

# Classification of control systems

- I. Open loop and closed loop control system
- II. Linear and non-linear control system
- III. Static and dynamic system
- IV. Continuous and discrete data system
- V. SISO and MIMO systems

a) If the aim is to maintain a physical variable at some fixed value when there are disturbances, this is a *regulator*.

Example: speed-control system on the ac generators of power utility companies.

b) The second class is the *servomechanism*. This is a control system in which a physical variable is required to follow (track) some desired time function.

Example: an automatic aircraft landing system, or a robot arm designed to follow a required path in space.

# Advantages of a Control System

- **Convenience of input form**

- In a temperature control system, the input is the position on a thermostat and the output is the heat. Thus a convenient position input yields a desired thermal output.

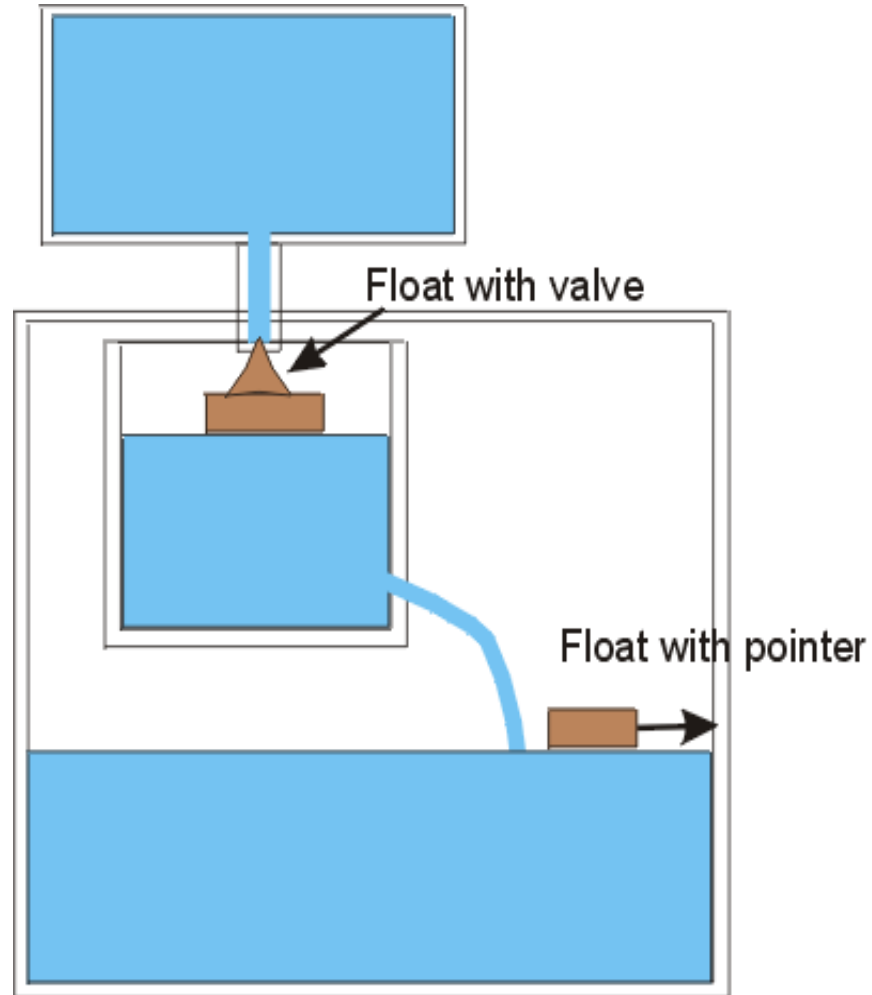
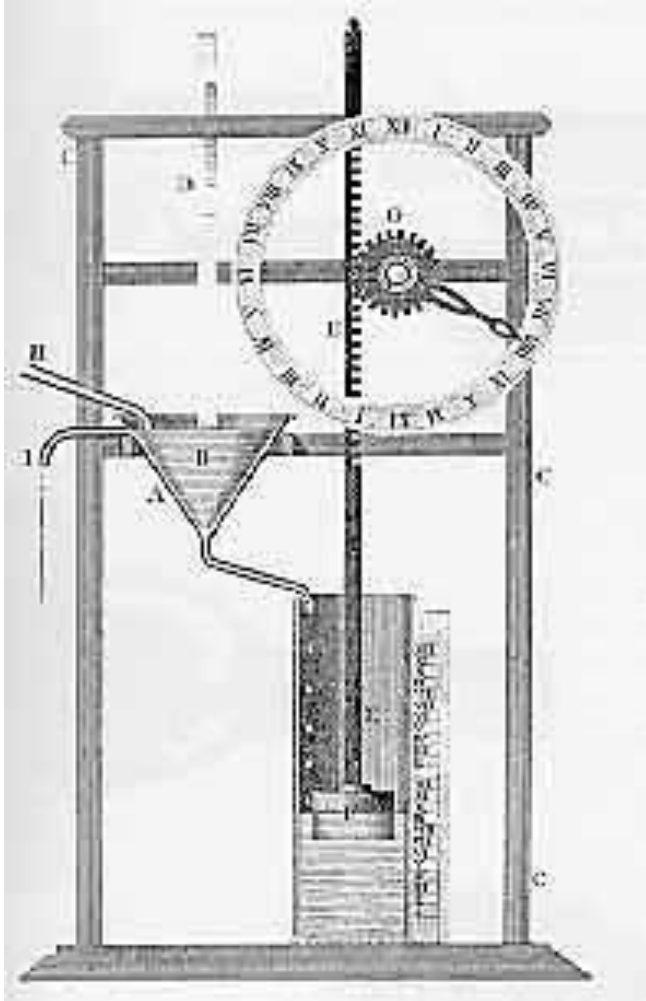
# Advantages of a Control System

- **Compensation for disturbances**

- In an antenna system that points in a commanded direction, wind can force the antenna to deviate from commanded direction. The system should detect the disturbance and act accordingly.

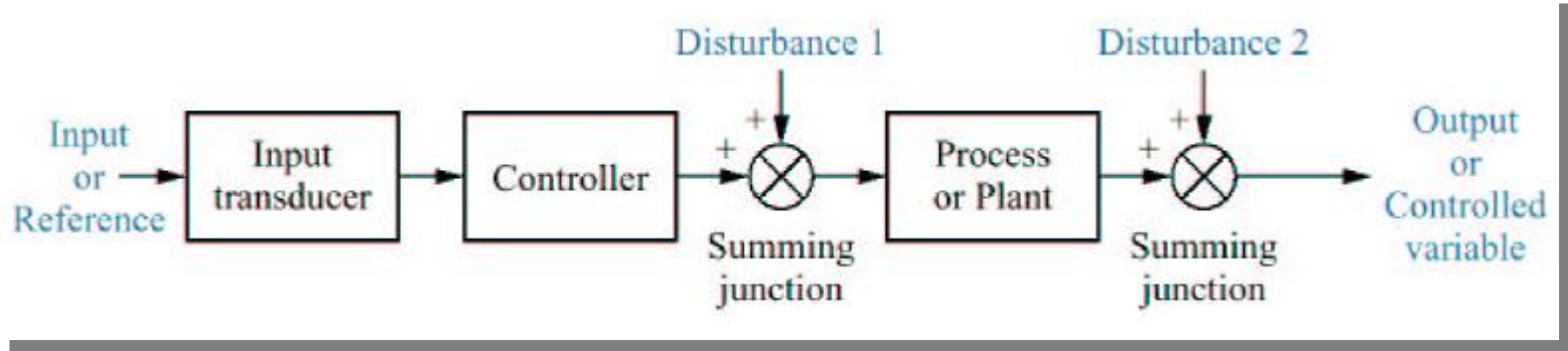
# Classical Control Systems

- Liquid Level Control



# Open-Loop Systems

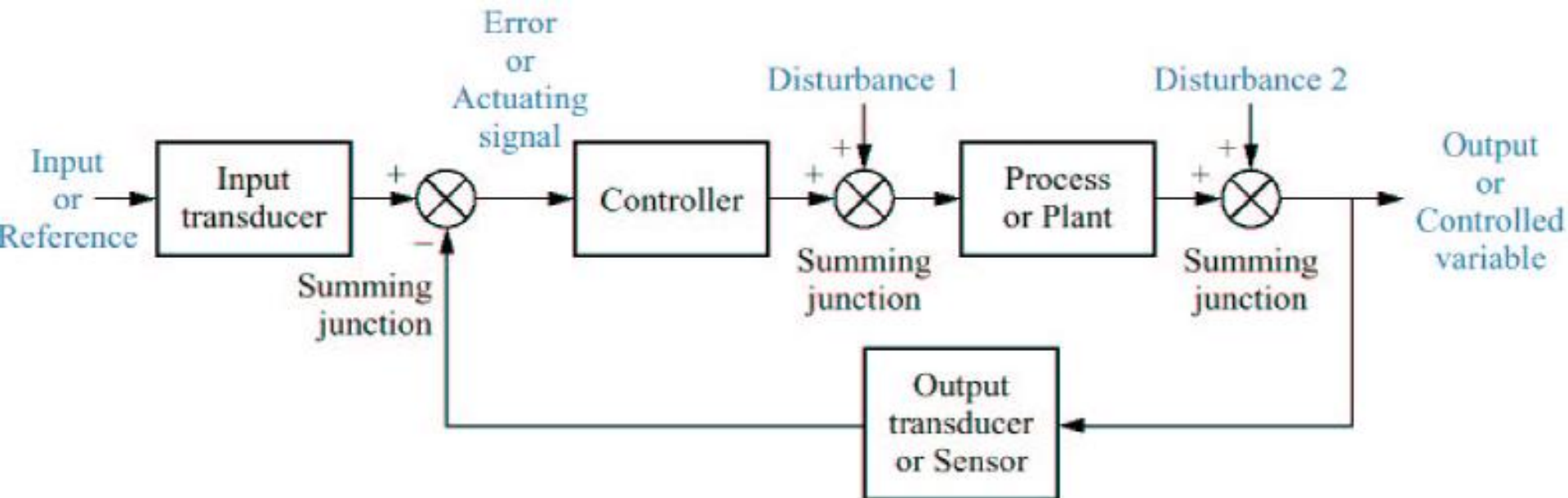
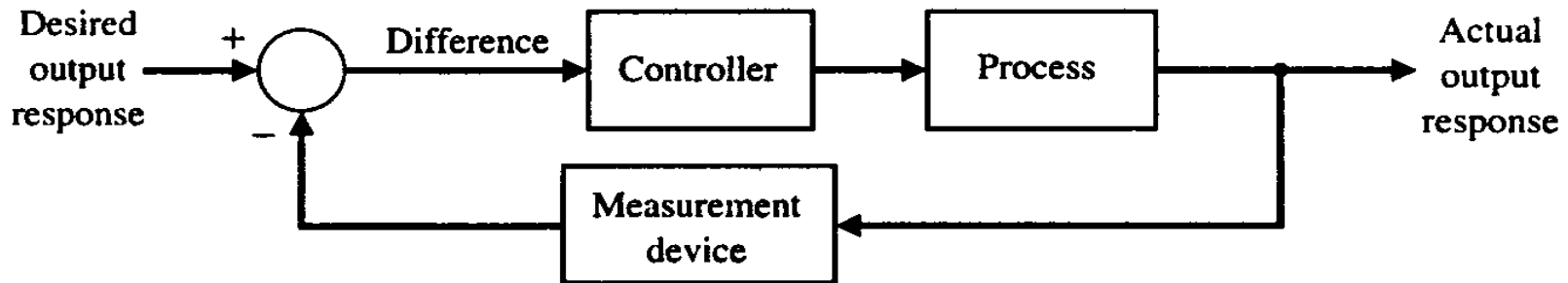
- An open-loop system cannot compensate for any disturbances that add to the controller's driving signal or to the process output.



# Closed-Loop (Feedback Control)

- A closed-loop system can compensate for disturbances by measuring the output, comparing it to the desired output, and driving the difference toward zero.

# Closed-Loop (Feedback Control)



# Feedback

Feedback is a key tool that can be used to modify the behavior of a system.

- This behavior altering effect of feedback is a key mechanism that control engineers exploit deliberately to achieve the objective of acting on a system to ensure that the desired performance specifications are achieved.



# Closed-Loop (Feedback Control)

- Greater accuracy than open-loop systems
- Transient and steady-state responses can be controlled more easily
- More complex and expensive than open-loop systems
  - Requires monitoring the plant output

# Why Control Systems for CSE and ECE?

- *Engineering involves the study of design and analysis of engineering systems.*
- *Engineering systems are physical systems which could be modeled mathematically (mathematical models).*
- *Many engineering or physical systems are control systems.*  
*Examples are: central heating system, auto pilot, robots, automobiles, etc.*
- *Software engineers and Electronics engineers often participate in the development of softwares and hardwares for control systems, e.g. software for the control of the space shuttle.*