UNIT - 1

INTRODUCTION

Basic Definitions

SYSTEM :- A system is a combination or an arrangeme of different physical components which act together as an entire Unit to achieve certain objective.

eg:- Class room , Lamp

Class room → Benches , blackboard , fans , lighting arrange

Lamp made up of Glass , filament

Control System:-

To control means to regulate , to direct or to command. Hence a control system is an arrangement of diffe physical elements connected in such a manner so as to regula direct or command itself or some other system.

Eg :- 1) If in a classroom , Professor is delivering his lecture, the combination becomes a control system.

2) If LAMP switched ON & OFF using a switch the entire system can be called a control system.

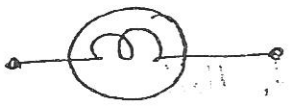


fig:- Physical System

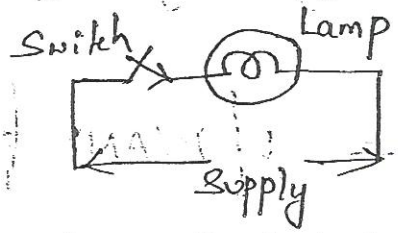


fig :- Control system

Plant :- The portion of a system which is to be controlled or regulated is called the plant or the process

Controller :- The element of a system itself or external the system which controls the plant or the process is calle controller.

Input :-

It is an applied signal or an excitation signal applied to a control system from an external energy source in order to produce a specified output.

Output :-

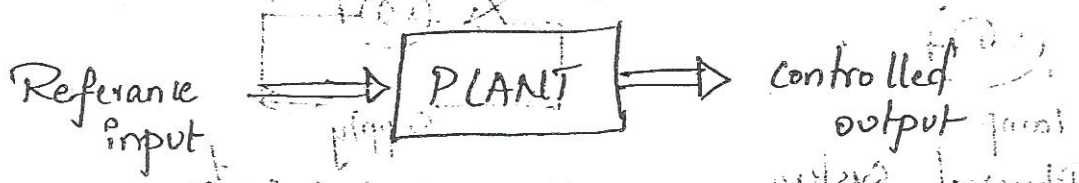
It is the particular signal of interest & the actual response obtained from a control system when input is applied to it.

Disturbances :- Disturbance is a signal which tends to adversely affect the value of the output of the system.

If such a disturbance is generated within the system itself, it is called an internal disturbance. The disturbance generated outside the system acting as an extra input to the system in addition to its normal input, affecting the output adversely is called an External disturbance.

Input variable is reffered as REFERENCE INPUT

Output is generally reffered as CONTROLLED OUTPUT



Feedback System :-

It converts the controlled variable to a form which is comparable to reference signal

ex :- If the referance input is voltage and output is speed then the feed back element (transducer) converts speed into voltage which is compared with reference input signal which is also in the form of voltage.

Error Detector :-

The function of error detector is to generate error signal by comparing input signal and the feedback signal. These error signal is feed to the controller necessary controlling action.

CLASSIFICATION OF CONTROL SYSTEMS

1) Natural Control Systems
2) Manmade control Systems
3) Combinational control Systems
4) Time varying and Time Invarient Systems
5) Linear and Nonlinear Systems
6) Continous time and Discrete time control systems
7) Deturministic and stochastic control systems
8) Lumped parameters and Distributed parameter control system
9) Single input single output (SISO) and Multiple Input and Multiple output MIMO
10) Open loop and closed loop systems
11) Regenerative and Degenera control syste
12) Static & Dynamic contro system

(1) Natural control System :- The biological systems, system ins human being are of natural type.

Eg :- The perspiration system inside the human being is a good example of natural control system. This system activ the secretion glands, secreating sweat and regulates the tempera of human body.

(2) Manmade Control Systems :- The various systems, we are using in our day to day life are designed and manufactu by human beings. Such systems like vechicles, switches, various controllers etc, are called manmade control systems.

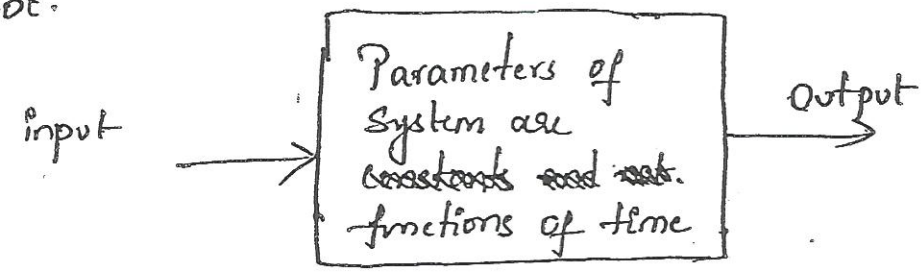
Eg :- An automobile system with gears, accelerator, braking system etc,

③ Combinational control systems :-

Combinational control system is one, having combination of natural and manmade together i.e, driver driving a real vehicle.

④ Time Varying and Time - Invariant Systems :-

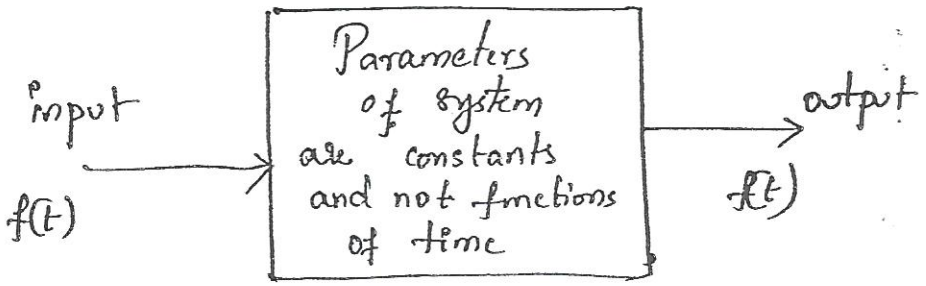
Time varying control systems are those in which parameters of the system are varying with time. It is not dependent on whether input and output are functions of time & not.



(a) Time Varient Systems

Eg :- Space Vechicle whose mass decreases with time, as it leaves earth.

If inputs and outputs are functions of time but the parameters of system are independent of time, which are not varying with time and are constants, then system is said to be time invarient system.



(b) Time invarient systems

(5) Linear and Nonlinear Systems :-

A control system is said to be linear if it satisfies following property.

a) The principle of superposition is applicable to the system. This means the response to several inputs can be obtained by considering one input at a time and then algebraically adding the individual results.

Mathematically principle of superposition is expressed by two properties.

i) additive property which says that for x and y belonging to the domain of the function f then

$$f(x+y) = f(x) + f(y)$$

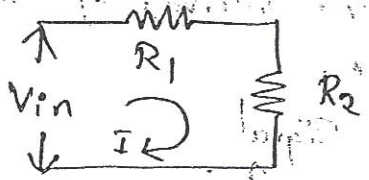
ii) Homogenous property which says that for any x belonging to the domain of the function f and for any scalar constant α we have

$$f(\alpha x) = \alpha f(x)$$

b) The differential equation describing the system is linear having its coefficients as constants.

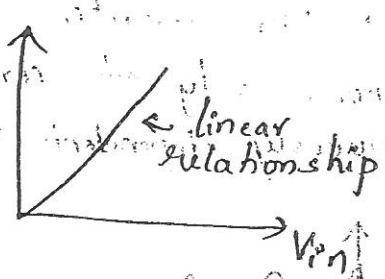
c) Practically the output i.e. response varies linearly with the input

Eg :-



V_{in} = input, I = Output

(a) linear System



b) Response of system

A Control System is said to be Nonlinear, if,

a) It does not satisfy the principles of superposition.

b) The equations describing the equal system are nonlinear in nature.

$f(x) = x^2$ is nonlinear because

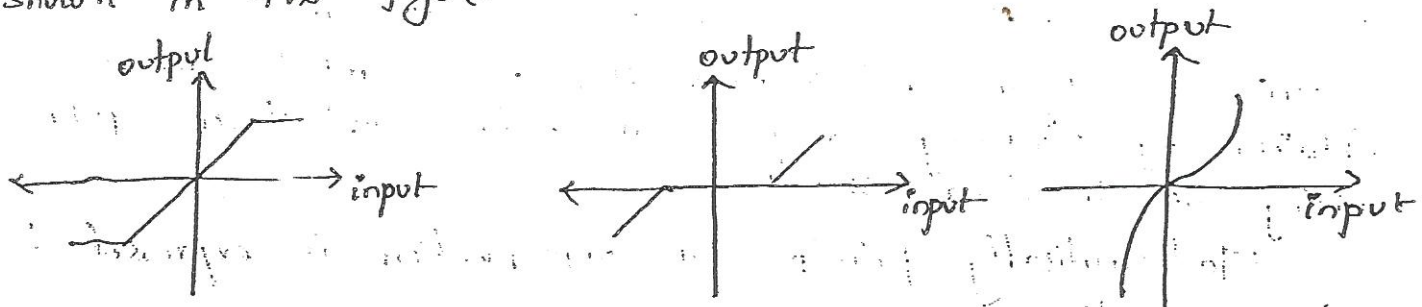
$$f(x_1+x_2) = (x_1+x_2)^2 \neq (x_1)^2 + (x_2)^2$$

Eg $f(\alpha x) = (\alpha x)^2 \neq \alpha x^2$ where α = constant

The equations of nonlinear system involves such non

The output does not vary linearly for non linear functions / systems.

Various nonlinearities practically present in the system are shown in the figure.



(a) saturation b) Dead zone (c) Exponential or square law

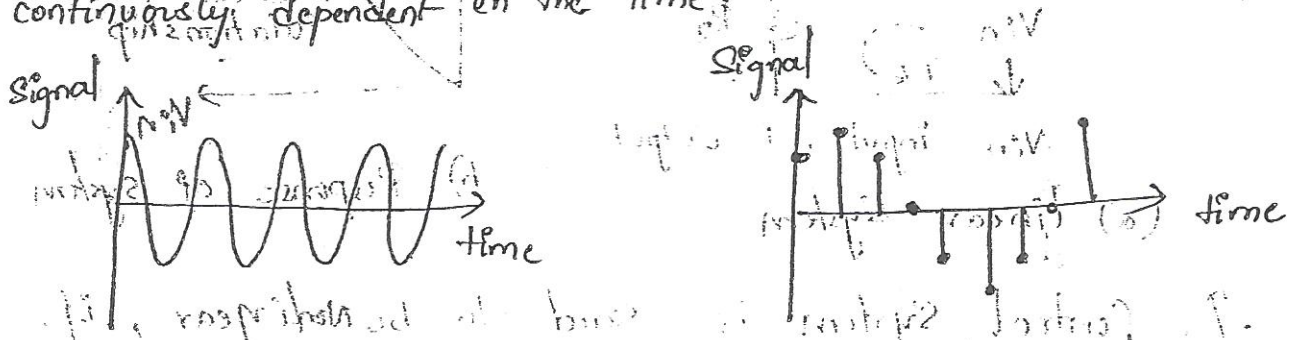
fig:- Nonlinearities

(6) Continouse time and Discrete time Control systems

In a continous time control system all system variables are the functions of a continous time variable 't'.

eg:- Speed control of a dc motor using a tachogenerator

In discrete time systems one or more system variables are known only at certain discrete intervals of time. They are not continuously dependent on the time.



a) Continous signal b) Discrete signal

(7) Deterministic and stochastic Control systems:-

A control system is said to be deterministic when its response to input as well as behaviour to external disturbances is predictable and repeatable.

If such response is unpredictable, system is said to be stochastic in nature.