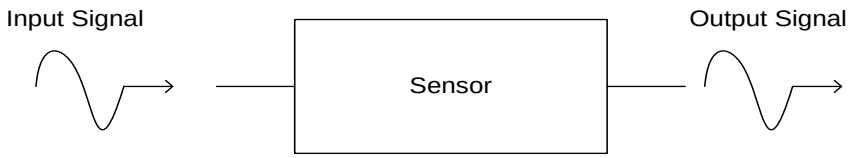
Unit-2: SENSORS & ACTUATORS



By: Ms. Swati C. Hadke
Assistant Professor
Electronics & Telecommunication Engineering Department
G H Raisoni Colege of Engineering & Management, Naagpur

What are Sensors?

- American National Standards Institute (ANSI) Definition
  - A device which provides a usable output in response to a specified measurand



- A sensor acquires a physical parameter and converts it into a signal suitable for processing (e.g. optical, electrical, mechanical)

- A transducer
  - Microphone, Loud Speaker, Biological Senses (e.g. touch, sight,…ect)

Detectable Phenomenon

Stimulus	Quantity
Acoustic	Wave (amplitude, phase, polarization), Spectrum, Wave Velocity
Biological & Chemical	Fluid Concentrations (Gas or Liquid)
Electric	Charge, Voltage, Current, Electric Field (amplitude, phase, polarization), Conductivity, Permittivity
Magnetic	Magnetic Field (amplitude, phase, polarization), Flux, Permeability
Optical	Refractive Index, Reflectivity, Absorption
Thermal	Temperature, Flux, Specific Heat, Thermal Conductivity
Mechanical	Position, Velocity, Acceleration, Force, Strain, Stress, Pressure, Torque

By: Ms. Swati C. Hadke

Physical Principles

- Amperes's Law
  - A current carrying conductor in a magnetic field experiences a force (e.g. galvanometer)
- Curie-Weiss Law
  - There is a transition temperature at which ferromagnetic materials exhibit paramagnetic behavior
- Faraday's Law of Induction
  - A coil resist a change in magnetic field by generating an opposing voltage/current (e.g. transformer)
- Photoconductive Effect
  - When light strikes certain semiconductor materials, the resistance of the material decreases (e.g. photoresistor)

Need for Sensors

- Sensors are omnipresent. They embedded in our bodies, automobiles, airplanes, cellular telephones, radios, chemical plants, industrial plants and countless other applications.

- Without the use of sensors, there would be no automation !!

Choosing a Sensor

Environmental Factors	Economic Factors	Sensor Characteristics
Temperature range	Cost	Sensitivity
Humidity effects	Availability	Range
Corrosion	Lifetime	Stability
Size		Repeatability
Overrange protection		Linearity
Susceptibility to EM interferences		Error
Ruggedness		Response time
Power consumption		Frequency response
Self-test capability		

By: Ms. Swati C. Hadke

By: Ms. Swati C. Hadke

By: Ms. Swati C. Hadke

By: Ms. Swati C. Hadke

By: Ms. Swati C. Hadke

By: Ms. Swati C. Hadke

By: Ms. Swati C. Hadke

Dynamic Characteristics of Instrument

- Input varies with time

Dynamic characteristics: The set of criteria defined for the instruments, which are changes rapidly with time, is called ‘dynamic characteristics’.

The various dynamic characteristics are:

i) Speed of response

ii) Measuring lag

iii) Fidelity

iv) Dynamic error

Speed of response: It is defined as the rapidity with which a measurement system responds to changes in the measured quantity.

Measuring lag: It is the retardation or delay in the response of a measurement system to changes in the measured quantity.

The measuring lags are of two types:

a) **Retardation type:** In this case the response of the measurement system begins immediately after the change in measured quantity has occurred.

b) **Time delay lag:** In this case the response of the measurement system begins after a dead time after the application of the input.

c) Fidelity: It is defined as the degree to which a measurement system indicates changes in the measurand quantity without dynamic error.

Dynamic error: It is the difference between the true value of the quantity changing with time & the value indicated by the measurement system if no static error is assumed. It is also called measurement error.