ERRORS IN MEASUREMENT

The types of errors are follows

    i)   Gross errors

    ii)   Systematic errors

    iii)   Random errors

Gross Errors

The gross errors mainly o c c u r due to carelessness or lack of experience of a human begin. These errors also occur due to incorrect adjustments of instruments these errors cannot be treated mathematically

These errors are also called 'personal errors'.

Ways to minimize gross errors:

The complete elimination of gross errors is not possible but one ca n minimize them by the following ways:

Taking great care while taking the reading, recording the reading &calculating the result without depending on only one reading, at least three or more readings must be taken preferably by different persons.

Systematic errors

A constant uniform deviation of the operation of an instrument is known as Systematic error. The Systematic errors are mainly due to the short comings of the instrument & the characteristics of the material used in the instrument, such as defective or worn parts, ageing effects, environmental effects, etc.

Types of Systematic errors:

There are three types of Systematic errors as:

    i)   Instrumental errors

    ii)   Environmental errors

    iii)   Observational errors

Instrumental errors:

These errors can be mainly due to the following three reasons:

    a) Short coming of instruments:

These are because of the mechanical structure of the instruments. For example friction in the bearings of various moving parts; irregular spring tensions, reductions in due to improper handling , hysteresis, gear backlash, stretching of spring, variations in air gap, etc ., Ways to minimize this error:

These errors can be avoided by the following methods:

Selecting a proper instrument and planning the proper procedure for the measurement recognizing the effect of such errors a n d applying t h e proper correction factors calibrating the instrument carefully against a standard

b) Misuse of instruments:
   A good instrument if used in abnormal way gives misleading results. Poor initial adjustment, Improper zero setting, using leads of high resistance etc., are the examples of misusing a good instrument. Such things do not cause the permanent damage to the instruments but definitely cause the serious errors.

c) Loading effects

Loading effects due to improper way of using the instrument cause the serious errors. The best ex ample of such loading effect error is connecting a w ell calibrated volt meter across the two points of high resistance circuit. The same volt meter connected in a low resistance circuit gives accurate reading.

Ways to minimize this error:

Thus the errors due to the loading effect can be avoided by using an instrument intelligently and correctly.

Environmental errors:

These errors are due to the conditions external to the measuring instrument. The various factors resulting these environmental errors are temperature changes,pressure changes, thermal emf, and ageing of equipment and frequency sensitivity of an instrument

Ways to minimize this error:

The various methods which can be used to reduce these errors are:

i)   Using the proper correction factors and using the information
     supplied by the manufacturer of the instrument

ii) Using the arrangement which will keep thesurrounding conditions Constant

iii) Reducing the effect of dust ,humidity on the components by hermetically

sealing the components in the instruments

iv)   The effects of external f i e l d s can be minimized by using the

magnetic or electro static shields or screens

v)   Using the equipment which is immune to such environmental effects.

Observational errors:

These are the errors introduced by the observer.

These are many sources of observational errors such as parallax error while reading a meter, wrong scale selection, etc.

Ways to minimize this error

To eliminate such errors one should use the instruments with mirrors, knife edged pointers, etc. The systematic errors can be subdivided as static and dynamic errors. The static errors are caused by the limitations of the measuring device while the dynamic errors are caused by t h e instrument not responding fast enough to follow the changes in the variable to be measured.

Random errors

Some errors still result, though the systematic and instrumental errors are reduced or at least accounted for. The causes of such errors are unknown and hence the errors are called random errors.

Ways to minimize this error

The only way to reduce these errors is by increasing t h e number of observations and using the statistical methods to obtain the best approximation of the reading.