ROHINI
COLLEGE OF ENGINEERING & TECHNOLOGY
Approved by AICTE and Affiliated to Anna University, (An ISO Certified Institution)
Near Anjugramam Junction, Kanyakumari Main Road, Palkulam, Variyoor P.O - 629 401

DEPARTMENT OF BIOMEDICAL ENGINEERING

III Semester- BM3301 SENSORS AND MEASUREMENTS

UNIT -1

1.2 Classification of Transducer

A transducer is a device that converts one form of energy into another, such as converting mechanical energy into electrical signals. The transducer can also be used for the transformation of a non-electrical physical quantity into an electric signal.

Examples of transducers are pressure transducers, potentiometer, piezoelectric transducer, Hall effect transducer

On the other hand, **a sensor** is a device that detects and responds to a specific input, such as light, temperature, pressure, or motion and converts it into a measurable output. The output signal can be any measurable signal and is generally an electrical quantity.

Examples are thermometer, pressure sensor, ultrasonic sensor.

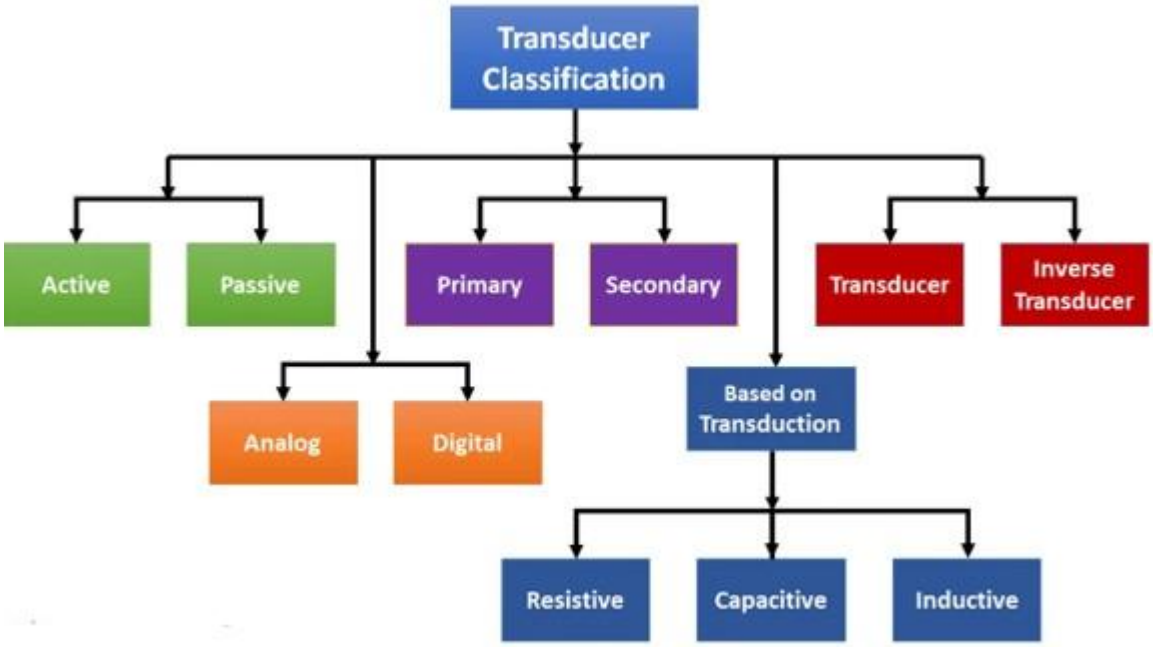
Sensor and transducer are both used interchangeably, however; sensor refers to physical devices that only sense or detect any physical quantity or changes in it. While a transducer refers to those devices that convert one form of energy into another. Transducer is a broad term while a sensor is a sub-component of a transducer. Therefore we can say that all sensors are transducers but not the other way around.

1.2.1 Classification of Transducer:

The transducers can be classified as following,

1. as a primary and secondary transducer
2. as a passive and active transducer
3. as analogue and digital transducer
4. as the transducer and inverse transducer

5. on the basis of transduction method used



https://instrumentationtools.com/sensors-and-transducers-classification/

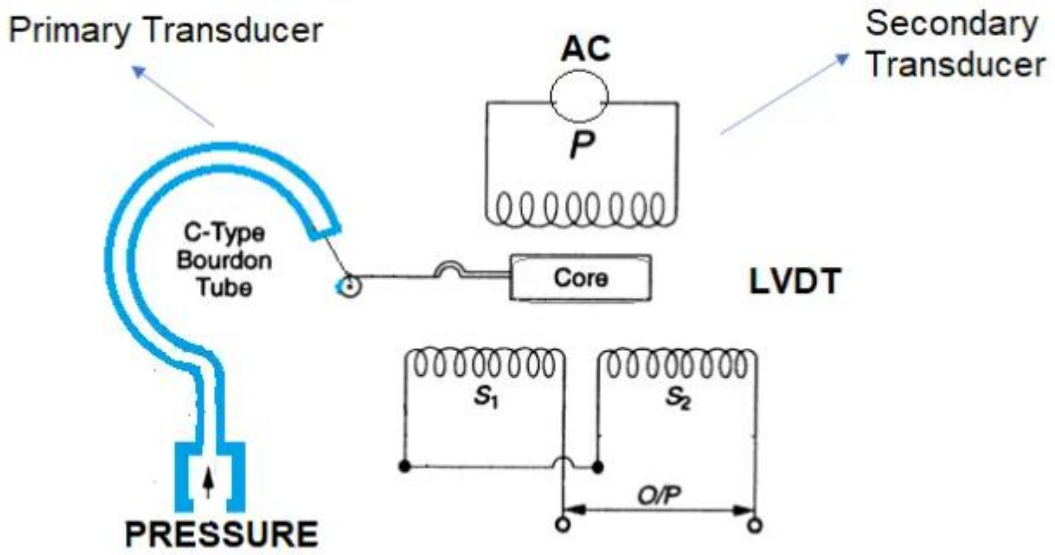
1.2.2 Primary and Secondary Transducer:

When the input signal is directly sensed by the transducer and physical phenomenon is converted into the electrical form directly then such a transducer is called the **primary transducer**. The primary transducer is the first element which is directly exposed to the process variable to be measured that senses physical changes or any change in its surrounding and produces an equivalent functional output which is detected by next stage or a second stage.

Bourdon tube, diaphragm, bellows in a pressure measurement, bimetallic thermometer, liquid filled thermometer, manometer etc. are some examples of primary transducers.

Secondary transducer is basically a second stage in a measurement system which detects the mechanical or physical change produced by primary sensing element and converts or manipulates into electrical signal mostly. The magnitude of the output signal depends on the input mechanical signal.

Some examples of Secondary Transducers are LVDT, Piezo electric crystal, pinion gear arrangement etc.



Bourdon Gauge with LVDT in Pressure measurements

https://in.pinterest.com/pin/primary-and-secondary-transducers--741757001132563759/

1.2.3 Active and Passive Transducers:

Active transducers do not need any external source of power for their operation. Therefore, they are also called self-generating type transducer.

Examples: Piezo-electric, Photovoltaic, Piezoelectric, Electromagnetic.

The **Passive transducers** need an external source of power for their operation. So, they are not self-generating type transducers.

Examples: Resistive, Inductive and Capacitive transducers.

1.2.4. Analog and Digital Transducer:

Analog Transducers converts the input quantity into an analog signal output, which is a continuous function of time.

Example: Potentiometer, LVDT, thermistor, RTD, thermocouple

Digital transducers which convert input signal into output in the form of pulses.

Examples: Shaft encoder, limit switch, pressure switch, digital tachometer, digital resolver etc.

1.2.5 Transducer and Inverse Transducer:

Transducer, as already defined, is a device that converts a non-electrical quantity into an electrical quantity. Normally a transducer and associated circuit has a non-electrical input and an electrical output.

Example: Thermocouple, Strain gauge

An inverse transducer is a device that converts an electrical quantity into a non-electrical quantity.

Example: piezoelectric crystal, I to P converter

1.2.6. on the basis of transduction method used:

On the basis of transduction principle used the transducer is further classified as

(i) Resistive transducer
(ii) Inductive transducer
(iii) Capacitive transducer

(i) Resistive Transducer:

The resistive transducers or resistive sensors are also called as variable resistance transducers. The variable resistance transducers are one of the most commonly used types of transducers. They can be used for measuring various physical quantities, such as, temperature, pressure, displacement, force, vibrations etc. These transducers are usually used as the secondary transducers.

Example : Resistance Potentiometer, Resistance strain Gauge

(ii) Inductive Transducer:

Inductive transducers work on the principle of inductance change due to any appreciable change in the quantity to be measured.

For example, LVDT, a kind of inductive transducers, measures displacement in terms of voltage difference between its two secondary voltages. Secondary voltages

are nothing but the result of induction due to the flux change in the secondary coil with the displacement of the iron bar.

(iii) Capacitive Transducer:

The capacitive transducer is used for measuring the displacement, pressure and other physical quantities. It is a passive transducer that means it requires external power for operation. The capacitive transducer works on the principle of variable capacitances. The capacitance of the capacitive transducer changes because of many reasons like overlapping of plates, change in distance between the plates and dielectric constant.

Example: Parallel plate capacitance with Rectangular plates.