## Classification of Error:-

Errors in measurement can be classified into 3 types:-

1): Gross Error
2): Systematic Error
3): Random Error

### 1): Gross Error:-

This type of error occurs due to human negligency. It can be explained by below given examples.

a): A person reading pressure guage $1.01 N/m^2$ as $1.10 N/m^2$. It maybe due to the person's bad habit of not properly remembering data at the time of taking down Reading.

b): Reading of the instrument value before it reaches Steady state.

c): Calculating a derived measurand wrongly. like a person is calculating resistance from Voltmeter and ammeter values So if he has done some wrong division, then the value of resistance will be wrong.

→ Careful reading and recording of the data can reduce gross errors.

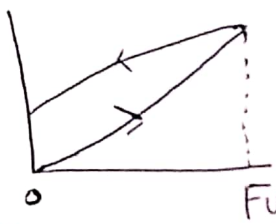
2):- Systematic Error:-

→ These are common error and are not due to human negligency.
→ occurs due to fault in the measuring device.

These error are further divided into 3 types:-

a):- Instrumental Error:-

can be due to hyterisis or friction. Hysteresis means that when there is no input, still output is shown to us. and it is due to residual flux in the material of the instrument.



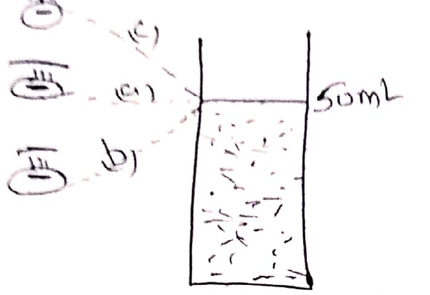

Also due to friction, the moving parts of an instrument can cause wear and tear due to which the instrument may not give us actual value.

b):- Enviromental Error:-

"due to temperature or due to humidity". Suppose we are measuring resistance as we know that resistance is directly proportional to temperature. So incase of high temp around, we cannot measure the actual of resistance i.e we will get a high value of resistance.
Also, a metal ruler can expand in hot weather which will give us wrong reading while measuring length.

## (c). Observational Errors:-

→ occurs due to wrong observation or reading in the instruments.
common example of observational error is the parallex which occurs due to the different level at which the observer is taking the reading.




Suppose a person is taking reading of a fluid from a glass tube. The reading will be accurately obtained at position (a) and suppose actual reading is 50mL. Now, if he is reading from position (b), he will get a lower value (suppose 49.9) and if he is reading from position (c), he will get a higher value (suppose 50.1). This type of error is called parallel error.

## (3):- Random Error:-

→ caused by the Sudden change in experimental conditions and noise or tiredness in the working persons.

→ These error generally occurs due to Sudden change in experimental conditions e.g:- Unexpected change in temp, humidity, fluctuation in voltage.

# Moving coil Galvanometer:-

## Definition:-

"Galvanometer is a device used for the detection and measurement of very small current in a Circuit".
(milli-Amp/microAmp)

→ To measure large value of current, we will convert it into Ammeter.

## Principle:-

"When a current carrying conductor is placed in a magnetic field, it will experience a torque".

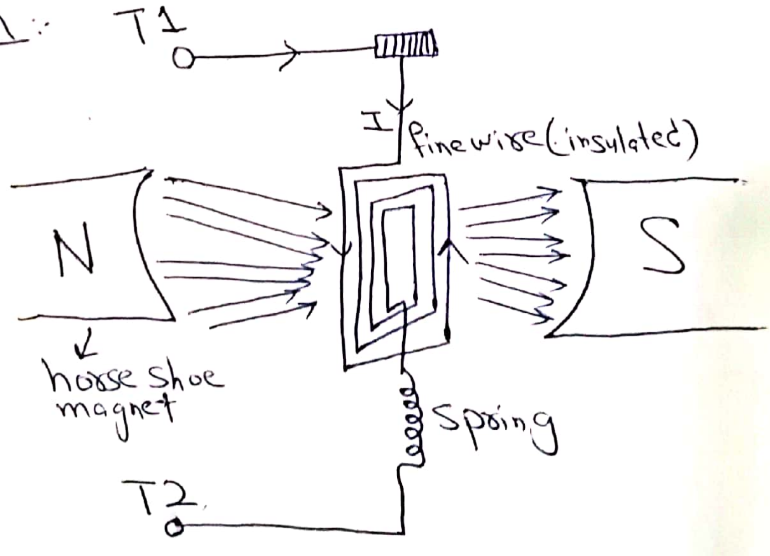
→ We chose a coil having many turns placed in a strong magnetic field.

→ When the current to be measured is sent to the coil, a torque acts on coil which, in turn, rotates it

- We use a pointer and scale to obtain this rotation (deflection) of coil.

→ more the current, more in torque.
more is deflection, more is reading on the scale.

## Construction:-



→ The moving coil galvanometer consists of a rectangular coil of thin insulated copper wires having a large number of turns.

→ The coil is suspended b/w the poles of a powerful horse shoe magnet by a suspension fibre of phosphor-bronze.

→ A spring is attached to the other end of the coil. The current enters the coil through the fibre and leaves the coil through the spring.

→ The horse shoe magnet has cylindrically concave pole pieces because due to this shape, the magnet produces radial magnetic field so that when coil rotates in any position, it will be perpendicular to the magnetic field thus creating maximum torque.

→ The fine wire is wound on a soft iron cylinder. Soft iron has high permeability, thus increasing the strength of the radial magnetic field.

→ A pointer and a scale is also attached with the fine wire to measure the rotation of the coil.

→ When the current is sent to the coil, the magnetic field (B) and current are perpendicular to each other which in turn produces a force (torque) on the coil.

→ The direction of this force is given by Fleming's left hand rule.

(1):- Thumb ⇒ direction of force
(2):- 1st finger → " " field
(3):- middle finger → " " current.

The Torque acting on the coil is given by.

$\tau = NIAB\sin\theta$

where N = number of turns of coil
A = Area of coil
B = magnetic field
$\theta$ = Angle b/w I and B.

→ It should be noted that the spring provides the controlling torque in order to bring the pointer back to its original position when the flow of current stops.