



Q1) Give the different classification of error.
→ There are 3 types of errors that are classified based on source they arise from; They are:

- 1) Gross error
- 2) Random error
- 3) Systematic error

1) Gross error

This category basically takes into account human oversight & other mistake while reading, recording & readings. The most common human error in measurement falls under this category of measurement errors.

2) Random error

The random errors are those errors which occur irregularly and hence are random. These can arise due to random & unpredictable fluctuations in experimental conditions. example: unpredictable fluctuations in temperature, voltage supply, mechanical vibrations of experimental set-ups.

a) Systematic error

Systematic error get divided into 3 subgroups, they are

- i) Environmental Error
- ii) Observational Error
- iii) Instrumental Error

i) Environmental Error

This type of error arises in measurement due to effect of the external conditions on measurement. The external condition includes temperature, Pressure & humidity and can also include external magnetic field.

ii) Observational Error

These are the errors that arise due to an individual's bias, lack of proper setting of apparatus, and wrong reading also.

iii) Instrumental Error

These error arise due to faulty construction & calibration of measuring instruments. Such errors arise due to hysteresis of equipment or due to friction.

2] Explain Static & dynamic characteristic of transducer.

* Static Characteristic

- 1] Sensitivity
- 2] Resolution
- 3] Precision
- 4] Span & Range
- 5] Drift
- 6] Stability
- 7] Repeatability
- 8] Threshold

* Dynamic Characteristic

- 1] Dynamic error
- 2] Fidelity
- 3] Speed of Response
- 4] Bandwidth

3] Give the different performance measures of sensors.

→ A sensor is a device that can be used for measuring the physical quantity and converts it into signals that can be read by user, an observer, or by an instrument.

* Performance measures of Sensors.

i) Range & Span

The range of transducer defines the limits betⁿ which the input can vary on working.

The span is the difference betⁿ maximum value & the minimum value.

ii) Error

Error is difference betⁿ the result of measurement and the true value of quantity being measured

$$\text{Error} = \text{Measured value} - \text{true value}$$

iii) Accuracy

It is term which defines the way of measurement & your readings are totally correct

iv) Sensitivity

It is normally termed as relationship showing how much output there is per unit input.

Q4 Explain different sensor calibration technique.

→ The comparison betⁿ Expected output and measured output is called Sensor Calibration.

- It is used to measure the structural errors caused by sensors.

- There are 3 standard calibration methods used for sensors.

- 1) one-point calibration
- 2) Two-point calibration
- 3) Multi-point Curve Fitting

1) one-point calibration

- one point calibration is used to correct the sensor offset errors when accurate measurement of only single level is required & the sensors is linear.

ex. Temperature sensors

2) Two-point calibration

- It is used to correct both slope & off-set errors.

- This calibration is used in the cases when the sensors we know that sensors output is reasonable linear over measurement range.

3) Multi-point Curve Fitting

- It is used for sensors that are not linear over the measurement range & require some curve-fitting to get the accurate measurements. Multi-point curve fitting is usually done for thermocouples when used in extremely hot or extremely cold conditions.



Q5] Explain with suitable diagram work of RTD.

→ An RTD stands for "Resistance Temperature Detector" and it is a sensor whose resistance changes when its temperature changes and it is used to measure temperature. The RTD's resistance increases linearly when the temperature increases.

* Working

Resistance thermometers or resistance temperature detector works on principle of positive temperature coefficient of resistance. i.e. as temperature increases, resistance offered by thermometer also increases. The resistance element of platinum & iron metal wire is wrapped around an electrically insulating support of glass, ceramic or mic & from outside, the protective sheath of metallic tube can be provided. The lead wires are taken out from resistance elements which are joined to a circuitary.

* RTD Formula

$$R_T = R_0 [1 + \alpha(T - T_0)]$$

α - Temp.

R_T - Resistance at temperature (T) | α - Temp. coeff

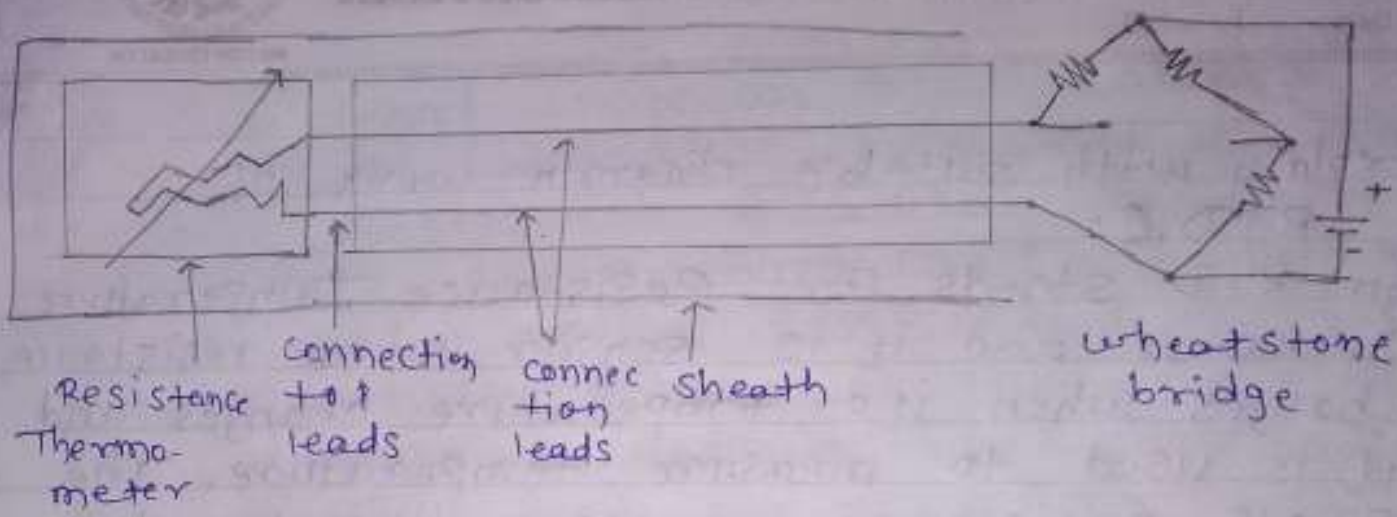
R_0 - Resistance at temperature (0°C) | T - Temperature (0°C)

MINAL

T_0 - Initial temp.



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Q 6] write Short note on digital camera.

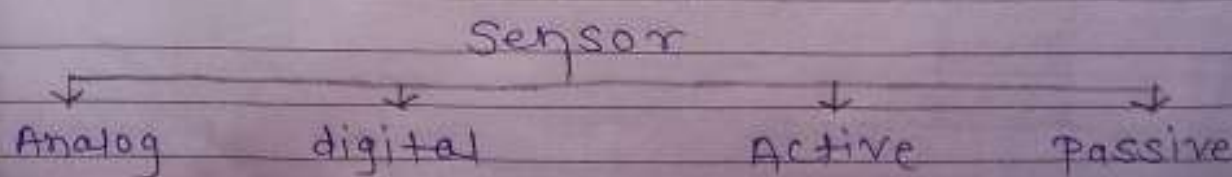
→ A digital camera is hardware device that takes photograph & stores the image as data on memory card. Digital camera uses digital optical components to register the intensity & color of light and converts it into Pixel data. A digital camera may be considered both an input & output device as it can both takes picture and send them to your computer.

* History

- The First digital camera was invented in 1975 by Steven Sasson, an engineer at Eastman Kodak. It Primarily used a charge coupled device, a type of image sensor but originally used camera tube for image capture. That functionality was later digitized by Kodak.

Q 7] Give different classification of sensors.

→ Following are the Classification of Sensors.



1) Analog sensor

- Analog sensor produce an analog output i.e. a continuous output signal (usually voltage but sometimes other quantities like resistance) with respect to quantity being measured.

2) Digital sensor

- It work with discrete or digital data. The data in digital sensors, which is used for conversion & transmission is digital in nature.

3) Active sensor

- Active sensor are those which require an external excitation signal or power signal.

4) Passive signal

- Passive signal do not require any external power signal & directly generates output response.

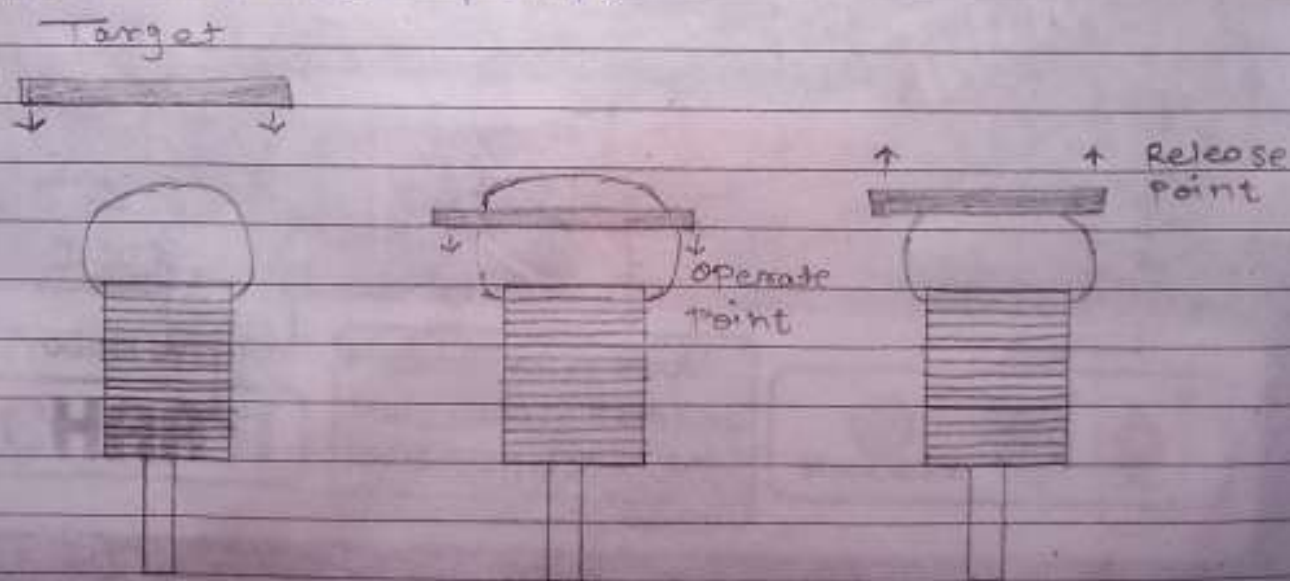
Q8] Explain inductive & Capacitive Proximity Sensor.

* Inductive Proximity sensor

An inductive Proximity sensor is sensing device that detects metal target using electro-magnetic energy and without contact.

* working

An inductive Proximity sensor creates an electro-magnetic field in the vicinity of the face of sensor to create detection zone. A detection occurs & the sensors switches on when metal target in vicinity of sensor disturbs that field & reaches the operate point. The sensor switches off when the target moves away from sensor & reaches the release point.



* Capacitive Proximity sensor

- Capacitive Proximity sensor (CPS) are sensing device designed to detect both metallic & non-metallic targets. They can detect light-weight or small objects that cannot be detected by mechanical limit switches.

* working

- A Capacitive Proximity sensor uses dielectric principles of capacitance to establish a sensing field in the vicinity of the face of sensor that creates a detection zone.

A detection occurs & the sensor switches on when target in the vicinity of sensor disturbs that field & reached the operate point. The sensor switches off when the target moves away from sensor and reaches the release point.

