Control Systems

Types of Control Systems

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Types of control systems

➢ There are various types of control systems, and all of them are created to control outputs.

➢ The system used for controlling the position, velocity, acceleration, temperature, pressure, voltage and current etc. are examples of control systems.

1. Natural, Man-made and Combinational control system:

- **Natural control system:** It is a control system that is created by nature,

  i.e. solar system, digestive system of any animal, etc.

- **Man-made control system:** It is a control system that is created by humans, **i.e.**
- automobile, power plants etc.
- **Combinational control system:** It is a control system that is a combination of natural and man-made control systems, i.e. driving a car etc.

2. Manual, Automatic and Combinational control system:

Manual control system: It is a control system in which the control adjustment is made manually.

e.g., Room heating by using a heating element or coil

- **Automatic control system:** It is a control system that is made by using basic theories from mathematics and engineering. This system mainly has sensors, actuators and responders. **e.g.**

  i.   **Room heating by using a heating element or coil with predetermined timing.**

  ii. **Room heating by using a heating element or coil with error measuring sensor.**

3. Open-loop control system and Closed-loop control system:

Open-loop control system: It is a control system where its control action only depends on input signal and does not depend on its output response.

Closed-loop control system : It is a control system where its control action depends on both of its input signal and output response.

4. Time-variant control system and Time-invariant control system:

- **Time-variant control system:** It is a control system where any one or more parameters of the control system vary with time i.e. driving a vehicle.

- **Time-invariant control system:** It is a control system where none of its parameters vary with time i.e. control system made up of inductors, capacitors and resistors only.

5. Linear control system and Non-linear control system:

- **Linear control system:** It is a control system that satisfies properties of homogeneity and additive.

- Additive property : $f(x + y) = f(x) + f(y)$

- Homogeneous property : $f(Kx) = K\,f(x)$

- **Non-linear control system:** It is a control system that does not satisfy properties of homogeneity and additive, i.e. $f(x) = x^3$

6. Continuous-Time control system and Discrete-Time control system:

- **Continuous-Time control system:** It is a control system where performances of all of its parameters are function of time, i.e. armature type speed control of motor.

- **Discrete -Time control system:** It is a control system where performances of all of its parameters are function of discrete time i.e. microprocessor type speed control of motor.

7. Deterministic control system and Stochastic control system:

- **Deterministic control system:** It is a control system where its output is predictable or repetitive for certain input signal or disturbance signal.

- **Stochastic control system:** It is a control system where its output is unpredictable or non-repetitive for certain input signal or disturbance signal.

8. Lumped-parameter control system and Distributed-parameter control system:

- **Lumped-parameter control system:** It is a control system where its mathematical model is represented by ordinary differential equations.
- **Distributed-parameter control system:** It is a control system where its mathematical model is represented by partial differential equations.

 an electrical network that is a combination of resistors, inductors and capacitors.

9. Single-input-single-output (SISO) control system and Multi-input-multi-output (MIMO) control system:

- **SISO control system:** It is a control system that has only one input and one output.

- **MIMO control system:** It is a control system that has only more than one input and more than one output.