

## Introduction to Measurement Systems :-

### → General Concepts & Terminology :

1. Measurement Systems :- A system is a combination of two (or) more elements, subsystems & parts necessary to carry out one (or) more functions. The function of a measurement system is the objective & empirical assignment of a number to a property (or) quality of an object (or) event in order to describe it. That is, the result of a measurement must be independent of the observer & experimentally based (empirical).

It is a system using which one can convert physical parameters to meaningful numbers. The numerical measure is meaningless unless followed by a unit used, since it (unit) identifies the characteristic of the property being measured.

One objective of a measurement can be process monitoring: for example, ambient temp. measurement, gas & water volume measurement.  
 Another objective can be process control: for example, for temp. (or) level control in a tank.

→ Transducer :- A transducer is a device that converts a signal from one physical form to a corresponding signal having a different physical form.  
 This means it is an energy converter.

They are often employed at the automation, measurement & control systems where electrical signals are converted to & from other physical quantities. (Energy, force, torque, light etc).  
The process of conversion is called transduction.

→ Sensors :- A sensor is a transducer whose purpose is to sense or detect a parameter in the form of energy & report it in another, often an electrical signal.

Ex: A pressure sensor might detect pressure (mechanical energy) and convert it to electrical signal for display at a remote gauge.

Every transducer is (or has) a sensor but every sensor may need not be a transducer.

Sometimes in a sensor there is no conversion at all.

Ex: Thermometer, where the temp. is sensed & is directly measured. In a transducer, there is always a conversion i.e., transduction.

Ex: RTD, Thermocouple etc where the temp. is sensed & the measurement is made in terms of voltage.

Thus you may say that a sensor may or may not have a conversion, ~~but~~ and it only senses. A transducer always involves conversion & also has signal conditioning involved.

→ Actuators :- An actuator is a component of <sup>(2)</sup> a machine that is responsible for moving & controlling a mechanism (or) system, for example by opening a valve.

An actuator requires a control signal & a source of energy. The control signal is relatively low energy & may be electric voltage (or) current, pneumatic (or) hydraulic pressure (or) even human power. Its main energy source may be an electric current, hydraulic fluid pressure (or) pneumatic pressure. When it receives a control signal, an actuator responds by converting the signal's energy into mechanical motion.

Ex: 1. Pneumatic Actuators enable large forces to be produced from relatively small pressure changes (eg. pneumatic brakes are very responsive to small changes in pressure applied by the driver).

2. An Electric Actuator is generally powered by a motor that converts electrical energy into mechanical torque.

→ Classification of Sensors & Transducers :-

Sensors can be classified :

- (i) on the basis of transduction form used
- (ii) as primary & secondary transducers.