ELECTRONIC MEASUREMENT & INSTRUMENTATION (BEC-29)

Instructor

Dr. B. P. Pandey

Assistant Professor

Department of Electronics and Communication Engineering

Madan Mohan Malaviya University of Technology , Gorakhpur

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UNIT- 2

Lecture-1

Transducers

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Transducer: Definition

Transducer is a device that receives energy from one form and transmits into a different form.

OR

Transducer is a device capable of being actuated by energizing input from one or more transmission media and in turn generating a related signal to one or more transmission system.

The output of transducer depends on the principle involved. The output can be analog, digital or frequency modulated.

Selection Parameters of Transducer

The following parameters are considered while selecting a transducer:

- **Operating range**: chosen to maintain range requirements and good resolution.
- **Sensitivity**: chosen to allow sufficient output.
- **Frequency response and resonant frequency**: flat over the entire desired range.
- **Environmental capability**: temperature range, corrosion and mounting range.
- **Minimum sensitivity**: to expected stimulus, other than measurand.
- **Accuracy**: repeatability and calibration errors as well as errors expected due to sensitivity to other stimuli.
- **Usage and ruggedness**: ruggedness of both electrical and mechanical intensities versus size and weight.
- **Electrical parameters**: length and type of cable required, signal to noise ratio when combined with amplifiers, and frequency response limitations.
- **Repeatability:** The I/P by O/P relationship for a transducer should be predictable over a long period of time.

There are two types of transducer: **Electrical** and **Mechanical**.

An **Electrical transducer** is a sensing device by which the physical, mechanical or optical quantities to be measured is transformed by a suitable mechanism into an electrical voltage/current proportional to input measured.

An electrical transducer must show the following properties:

- **Linearity:** proportional to the applied I/P.
- **Sensitivity:** defined as the electrical output per unit change in the physical parameter(V/0C for temperature sensor).
- **Dynamic range:** operating range of tranducer should be wide.
- **Repeatability:** The I/P by O/P relationship for a transducer should be predictable over a long period of time.
- **Physical size:** transducer must have minimal weight and volume.

Advantages of the Electrical Transducer

- Electrical amplification and attenuation can be easily done.
- Mass-inertia effects are minimized.
- Effects of friction are minimized.
- O/P can be indicated and recorded remotely from the sensing medium.
- O/P can be modified to meet the requirements of the indicating or controlling units.
- Signal can be conditioned or mixed to obtain any combination with outputs of similar transducer or control signal.
- Electrical or Electronic system can be controlled with a very small power level.
- Electrical O/P can be easily used, transmitted and processed for purpose of measurement.

Classification of Electrical Transducer

can be broadly classified into two categories

1) Active Transducer 2) Passive Transducer

Active Transducer:

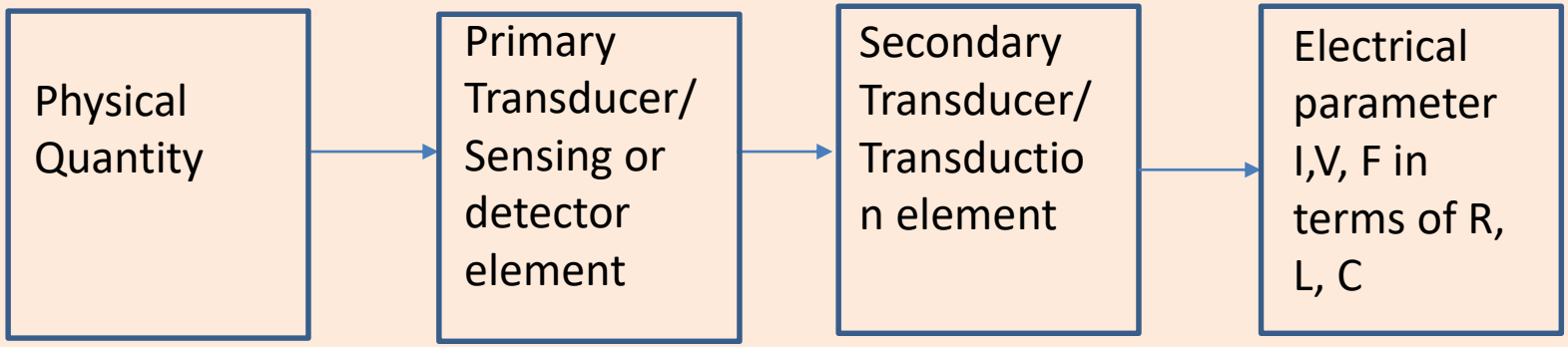
- Generate an electrical signal directly in response to the physical parameters and does not require an external power source for its operation.
- It is self generating devices which operate under energy conversion principle and generate an equivalent output signal.
- Example: Pressure or temperature change to electrical potential(Piezo-electric sensors) & Photovoltaic cells(generation of voltage in response to illumination).

Passive Transducer:

- operate under energy controlling principle, which makes it necessary to use an external electrical source with them. They depend upon the change in an electrical parameters(R,L, and C).
- Example: Strain gauges(resistance change in response to pressure), Thermistors(Resistance change corresponding to temperature variation).

Operation of Electrical Transducer

- Electrical transducer are used mostly to measure non-electrical quantities.
- For this purpose, a detector or sensing element is used , which converts the physical quantity into a displacement.
- This displacement actuates an electrical transducer, which acts as a secondary transducer and give an output that is electrical in nature.



Types of Transducer

- **Resistive Transducer**

1. Potentiometer
2. Resistive Pressure Transducer
3. Resistive Position Transducer

- **Strain Gauges Transducer**

1. Wire Strain Gauges
2. Foil Strain Gauges
3. Semiconductor Strain Gauges

- **Inductive Transducer**

1. Differential Output Transducer
2. Linear Variable Differential Transducer(LVDT)
3. Rotational Variable Differential Transducer(RVDT)

- **Pressure Inductive Transducer**
- **Capacitive Transducer**
- **Load Cell(pressure Cell) Transducer**
- **Piezo Electrical Transducer**
- **Photo Electric Transducer**

1. Photo-emissive
2. Photo Conductive
3. Photovoltaic

- **Semiconductor Photo Diode Transducer**
- **Photo-transistor Transducer**
- **Temperature Transducer**

1. Resistance Thermometer Transducer
2. Thermistors Transducer
3. Thermocouple Transducer

- **Mechanical(flow Measurement) Transducer**

1. Mechanical Flow Meter
2. Magnetic Flow Meter
3. Turbine Flow Meter

Assignment Questions

- Define a transducer.
- Explain the difference between primary sensors and transducers with the help of examples.
- What do you understand by electrical transducers? State the advantages of electrical transducers.
- State the various parameters of electrical transducers.
- What is the difference between active and passive transducers?
- List the factors to be considered while selecting a transducer.

THANK YOU