

VESP Vision

To be the centre of excellence in the field of technical education.

Program Code:- Common to all 1st semester

Course Name:-Basic Science(physics)

Course Code : - 22102

Course coordinator: Mrs. Deepa Gupte

Date: 12/07/2020



Unit No:1

Unit Name: Units and Measurements

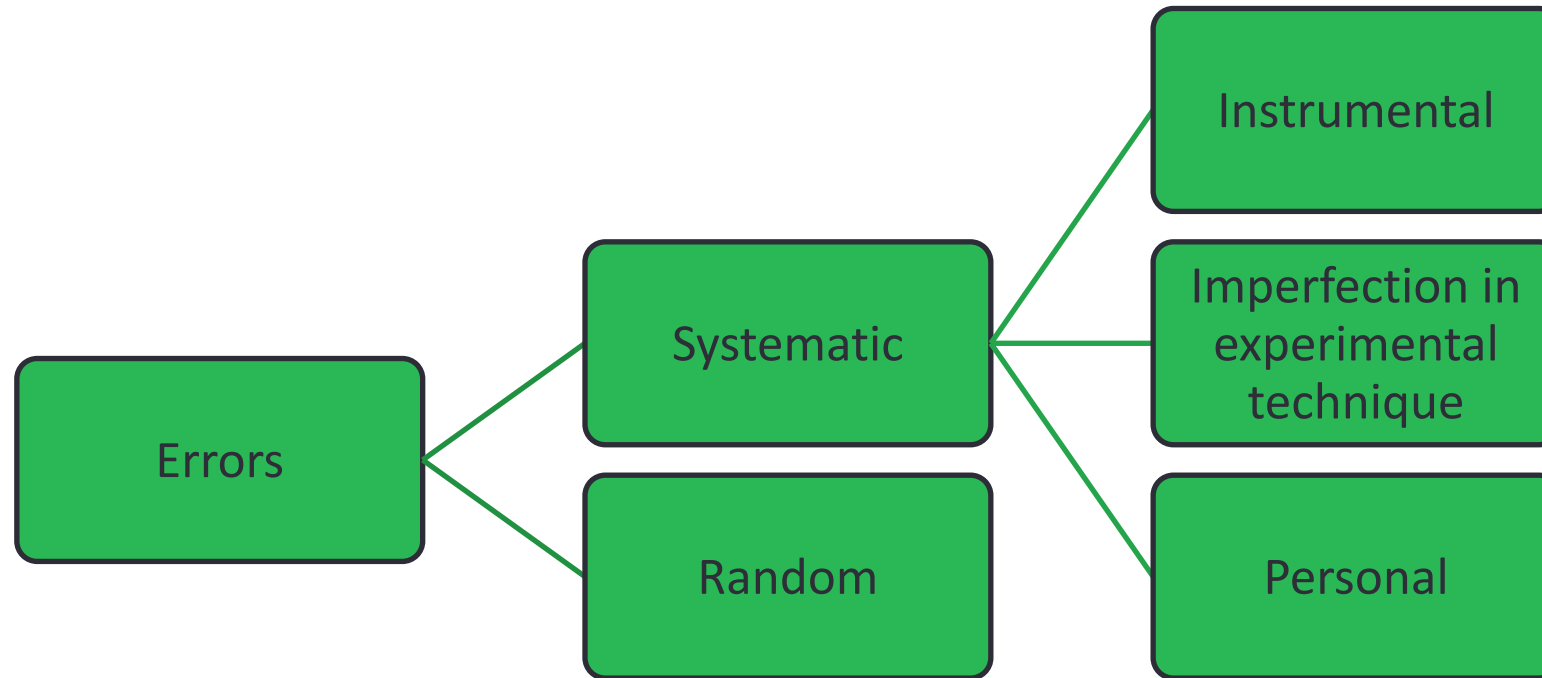
Unit Outcomes (UO1c): State with justification the error in the given measurement quantity

Learning Outcome (LO3): Students will be able to estimate the errors in the measurement.

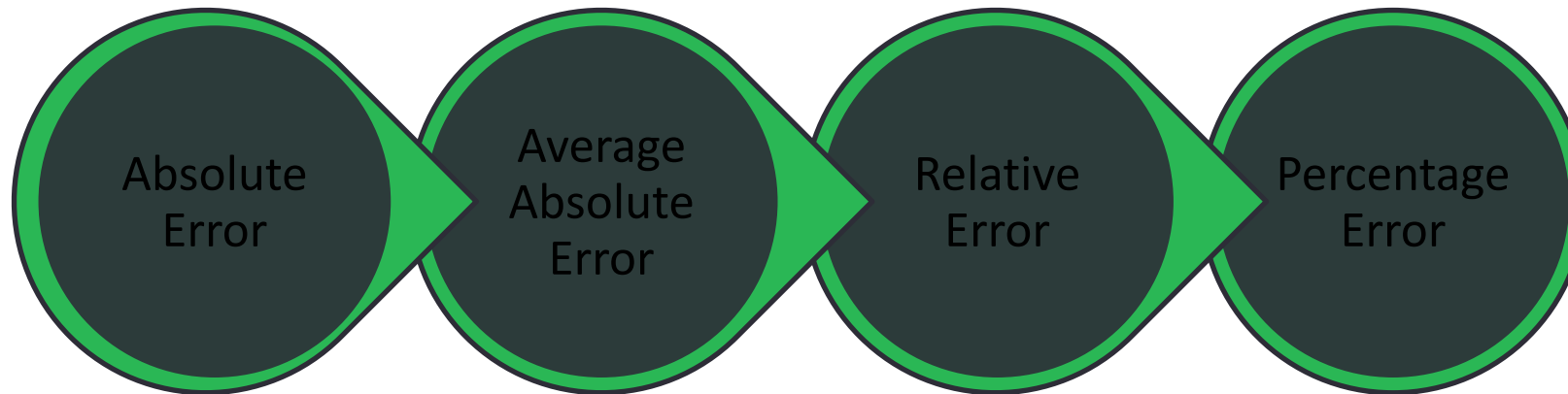
Contents: Errors, Systematic Error, Random Error, Estimation of Error



Types of Errors



Estimation of Errors



- ▶ Students will be able to identify type of errors in the measurement
- ▶ Students will be able to estimate errors in the measurement.
- ▶ Students will be able to apply methods to minimize errors in the measurement.



- ▶ The difference between the actual value (true value of mean value) and measured value is called errors.
- ▶ An error is a fault or uncertainty, which may occur even in the most careful observation while taking measurement by an instrument.
- ▶ Errors are classified as
 - ▶ Random
 - ▶ Systematic



- ▶ The errors caused due to sudden change in experimental conditions is called random errors.
- ▶ These error cannot be controlled and hence it is also called as accidental errors.
- ▶ Same person may get different readings because of human limitations, then the error caused is called random error.
- ▶ Errors caused due to change in temperature or pressure, change in humidity, fluctuation in voltage, etc. are examples of random error.



- ▶ Errors caused by virtue of certain definite rule or known causes are called systematic error.
The sources of Systematic errors are
- ▶ **Instrumental Errors:** These can be caused due to the defective setting or adjustment of the instruments by the experimenter.
 - ▶ If the pointer of a magnetic compass is not pivoted at the center of the magnetic scale, a systematic error will occur
 - ▶ This error may be due to a defective alignment of the instrument . e.g. Zero error.
 - ▶ The error due to imperfect experimental arrangement. e.g. radiation in calorimeter experiments.
 - ▶ **Imperfection in experimental technique:** If the experiment is not performed under proper guidelines or physical conditions around are not constant, then this leads to imperfection in technique errors
- ▶ **Personal error** :As this errors are persistent and related to personal cause it is also called persistent error or personal error. e.g. Parallax error



- ▶ Least Count Error depends on the resolution of the instrument.
- ▶ It occurs in both random as well as systematic errors .The Least Count Error can be calculated if we know the observations and least count of instruments.
- ▶ We use high-precision instruments in order to improve experiment techniques, thereby reducing least count error.



- ▶ The errors in any observation can be minimized by adopting the following steps.
 - ▶ taking large magnitude of the quantity to be measured.
 - ▶ consider mean value by taking multiple readings.
 - ▶ using smallest least count instrument.



Attempt Set 1 MCQs

Set 1: Question No 1	Set 1: Question No 2	Set 1: Question No 3
Errors caused by virtue of certain definite rule or known causes are called _____ error.	If the pointer of a magnetic compass is not pivoted at the center of the magnetic scale, which type of error will take place?	Zero error of an instrument introduces _____ error.
Recall/ Remembering	Understanding	Application
a) random	a) Random error	a) instrumental
b) instrumental	b) Instrumental error	b) systematic
c) systematic	c) Systematic error	c) personal
d) zero	d) Zero error	d) random
Ans: <c>	Ans: <c>	Ans: <a>



0:20



- ▶
 - ▶ Let \bar{x} be the true or correct or average or mean value and x_i be the measured value of the physical quantity to be measured.
 - ▶ Errors in any measurement can be represented by the following ways
 - ▶ Absolute error: The difference between the magnitude of true value and measured value is called the absolute error.
 - ▶ Absolute error $\Delta x = |\bar{x} - x_i|$



- ▶ Average absolute error: The average of all absolute error in a measurement is called mean or average absolute error.

- ▶ Average absolute error $\overline{\Delta x} = \frac{\sum_{i=1}^n |\bar{x} - x_i|}{n} = \frac{\Delta x}{n}$

- ▶ Relative error: It is defined as the ratio of average absolute error to the true value.

- ▶ Relative error $r = \frac{\overline{\Delta x}}{\bar{x}}$

- ▶ Percentage error: Relative error expressed in percentage is called percentage error.

- ▶ Percentage error = % $r = \left(\frac{\overline{\Delta x}}{\bar{x}} \times 100 \right) \%$



While measuring diameter of a wire by a micrometer screw gauge, let us assume that we get the following measured readings in cm.

Sr. No.	Measured Value	Average value
1.		
2.		
3.		
4.		
5.		
6.		



Example on Estimation of Error

While measuring diameter of a wire by a micrometer screw gauge, let us assume that we get the following measured readings in cm.

Sr. No.	Measured Value	Average value	Absolute Error
1.			
2.			
3.			
4.			
5.			
6.			



Example on Estimation of Error

While measuring diameter of a wire by a micrometer screw gauge, let us assume that we get the following measured readings in cm.

Sr. No.	Measured Value	Average value	Absolute Error	Average absolute error
1.				
2.				
3.				
4.				
5.				
6.				

