Topic	Definition	Examples	Formula / Notes
Screw Gauge	Instrument to measure small thickness/diameter with high accuracy	Diameter of a wire, small ball bearings	Least Count = Pitch ÷ No. of divisions
Slide Calipers (Vernier)	Measures internal/external dimensions & depth accurately	Diameter of test tube, depth of bottle	Least Count = 1 MSD – 1 VSD
Pitch (Screw Gauge)	Distance screw moves in one full rotation	-	Pitch = Distance moved ÷ Number of turns
Least Count	Smallest measurement an instrument can read	Screw Gauge LC, Vernier LC	Screw Gauge: Pitch ÷ Divisions Vernier: 1 MSD – 1 VSD
Constant Error	Error that occurs uniformly every time	Instrument always shows +0.1 cm	Fixed & predictable, e.g., due to calibration
Positive Error	Measured value is **more** than true value	Reading = 5.2 cm instead of 5 cm	Corrected by subtracting excess
Negative Error	Measured value is **less** than true value	Reading = 4.8 cm instead of 5 cm	Corrected by adding missing amount
Absolute Error	Difference between measured and true value	Measured = 5.2 cm, True = 5 cm → 0.2 cm	(\text{AE} =
Relative Error	Ratio of absolute error to actual value	AE = 0.2 cm, True = 5 cm → 0.04	$\frac{\text{AE}}{\text{True value}}$
Percentage Error	Relative error expressed in percentage	RE = 0.04 → 4%	$\text{RE} \times 100\%$
Physical Quantity	Any property that can be measured	Mass, Length, Time	Must be expressed with units
Fundamental Quantity	Cannot be derived from other quantities	Length, Time, Mass, Temperature	7 total (in SI)
Derived Quantity	Formed by combining fundamental quantities	Area = Length × Breadth, Speed = Dist./Time	Has formula, e.g., Speed = Distance ÷ Time

2.1 Definitions

Motion: A body is said to be in motion if its position changes with time relative to a fixed point.

Rest: A body is said to be at rest if it does not change its position with time relative to a fixed point.

2.2 Types of Motion

Type of Motion	Description	Example
Translatory Motion	Whole body moves in the same direction	Car moving on road
Rotatory Motion	Body spins around a fixed axis	Spinning fan, Earth's rotation
Oscillatory Motion	To-and-fro motion about a mean position	Pendulum, swing
Periodic Motion	Repeats in regular time intervals	Hands of a clock
Random Motion	Motion without fixed path or direction	Dust particles in air

Friction – A Necessary Evil:

- It is helpful yet causes loss of energy.

3.9 Gravitational Force

- Force of attraction between any two masses
- On Earth: $F = mg$, where $g = 9.8\, m/s^2$

3.10 Action and Reaction (Third Law)

- Action and reaction forces act on **different bodies** and are equal in magnitude, opposite in direction

Example:

- Jumping off a boat: boat pushed on pushing air downward

3.11 Units Summary

Quantity	Unit	Symbol
Force	Newton	N
Mass	kilogram	kg
Acceleration	m/s^2	m/s^2
Momentum	kg·m/s	kg·m/s

4.1 Work

Work: Work is said to be done when a force is applied on an object and it causes displacement.

- Formula: $W = F \times d \times \cos\theta$
  - F: force, d: displacement, θ: angle between force and displacement
- Unit: **Joule (J)**
- 1 Joule = Work done when 1 N of force displaces an object by 1 m

Positive Work: When force and displacement are in same direction. **Negative Work:** When force and displacement are in opposite directions. **Zero Work:** No displacement occurs.

4.2 Energy

Energy: Capacity to do work.

- Unit: **Joule (J)**

Different Forms of Energy:

- Mechanical (Kinetic + Potential)
- Heat Energy
- Chemical Energy
- Light Energy
- Sound Energy
- Electrical Energy
- Nuclear Energy

4.6 Efficiency

Efficiency: Ratio of useful energy output to total energy input

- Formula: $\text{Efficiency} = \frac{\text{Useful Output}}{\text{Total Input}} \times 100\%$

4.7 Sources of Energy

Source	Examples	Renewable?
Fossil Fuels	Coal, Petrol, Diesel	No
Solar Energy	Sunlight	Yes
Wind Energy	Wind turbines	Yes
Hydro Energy	Dams, waterfalls	Yes
Biomass	Cow dung, organic waste	Yes
Nuclear Energy	Nuclear fission of Uranium	No (but long-lasting)

4.8 Conservation and Transformation of Energy

- **Law of Conservation of Energy:** Energy can neither be created nor destroyed. It only transforms from one form to another.
- **Examples:**
  - Electric fan: Electrical → Mechanical
  - Solar panel: Light → Electrical

4.9 Mass-Energy Relation

Einstein's equation:

- $E = mc^2$
  - E: energy (J), m: mass (kg), c: speed of light $\approx 3 \times 10^8$ m/s