UNIT -3

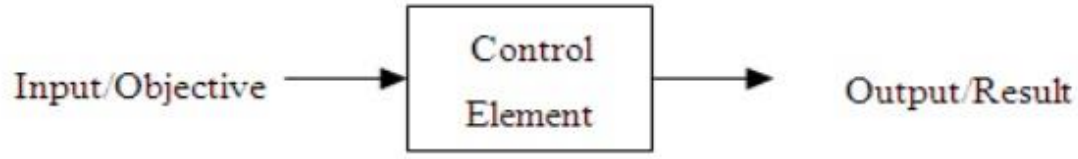
CONTROL SYSTEM REPRESENTATION

Basic elements of control system

In recent years, control systems have gained an increasingly importance in the development and advancement of the modern civilization and technology. Figure shows the basic components of a control system. Disregard the complexity of the system; it consists of an input (objective), the control system and its output (result). Practically our day-to-day activities are affected by some type of control systems. There are two main branches of control systems:

1) Open-loop systems and

2) Closed-loop systems.



Basic Components of Control System

The controller is the element of the system. It can also lie external to the system. The function of the controller is to control the plant or process. Every system accepts an input and defines the output after analyzing the nature of the input. The controller in the control system is a mechanism that reduces the difference between the **actual value** and **desired value** of the system. Here, the actual value signifies the real value, while desired value is the set-point or target value.

Input

It is a signal from the external energy source applied to the control system to produce the desired output.

Or It is the desired action that is capable of producing any response in a system.

The common types of input used in the control system are **SISO** (Single Input Single Output) and **MIMO** (Multiple Input and Multiple Output). SISO means that the system produces single output for the single input, while MIMO produces multiple outputs for the multiple inputs. It is shown below:

The reference input in a control system is also known as the **set-point**, the desired value. It acts as the basis for error-controlled regulation using negative feedback for error control.

Output

It is an actual response of the applied input signal from the control system. The inputs are excited into the system and the outputs are the processed results of that inputs. The outputs are the results of either a small part of the process or the entire process.

Basic terminologies in control system

System: A combination or arrangement of a number of different physical components to form a whole unit such that that combining unit performs to achieve a certain goal.

Control: The action to command, direct or regulate a system.

Plant or process: The part or component of a system that is required to be controlled.

Input: It is the signal or excitation supplied to a control system.

Output: It is the actual response obtained from the control system.

Controller: The part or component of a system that controls the plant.

Disturbances: The signal that has adverse effect on the performance of a control system.

Control system: A system that can command, direct or regulate itself or another system to achieve a certain goal.

Automation: The control of a process by automatic means

Control System: An interconnection of components forming a system configuration that will provide a desired response.

Actuator: It is the device that causes the process to provide the output. It is the device that provides the motive power to the process.

Design: The process of conceiving or inventing the forms, parts, and details of system to achieve a specified purpose.
Simulation: A model of a system that is used to investigate the behavior of a system by utilizing actual input signals**.**

Optimization: The adjustment of the parameters to achieve the most favorable or advantageous design.

Feedback Signal: A measure of the output of the system used for feedback to control the system.

Negative feedback: The output signal is feedback so that it subtracts from the input signal.

Block diagrams: Unidirectional, operational blocks that represent the transfer functions of the elements of the system.

Signal Flow Graph (SFG): A diagram that consists of nodes connected by several directed branches and that is a graphical representation of a set of linear relations.

Specifications: Statements that explicitly state what the device or product is to be and to do.It is also defined as a set of prescribed performance criteria.

Open-loop control system: A system that utilizes a device to control the process without using feedback. Thus the output has no effect upon the signal to the process.

Closed-loop feedback control system: A system that uses a measurement of the output and compares it with the desired output.

Regulator: The control system where the desired values of the controlled outputs are more orless fixed and the main problem is to reject disturbance effects.

Servo system: The control system where the outputs are mechanical quantities like acceleration, velocity or position.

Stability: It is a notion that describes whether the system will be able to follow the input command. In a non-rigorous sense, a system is said to be unstable if its output is out of control or increases without bound.

Multivariable Control System: A system with more than one input variable or more than one output variable.

Trade-off: The result of making a judgment about how much compromise must be made between conflicting criteria.