

Chapter 1

1-1 Basic Terms and Concepts

- **Reference Components:** a reference component generates the reference signal or the input signal
- **Controlled Variable:** the quantity or condition that is measured and controlled
- **Comparison Components:** compare the input with feedback signal and generate the error signal
- **Plant** or Process: any physical object or operation to be controlled
- **Controller:** a compensation component, improves the performance of the system
- **Actuator:** acts on that plant directly to adjust the controlled variable
- **Disturbance:** a signal that tends to adversely affect the value of the output of a system
- **Sensor** or measurement component: measure the output or the controlled variable and generate feedback signal

Examples

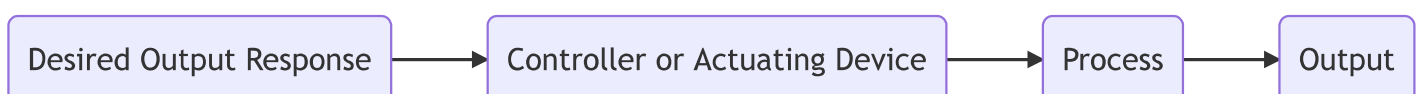
Control System	Plant	Controlled Variable
	water tank	water level
	electric furnace	the furnace temperature

1-2 Types of Control

Open-loop Control Systems

An open-loop system is a system without feed back

- the output of the open-loop system has no effect upon the input signal
- there is only forward action from the input to the output



Advantages

- simple construction and ease of maintenance

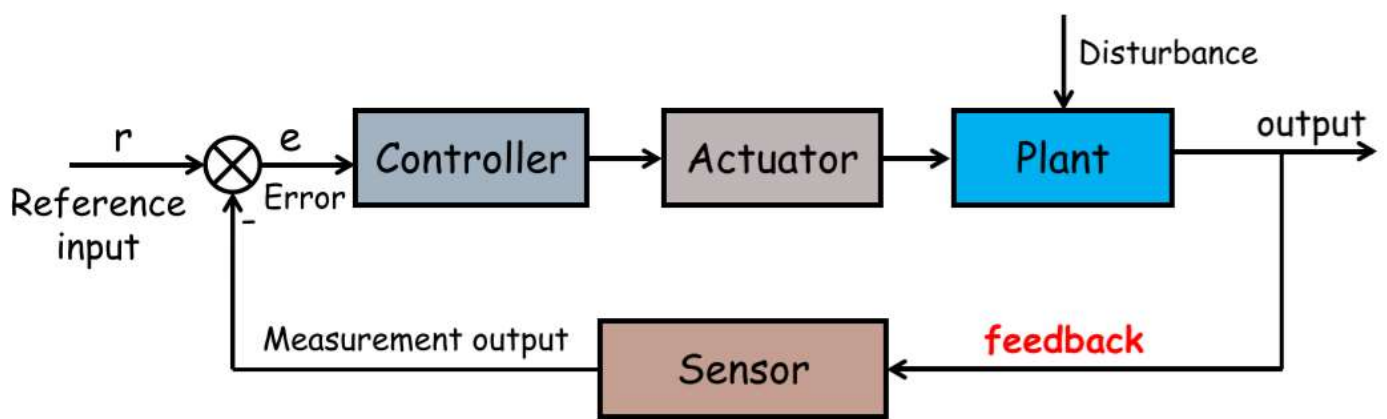
- less expensive
- no stability problem
- convenient when output is hard to measure

Disadvantages

- disturbance and changes in calibration cause errors
- to maintain the required quality in the output, recalibration is necessary from time to time

Closed-loop Control System

A closed-loop control system uses a measurement of the output and feedback of this signal to compare it with the desired output



Features

- there are feedbacks in the system so that signals flow through closed loops
- the error signal controls the system

General Requirements for Control Systems

- **Stability:** stability, smooth and steady
- **Swiftness:** peak time, settling time
- **Accuracy:** steady-state error

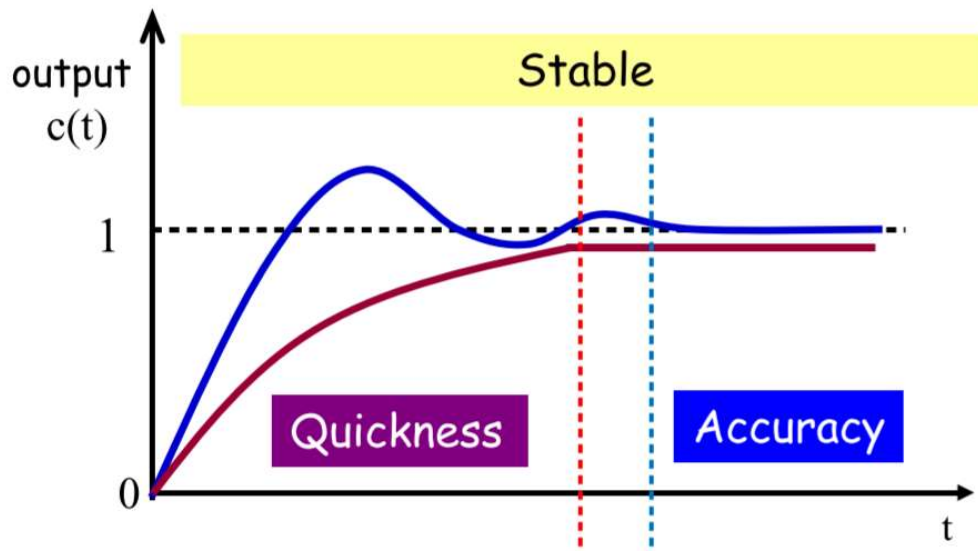
Stable and Unstable

Stable	Unstable

Regulation Process

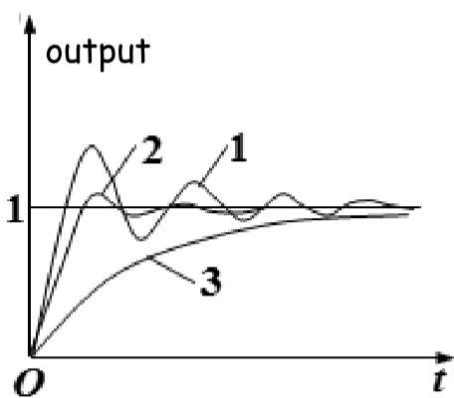
The whole regulation process can be divided into two stages

transient process + steady-state process



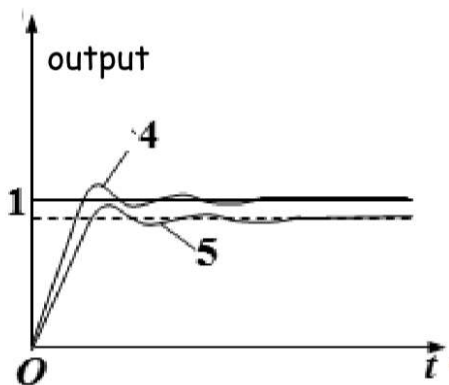
- **transient process** reflects dynamic characteristics
- **steady-state process** reflects steady-state characteristics

Transient Response



- **swiftness**: peak time, settling time

Steady-State Response



- **accuracy**: steady-state error