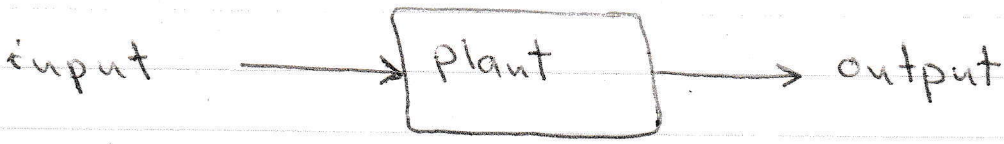
Chapter 1: Basic definitions

Systems: A system is a combination of components that act together and perform a certain objective. A system is not limited to phy. ones. The word system should be interprete to imply physical, biological, economic, and th like, systems.

A Control system is an interconnection of components forming a system configuration th will provide a desired system response. T basis for analysis of a system is the foundati provided by linear system theory, which assu a cause_effect relationship for the compone of a system.

Plants: A plant may be a piece of equipment, perhap just a set of machine parts functioning toge the purpose of which is to perform a particu operation. Therefore, any physical object to b controlled (such as a mechanical device, a heatin furnace, a chemical reactor) a plant. A pla to be controlled can be represented by a block as s below.

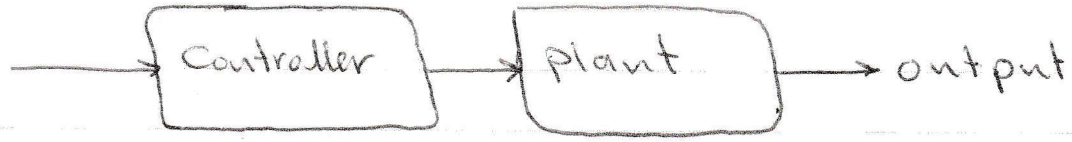


Linear Systems: A system is defined as linear in terms of the system excitation and response. A necess[ary] condition for a linear system can be determin[ed] in terms of an excitation $x(t)$ and a resp[onse] $y(t)$. When the system is subjected to an excitation $x_1(t)$, it provides a response $y_1(t)$. Furthermore, when the system is subjected to an excitation $x_2(t)$, it provides a corre[spond]ind response $y_2(t)$. For a linear system it is necessary thet the excitation $x_1(t)+$ result in a response $y_1(t) + y_2(t)$. This i[s] usually called the principle of superposi[tion].

Example: A system characterized by the relation $y = x^2$ not linear, why?

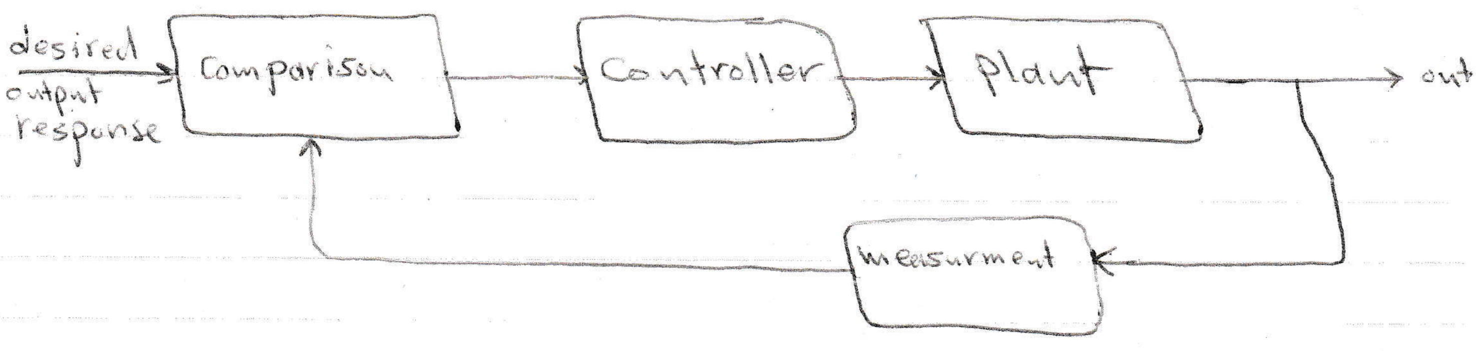
Linear Time- invariant Systems and Linear Time-Varying Systems: differential equation is linear if the coefficients are const[ant] or functions only of the independent variable. Dynamic system that are composed of linear time-invariant lumped-param[eter] components may be described by linear time- invariant (constan[t] coefficient) differential equations. Such systems are called l[inear] time- inavariant systems. Systems that are described b[y] differential equations whose coefficients are functions of [time] are called time-varying systems. An example of a time-v[arying] control system is a spacecraft control system.

Open loop Control system: A system that utilizes a devic to control the plant without using feedback. Thus the output has no effect upon the Signal enterin the plant, as shown in Figure below:



In any open loop control system the output is not compared with reference input. Thus, to each referen input there corresponds a fixed operating condition, a a result the accuracy of the system depends on ca ration. Note that any control system that operates on a time basis is open loop. For instance, traffic contro by means of signals operated on a time basis is an example of open loop control.

Closed loop control system: Feedback control systems a often referred to as closed loop control systems. In c rast to an open loop control, a closed loop control syst utilizes an additional measure of the actual output to c are the actual output with desired output response. measure of the output is called the feedback sig A simple closed loop feedback control system is show in Figure below:



An advantage of the closed loop control system is the fact t
the use of feedbacks makes the system response relativ
insensitive to external disturbances and internal variations
system parameters.

From the point of view af stability, the open loop co
system is easier to build because system stabilit
is not a major problem. On the other hand, stabili
is a major problem in the closed loop control syste
which may tend to overcorrect errors and thereby
cause oscillations of constant or changing amplitude.