

INTRODUCTION TO CONTROL SYSTEM

Presented by

Dr. Nursadul Mamun
Assistant Professor
Dept. of ETE

Department of Electronics and Telecommunication Engineering
Chittagong University of Engineering and Technology

6/18/2025



Background

PhD : Cochlear Implant Processing Laboratory, Center for Robust Speech Systems (CRSS)

Erik Jonson School of Engineering & Computer Science, University of Texas at Dallas, USA
Fall 2018 – Fall 2023

Advisor: John H. L. Hansen

Thesis Topic: Improving Speech Intelligibility with Cochlear Implant/Hearing aid using ML constraint mapping

Master (2nd): Electrical Engineering,

Erik Jonson School of Engineering & Computer Science, University of Texas at Dallas

Master (1st): Biomedical Engineering

Department of Biomedical Engineering, The University of Malaya, Malaysia

Undergraduate: Department of Electrical Engineering,
Chittagong University of Engineering & Technology (CUET), Bangladesh



Job/Research Experience

Research Intern : 1. Acoustic system Engineering Intern (Full Time),
Apple Inc., Cupertino, California.
Spring 2021 – Summer 2021 (7 Months)

2. Research Scientist Intern (Full Time),
Facebook Inc./Meta, Redmond, Washington.
Summer 2022 (4 Months)
2. Research Scientist Intern (Part Time),
Facebook Inc./Meta, Redmond, Washington.
Fall 2022 (2 Months)

Research Assistant: Cochlear Implant Processing Laboratory, Center for Robust Speech Systems
Erik Jonson School of Engineering & Computer Science, University of Texas at Dallas, USA

Research Assistant: Auditory Neuroscience Laboratory, Department of Biomedical Engineering,
The University of Malaya, Malaysia

Assistant Professor: Department of Electronics and Telecommunication Engineering,
Chittagong University of Engineering & Technology (CUET), Bangladesh



Contents:

- ✓ Motivation
- ✓ Defination
- ✓ Classification
- ✓ Open loop & Close control system
- ✓ Differences
- ✓ DC Shunt Motor
- ✓ General Nature of Engineering Control system
- ✓ Conclusion

Reference

- D'AZZO:
Chapter 1; Section: 1.2, 1.3, 1.7
- Nise:
Chapter 1; Section: 1.6

CONTROL SYSTEM

6

Rover was build to work in contaminated areas

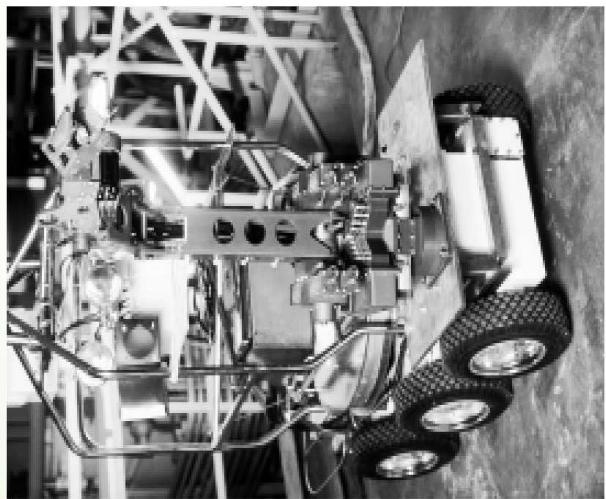
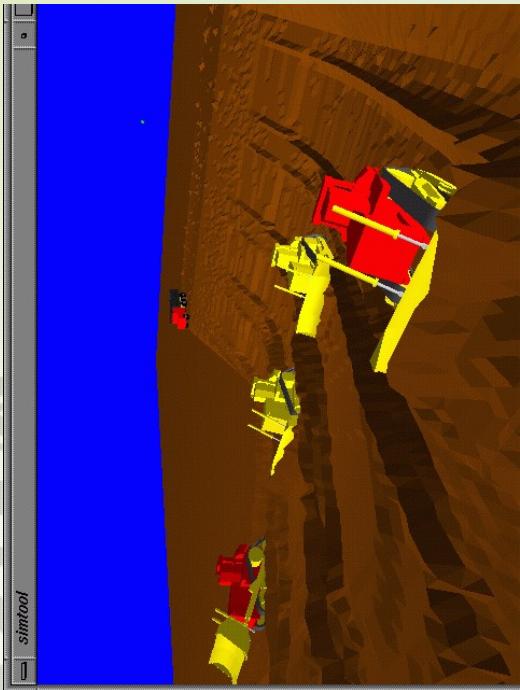


Photo © Hank Morgan/Rainbow/PNI.



Robots used in surface mining,
planetary exploration

6/18/2025

CONTROL SYSTEM

7

Mobile robots lead-follow
example



6/18/2025

Motivation

8

- ❖ Modern society have **sophisticated control systems** with **successful operation.**
- ❖ Essential role from simple **household washing machine** to high performance **F-16 fighter aircraft.**

Examples:

- ✓ Radar antenna (input is a low-power rotation of a knob, and output is a rotation which needs a large amount of power.)
- ✓ Robots
- ✓ Temperature control (input: position on thermostat, output is heat)
- ✓ Power system transient stability.

CONTROL SYSTEM

CONTROL

The word control is usually taken to mean:

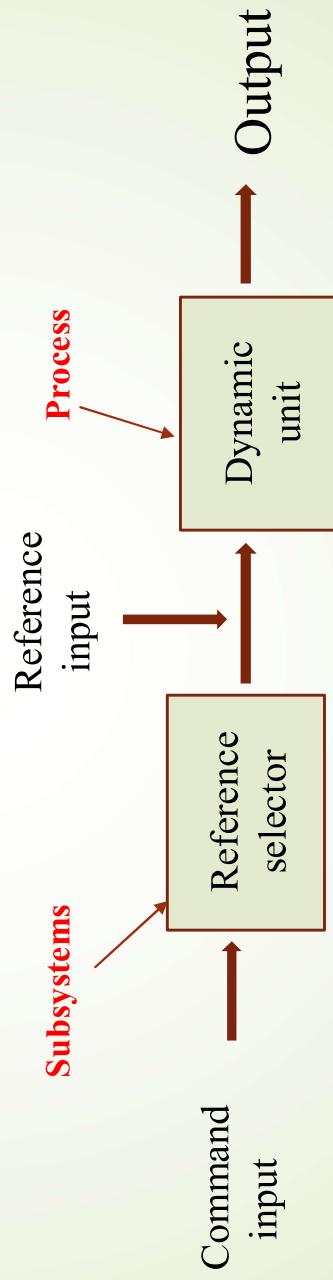
- ◇ Regulate
- ◇ Direct
- ◇ Command

CONTROL SYSTEM

10

System : An interconnection of elements and devices for a desired purpose.

Control System : A control system consists of **subsystems & processes** designed for the purpose of obtaining a **desired output** with desire performances with a given input.



In other word, An interconnection of components forming a system configuration that will provide a desired response.

6/18/2025

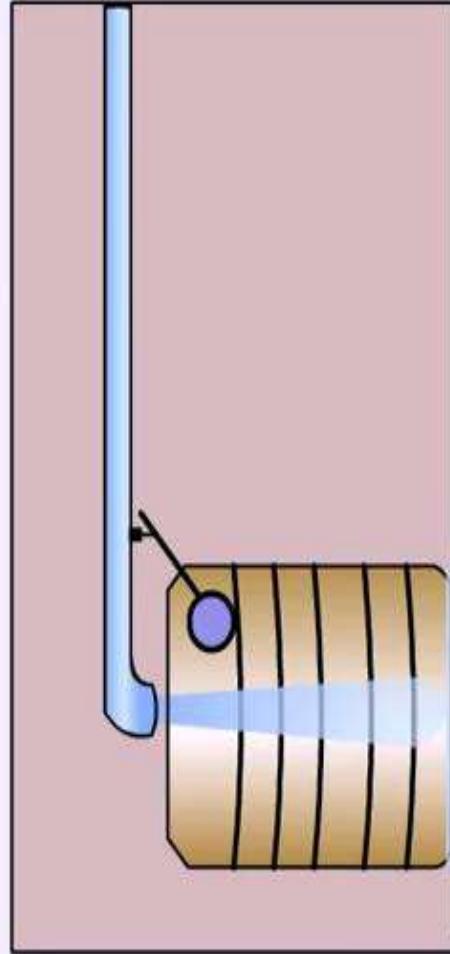
CONTROL SYSTEM

Example-

Control System

Classification

- Man made Control system



6/18/2025
Click@future
Wire closure/tire open

EduGATE

CONTROL SYSTEM

12

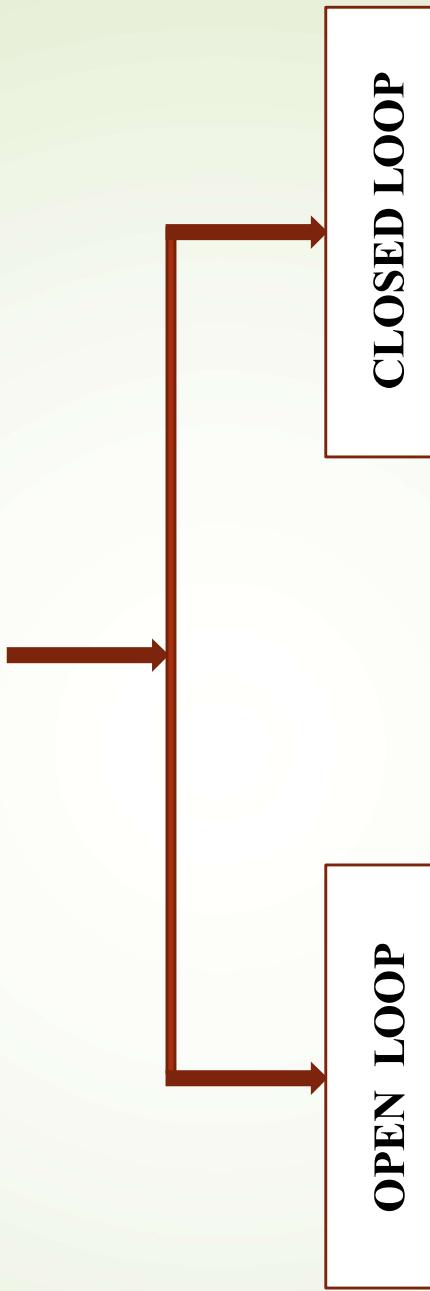
Importance:

1. Automation
2. Remote control
3. Compensation of disturbance

6/18/2025

CLASSIFICATION

CONTROL SYSTEM



CONTROL SYSTEM

14

Classification:

Two types –

1. Open loop control system
2. Closed loop control system

CONTROL SYSTEM

Open Loop

- Controlling action are independent of the output of system.
- No feedback.

Structure

Two components:

- 1) Controller
- 2) System

CONTROL SYSTEM

16

Open Loop

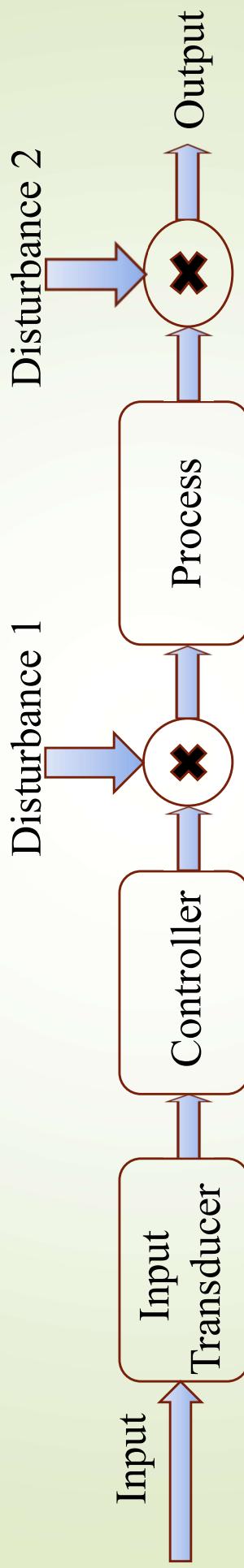


Fig 1: Block diagram of Open loop control system

CONTROL SYSTEM

Some examples-

17

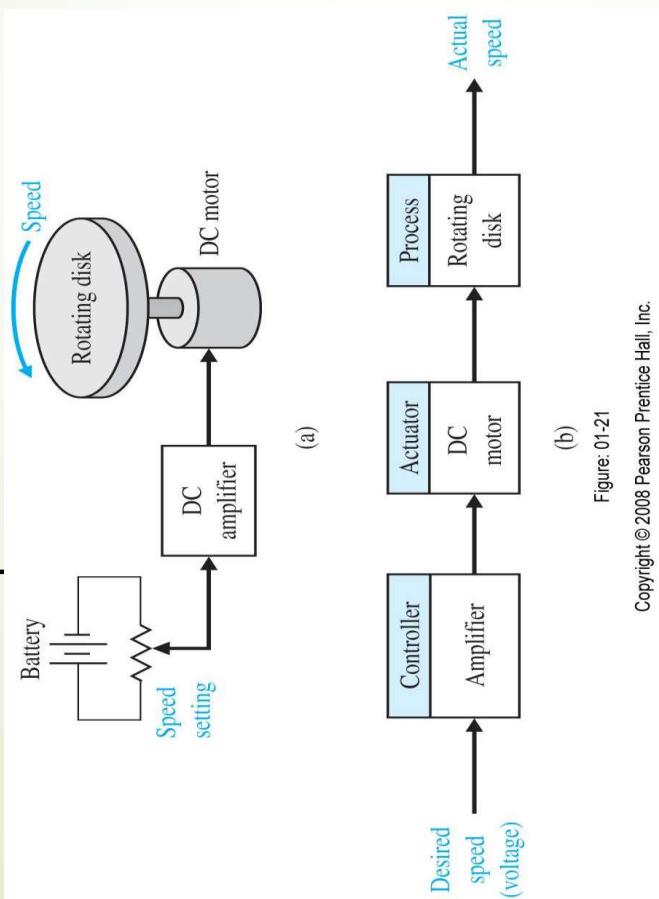
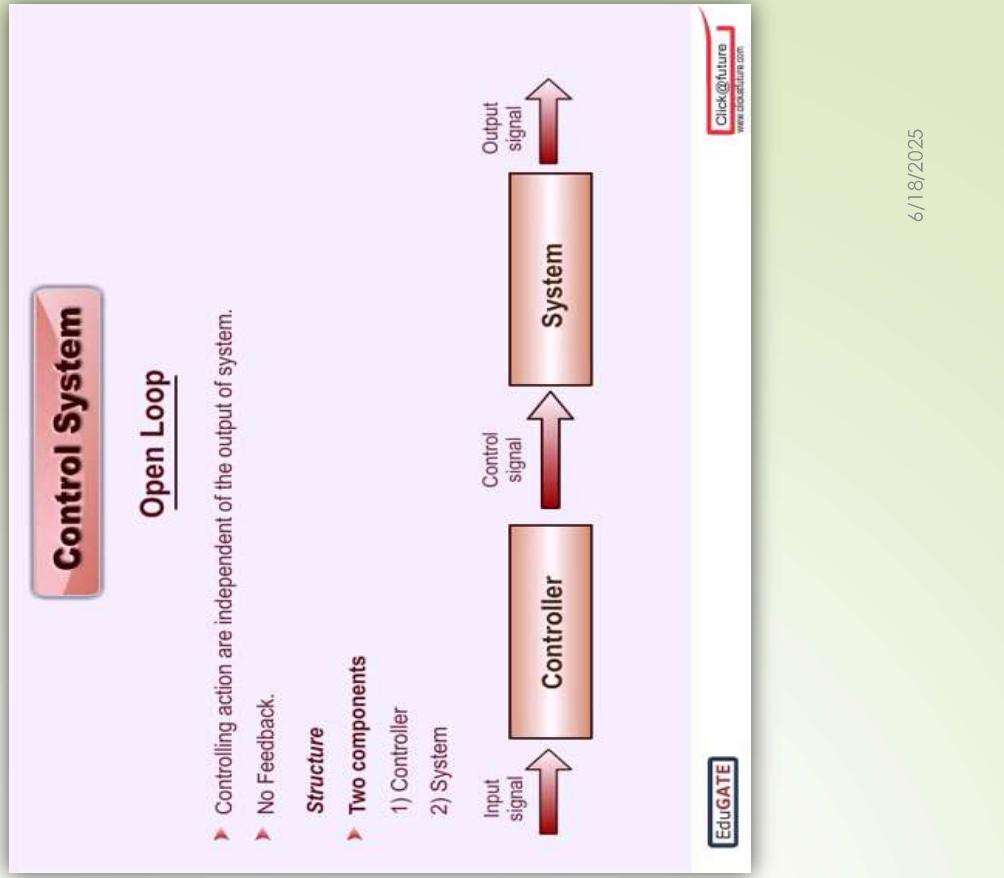


Figure 01-21
Copyright © 2008 Pearson Prentice Hall, Inc.



6/18/2025

CONTROL SYSTEM

Open Loop

Advantages-

- Simple to design
- Less maintenance require

Disadvantages-

- Inaccurate
- Not reliable
- Internal noise and parameter variation affects system performance

CONTROL SYSTEM

Close Loop

- Dependent on output
- Feedback present
- Consists of-

1. Controller

2. System

3. Feedback system

4. Error detector/ comparator

CONTROL SYSTEM

Close Loop

20

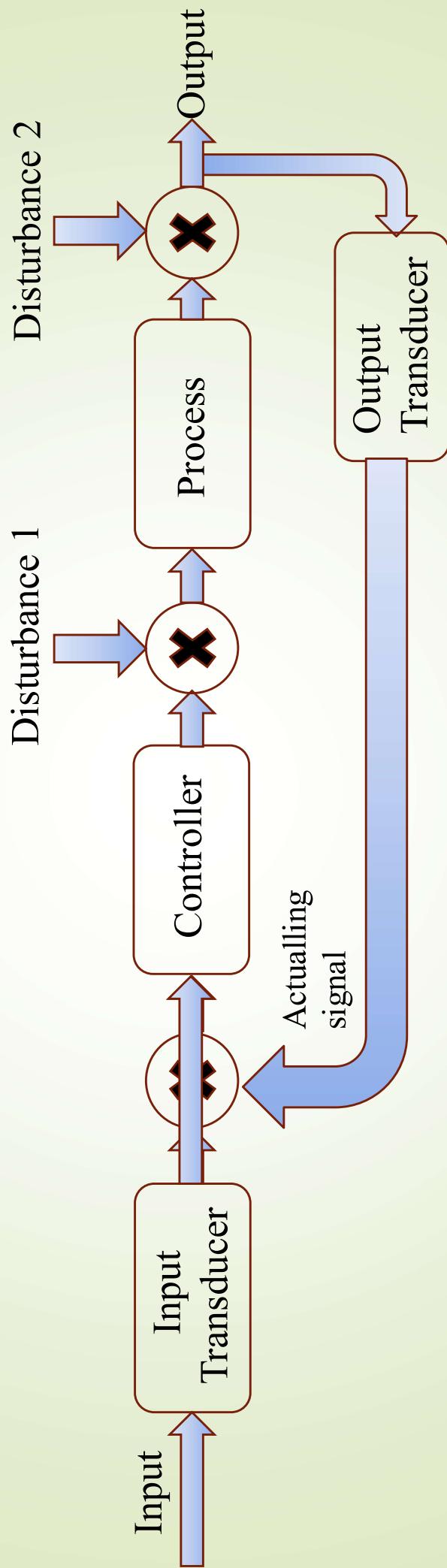


Fig 2: Block diagram of Close loop control system

6/18/2025

CONTROL SYSTEM

Example-

Control System

Close Loop System

Example

Click@future
www.clickfuture.com

EduGATE

6/18/2025

CONTROL SYSTEM

Close Loop

22

Advantages-

- Accurate and reliable
- Faster
- Reduced effect of parameter variation

Disadvantages-

- Complicated to design
- Costly
- Can become unstable under certain condition

Difference between open & close loop:

Close Loop

1. Less sensitive to noise.
2. Transient & steady state error can be controlled more conveniently.
3. Gain is controllable.
4. More complex and expensive.

Open Loop

1. More sensitive to noise.
2. Transient & steady state error can't be controlled.
3. Gain isn't controllable.
4. Simple and cost effective.

CONTROL SYSTEM

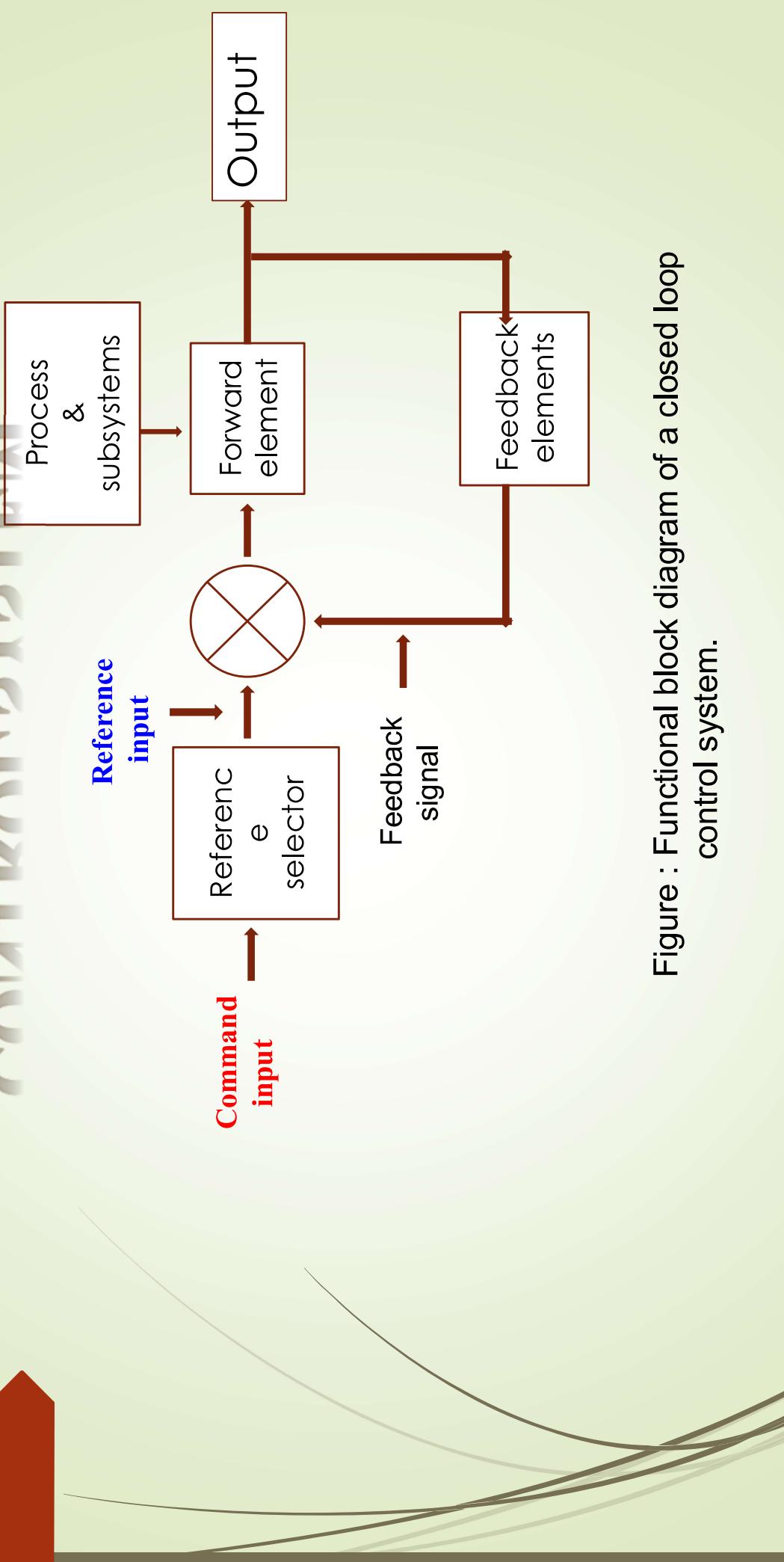


Figure : Functional block diagram of a closed loop control system.

Command Input :

- Motivating input signal to the system.
- Independent of output of the system.
- If the system is completely controllable , exercise complete control over it.

Reference Input :

- Actual signal input to the control system.
- Produced by the reference selector.
- Is not independent of output of the system.



Steps of Engineering Control System

26

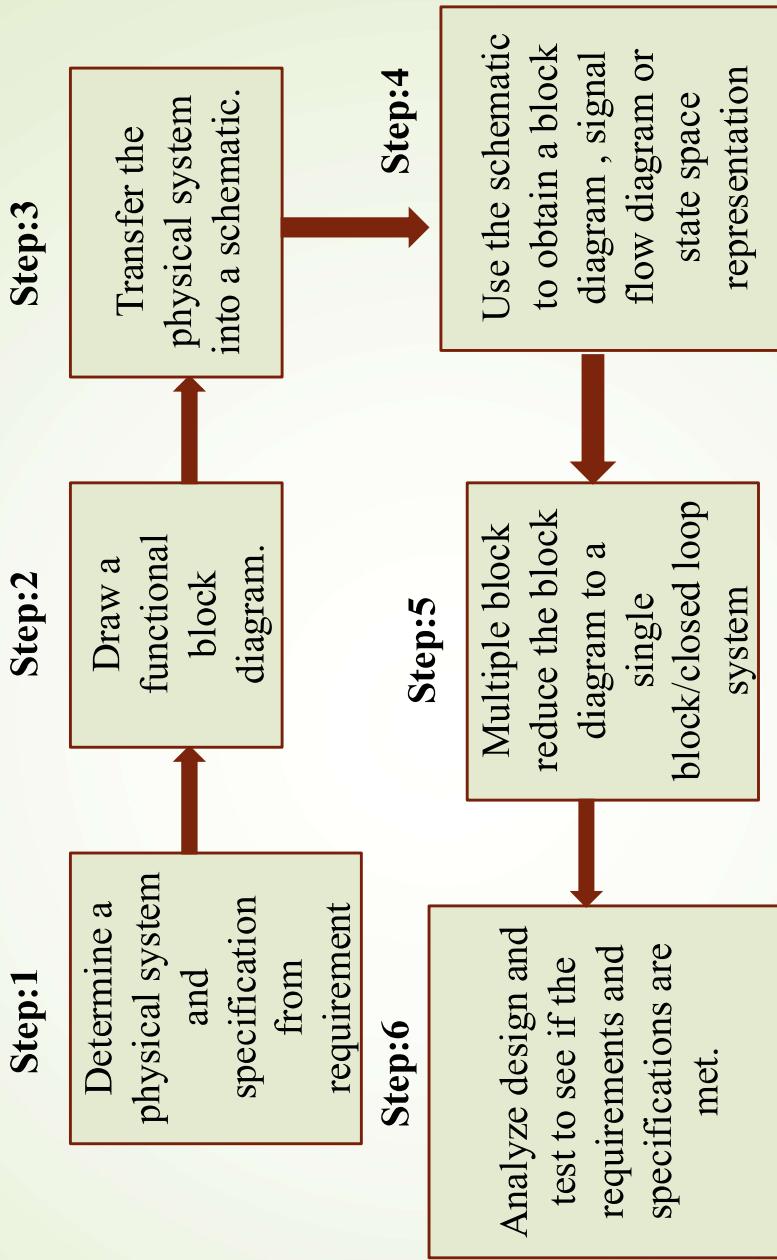
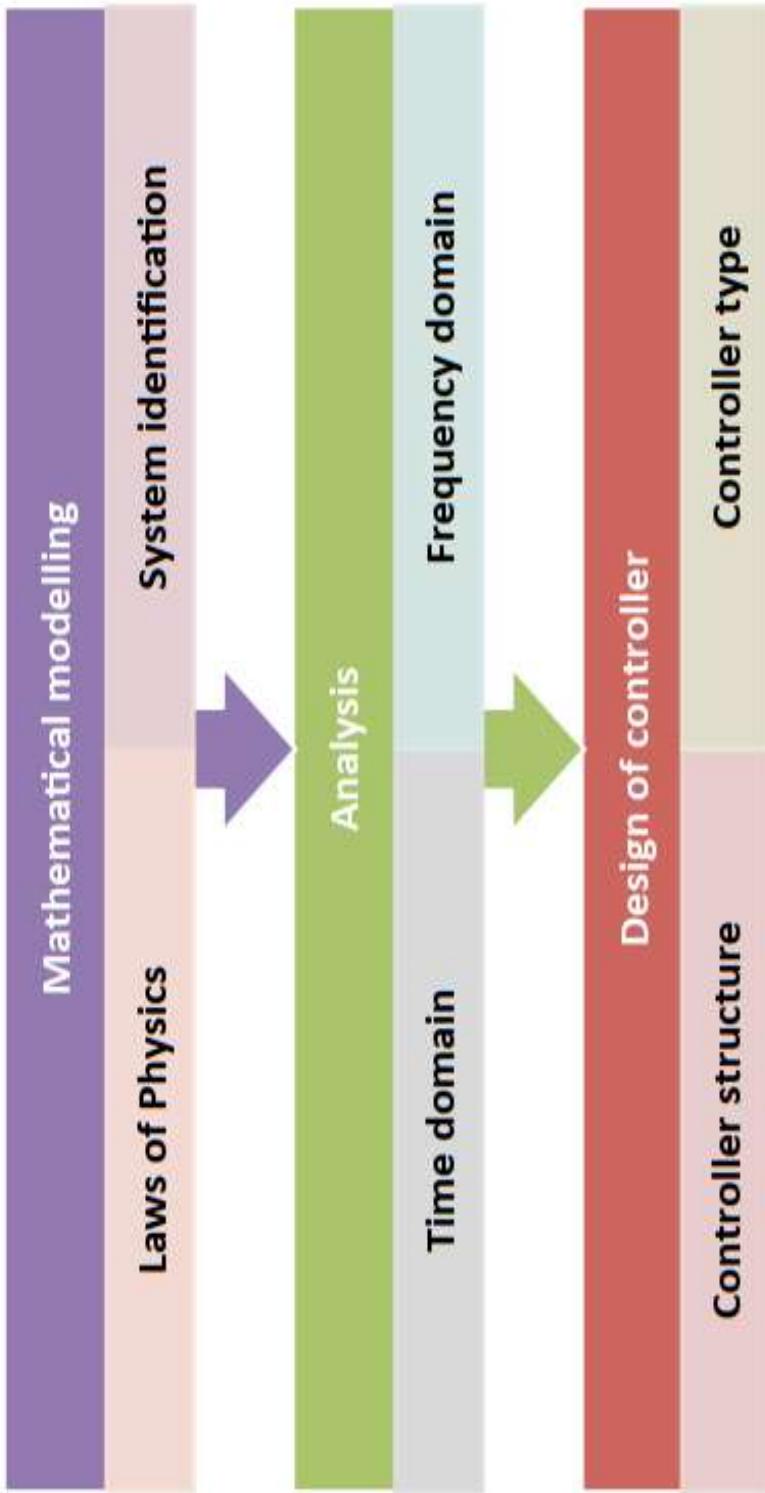


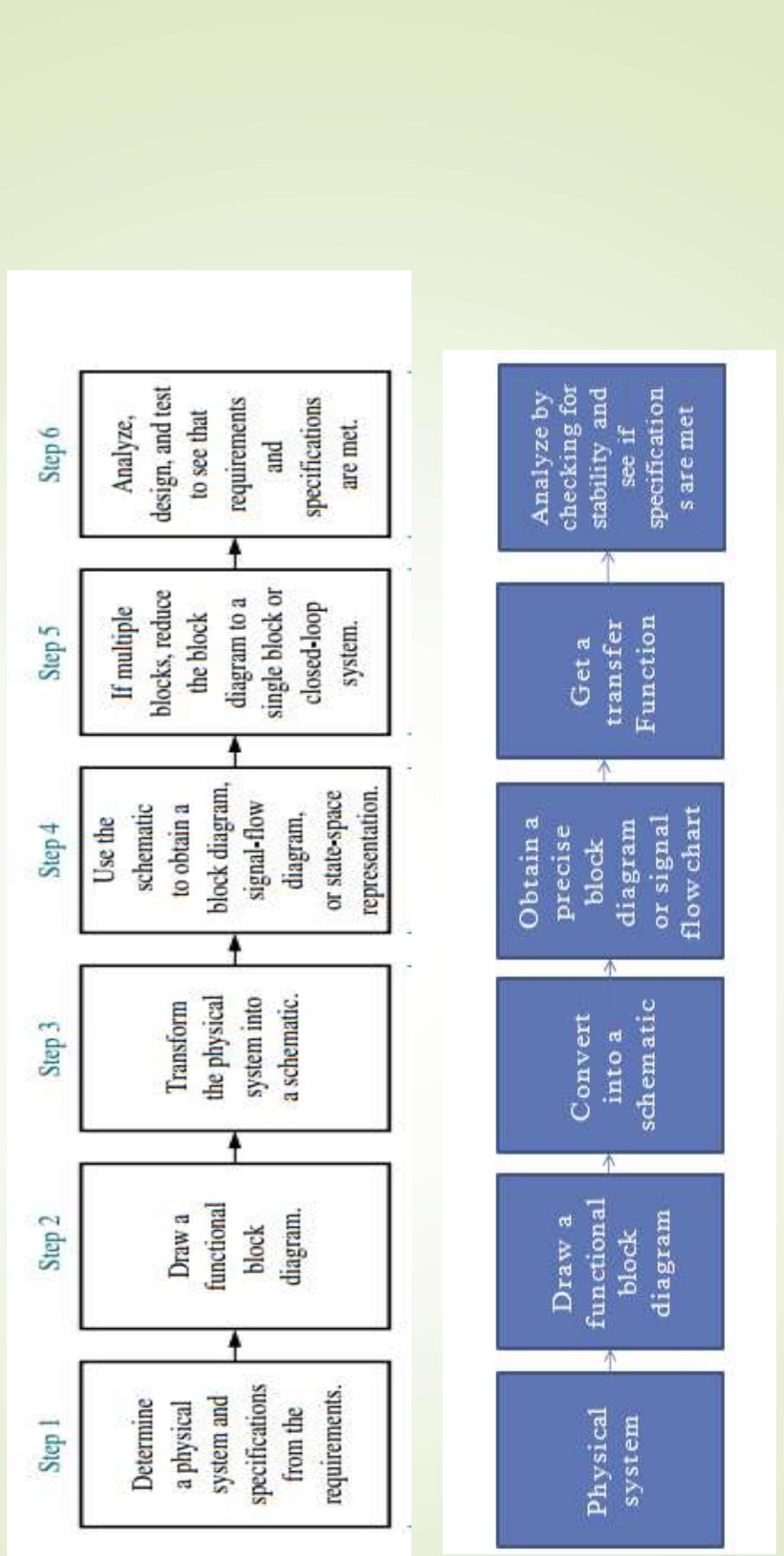
Figure : Block diagram of different steps of Engineering Control System.

Control system design

General Controller Design Process



Design Process



Steps of Design process

The design of a control system follows these steps:

Step 1 Determine a physical system and specifications from requirements.

Step 2 Draw a functional block diagram.

Step 3 Represent the physical system as a schematic.

Step 4 Use the schematic to obtain a mathematical model, such as a block diagram.

Step 5 Reduce the block diagram.

Step 6 Analyze and design the system to meet specified requirements and specifications that include stability, transient response, and steady-state performance.

Open or Close loop control system ?

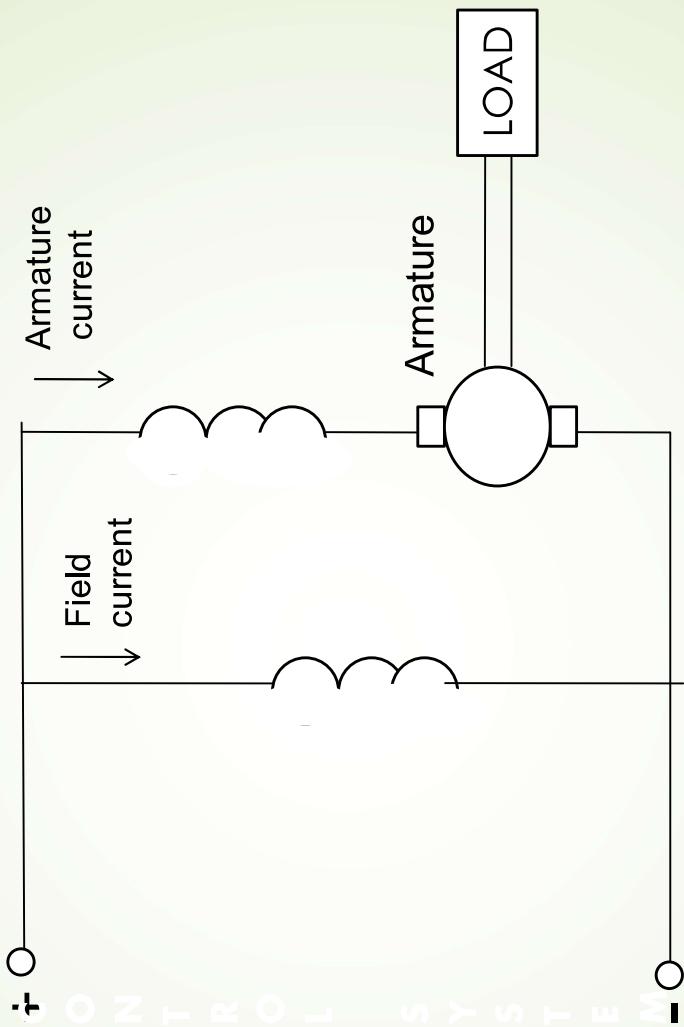


Figure: DC shunt motor.

Open or Close loop control system ?

31

In This Case,

- The motor is the dynamic part, applied armature voltage is the input quantity and the speed is the output quantity.

Here,

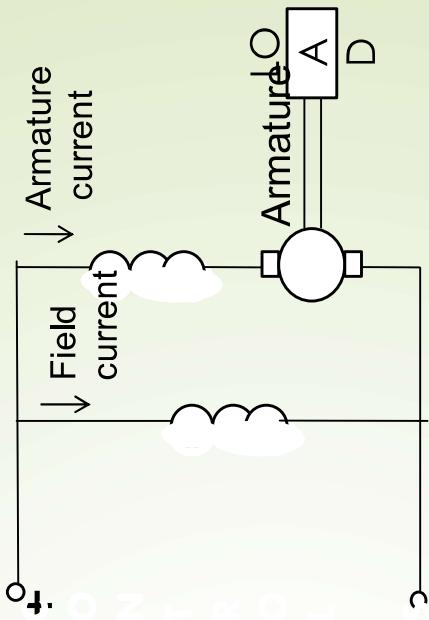
- A variation of the speed from the desired value, due a change of mechanical load on the shaft can in no way cause a change in the value of applied armature voltage to maintain the desired speed.

So,

- The output quantity has no influence on the input quantity.

That's Why.....

An DC shunt motor is an **open loop** control system



Types of navy command and control systems

- Combat management systems (CMS)
- Sensor suites including detection and identification sensors
- Data transfer communication systems
- Radar display and target tracking
- Electro-optical systems for naval firing control
- Multi-function console systems
- Navigation and data management systems
- Network computing products
- Data fusion solutions
- Sensor networking solutions, and
- Weapon control systems

CONTROL SYSTEM

33

Conclusion:

The central problem in control is to find a technically feasible way to act on a given process so that the process behaves, as closely as possible, to some desired behavior. Furthermore, this approximate behavior should be achieved in the face of uncertainty of the process and in the presence of uncontrollable external disturbances acting on the process.

6/18/2025

**For beautiful eyes, look for the good in others;
for beautiful lips, speak only words of kindness;
and for poise, walk with the knowledge that you
are never alone.**

-Audrey Hepburn

Smile is Sunnah

Keep Smiling

THANK YOU