Welcome students. This presentation is for the program

of Bachelor of Science in the subject of electronics for

Semester 5. The paper title isTransducers and instrumentation.

This presentation is on the module loadcell and piezo electric

transducers. Module number is 13. I'm Dr. Sulaxana Vernekar

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The outline of my presentation

is. Load cell or pressure cell. Types of load cells.

Applications of load cell.

Piezo electric transducer, working of Piezo electric

transducer, advantages and disadvantages of Piezo electric

transducer and applications of Piezoelectric transducers.

The learning outcomes of this module are: After going through this presentation,

a student will be able to explain the working of a load

cell. Study the applications of load cell. Explain the working

of piezo electric transducers.

And study the applications of Piezo electric transducers.

So first we'll start with what is a load cell or it is also

called as a pressure cell.

A load cell is a transducer that converts a force or a load

acting on it into an electrical

output. The electrical output may be in the form of a

voltage change, a currentchange, or a frequency change.

Load cells can be of. different types, so first type is called as the resistive load

cell. And these load cells are based on the principle of piezo

resistivity, which is the change in resistance whenever

any external force or load is applied to the sensor.

This change in resistance,which is observed, is

measured in terms of change in the output voltage.

Next we have the capacitive load sense which work on the

principle of change in

capacitance. Which indicates the ability of a system to

hold charge when voltage is applied to it.

When external force is applied to a capacitive load

cell, a change in its capacitance is observed.

Next we see the working of a load cell.

The Load cell uses strain gauges to weigh the load.

The diagram of the load is as shown here in Figure 1.

It consists of a steel bar on which the strain gauges are

mounted in the form of aWheatstone bridge.

Now, to measure the.

Weight or the pressure applied to the load cell,

The stress or the pressure is applied along the S direction as

shown in the figure.

Due to which the steel bar experiences a compression along

that Axis, and an expansion along the X&Y axis.

So the same thing is shown inFigure 2 in the form of a

Wheatstone bridge where we have.

Four strain gauges mounted on that steel bar as shown in the

previous diagram. So when the pressure is applied in the

direction as shown in the previous diagram, there is a

decrease in resistance for strain gauge R1 and

an increase in resistance for strain gauge R2.

These two gauges along with the gauges on the remaining

sides of the steel bar are arranged to form a bridge

circuit as shown over here.

Now the output voltage.

Is proportional to the applied force. And is a measure of the

weight that is applied.

Arranging the strain gauge in the form of a Wheatstone bridge,

Increases the sensitivity of the sensor up to four times.

Applications of load cells.

Because of its simple manufacturing process, an low processing costs the strain gauge. Load cells have been mass produced and are widely used in industrial applications such as process detection and control,automatic measuring, and other fields. Lord cells are also used in large number of measuring instruments such as laboratory balances, industrial scales, platform scales and universal testing machines.

And next we see the piezoelectric transducer.

Piezo electric transducers are active sensors and they work on the principle of Piezoelectric effect.

Piezo electric materials are used in the transducers.

for converting pressure or force into an electrical quantity. Application of a mechanical stress.

Leads to the generation of electrical voltage proportional to the applied stress, which is known as piezo electric effect and this is exhibited by the piezo electric materials.

Examples of piezoelectric materials are quartz, Rochelle salt, barium titanate,ammonium dihydrogen phosphate, and ceramic.

Next we see the working of Piezoelectric transducer.

Piezoelectric effect as we know is the generation of voltage

across the piezoelectric material surface due to the

mechanical strain that is applied to the crystal.

So the diagram of the piezoelectric transducer is is as

shown and it's equivalent circuit is as shown over here.

The amount of voltage that is produced is proportional to the

rate of change of force which is applied as input.

The piezoelectric transducer consists of a piezoelectric

crystal placed between a solid base and a force summing member.

As shown over here in the Figure 3.

When a mechanical deformation takes place, it generates charge

and hence it acts as a

capacitor. A voltage proportional to the applied

mechanical deforming force is developed across the

electrodes of the transducer, which can be

measured and calibrated with the deforming force.

The advantages of piezoelectric transducers are.

High frequency response piezoelectric materials are found

to show high frequency response and are hence used

widely in high frequency applications. They also

exhibit high transient response.

There is no need of external

power source since. The voltage is self generated.

They can be easily installed in high density electronic

devices because of their small dimensions.

Most of the pizza electric materials are highly flexible

and hence they can be constructed in a wide variety of

shapes and sizes and they are found to be very rugged.

The disadvantages of preselected transducers are.

Since the piso materials produce a fairly small electric charge,

a high impedance cable is required to connect them to an

electrical interface. The output generated is also

very low and hence external circuitry may be required

for amplifying the output.

Some of the puzzle materials are also affected by

temperature and humidity and hence may affect the output.

This piezo electric transducers cannot be used to measure static

pressure or force.

Because when it is done so, the output that is

generated will be 0.

Applications of piezoelectric materials or piezoelectric

transducers because of its excellent high frequency

response, they are widely used in high frequency accelerometers where the output is in the order of 1 to 30 millivolts per gravity of acceleration.

They can also be used for measuring force, pressure and displacement in terms of voltage. Some of the industrial applications of pizza electric sensors are. In engine knock sensors, as pressure sensors and in sonar equipment. In the field of medicine, the sensors are used in ultrasound imaging,and ultrasonic procedures.

The references are.

The following books electronic instrumentation by HS, Kalsi

Transducers and instrumentation By D.V.S Muthy,

Introduction to instrumentation and Control by A.K. Ghosh,

instrumentation devices and systems, C.S. Rangan.

Thank you.