Instrument Characteristics

STATIC & DYNAMIC CHARACTERISTICS OF MEASUREMENT SYSTEM

STATIC CHARACTERISTICS:- The static characteristics are defined for the instruments which measure quantities which do not vary with time or mostly constant.

The various static characteristics are:

- Accuracy
- Precision
- Sensitivity
- Linearity
- Reproducibility
- Repeatability
- Resolution

STATIC CHARACTERISTICS OF MEASUREMENT SYSTEM

- **Accuracy**: It is the degree of closeness with which the reading approaches the true value of the quantity to be measured.

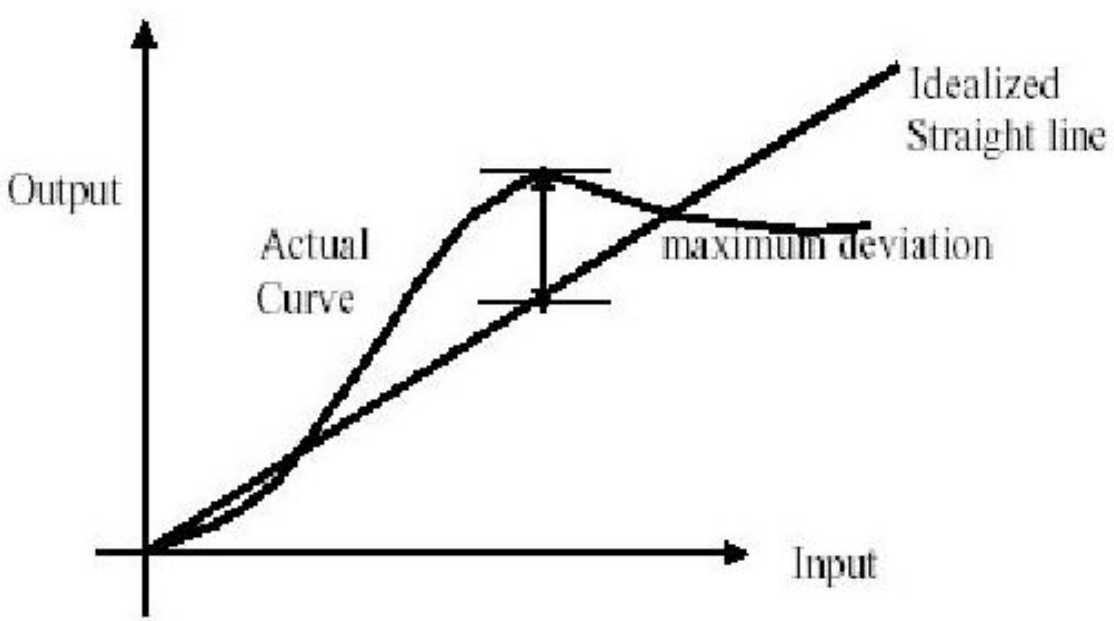
  The accuracy of a measurement indicates the nearness to the actual/true value of the quantity.

- **Sensitivity**: The sensitivity denotes the smallest change in the measured variable to which the instrument responds.
- It is defined as the ratio of the changes in the output of an instrument to a change in the value of the quantity to be measured.

STATIC CHARACTERISTICS OF MEASUREMENT SYSTEM

Linearity:

The linearity is defined as the ability to reproduce the input characteristics symmetrically & linearly. The curve shows the actual calibration curve & idealized straight line.



Linearity is defined as,
linearity=Maximum deviation of o/p from idealized straight line /Actual readings

- **Precision:**

  Precision is a measure of the degree to which successive measurements differ from each other.

  Precision describes the reproducibility of the measurement. For example, measure a steady state signal many times. In this case if the values are close together then it has a high degree of precision or repeatability. The values do not have to be the true values just grouped together. Take the average of the measurements and the difference between it and the true value is accuracy.

STATIC CHARACTERISTICS OF MEASUREMENT SYSTEM

- **Reproducibility**: It is the degree of closeness with which a given value may be repeatedly measured.
- It is specified in terms of scale readings over a given period of time.

  Perfect reproducibility signifies that the given readings that are taken for an input, do not vary with time.
- **Resolution**: If the input is slowly increased from some arbitrary input value, it will again be found that output does not change at all until a certain increment is exceeded. This increment is called resolution.

STATIC CHARACTERISTICS OF MEASUREMENT SYSTEM

- **Hysteresis:**

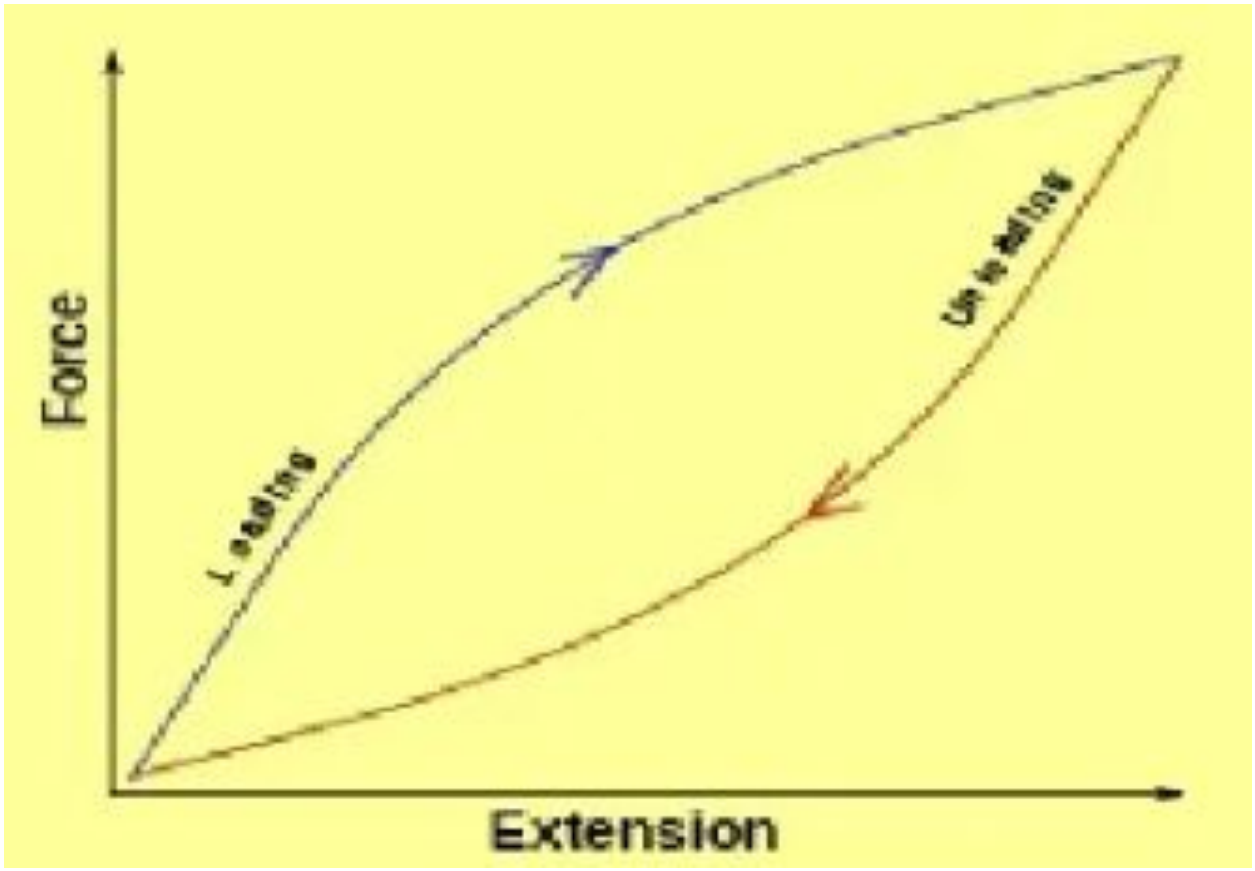
  Hysteresis is a phenomenon which depicts different output effects while loading and unloading.

  Hysteresis takes place due to the fact that all the energy put into the stressed parts when loading is not recoverable while unloading.

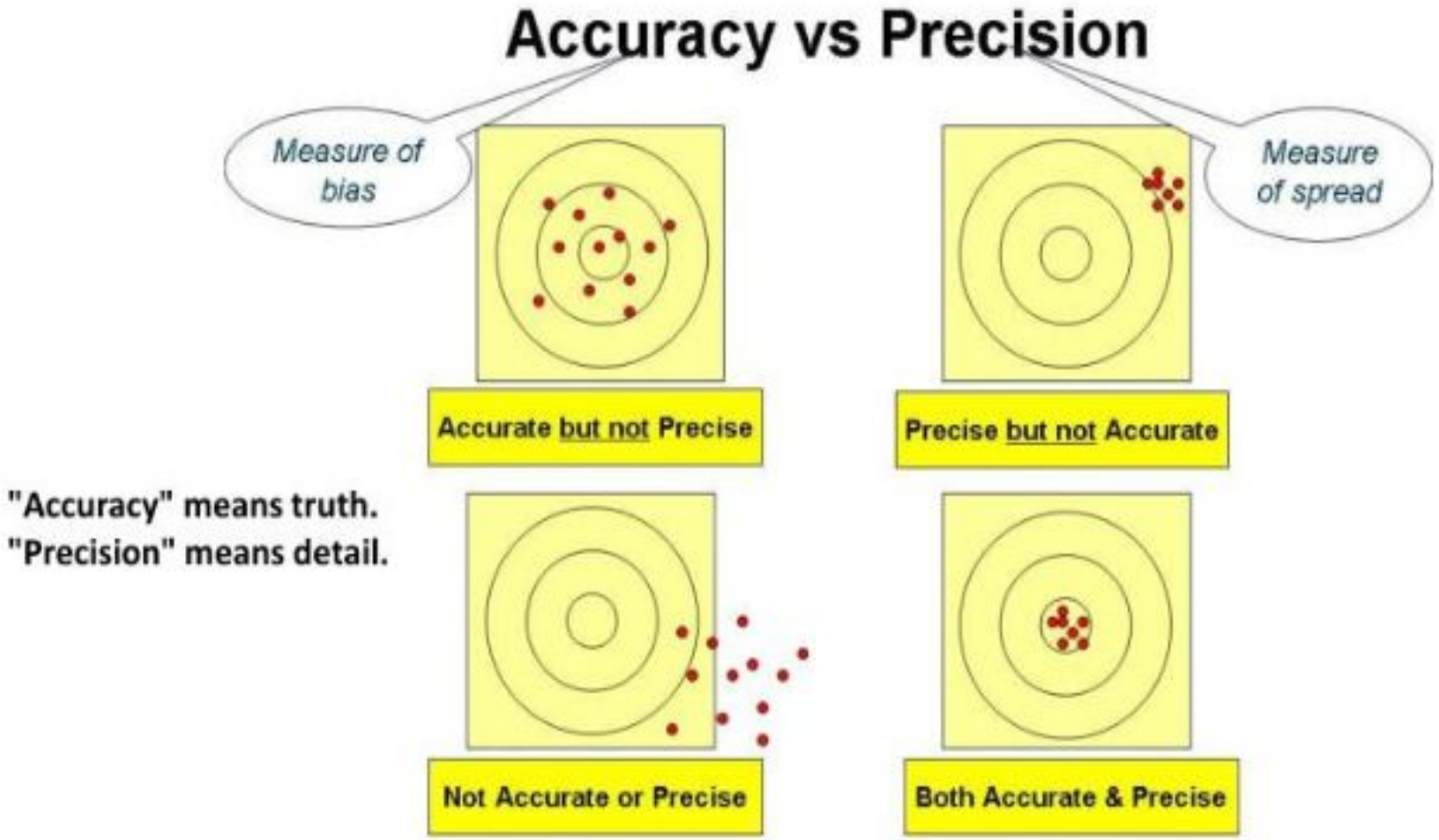
  When the input of an instrument is varied from zero to its full scale and then if the input is decreased from its full scale value to zero, the output varies.

  The output at the particular input while increasing and decreasing varies because of internal friction or hysteric damping.

Hysteresis



Accuracy vs Precision



Dynamic Characteristics Of Measurement System

- Dynamic characteristics: The set of criteria defined for the instruments, which are changes rapidly with time, is called ‘dynamic characteristics’.

  The various dynamic characteristics are:

  i) Speed of response

  ii) Measuring lag

  iii) Fidelity

  iv) Dynamic error

Dynamic characteristics of Measurement System

- **Speed of response**: It is defined as the rapidity with which a measurement system responds to changes in the measured quantity.
- **Measuring lag**: It is the retardation or delay in the response of a measurement system to changes in the measured quantity. The measuring lags are of two types:
- a) **Retardation type:** In this case the response of the measurement system begins immediately after the change in measured quantity has occurred. b) **Time delay lag**: In this case the response of the measurement system begins after a dead time after the application of the input.
- **Fidelity:** It is defined as the degree to which a measurement system indicates changes in the measured quantity without dynamic error. **Dynamic error**: It is the difference between the true value of the quantity changing with time & the value indicated by the measurement system if no static error is assumed. It is also called measurement error.