Class XI
Physics

Physical World

- **Science** means organized knowledge.

It is human nature to observe things and happenings around in the nature and then to relate them. This knowledge is organized so that it become well connected and logical. Then it is known as Science. It is a systematic attempt to understand natural phenomenon and use this knowledge to predict, modify and control phenomena.

Scientific Method

Scientific methods are used to observe things and natural phenomena. It includes several steps :

- Observations
- Controlled experiments,
- Qualitative and quantitative reasoning,
- Mathematical modeling,
- Prediction and
- Verification or falsification of theories.

There is no 'final' theory in science and no unquestioned authority in science.

- Observations and experiments need theories to support them. Sometimes the existing theory is unable to explain the new observations, hence either new theories are formed or modification is done in the existing theories.
- For example to explain different phenomena in light, theories are changed. To explain bending of light a new Wave-theory was formed, and then to explain photoelectric effect help of quantum mechanics was taken.

Natural Sciences can be broadly divided in three branches namely Physics, Chemistry and biology

- **Physics** is a study of basic laws of nature and their manifestation in different phenomenas.

Principal thrusts in Physics

- There are two principal thrusts in Physics;
- 1.Unification 2. reduction

Unification

- Efforts are made to explain different phenomena in nature on the basis of one or minimum laws. This is principle of Unification.

Example: Phenomena of apple falling to ground, moon revolving around earth and weightlessness in
the rocket, all these phenomena are explained with help of *one* Law that is, Newtons Law of Gravitation.

Reductionism

- To understand or to derive the properties of a bigger or more complex system the properties of its simpler constituents are taken into account. This approach is called reductionism.

It is supposed to be the heart of Physics.
For example a complex thermo dynamical system can be understood by the properties of its constituent like kinetic energy of molecules and atoms.

- ***<u>The scope of Physics</u>*** can be divided in to two domains; Macroscopic and Microscopic.
- Macroscopic domain includes phenomena at the level of Laboratory, terrestrial and astronomical scales.
- Microscopic domain I ncludes atomic, molecular and nuclear phenomena.
- Recently third domain in between is also thought of with name Mesoscopic Physics. This deals with group of Hundreds of atoms
    - Scope of physics is very wide and exciting because it deals with objects of size as large as Universe (10^{25}m) and as small as 10^{-14} m, the size of a nucleus.

<u>The excitement of Physics</u> is experienced in many fields Like:

- Live transmissions through television.
- Computers with high speed and memory,
- Use of Robots,
- Lasers and their applications

Physics in relation to other branches of Science

Physics in relation to Chemistry.

- Chemical bonding, atomic number and complex structure can be explained by physics phenomena of Electrostatic forces,
- taking help of X-ray diffraction.

Physics in relation to other Science

- Physics in relation to Biological Sciences: Physics helps in study of Biology through its inventions. Optical microscope helps to study bio-samples, electron microscope helps to study biological cells. X-rays have many applications in biological sciences. Radio isotopes are used in cancer.
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Physics in relation with Astronomy:

- Giant astronomical telescope developed in physics are used for observing planets. Radio telescopes have enabled astronomers to observe distant limits of universe.
- Physics related to other sciences: Laws of Physics are used to study different phenomenas in other sciences like Biophysics, oceanography, seismology etc.

<u>Fundamental Forces in Nature</u>

There is a large number of forces experienced or applied. These may be macroscopic forces like gravitation, friction, contact forces and microscopic forces like electromagnetic and inter-atomic forces. But all these forces arise from some basic forces called Fundamental Forces.

Fundamental Forces in Nature..

1. Gravitational force.

- *It is due to Mass of the two bodies.*
- *It is always attractive.*
- *It operates in all objects of universe.*
- *Its range is infinite*

It's a weak force. 10^{-38} times compared to strong Nuclear force

2.Electromagnetic Forces:

- It's due to stationery or moving Electrical charge
- It may be attractive or repulsive.
- It operates on charged particles
- Its range is infinite
- Its stronger 10^{36} times than gravitational force but 10^{-2} times of strong Nuclear force.

3. Strong nuclear force:

- Operate between Nucleons
- It may be attractive or repulsive
- Its range is very short, within nuclear size (10^{-15} m).
- Its strongest force in nature

4.Weak Nuclear force:

- Operate within nucleons I.e. elementary particles like electron and neutrino.
- It appears during radioactive b decay.
- Has very short range 10^{-15}m.
- 10^{-13} times than Strong nuclear force.

Conservation Laws

- In any physical phenomenon governed by different forces, several quantities do not change with time. These special quantities are conserved quantities of nature.

1. For motion under conservative force, the total mechanical Energy of a body is constant.
2. Total energy of a system is conserved, and it is valid across all domains of nature from microscopic to macroscopic. Total energy of the universe is believed to be constant.
3. Conservation of Mass was considered another conservation law, till advent of Einstein. Then it was converted to law of conservation of mass plus energy. Because mass is converted into energy and vice-versa according to equation $E = mc^2$ The examples are annihilation and pair production.
4. Momentum is another quantity which is preserved. Similar is angular momentum of an isolated system.
5. Conservation of Electric charge is a fundamental law of nature.
6. Later there was development of law of conservation of attributes called baryon number, lepton number and so on.

The laws of nature do not change with change of space and time. This is known as symmetry of space and time. This and some other symmetries play a central role in modern physics. Conservation laws are connected to this.

Laws of Physics related to technology :

Principal of Physics	***Technology***
Electromagnetic Induction	Electricity Generation
Laws of Thermodynamics	Steam, petrol, or diesel Engine
Electromagnetic Waves propagation	Radio, TV, Phones

Nuclear chain reaction	Nuclear reactor for power
Newtons Second & Third Law	Rocket propulsion
Bernoulli's theorem	Aero planes
Population inversion	Lasers
X-rays	Medical Diagnosis
Ultra high magnetic fields	Superconductors
Digital electronics	Computers and calculators
Electromagnetic Induction	Electricity Generation

Physicist and their contributions

Name	***Contribution***	***country***
Isaac Newton	Law of Gravitation, Laws of Motion, Reflecting telescope	U.K.
Galileo Galilei	Law of Inertia	Italy
Archimedes	Principle of Buoyancy, Principle of Lever	Greece
James Clerk Maxwell	Electromagnetic theory, light is an e/m wave.	U.K.
W.K.Roentgen	X-rays	Germany
Marie S. Curie	Discovery of Radium, Polonium, study of Radioactivity	Poland
Albert Einstein	Law of Photo electricity, Theory of Relativity	Germany
S.N.Bose	Quantum Statistics	India
James Chadwick	Neutron	U.K.
Niels Bohr	Quantum model of Hydrogen atom	Denmark
Earnest Rutherford	Nuclear model of Atom	New Zealand
C.V.Raman	Inelastic Scattering of light by molecules	India
Christian Huygens	Wave theory of Light	Holland
Michael Faraday	Laws of Electromagnetic Induction	U.K.
Edvin Hubble	Expanding Universe	U.S.A.
H.J.Bhabha	Cascade process in cosmic radiation	India
Abdus Salam	Unification of week and e/m interactions	Pakistan
R.A.Milikan	Measurement of Electronic Charge	U.S.A.
E.O.Lawrence	Cyclotron	U.S.A.
Wolfgong Pauli	Quantum Exclusion principle	Austria
Louis de Broglie	Wave nature of matter	France
J.J.Thomson	Electron	U.K.
S.Chandrashekhar	Chandrashekhar limit, structure of stars	India
Christian Huygens	Wave theory of Light	Holland

Michael Faraday	Laws of Electromagnetic Induction	U.K.
Edvin Hubble	Expanding Universe	U.S.A.
Henrick Hertz	Electromagnetic Waves	Germany
J.C.Bose	Ultra short radio waves	India
Hideki Yukava	Theory of Nuclear Forces	Japan
W.Heisenberg	Quantum mechanics, Uncertainty principle	Germany
M.N.Saha	Thermal Ionization	India
G.N.Ramachandran	Triple Helical structure of proteins	india