Control

1 - Basic Definition :-

Automatic Control of many day to day tasks relieves the human beings from performance repetitive manual operations. Automatic control allows optimal performance of dynamic system, increases productivity enormously ~~? rem.~~ Imagin manual Control of a simple room heating System. If the room temperature is to be manipulated at a desired temperature T°C, by controlling the current in an electrical heating system, the current may be adjusted by moving the variable arm in a rheostat. The temperature of the room depends on a host of factors: number of persons in the room, the opening and closing of doors due to persons moving in and out, fluctuating in the supply voltage, etc. A human operator has to continuously monitor the temperature indicated by a ~~thermometer~~ thermometer and keep on adjusting the rheostate to maintain the temperature all

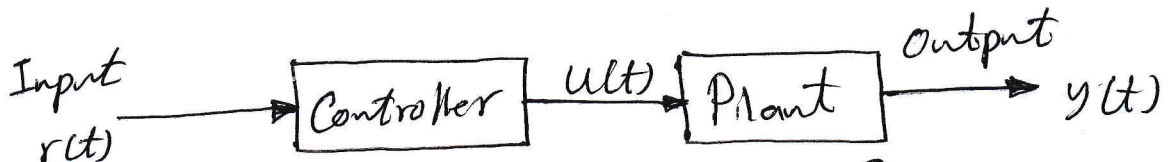
the twenty four hours. The operator should be continuously alert and relentlessly perform a simple job of moving the arm of the rheostat. Any mistake on his part may result in great discomfiture to the persons in the room.

1-2 Open Loop and Closed Loop Control Systems :-

- open Loop Control System :-

A system in which the output has no effect on the control action is known as an open loop control system produces a certain output. If there are any disturbances, the output changes and there is no adjustment of the input to bring back the output to the original value. A perform calibration is required to get good accuracy and the system should be free from any external disturbances. No measurements are made at the output.

A traffic control system is a good example of an open loop system. A washing machine is another example of an open loop control system.

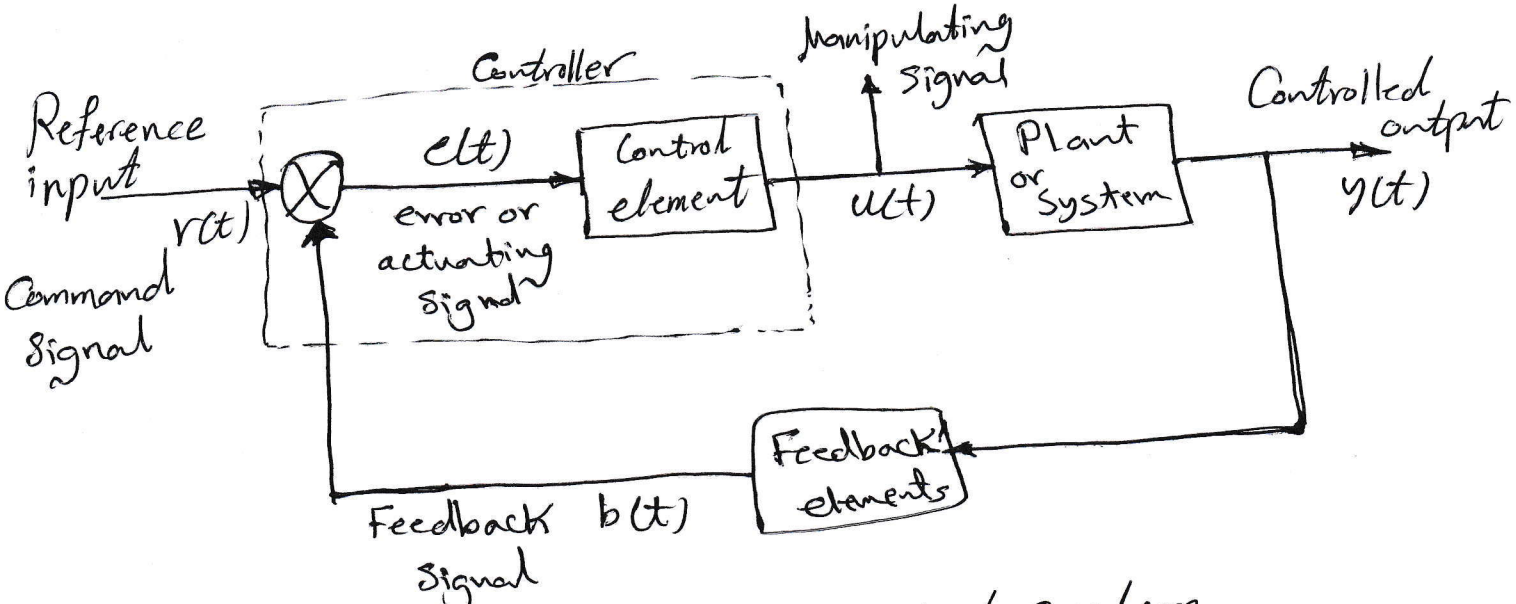


open loop Control System.

1-2

Closed Loop Control Systems :-

These are also known as a feed back control Systems. A system which maintains a prescribed relationship between the controlled variable and the reference input, and uses the difference between them as a signal to activate the control, is known as a feedback control System. The output or the controlled variable is measured and compared with the reference input and an error signal is generated. This is the activating signal to the controller which, by its action, tries to reduce the error. Thus the controlled variable is continuously feedback and compared with the input signal. If the error is reduced to Zero, the output is the desired output and is equal to the reference input signal.



Feedback control System

1-3 Open Loop Vs Closed Loop Control Systems :-

(a) open Loop Systems

advantages :-

1- they are simple and easy to build.
2- they are cheaper, as they use less number of components to build.
3- they are usually stable.
4- Maintenance is easy.

Disadvantage :-

1- they are less accurate.
2- If external disturbances are present, output differs significantly from the desired value.
3- If there are variations in the parameters of the system, the output changes.

Closed Loop Systems :-

Advantages :-

1- They are more accurate.

2- The effect of external disturbances signals can be made very small.

3- The variations in parameters of the system do not affect the output of the system.

4- Speed of the response can be greatly increased.

Disadvantages :-

1- They are more complex and expensive.

2- They require higher forward path gains.

3- They system are prone to instability - Oscillations in the output many occur.

4- Cost of maintenance is high.

1-5 Classification of Control Systems

Depending on the type of signals present at the various parts of a feedback control system, the system may be classified as a (i) continuous time feedback control system or a (ii) discrete time feedback control system.

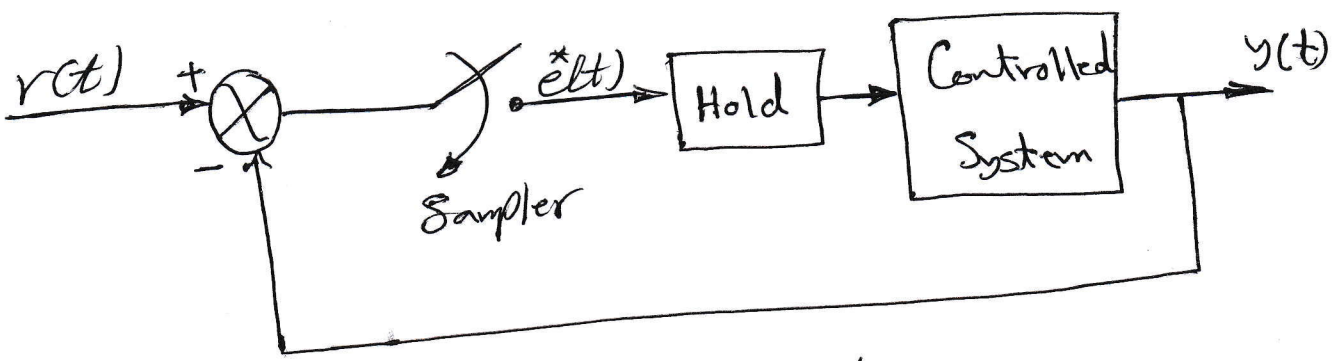
1-5-1 Continuous Time Feedback Control Systems

If the signals in all parts of a control system are continuous functions of time, the system is classified as continuous time feedback control system. Typically all control signals are of low frequency and if these signals are unmodulated, the system is known as a d.c. ~~amplifier and the error signal drives a servo motor as actuating device and d.c.~~ "control system". These systems use potentiometers as error detectors, d.c. amplifiers to amplify the error signal, d.c. servo motor as actuating device and d.c. tachometers or potentiometers as feedback elements. If the control

Signal is modulated by an a.c. carrier wave, the resulting system is usually referred to as a.c Control System. These systems frequently use Synchros as error detectors and modulators of error signal, a.c amplifiers to amplify the error signal and a.c servo motors as actuators. These motors also serve as demodulators and produce an unmodulated output signal.

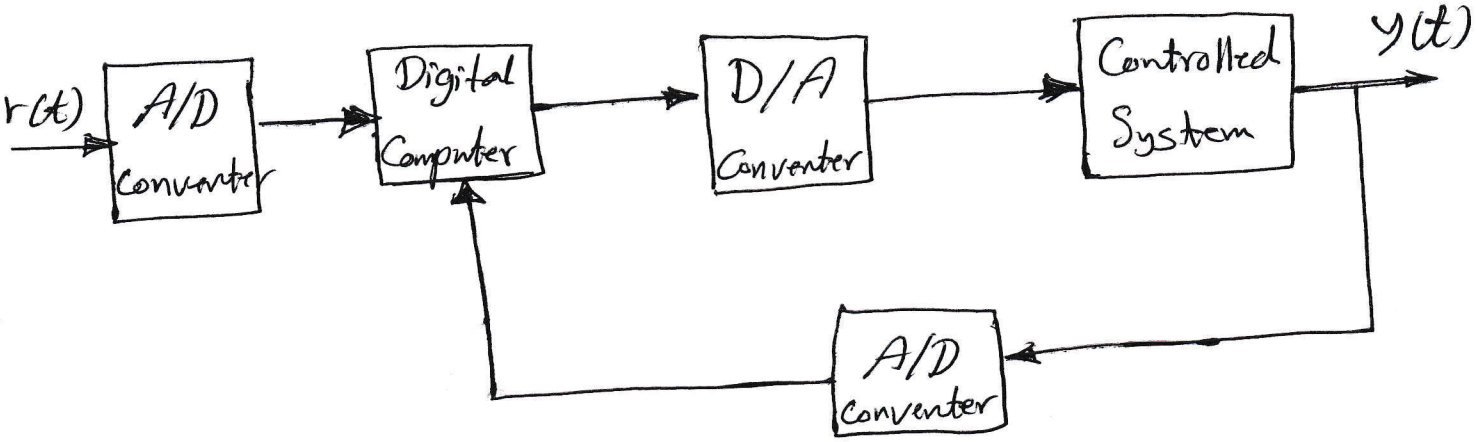
1-5-2 Discrete Data Feedback Control Systems :-

Discrete data control systems are those systems in which at one or more parts of the feedback control system, the signal is in the form of pulses. Usually, the error in such system is sampled at uniform rate and the resulting pulses are fed to the control system.



Discrete data control system.

Discrete data control systems, in which a digital Computer is used as one of the elements, are known as digital control systems. The input and output to the digital Computer must be binary numbers and hence these systems require the use of digital to analog and analog to digital Converters.



Digital feedback Control System

A future classification of Control systems can be made depending on the nature of the systems, namely,

1- Linear Control systems.

2- Non-linear Control Systems.

1-5-3 Linear Control Systems :-

If a system obeys superposition principle, the system is said to be a linear system. Let $x_1(t)$ and $x_2(t)$ be two inputs to a system and $y_1(t)$ and $y_2(t)$ be the corresponding outputs. For arbitrary real constants K_1 and K_2, and for input $K_1 x_1(t) + K_2 x_2(t)$, if the output of the system is given by $K_1 y_1(t) + K_2 y_2(t)$, then the system is said to be a linear system. There are several simple techniques available for the analysis and design of linear control systems.

1-5-4 Non-Linear Control Systems :-

Any system which does not obey superposition principle is said to be a non-linear system. Physical systems are in general non-linear and analysis of such systems is very complicated. Hence these systems are usually linearlised and well known linear techniques are used to analyse them.

These systems can be further classified depending on whether the parameters of the systems are constants, or varying with respect to time when the input to a system is delayed by T seconds, if the output is also

delayed by the same time T, the system is said to be a time invariant system. Thus on the other hand, if the output is dependent on the time of application of the input, the system is said to be a time varying system. Like non-linear systems, time varying systems also are more complicated for analysis.