



UNIT - 1

SCIENCE OF MEASUREMENT AND TRANSDUCERS

Errors in Measurements - Static and Dynamic



Measurement Error

No measurement can be made with perfection and accuracy, but it is important to find out what the accuracy actually is and how different errors have entered into the measurement. Error occurs due to several sources like human carelessness in taking reading, calculating and in using instrument etc. Some of the time error is due to instrument and environment effects. Errors come from different sources and are classified in three types:

- 1. Gross Error**
- 2. Systematic Errors**
- 3. Random Errors**



Gross Error

The gross error occurs due to the human mistakes in reading or using the instruments. These errors cover human mistakes like in reading, calculating and recordings etc. It sometimes occurs due to incorrect adjustments of instruments.

The complete elimination of gross errors is impossible, but we can minimize them by the following ways:

- 1. It can be avoided by taking care while reading and recording the measurement data.**
- 2. Taking more than one reading of same quantity. At least three or more reading must be taken by different persons.**



Systematic Errors

A systematic error is divided in three different categories: instrumental errors, environmental errors and observational errors.

1. Instrumental Errors

The instrument error generate due to instrument itself. It is due to the inherent shortcomings in the instruments, misuse of the instruments, loading effects of instruments. For example in the D' Arsonval movement friction in bearings of various moving components may cause incorrect readings. There are so many kinds of instrument errors, depending on the type of instrument used.

Instrumental errors may be avoided by

- (a) Selecting a suitable instrument for the particular measurement application**
- (b) Applying correction factors after determining the amount of instrumental error**
- (c) Calibrating the instruments against a standard.**



Environmental Errors

Environmental errors arise as a result of environmental effects on the instrument. This includes conditions in the area surrounding the instrument, such as the effects of changes in temperature, humidity, barometric pressure or of magnetic or electrostatic fields.

For example when making measurements with a steel rule, the temperature when the measurement is made might not be the same as that for which the rule was calibrated. Environmental errors may be avoided by

- (a) Using the proper correction factor and information supplied by the manufacturer of the instrument.***
- (b) Using the arrangement which will keep the surrounding condition constant like use of air condition, temperature controlled enclosures etc.***
- (c) Making the new calibration under the local conditions.***



Observational Errors

These errors occur due to carelessness of operators while taking the reading. There are many sources of observational errors such as parallax error while reading a meter, wrong scale selection, the habits of individual observers etc.

To eliminate such observational errors, one should use the instruments with mirrors, knife edged pointers, etc. Now a day's digital display instruments are available, which are much more versatile.



Random Errors

These errors are due to unknown causes and occur even when all systematic errors have been accounted for. In some experiments some random errors usually occur, but they become important in high-accuracy work.

These errors are due to friction in instrument movement, parallax errors between pointer and scale, mechanical vibrations, hysteresis in elastic members etc.