

# Methods of Measurement:-

2

1):- Direct Method

2):- Indirect Method

1):- Direct Method:-

"In direct measurement method, the unknown quantity (measurand) is measured directly using a measuring instrument".

● Examples:-

a):- measurement of current using Ammeter.

b):- measurement of voltage using Voltmeter.

c):- " " Power " Wattmeter.

The direct measurement methods are further classified into

two types:-

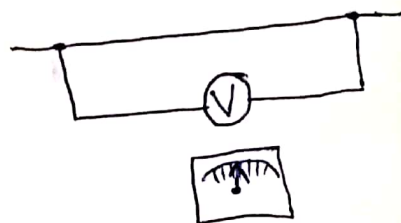
● a):- Deflection method

b):- Comparison method.

a):- Deflection method:-

"In this method of measurement, the measurement is indicated by the deflection of pointer across a scale.

For example, we want to measure voltage across a conductor. So we will connect a voltmeter in parallel with the conductor as show below:-



Hence, in this method of measurement, the voltage was measured by the deflection of the pointer on the scale of voltmeter.

b): Comparison method:-

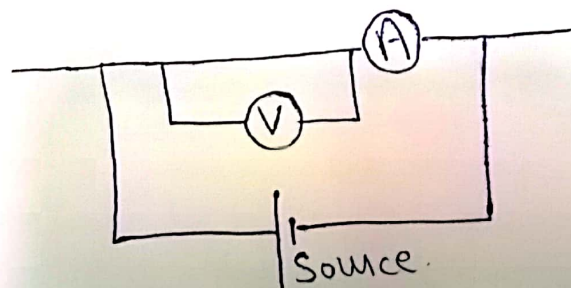
In comparison method of measurement, the unknown quantity (measurand) is compared with a known (standard) quantity. ex "value of the unknown quantity is determined by the comparison with a standard of the given quantity."

For example, unknown mass with a known mass of 1kg. Hence, on one side of the balance machine, we keep the known mass of 1kg and on the other side we keep the unknown mass. When the balance of both the masses are equal, we will say that the unknown mass is also of 1kg.

2. In direct method:-

In this method of measurement, the unknown quantity is determined by measuring the functionally related quantity and then calculating the desired quantity rather than measuring it directly.

For example, we want to measure the resistance of a wire by indirect method. Hence, we will calculate the current through the conductor using ammeter and then we will measure the voltage across the conductor using a voltmeter.



Now, from ammeter, we will get the value of current and from voltmeter, we will get the value of voltage. Now from ohm's law,  $R = \frac{V}{I}$ , we can easily calculate the value of Resistance of the wire.

## UNIT OF MEASUREMENT:-

We have seen earlier that whenever we do measurement, we express the result in two parts i.e. one is the number and second is the unit of measurement.

"A unit of measurement is a definite magnitude of a physical quantity defined and adopted by convention and/or by law that is used as a standard for measurement of the same physical quantity."

In simple words "unit is the basic quantity in a given system of measurement."

e.g :- yards, metre, inch, kilogram, litres.

→ Some units can be a combination of different basic unit.

Force = mass  $\times$  Acceleration.  
Newton =  $\text{kg} \times \text{m/s}^2$



The Three basic units are:-

a). Mass  $\rightarrow$  Kg

b). length  $\rightarrow$  m

c). Time  $\rightarrow$  sec

All other units are expressed in terms of these 3 basic units.

Units of measurement are of 2 types:-

i). Fundamental units  $\rightarrow$  primary

ii). Derived units  $\rightarrow$  Auxiliary

iii). primary fundamental units are in length, mass & time (m) (kg) (sec)

while Auxiliary fundamental units are given below.

i) Current  $\rightarrow$  Ampere

ii) Temperature  $\rightarrow$  Kelvin

iii) Amount of a substance  $\rightarrow$  mole

iv) Luminous Intensity  $\rightarrow$  Candela.

2). Derived units can be expressed in terms of the fundamental units.

$\rightarrow$  Every derived unit originates from some physical law defining that unit. like Newton is the derived unit for force.

because: Force = mass  $\times$  acceleration  
Newton =  $\text{Kg} \times \text{m/s}^2$

## Classification of Measuring Instruments:-

### (i):- Analogue Instrument:-

"The instrument whose output is the continuous function of time, and they have a constant relation to the input. → The physical quantity like voltage, current, power and energy are measured through the analogue instruments. → Most of the analogue instrument use pointer for indicating the magnitude of the measured quantity. on the basis of representation, there are 3 types of Analogue instruments:-

- a):- Indicating Type
- b):- Recording Type
- c):- Integrating Type

### (ii):- Indicating Type:-

"The value of the electrical quantity is indicated by these instruments at the time when it is being measured!"

In simple words, indicating type instruments only gives display. There is not recording or storage function. Ammeter, voltmeter, wattmeter are the examples of these instruments.

D):- Recording Type:-  
"A continuous record of variation of the electrical quantity, over a period of time is given by these instruments."

In simple words, these instruments have display plus recording functions.

e.g. if we want to measure the functionality of a heart, we will use ECG machine

2):- Another example is CVR (Cockpit Voice recorder) which records conversations between crew members and with air traffic control.

3):- 3rd example is Seismograph which is used to detect and record earth quakes.

C):- Integrating Type:-

"These type of instrument measures the total energy supplied by the circuit in a given interval of time."  
Hence, it has display, recording and addition function.  
Energy meter is an example of integrating type instrument.



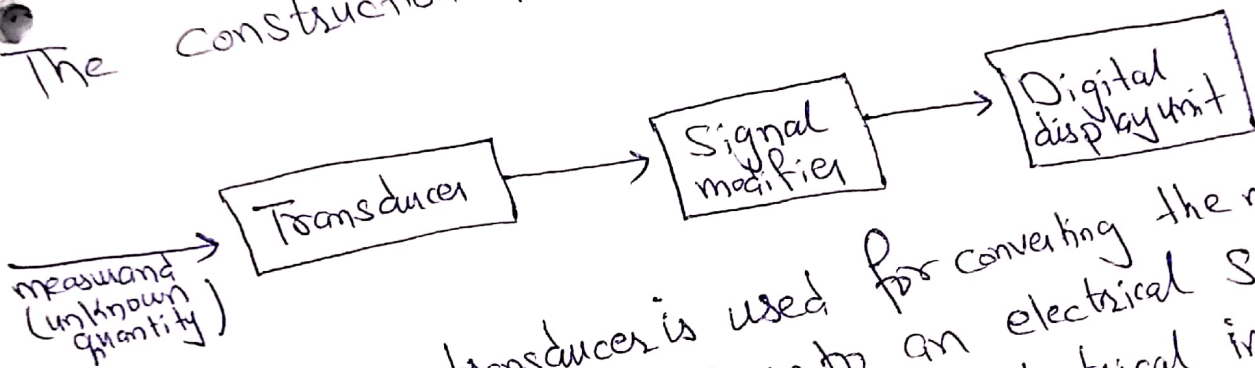
## Digital Instrument:-

"The instrument which represents the measured value in the form of the digital number is known as the digital instrument."

The digital multimeter, digital voltmeter are the examples of the digital instruments.

## Construction of digital Instrument:-

The construction of the digital instrument is shown below:



1) Transducer: The transducer is used for converting the non-electrical (temperature, pressure, mass etc) into an electrical signal. The transducer is not required for the electrical input.

2) Signal modifier: It is used for modifying the input signal of very weak strength.

3) Display unit: The display unit is used for showing the measured in the numeric form. mostly LCD is used as display unit.

## Differences b/w Analogue and Digital Instruments:-

### Analogue Instruments

- 1):- The accuracy is less
- 2):- Requires more power
- 3):- They are cheap not easily.
- 4):- They are portable

### Digital Instruments

- 1):- The Accuracy is more
- 2):- Requires less power
- 3):- They are expensive
- 4):- They are easily portable