ERROR AND MEASUREMENT

1. Least Count

2. Significant Figures

- Non-zero digits are significant
- Zeros occurring between two non-zeros digits are significant.
- Change of units cannot change S.F.
- In the number less than one, all zeros after decimal point and to the left of first non-zero digit are insignificant
- The terminal or trailing zeros in a number without a decimal point are not significant.

3. Permissible Error

- Max permissible error in a measured quantity = least count of the measuring instrument and if nothing is given about least count then Max permissible error = place value of the last number
- $f(x,y) = x + y$ then $(\Delta f)_{max}$ = max of $(\pm \Delta X \pm \Delta Y)$
- $f(x,y,z) = (\text{constant})\, x^a y^b z^c$ then $\left(\frac{\Delta f}{f}\right)_{max}$

$$= \text{max of } \left(\pm a\frac{\Delta x}{x} \pm b\frac{\Delta y}{y} \pm c\frac{\Delta z}{z}\right)$$

4. Errors in averaging

- Absolute Error $\Delta a_n = |a_{mean} - a_n|$
- Mean Absolute Error $\Delta a_{mean} = \left(\sum_{i=1}^{n} |\Delta a_i|\right) \Big/ n$
- Relative error = $\frac{\Delta a_{mean}}{a_{mean}}$
- Percentage error = $\frac{\Delta a_{mean}}{a_{mean}} \times 100$

5. Experiments

- Reading of screw gauge

Thicknes of object = Reading of screw gauge

$$= \begin{pmatrix}\text{main}\\ \text{scale}\\ \text{reading}\end{pmatrix} + \begin{pmatrix}\text{circular}\\ \text{scale}\\ \text{reading}\end{pmatrix}\begin{pmatrix}\text{Least}\\ \text{count}\end{pmatrix}$$

$$\text{least count of screw gauge} = \frac{\text{pitch}}{\text{No. of circular scale division}}$$

- Vernier callipers

Thicknes of object = Reading of vernier calliper

$$= \begin{pmatrix}\text{main}\\ \text{scale}\\ \text{reading}\end{pmatrix} + \begin{pmatrix}\text{vernier}\\ \text{scale}\\ \text{reading}\end{pmatrix}\begin{pmatrix}\text{Least}\\ \text{count}\end{pmatrix}$$

Least count of vernier calliper = 1 MSD – 1 VSD