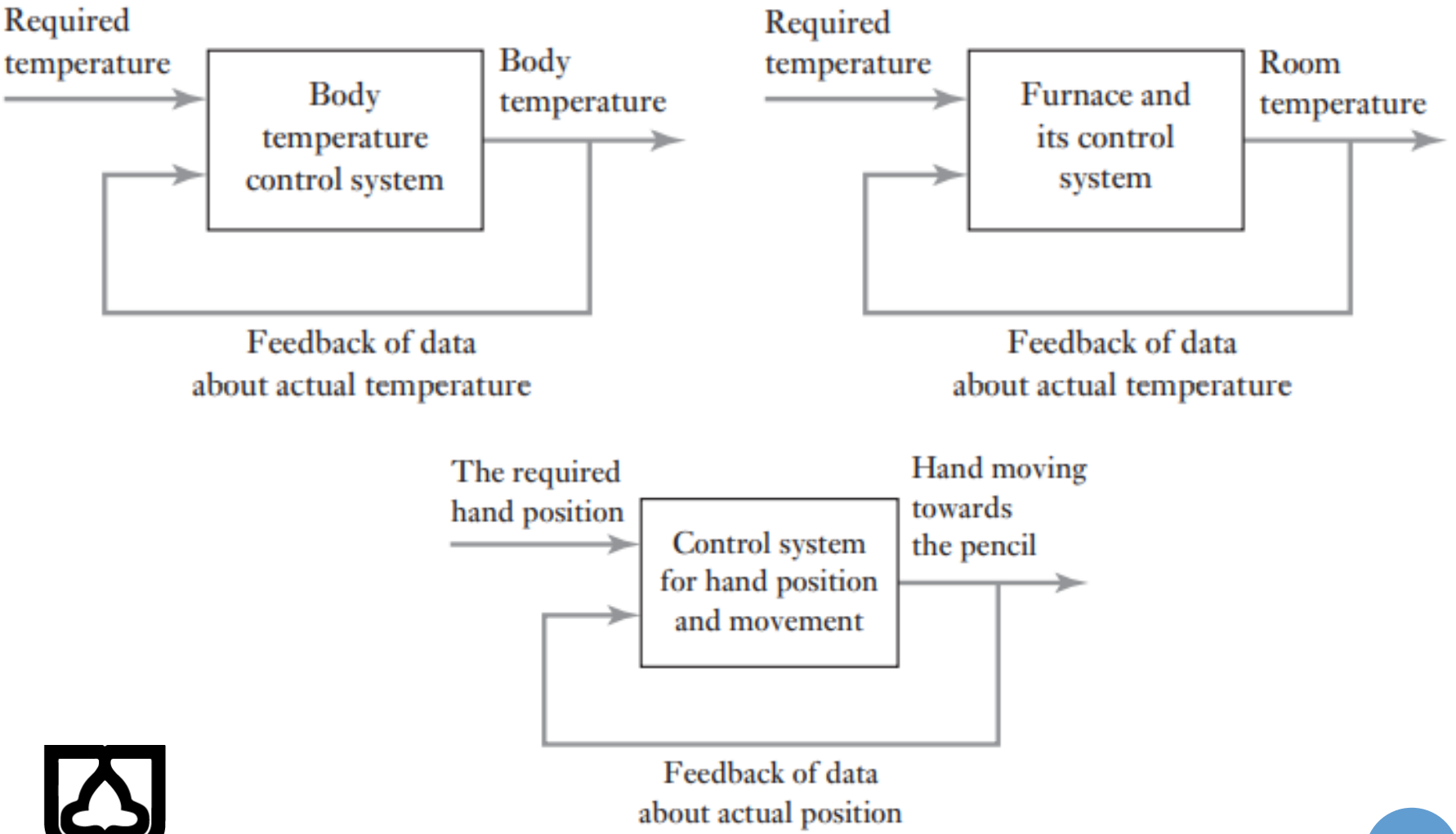


## 1.5 Control systems

- A control system can be thought of as a system which can be used to:
  1) Control some variable to some particular value
  2) Control the sequence of events
  3) Control whether an event occurs or not

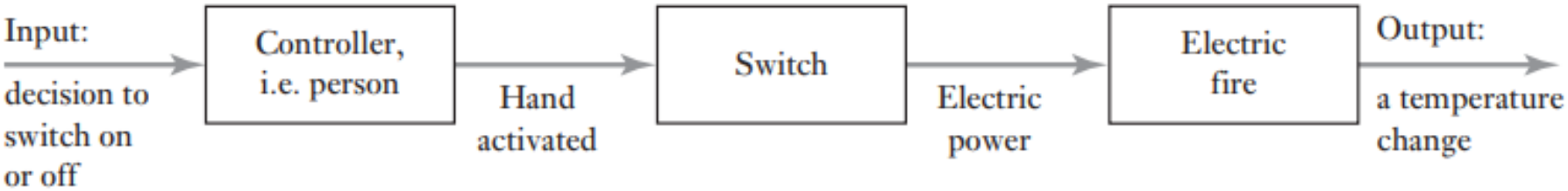
- Feedback control:
  - Signals are fed back from the output, in order to modify the reaction of the body to enable it to restore to the ‘normal’ value.

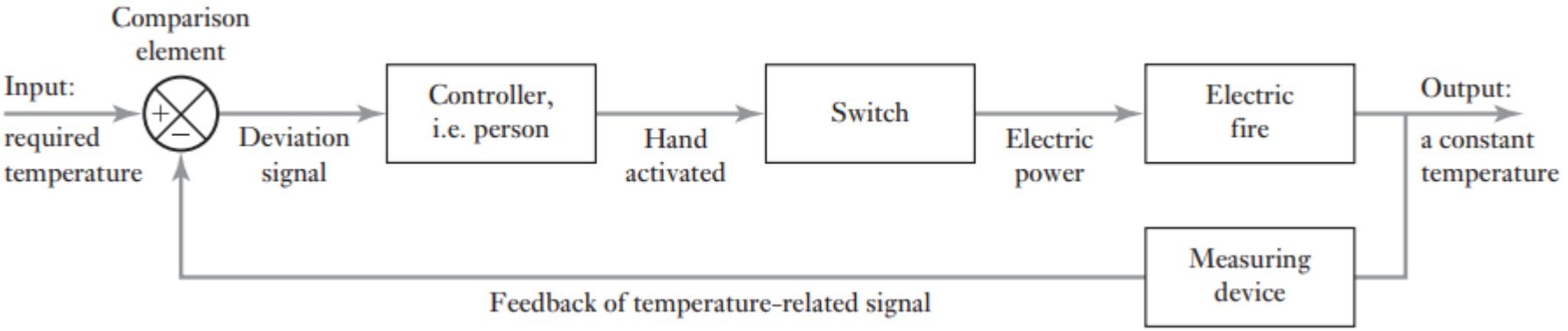
## 1.5 Control systems



## 1.5 Control systems

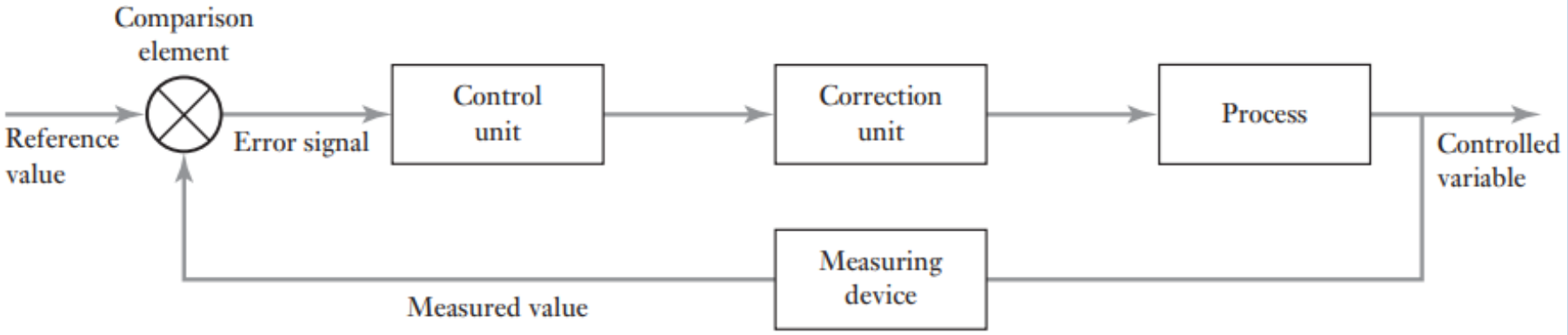
- Open- and closed-loop systems
  - Heating a room



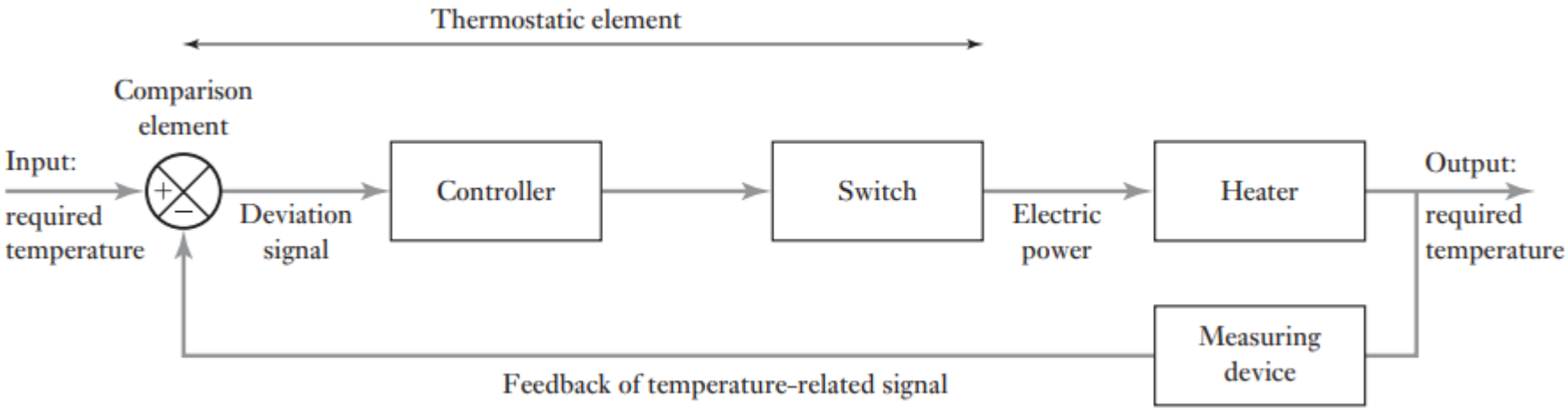
## 1.5 Control systems

- Basic elements of a closed-loop system
  1) Comparison element
  2) Control element
  3) Correction element
  4) Process element
  5) Measurement element



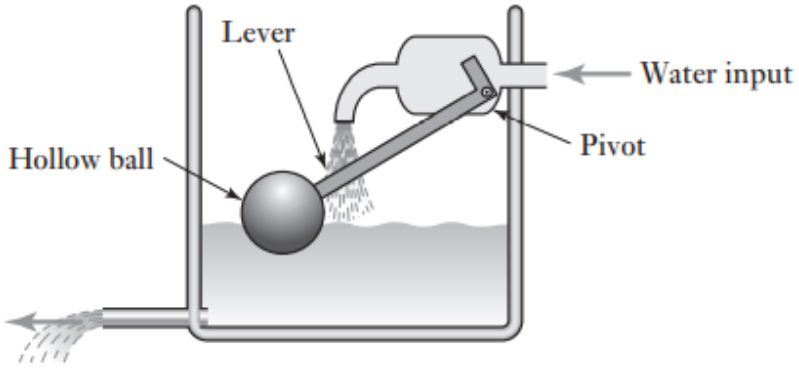
## 1.5 Control systems

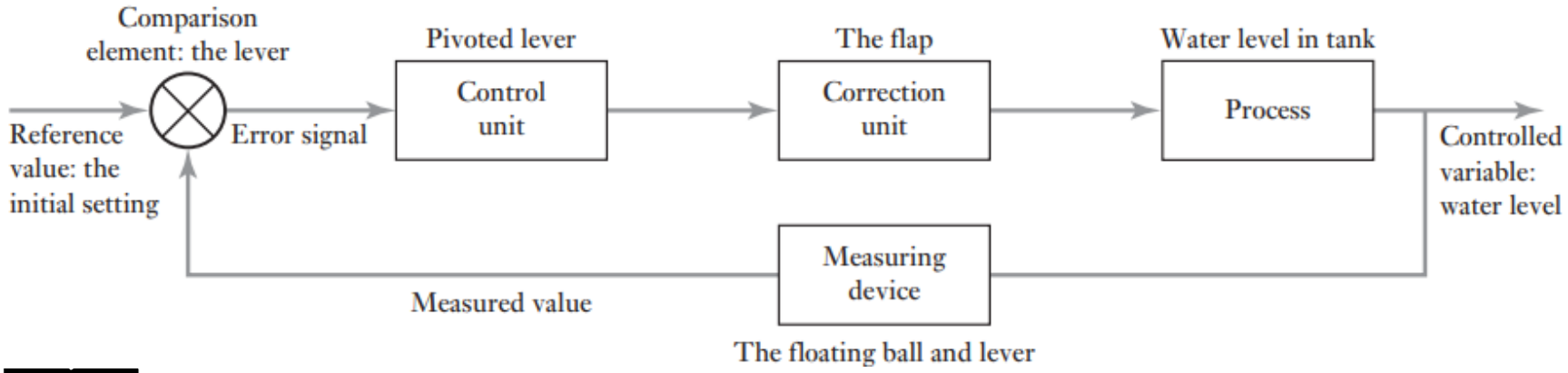
- Heating a room: a closed-loop system



## 1.5 Control systems

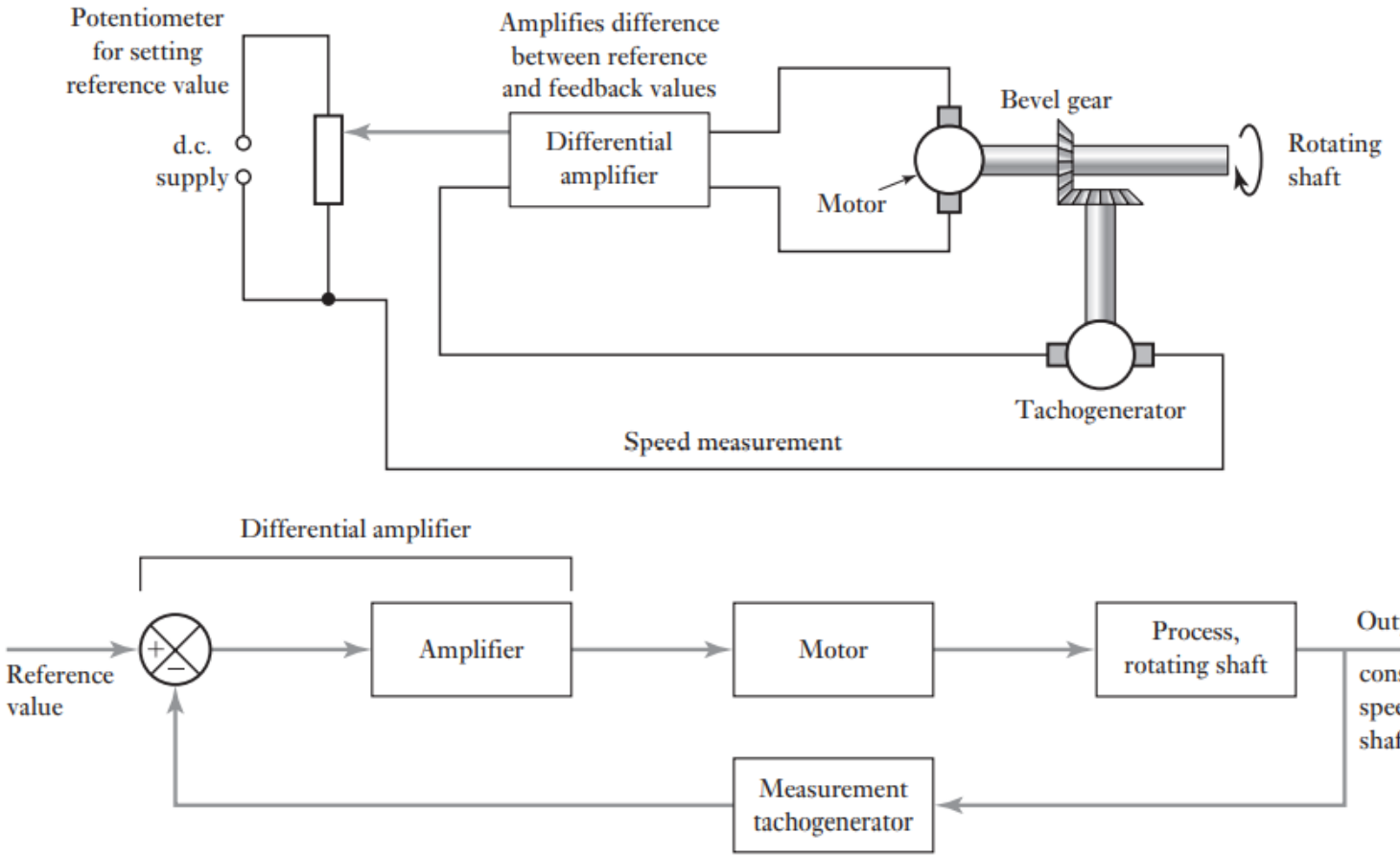
- The automatic control of water level



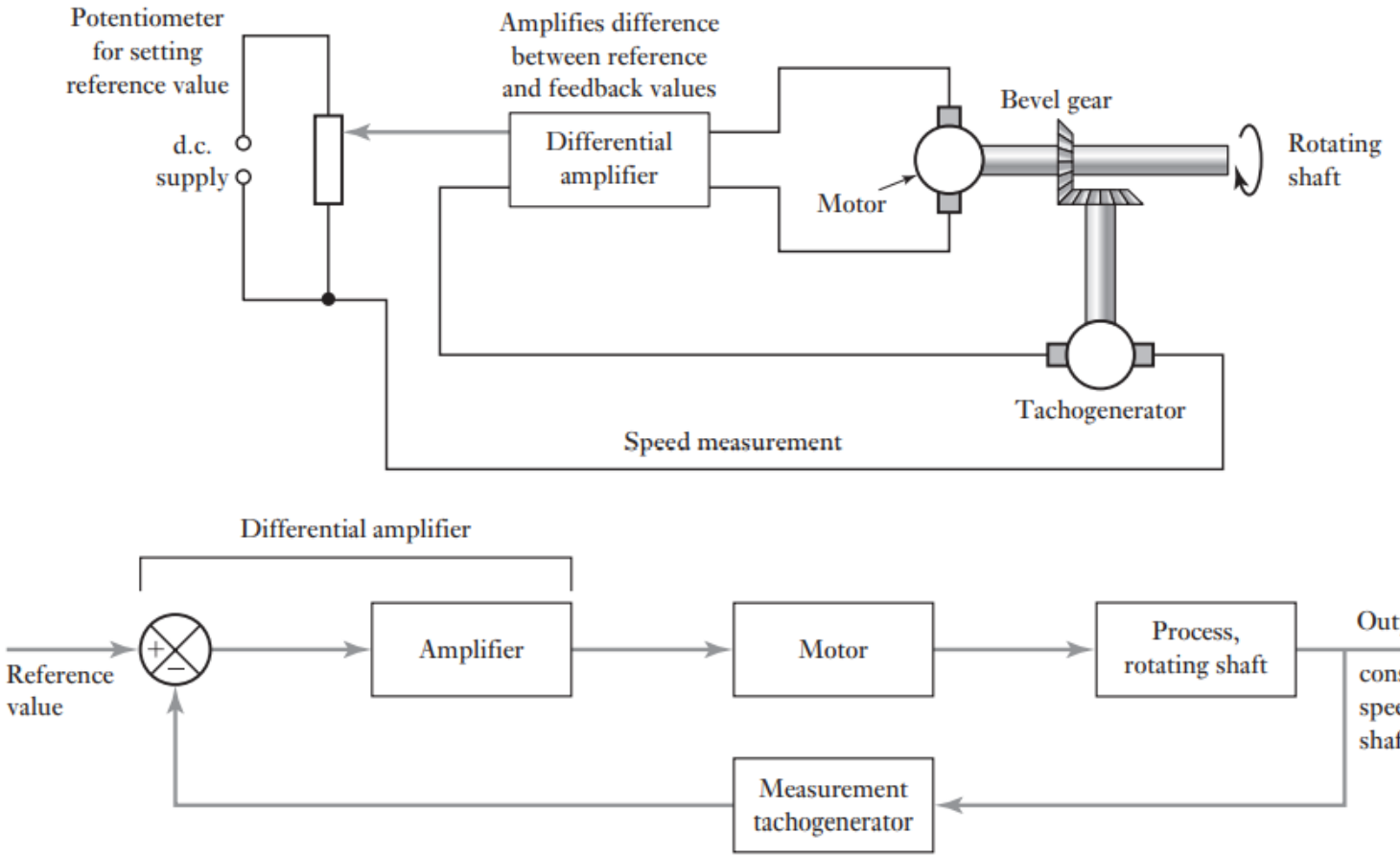
## 1.5 Control systems

- Shaft speed control



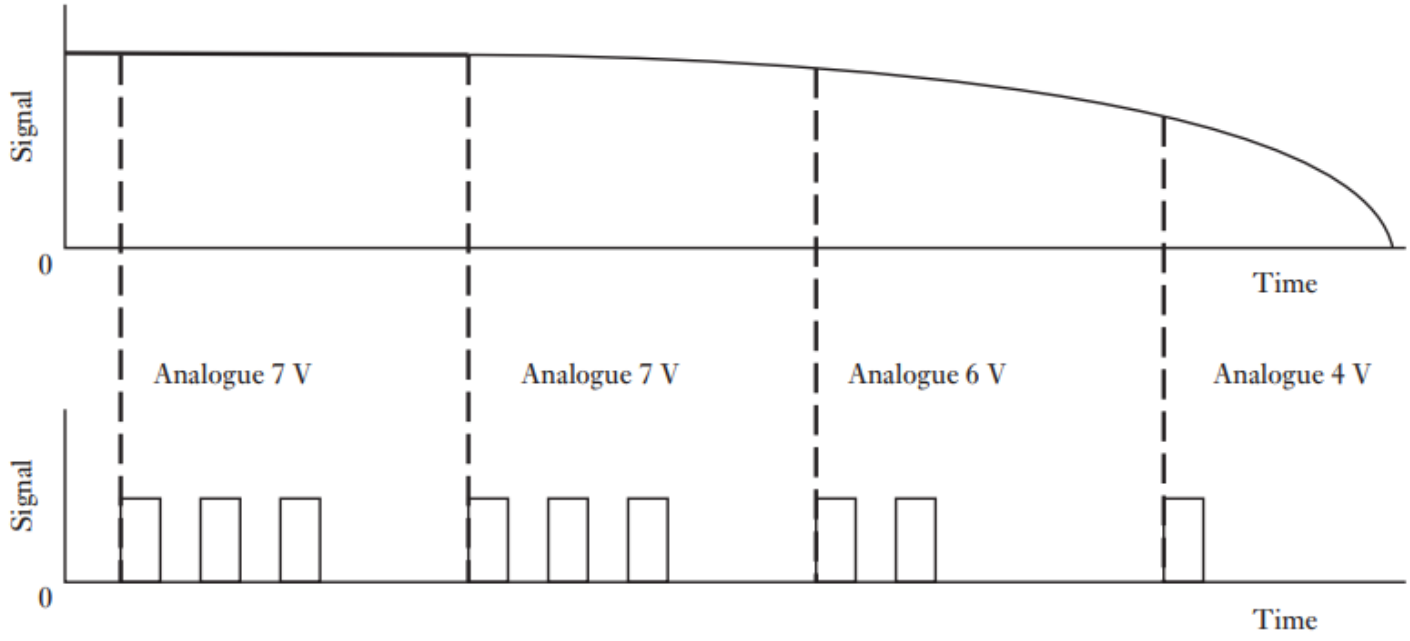
## 1.5 Control systems

- Shaft speed control



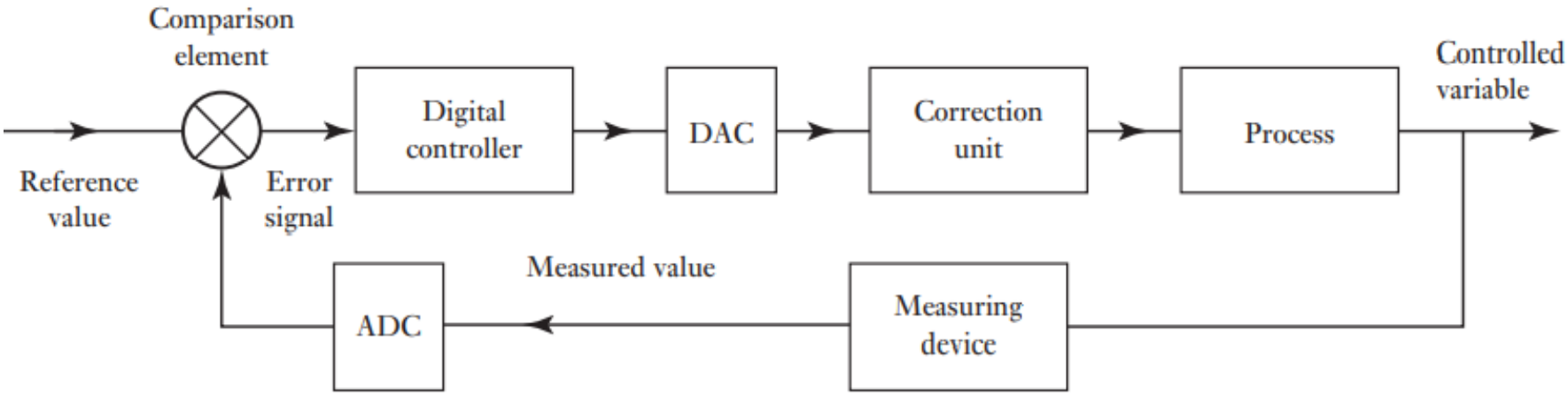
## 1.5 Control systems

- Analogue and digital control systems
  - Analogue systems are ones where all the signals are continuous functions of time and it is the size of the signal which is a measure of the variable.
  - Digital signals can be considered to be a sequence of on/off signals, the value of the variable being represented by the sequence of on/off pulses



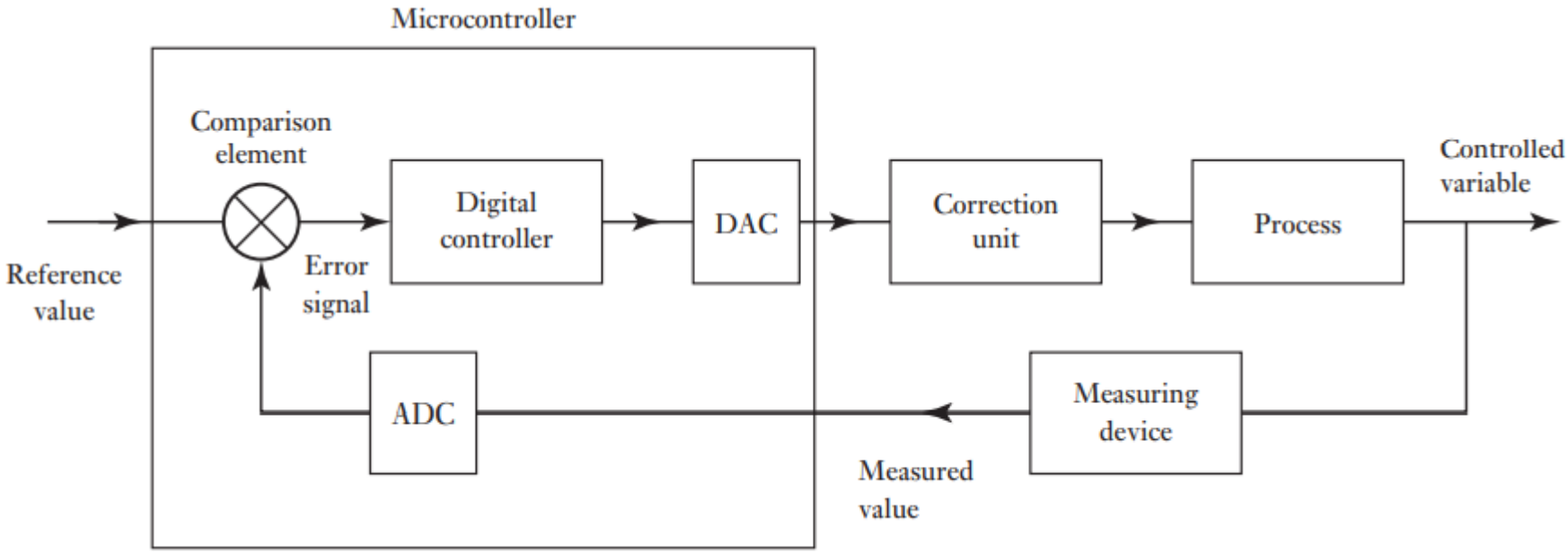
## 1.5 Control systems

- Digital closed-loop control system



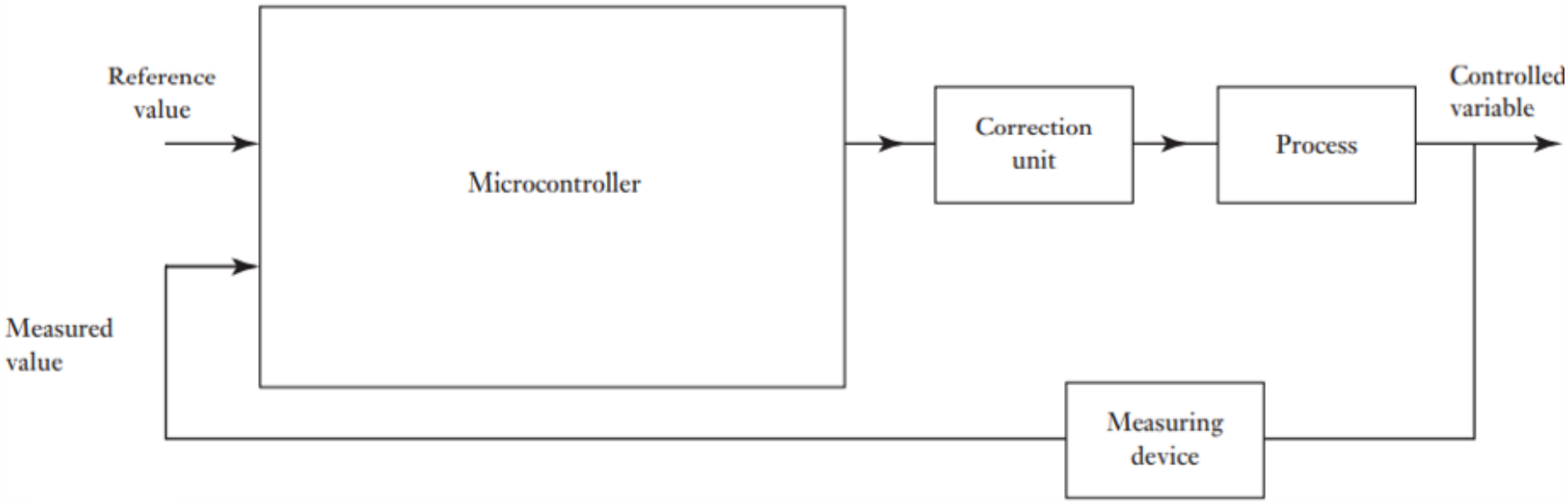
## 1.5 Control systems

- Microcontroller control



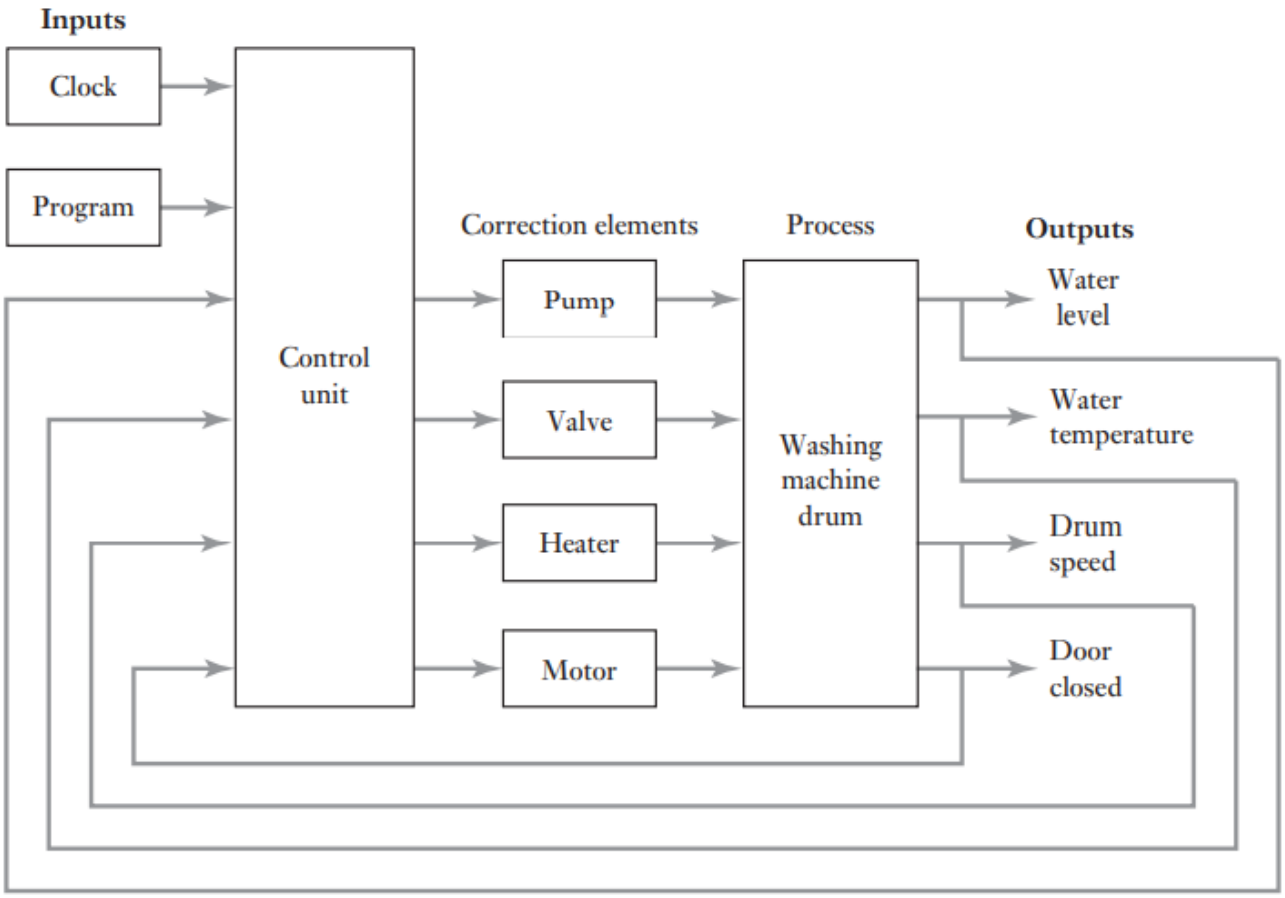
## 1.5 Control systems

- Microcontroller control



## 1.5 Control systems

- Washing machine




Feedback from outputs of water level, water temperature, drum speed and door closed