

## 1.1 INTRODUCTION

A system is a combination of components connected to perform a required action. The control component of a system plays a major role in altering or maintaining the system output based on our desired characteristics. There are two types of control systems: manual control and automatic control. For example, in manual control, a man can switch ON or OFF the bore well motor to control the level of water in a tank. On the other hand, in automatic control, level switches and transducers are used to control the level of water in a tank. Control systems have naturally evolved in our ecosystem. In almost all living things, automatic control regulates the conditions necessary for life by tackling the disturbance through sensing and controlling functionalities. They operate complex systems and processes and achieve control with desired precision. The application of control systems facilitates automated manufacturing processes, accurate positioning and effective control of machine tools. They guide and control space vehicles, aircrafts, ships and high-speed ground transportation systems. modern automation of a plant involves components such as sensors, instruments, computers and application of techniques that involve data processing and control. It is essential to understand a system and its characteristics with the help of a model, before creating a control for it. The process of developing a model is known as modeling. Physical systems are modeled by applying notable laws that govern their behavior. For example, mechanical systems are described by Newton's laws and electrical systems are described by Ohm's law, Kirchhoff's laws, Faraday's laws and Lenz's law. These laws form the basis for the constitutive properties of the elements in a system.

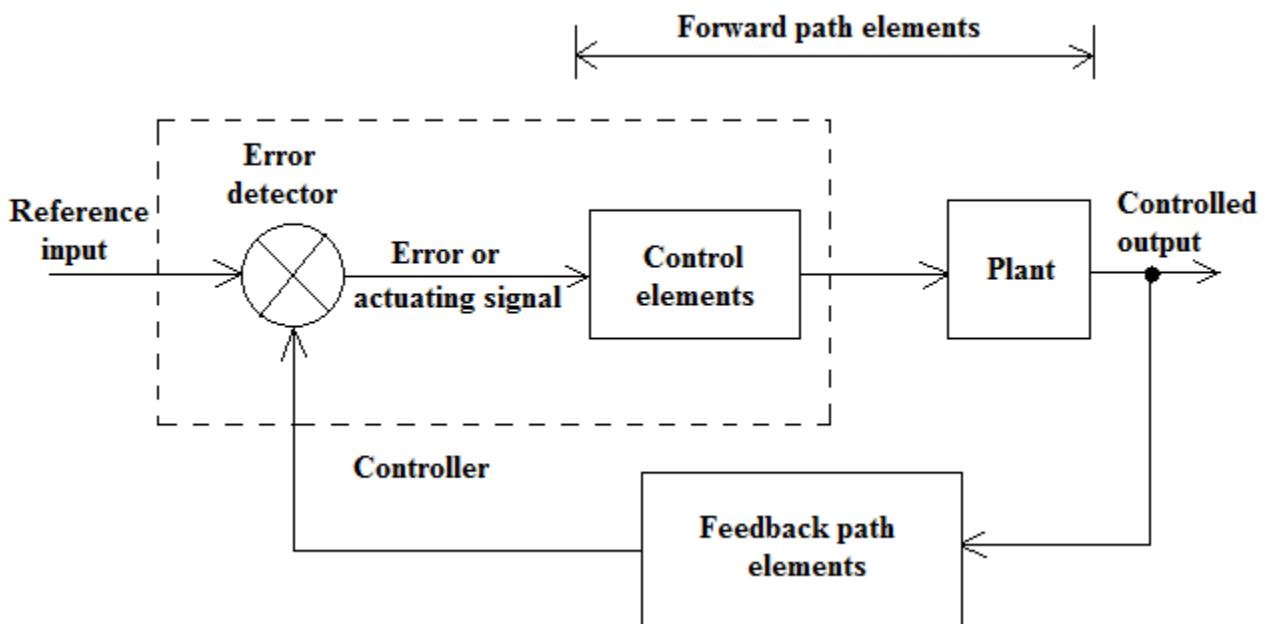
## BASIC ELEMENTS IN CONTROL SYSTEMS

In recent years, control systems have gained an increasingly importance in the development and advancement of the modern civilization and technology. 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 four basic elements of a typical motion control system. These are

- Controller
- Amplifier

- Actuator
- Feedback
- Error detector

The complexity of each of these elements will vary depending on the types of applications for which they are designed and built. A dynamical system manipulates entities such as energy, material, information, capital investment etc. It is characterized by relationships among certain variables that are chosen in its description. Usually inputs (causes) and outputs (effects) are important variables, which are connected by relations. Although a relationship is a function of time, the properties embedded in it may be time-invariant. A system may have only one input and one output. Such a system is termed a single-input-single-output (SISO) system. Some may be multiple-input-multiple-output (MIMO) systems. Large systems are characterized by several levels of organization, in a hierarchy. Figure 1 shows the schematic diagrams of systems indicating such features. The fields of systems, control and information processing are closely related to the science of cybernetics. Cybernetics attempts to understand the behavior of the system in nature. This understanding leads to the knowledge enabling us to improve the performance of natural or man-made processes.



**Figure 1.1.1 Basic Elements in Control Systems**

[Source: "Control Systems Engineering" by I.J.Nagrath, M.Gopal, Page: 5]