# Chapter - 1 Physical World

- The word Science originates from the Latin verb Scientia meaning ‘to know’
- Science is a systematic attempt to understand natural phenomena in as much detail and depth as possible, and use the knowledge so gained to predict, modify and control phenomena.

## THE STEPS IN SCIENTIFIC METHOD

- Systematic observations
- controlled experiments
- qualitative and quantitative reasoning
- mathematical modelling
- Prediction and verification or falsification of theories.

## PHYSICS

- Physics is a basic discipline in the category of Natural Sciences.
- Physics as a study of the basic laws of nature and their manifestation in different natural phenomena.
- In Physics, we attempt to explain diverse physical phenomena in terms of a few concepts and laws.
- The two approaches of physics are unification and reductionism.
- Attempting to explain diverse physical phenomena with a few concepts and laws is unification.
- An attempt to explain a macroscopic system in terms of its microscopic constituents is reductionism.

## SCOPE OF PHYSICS

Macroscopic domain

- The macroscopic domain includes phenomena at the laboratory, terrestrial and astronomical scales.
- Classical Physics deals mainly with macroscopic phenomena and includes subjects like Mechanics, Electrodynamics, Optics and Thermodynamics.
- Mechanics -founded on Newton’s laws of motion

- Electrodynamics – deals with electric and magnetic phenomena associated with charged and magnetic bodies.
- Optics – deals with the phenomena involving light
- Thermodynamics. – it deals with systems in macroscopic equilibrium and is concerned with changes in internal energy, temperature, entropy, etc., of the system through external work and transfer of heat.

**Microscopic domain**

- The microscopic domain includes atomic, molecular and nuclear phenomena.
- Quantum Theory is currently accepted as the proper framework for explaining microscopic phenomena.

Link between technology and physics

| Technology | Scientific principle |
|---|---|
| Steam engine | Laws of thermodynamics |
| Nuclear reactor | Controlled nuclear fission |
| Radio and TV | Generation, propagation and detection of electromagnetic waves |
| Computers | Digital logic |
| Lasers | Light amplification by stimulated emission of radiation |
| Production of ultrahigh magnetic fields | Superconductivity |

| | |
|---|---|
| Rocket propulsion | Newton’s laws of motion |
| Electric generator | Faraday’s laws of electromagnetic induction |
| hydroelectric power | Conversion of gravitational potential energy in to electrical energy |
| Aeroplane | Bernoulli’s principle in fluid dynamics |
| Particle accelerators | Motion of charged particles in electromagnetic fields |
| Sonar | Reflection of ultrasonic waves |
| Optical fibres | Total internal reflection of light |
| Electron microscope | Wave nature of electrons |
| Photocell | Photoelectric effect |

**FUNDAMENTAL FORCES IN NATURE**

- Gravitational force
- Electromagnetic force
- Strong nuclear force
- Weak Nuclear force

**Gravitational force**

- Force of mutual attraction between two weak bodies due to their masses.
- It is a universal force.
- It is a non-contact force.
- Obeys inverse square law.
- Weakest force of all forces.
- Long range force.
- Independent of intervening medium.

**Electromagnetic force**

- The force between charged particles.
- May be repulsive or attractive.
- Depends on the intervening medium.
- Large compared to gravitational force.
- Acts over large distances.
- Electric force between two protons, for example, is 1036 times the gravitational force between them, for any fixed distance.
- The forces like ‘tension’, ‘friction’, ‘normal force’, ‘spring force’, etc. are electromagnetic.

**Strong nuclear force**

- The strong nuclear force binds protons and neutrons in a nucleus.
- Attractive in nature.
- Strongest force in nature-about 100 times the electromagnetic force in strength.
- It is charge-independent and acts equally between a proton and a proton, a neutron and a neutron, and a proton and a neutron.
- Short range force-about nuclear dimensions.

**Weak nuclear force**

- Appears only in certain nuclear processes such as the β-decay of a nucleus.
- In β-decay, the nucleus emits an electron and an uncharged particle called neutrino.
- The electron and neutrino interacts through weak force.
- not as weak as the gravitational force, but much weaker than the strong nuclear and electromagnetic forces.
- The range of weak nuclear force is exceedingly small, of the order of 10-16m.

**Ratio of strengths of forces**

**Strong force > electromagnetic > force > gravitational**

**The ratio of strengths is 1: 10-2: 10-13: 10-39**