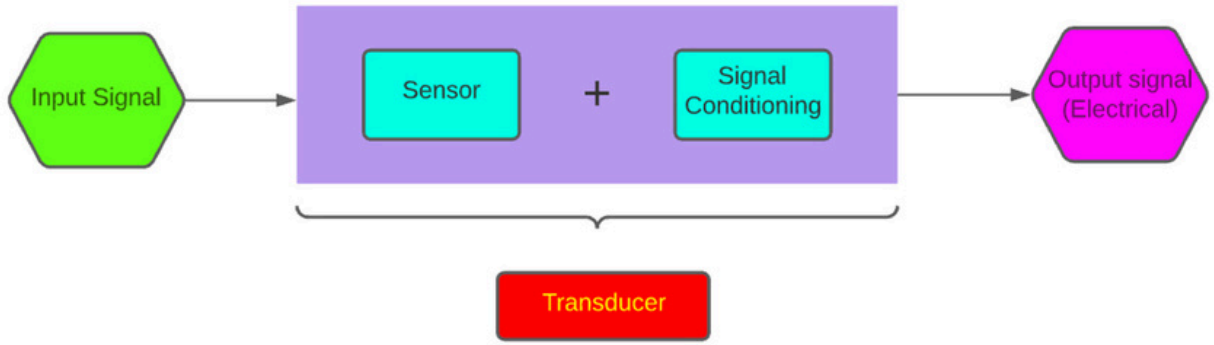
TRANSDUCERS AND MEASURING INSTRUMENTS

Concept of Transducer and sensor with their differences

- The transducer is a device that changes the physical attributes of the non-electrical signal into an electrical signal which is easily measurable.
- The process of energy conversion in the transducer is known as the transduction.
- The transduction is completed into two steps. First by sensing the signal and then strengthening it for further processing.



Sensor

- The transducer has three major components; they are the input device, signal conditioning or processing device and an output device.
- The input devices receive the measurand quantity and transfer the proportional analogue signal to the conditioning device. The conditioning device modified, filtered, or attenuates the signal which is easily acceptable by the output devices.

Differences between Sensor and Transducer

1. The sensor senses the physical change across the surrounding whereas the transducer transforms the one form of energy into another.
2. The sensor itself is the major component of the sensor, whereas the sensor and the signal conditioning are the major elements of the transducer.
3. The primary function of the sensor is to sense the physical changes, whereas the transducer converts the physical quantities into an electrical signal.
4. The accelerometer, barometer, gyroscope are the examples of the sensors whereas the thermistor, and thermocouple is the examples of the transducer.

Different type of Transducers & concept of active and passive transducer.

Classification of Transducers

- The classification of transducers is made from the following basis:

1. Based on the physical phenomenon

- Primary transducer
- Secondary transducer

2. Based on power type

- Active transducer
- Passive transducer

3. Based on the type of output the classification of transducers are made

- Analog transducer
- Digital transducer

4.Based on electrical phenomenon

- Resistive transducer
- Capacitive transducer
- Inductive transducer
- Photoelectric transducer
- Photovoltaic transducer

5. Based on the non-electrical phenomenon Classification of transducer

- Linear displacement
- Rotary displacement

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6. Based on the transduction phenomenon

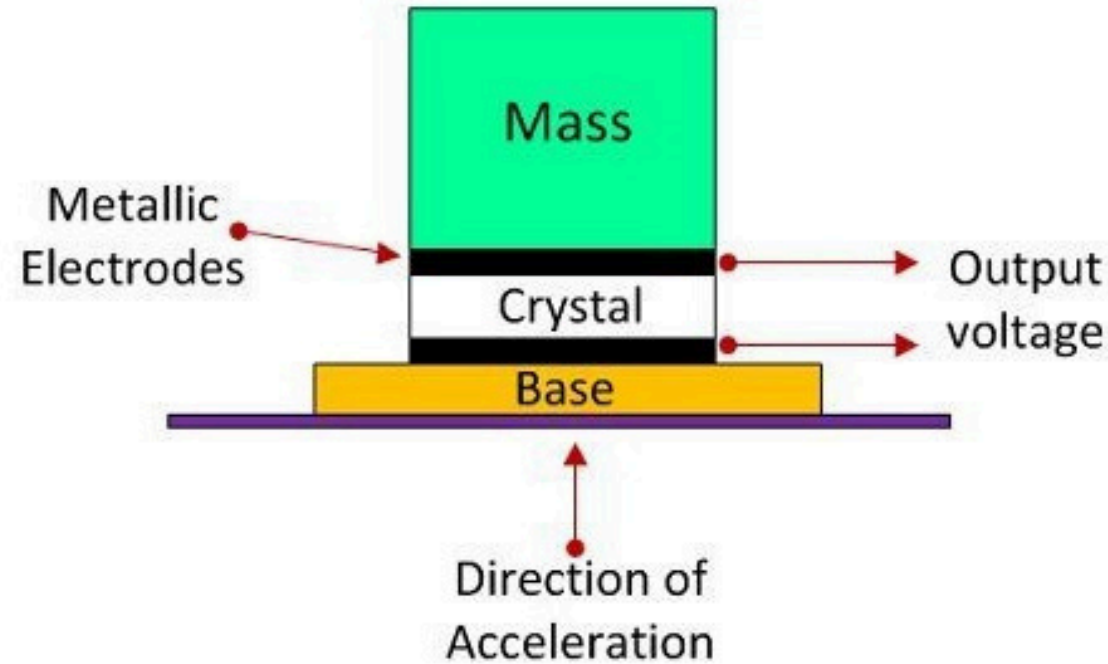
- Transducer
- Inverse transducer.

Concept of active and passive Transducer.

Active Transducer

- The transducer which does not require the external power source is known as the active transducer.
- Such type of transducer develops theirs owns voltage or current, hence known as a self- generating transducer.
- The energy requires for generating the output signals are obtained from the physical quantity which is to be measured.

Example: The Piezo electrical crystal is the example of the natural active transducer. The crystal has the property of producing the output voltage when the external force applied to them. The piezoelectric crystal is placed between the two metallic electrodes. When the force applied to the crystal, the voltage induces across it.


Mass
Metallic
Electrodes
Crystal
Output
voltage
Base
Direction of
Acceleration

Passive Transducer

- The transducer which requires the power from an external supply source is known as the passive transducer.
- They are also known as the external power transducer. The capacitive, resistive and inductive transducers are the example of the passive transducer.
- The passive transducer takes power from the external energy source for transduction. The word transduction means conversion of energy from one form to another.

Example: The linear potentiometer is the examples of the passive transducer. It is used for measuring the displacement. The POT requires the external power source ei for work. It measures the linear displacement xi.

Working principle of photo emissive, photoconductive, photovoltaic transducer and its application

The photoelectric transducer converts the light energy into electrical energy. It is made of semiconductor material. The photoelectric transducer uses a photosensitive element, which ejects the electrons when the beam of light absorbs through it.

These photoelectric transducers are classified into five types which include the following

- Photo emissive Cell
- Photodiode
- Phototransistor
- Photo-voltaic cell
- Photoconductive Cell

Photo-emissive Cell

- The Photo-emissive cell converts the photons into electric energy. It consists the anode rode and the cathode plate. The anode and cathode are coated with Photo-emissive material called caesium antimony.
- When the radiation of light fall on cathode plates the electrons starts flowing from a node to cathode. Both the anode and the cathode are sealed in a closed, opaque evacuated tube. When the radiation of light falls on the sealed tube, the electrons starts emitting from the cathode and moves towards the anode.
- The anode is kept to the positive potential. Thus, the photoelectric current starts flowing through the anode. The magnitude of the current is directly proportional to the intensity of light passes through it.

Photoconductive Cell

- The photoconductive cell converts the light energy into an electric current. It uses the semiconductor material like cadmium selenide, Ge, Se, as a photo sensing element.
- When the beam of light falls on the semiconductor material, their conductivity increases and the material works like a closed switch. The current starts flowing into the material and deflects the pointer of the meter.

Photo-voltaic cell

- The photovoltaic cell is the type of activetransducer. The current starts flowing into the photovoltaic cell when the load is connected to it. The silicon and selenium are used as a semiconductor material. When the semiconductor material absorbs heat, the free electrons of the material starts moving. This phenomenon is known as the photovoltaic effect.
- The movements of electrons develop the current in the cell, and the current is known as the photoelectric current.

Applications of Photoelectric Transducer

- The applications of this transducer mainly include the following.
- These transducers are used in biomedical applications
- Pickups of pulse
- Pneumography respiration
- Measure blood pulsatile volume changes
- Records Body movements.

Multimeter and its applications

- A multimeter is an electronic measuring instrument that combines several measurement functions in one unit.
- A typical multimeter can measure voltage, current, and resistance. It is an indispensable instrument and can be used for measuring d.c as well as a.c voltages and currents.
- Multimeter is the most inexpensive equipment and can make various electrical measurement with reasonable accuracy.

Multimeter and its applications

Applications

- For checking the circuit continuity. • For measuring d.c current flowing through the cathode, plate, screen and other vacuum tube circuits.
- For measuring d.c voltages across various resistors in electric circuits.
- For measuring a.c voltages across power supply transformers.
- For ascertaining whether or not open or short circuit exits in the circuit under study.

Analog and Digital Multimeter and their differences

- AnalogMultimeterisbasicallyamovingcoilinstrument.Arectifierunitisalsoprovided with the instrument. It is a multirange instrument and various ranges are obtained by different resistance elements in series or in parallel with the movement of the instrument. With the help of a rotary selector switch the various ranges are used.
- The digital multimeter is an instrument capable of measuring dc voltage, ac voltage, dc current, ac current, resistance, conductance and decibles. Thus DMM offers increased versatility. Some DMMs can measure the temperature, frequency etc.
- A DMM has a digital display and a function selector switch. The range selection takes place automatically. There are four input terminals, out of which two terminals are used for measurement of all the general purpose quantities such as ac/dc voltage, resistance, capacitance and diode, transistor testing.

Difference between Analog and Digital Multimeter

Visual indication of changes in the reading is not that much better	Better visual indication of changes in the reading is obtained
Less suffered from electrical noise	More suffered from electrical noise
Less isolation problems.	More isolation problems.
Accuracy is less	High accuracy is obtained.
The output cannot be interfaced with external equipment	The output can be interfaced with external equipment
Construction is simple	Construction is complicate
Bigger in size	Smaller in size
Many times output is ambiguous	An unambiguous reading is obtained
Less expensive	More expensive

Thank You

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