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Unit-	**1 (Part-2)**
Topic-	**Units and Dimensions**
Sub-Topic-	**Numerical Value, Units, properties of unit, types of unit, fundamental units, Derived units, Supplementary units, M.K.S System, C.G.S System, F.P.S system, Standard Units.**

Faculty-	**Mr. AMIT KUMAR SAINI**
E-mail-	**amit.kumar.saini@monad.edu.in**

I. **Unit or Standard:** Unit of a physical quantity is called the standard in which the quantity measured.

Numerical Value: The numerical value of a physical quantity denotes the number of units contains in that quantity units give the magnitude of some dimension relative to an arbitrary standard for example when we say a person is five feet tall, we mean that person is five times as long as an object whose length is defined to be one foot.

The standard size chosen must have the following characteristics

(i) Well defined (ii) Accessibility (iii) In variability

Thus, measurement is a technique in which the value of any physical quantity is to be determine.

Unit

"A unit is defined as the quantity that can be used as a standard of measurement".

In other words unit is a value, quantity or magnitude in terms of which other values, quantities or magnitudes are expressed. For Example: When we say a rod is of 18 meter long we mean that the unit of the length is meter and the length of the rod is eighteen times this unit. For a given measurement

Q = nu

Here, Q = Physical quantity

n = Numerical value (magnitude)

u=Unit of the quantity

Thus, a physical quantity is a quantity which has the numerical value and the unit both.

Properties of a Unit

A unit should be such that

a) It should be accurately defined

b) It should be convenient in size.

c) It should be easy to reproduce.

d) It should not change with time and place.

e) It should be possible to multiply or divide each one of the standard.

f) It should be internationally acceptable.

g) Its value should remain same under all physical conditions like pressure, temperature etc.

Types of Units

Mainly, there are three types of units:

1. Fundamental Units

2. Derived Units

3. Supplementary Units

1. **Fundamental Units:** Fundamental units are those units which are used for the measurement of fundamental quantities and these units are unique and independent. Meter, kilogram, Second, Ampere, Kelvin, Candela, Mole are seven fundamental units.

2. **Derived Units:** Derived units are those units which are used for the measurement of de quantities and these units are not independent but are dependent upon fundamental units. For Example: When distance and time combined, they give rise to speed, acceleration etc. Similarly when length combined with length, new quantities like area (= meter) and volume (= meter result ic., Derived units are obtained by the combination of the

fundamental units. The derived units of certain physical quantities are obtained below:

a. Area = length x breadth= meter x meter = $meter^2$=m^2

b. Volume = length x breadth x height= meter x meter x meter = $meter^3$ = m^3

c. Speed – Distance/time= meter/second= m/sec

d. Acceleration =Distance/Time X Time =meter/second x second=m/s^2

e. Momentum = mass X velocity= Kg x m/sec = kg-m/sec

f. Force = mass x acceleration = mass X Velocity/Time= Kg m/sec^2 = 1 Newton = IN The unit of force is called 'Newton' (N).

g. Work = force x displacement=Nm = Kg. m/sec^2.m= Kg. m^2/sec^2

1 Joule = 1J.The unit of work is called 'Joule'

3. **Supplementary Units:** Supplementary units are those units which are used for the measurement angle and solid angle like quantities. Radian and steradian are two supplementary units.

Systems of Units

The following systems of units are commonly used in mechanics:

1. C.G.S. System
2. F.P.S. System
3. M.K.S. System
4. Standard International System of Unit or S.I. System

1. **C.G.S. System:** In this system the units of length, mass and time are centimeter (cm) gram (g) and second (s) respectively. It is also known as "French System".

2. **F.P.S. System:** In this system the units of length, mass and time are Foot (ft), Pound (p) and second (s) respectively It is also known as "British system".
3. **M.K.S. System:** In this system the units of length, mass and time are meter (m), Kilogram (kg) and second (s) respectively. It is also known as "Metric system".
4. **Standard International System (S.I. Units):** This is a modified form of M.K.S. System. This system consists of seven basic or fundamental units and two supplementary units along with their symbols.

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