Self Study Series

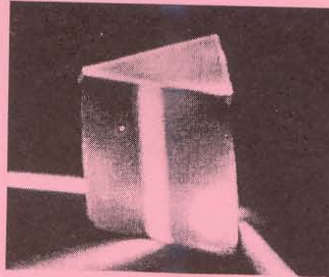> 950 terms

Definitions
of the Textbook
PHYSICS XI

Ross Nazir Ullah

GENERAL PREFACE

This book is one of the volume from a set of FIVE books. It is not a substitute for the text book. Instead it is a helping book to understand the text more clearly.

Our standard of education is deteriorating very fast. The major factors are hand-books, keys, made-easy books, notes, and finally tuition. I know there is a war in progress. This Self Study Series is an attempt to enhance the level of education. It is to be reminded that this set of FIVE Books is simply a guide to help the text book. Without prescribed text book these books are nothing.

It's a new idea in the field of F. Sc. Physics. It is a sincere effort for making prescribed text more important than any other helping books.

Comments, suggestions and criticisms are invited for the sake of education to improve this book.

F. C. College,   Ross Nazir Ullah
Lahore.

INTRODUCTION

The major definitions of this book have been taken from my book entitled "Basic Physics". This volume is more or less like a dictionary. As you read the text and whenever you stuck with some difficult word, just consult this Book of Definitions. The definitions of some words or terminology are given step by step as the prescribed text book states. I must confess few definitions have duplication even on the same page due to step by step effort of writing them. An index is added for further convenience at the end.

The readers should point out more words/ terminology not understood in the text. These will be accepted with gratitude so that those can be added in the next edition.

Ross Nazir Ullah

CONTENTS

MEASUREMENTS (Chapter 1)

Science: The inventory of all things observable together with carefully drawn statements
about the habitual behaviour of things animate and inanimate.

Physics: It is the study of the properties of matter, energy and of their mutual relationship.

Philosophy: The study and knowledge of the principles that cause, control, or explain facts
and events.

Natural Philosophy: The study and knowledge of facts and events pertaining to physical
universe.

Biology: The science, which deals with the origin and life history of plants and animals
including botany and zoology.

Biological science: The science, which deals with living things.

Natural science: Relating to the physical universe of a particular branch of nature.

Physical: Pertaining to nature; material as opposed to moral or spiritual.

Physical science: The science, which deals with non-living things.

Chemistry: The study of the elements and compounds they form.

Astronomy: The science, which treats of the heavenly bodies, their composition, their
distances, their motions, and the laws which control them.

Geology: The science that collects, studies, and explains the facts about the history of
the earth and its life, especially as recorded in the rocks.

Mechanics: The study of the effects of forces on matter.

Heat & Thermodynamics: The study of heat and thermodynamics with inter-linked matters.

Heat: Heat is a form of energy associated with molecular motion.

Thermodynamics: Study of quantitative relationships between heat and other forms of energy.

Electromagnetism: The study of electricity and magnetism with inter related phenomena.

Electricity: The nature and effects of moving or stationary electric charges.

Magnetism: The study of the nature and cause of magnetic force fields, and how
different substances are affected by them.

Optics: Branch of Physics which deals with the study of the behaviour of light.

Sound: The series of disturbances in matter to which the human ear is sensitive. Also similar
disturbances in matter above and below the normal range of human hearing.

Hydrodynamics: A branch of science of deformable bodies, being a study of the motion of
fluids. (liquid and gases)

Special relativity: It gives a unified account of the laws of mechanics and of
electromagnetism. It is concerned with relative motion between
non- accelerated frames of reference.

General relativity: It deals with general relative motion between accelerated frames of
reference

Quantum Mechanics: A branch of Mechanics that deals with quantum numbers and
other applications of the quantum theory.

Atomic physics: Branch of physics that deals with the structure and interaction of atoms
and ions with one another, and their interaction with electromagnetic field
and free electrons.

Molecular physics: Branch of physics, which deals with structure and properties of
molecules.

Nuclear Physics: It deals with the questions of nuclear structure and the radiation from
unstable nuclei.

Solid State Physics: The study of the structure and physical properties of solids.

Particle Physics: Study of elementary particles, the fundamental constituents of all matter.

Super conductivity: The effective disappearance of electrical resistance in certain substances when they are cooled close to absolute zero.

Super-fluid: A fluid that flows without any resistance.

Super fluidity: A property of liquid helium at very low temperatures. At 2.186 K liquid helium makes a transition to a super-fluid state, which has a high thermal conductivity and flows without friction.

Plasma: A highly ionized gas containing approximately equal numbers of positively charged ions and negatively charged electrons.

Plasma Physics: The study of the properties and behaviour of the matter in plasma state.

Magneto hydrodynamics (MHD): The study of the behaviour of a conducting fluid (e.g. an ionized gas, plasma, or collection of charged particles) under the influence of a magnetic flux.

Plasma: A mixture of free electrons and ions or atomic nuclei. Plasmas occur in thermonuclear reactions, as in the Sun.

Magnetic flux: The strength of the magnetic field through an area, based on the idea of the number of lines of force passing through the area.

Space physics: The study of the properties and behaviour of celestial bodies and regions above the earth.

Astrophysics: The study of the internal structure, properties, and evolution of celestial bodies, and the production and expenditure of energy in such systems and in the universe as a whole.

Celestial: Pertaining to the heavens; as stars are celestial bodies.

Biophysics: Physics of biological systems, with the use of physical methods in the study of biological problems, and with the biological effects of physical agents.

Chemical physics: Branch of physics which deals chemical laws based upon quantum physics.

Engineering physics: Branch of physics which deals with the design and construction of public works such as roads, railways and harbours.

Geophysics: The Physics of the Earth and the air and space surrounding it.

Medical physics: The application of physics to medicine, as in the radiotherapy, nuclear medicine, and medical electronics.

Radiotherapy: The use of the beams of ionizing radiation, such as, X-rays, gamma rays, and energetic electrons in the treatment of cancer.

Nuclear medicine: The branch of medicine concerned with the application of radioactive nuclei in diagnosis and therapy.

Electronics: The study and use of circuitry involving such components as semiconductors, resistors, capacitors, and inductors.

Physical oceanography: Physical study and description of the ocean.

Music: The art or science of making pleasing or harmonious combinations of sound tones.

Noise: Sound produced by irregular vibrations in matter.

Harmony: A combinations of musical tones which is pleasant to the ears.

Physics of music: Physics of expressions in sound, in melody and harmony, including composition and executing, especially instrumental performance.

Telescope: An optical system for collecting radiation from a distant object and producing an enlarged image.

Radio telescope: A type of telescope used in radio astronomy to record and measure the radio frequency emissions from celestial radio sources.

Radio astronomy: The study of astronomy through the radio signals emitted by some celestial body.

Radio: Use of electromagnetic radiation to transmit or receive electrical impulses or signals without connecting wires. Also the process of receiving or transmitting such signals.

Radio waves (Hertzian waves): Electromagnetic radiation produced by rapid reverses of current in a conductor.

Expanding universe: Lines in the spectrum of the light from remote galaxies are shifted towards the long wavelength end by an amount that is greater for those galaxies known to be farthest away. This leads to the conclusion that the distance between clusters of galaxies is continuously increasing.

Big-bang theory: The theory in cosmology that all matter and radiation in the universe originated in a violent explosion that occurred $10\text{-}20 \times 10^9$ years ago. Since this initial state of extreme density & temperature, universe has expanded and cooled.

Galaxy: A giant assembly of stars, gas, and dust held together and organized largely by the gravitational interactions between its components. Galaxies contain most of the observable matter in the universe.

Proton: An elementary particle having a rest mass of 1.6725×10^{-27} kg with a unit positive electric charge.

Neutrons: An elementary particle with zero charge and a rest mass of 1.67492×10^{-27} kg. Neutrons are nucleons, found in all nuclides except ^1H.

Mesons: Elementary particles, that more massive than electrons but lighter than protons and neutrons. Mesons are thought to be involved in the exchange forces between nucleons in the nucleus.

Nucleon: A particle found in the nucleus of atoms; i.e. a proton or a neutron.

Molecule: A single atom or a group of atoms joined by chemical bonds. It is the smallest unit of a chemical compound that can have an independent existence.

Physics: It is the study of the properties of matter, energy and of their mutual relationship.

Electromagnetic radiation: Energy propagated by vibrating electric and magnetic fields. Electromagnetic radiation forms a whole electromagnetic spectrum, depending upon frequency and ranging from high frequency cosmic rays to low frequency microwaves.

Cosmic rays: High-energy particles, apparently coming from beyond our solar system.

Microwave: An electromagnetic wave with a wavelength in the range 1 mm to 100 mm, i.e. with a frequency in the range 300 to 3GHz.

Nuclear Physics: It deals with the questions of nuclear structure and the radiation from unstable nuclei.

Nucleus (plural Nuclei): The positively charged dense central part of an atom.

Relativistic Mechanics: Mechanics based on theory of relativity which leads to four-dimensional space-time concept.

Solid State Physics: The study of the structure and physical properties of solids.

Physical chemistry: The study of physical changes associated with chemical reactions and dependence of physical properties on chemical composition.

Biophysics: Physics of biological systems, with the use of physical methods in the study of biological problems, and with the biological effects of physical agents.

Astrophysics: The study of the internal structure, properties, and evolution of celestial bodies, and the production and expenditure of energy in such systems and in the universe as a whole.

Celestial: Pertaining to the heavens; as stars are celestial bodies.

Health physics: A branch of medical physics concerned with the health and safety of personnel in medical, scientific, and industrial work. It is most particularly concerned with protection from ionizing radiation and from neutrons.

Information technology (IT): Any form of technology, primarily electronic equipment and techniques, used by people to handle and distribute information. It includes the technology of both computing and of telephony, television, and other forms of telecommunication.

Chip: A small piece of a single crystal of semiconductor material containing either a single electronic component or an integrated circuit.

Diameter: The length of a straight line through the centre of a circle.

Metalloid: One of those non-metallic elements that resemble the metals in some of their properties, as arsenic and antimony.

Semiconductor (or Semiconductor device): A material such as silicon or germanium that has a resistivity midway between that of conductors and that of insulators.

Silicon: ($_{14}$Si) An element of fourth group of periodic table, having four electrons in its outermost shell called valence electrons. It is used in semi-conductor devices in the form of single crystal.

Physical quantity: The quantity, in terms of which, the laws of physics are expressed, e.g. mass, length, and time, etc.

Mass: A measure of the quantity of matter.

Length: Basic dimension for measuring linear translation.

Time: A measurable period during which something exists, continues, or takes place.

Velocity: The distance covered in unit time in a particular direction.

Force: That which produces or prevents motion, or has a tendency to do so.

Density: The ratio of the mass of a substance to its volume.

Temperature: Degree of hotness as determined by a thermometer.

Electric current: A flow of electric charge.

Base quantities: Certain physical quantities such as length, mass and time.

Derived quantities: The physical quantities defined in terms of base quantities.

Velocity: The distance covered in unit time in a particular direction.

Acceleration: i) Rate of change of velocity. ii) Change of velocity in unit time.

Force: That which produces or prevents motion, or has a tendency to do so.

Accessible: Easy to reach; open to influence.

Invariable: Constant; uniform; unchanging.

Compromise: A settlement by which each party gives up something; to combine of two systems, plans, or the like, made by sacrifice on the part of each.

System International (SI): The internationally adopted system of units used for scientific purposes. It has seven base units (the metre, kilogram, second, kelvin, ampere, mole, and candela) and two supplementary units (the radian and steradian).

FPS System: The system in which the three fundamental units are the units of length, weight and time; namely, foot, pound, and second respectively.

MKS System: The system in which the three fundamental units are the units of length, mass, and time; namely, metre, kilogram and second respectively.

CGS System: The system in which, the three fundamental units are the units of length, mass, and time; namely, centimeter, gram, and second respectively.

British Engineering System: The system in which the three fundamental units are the units of force, length, and time; namely, pound, yard, and second.

Amenable: Easy to lead; ready to accept advice.

Arithmetical manipulation: To operate skillfully and artfully with numbers and figures.

Base units: There are seven base units for various physical quantities namely: length, mass, time, temperature, electric current, luminous intensity and amount of substance.

Unit: A reference value of a quantity used to express other values of the same quantity.

Derived units: The units of physical quantities expressed in terms of fundamental units.

Fundamental units: The units, for example, length, mass, and time that form the basis of most systems of units.

Supplementary units: Certain SI units, for time being, plane angle and solid angle, which are not yet classified by the General conference of Weights and Measures.

Angle: Figure formed by lines/surfaces meeting or the space between such lines/surfaces.

Plane angle: The figure formed by lines meeting in a flat or even surface.

Solid angle: The three dimensional analogue of angle; it is subtended at a point by a surface (rather than by a line).

Radian: The angle subtended at the centre of a circle by an arc equal in length to its radius.

Steradian: It is the solid angle (three-dimensional angle) subtended at the center of a sphere by an area of its surface equal to the square of radius of the sphere.

Newton: The force required to accelerate one kilogram of mass at the rate of one metre per second squared.

Joule: **The amount of work done, when a force of one Newton acting on a body displaces it through a distance of 1 meter along the direction of force.**

Watt: It is the power of an agency which does work at the rate of 1 joule per second.

Pascal: The SI unit of pressure, equal to a pressure of one Newton per square metre.

Coulomb: The SI unit of electric charge, equal to the charge transported by an electric current of one ampere flowing for one second.

Scientific notation: A system of signs or symbols of science, used in place of language.

Symbol: A mark, character or letter representing something; as a symbol in mathematics.

Prefix: A letter or a syllable placed at the beginning of a word to modify its meaning.

Micrometer screw gauge: A measuring instrument with a fine screw for very mall and accurate measuring up to 0.01 mm.

Error: A mistake; an inaccuracy.

Uncertainty: Not sure; doubtful.

Random error: Error due to fluctuations in the measured quantity.

Systematic error: Error due to incorrect design or calibration of the measuring device.

Significant figures: In any measurement, the accurately known digits and the first doubtful digit are called significant figures.

Uranium: A hard heavy, white metallic element which possesses radioactive properties, having three isotopes $_{92}U^{238}$, $_{92}U^{235}$, $_{92}U^{234}$.

Mount Everest: The highest mountain in the world, with a height 8,850 m, rises in the Himalayas on the frontier of Nepal and Tibet.

Round: Exact; whole; complete.

Rounded off figure: The figures of whole number up to (say) two decimal point.

Accuracy: In measurements considering the relative error. The less relative error gives more accurate result.

Precision (or absolute uncertainty): In measurements considering the magnitude of error. The less magnitude of error gives more precise measurement; it is equal to the least count of the measuring instrument.

Fractional uncertainty: The ratio of the least count of the measuring instrument with the recorded reading.

Percentage uncertainty: Obtained after multiplying fractional uncertainty with 100/100 to get % of that quantity.

Primary colours: Red, yellow, green and blue, by mixing of which any desired colour may be obtained.

Four colour scheme: Combining four printing plates of primary colours to get the natural colour of certain object.

Basic colours: Black, white and red are traditional colours for chalk or crayon drawings.

Exquisite: Highly finished and refined.

Bunsen burner: A laboratory gas burner having a vertical metal tube into which the gas is led, with a hole in the side of the base of the tube to admit air.

Aluminium (Al): A silvery-white lustrous metallic element belonging to group III of the periodic table.

Mercury (Hg): A heavy silvery liquid metallic element belonging to the zinc group.

Alcohols: Organic compounds that contain the –OH group.

Pluto: Ninth planet from the Sun and outermost known member of the solar system.

Cesium (Cs): White, soft, chemically reactive metallic element in group 1a of the periodic table. The atomic number is 55.

Atomic clock: The clock in which the periodic process is a molecular or atomic event associated with a particular spectral line.

Dimension: A measurement of any sort; especially length, height and width.

Dimensional analysis: A technique whose main uses are: a) to test the probable correctness of an equation between physical quantities; b) to provide a safe method of changing the units in a physical quantity; c) to solve partially a physical problem whose direct solution cannot be achieved by normal methods.

Homogeneity (adj. homogeneous): Uniform; of the same kind or nature; composed of similar elements.

Principle of homogeneity: The dimensions of the quantities on both sides of the equation should be same, irrespective of the form of the formula.

Anchor: A heavy iron implement for securing vessel to the ground under water or any similar thing to hold fast a movable object.

Pallet: A click or pawl used to convert or reciprocating into a rotatory motion or the reverse.

Modulus of elasticity (or Elastic Modulus): The ratio of the stress on a body to the strain produced. There are various modulii of elasticity depending on the type of stress applied.

VECTORS AND EQUILIBRIUM (Chapter 2)

Scalar quantity or Scalar: A physical quantity which is completely specified by a number associated with a suitable unit without any mention of direction in space.

Vector quantity or Vector: A physical quantity which requires both a magnitude in proper units and a direction for its complete description; Graphically it is represented by a straight line, length of which is equal to its magnitude and arrow-head shows its direction.

Coordinate: Suitable sets of numbers with which the positions of points are specified.

Cartesian coordinates (or Rectangular coordinates): Coordinates referred to three mutually perpendicular straight lines.

Addition of vectors (head-to-tail rule): Addition of vectors is obtained by drawing their representative lines in such a way that tail of first vector coincides with the head of the second vector and so on. Join tail of first vector with the head of last vector. This joining vector will represent the vector sum.

Resultant vector: The resultant of a number of similar vectors, is the single vector which would have the same effect as all the original vectors taken together.

Vector subtraction: The subtraction of a vector is equivalent to the addition of the same vector with its direction reversed.

Multiplication of a vector by a scalar: The product of a vector **A** and a number n > 0 is defined to be a new vector n**A** having the same direction as **A** but a magnitude n times the magnitude of **A**.

Unit vector: A vector in a given direction with magnitude one in that direction.

Null vector: It is a vector of zero magnitude and arbitrary direction.

Equal vectors: Two vectors **A** and **B** are said to be equal if they have the same magnitude and direction, regardless of the position of their initial points.

Components of a vector: A component of a vector is its effective value in a given direction.

Rectangular components (of a vector): Resolving of a vector into components along mutually perpendicular directions called rectangular components.

Position vector: The position vector **r** is a vector that describes the location of a particle with respect to the origin.

Acrobat: One who performs skilled or daring gymnastic feats.

Aisle: A passageway leading to the seats in a place of assembly.

Product of two vectors: There are two types of vector multiplications. The product of these two types is known as scalar product and vector product.

Scalar Product (or Dot Product): The Scalar or dot product of vectors A and B is the scalar quantity obtained by multiplying the product of the magnitudes of the vectors by the cosine of the angle between them. Mathematically,

$$A \cdot B \ = \ A \ B \ \cos \theta$$

Vector Product (or Cross Product): The vector product of two vectors (say) A and B is defined to be a vector such that:

i) its magnitude is A B sin θ , θ being the angle between A and B

ii) its direction is perpendicular to the plane of A and B and can be determined by right-hand-rule. Mathematically,

$$A \times B \ = \ A \ B \ \sin \theta \ n$$

Right-hand rule (in Vector Product): First place together the tails of the two vectors. Then rotate the vector that occurs first in the product into the second vector through the smaller of the two possible angles. Curl the fingers of the right hand along the direction of rotation. The direction of the thumb will represent direction of the vector product.

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Commutative Law: For a binary operation $*$,
$$a * b = b * a$$
     Example : $a + b = b + a$ and $a \cdot b = b \cdot a$

Associative Law: For a binary operation $*$,
$$(a * b) * c = a * (b * c)$$
     Example : $(a \cdot b) \cdot c = a \cdot (b \cdot c)$ and $(a + b) + c = a + (b + c)$

Distributive law: For two binary operations $*$ and o. The operation $*$ is said to be distributive over the operation o, if
$$a * (b \, o \, c) = (a * b) \, o \, (a * c)$$

     Example : $a \cdot (b + c) = (a \cdot b) + (a \cdot c)$ & $a + (b \cdot c) \neq (a + b) \cdot (a + c)$

Relations between the sides and angles of a triangle:

   i) <u>The Sine Formula</u>
$$\frac{a}{\sin \omega} = \frac{b}{\sin \theta} = \frac{a}{\sin \phi}$$

   ii) <u>The Cosine Formula</u>
$$\cos \theta = \frac{a^2 + b^2 - R^2}{2 \, ab}$$

Spanner: A wrench for tightening or loosening nuts.

Nut: A metal piece having an internal screw thread, as for securing or adjusting a bolt.

Torque (or Moment of force): i)The physical quantity which produces angular acceleration.
                         ii) Product of the force and its moment arm.

Moment arm: Perpendicular distance from the axis of rotation to the line of action of force.

Concurrent forces: Forces acting together on a body.

Angular velocity (ω): The rate of change of angular displacement.

Angular acceleration (α): The rate of change of angular velocity.

Coplanar forces: Forces in a single plane.

Equilibrium: i) State of balance in which the sum of all the forces and the sum of all the moments are equal to zero. ii) If a body remains at rest or moves with uniform velocity, it is said to be in equilibrium.

Static equilibrium: State of rest.

Dynamic equilibrium: The state of a body moving with a uniform velocity or rotating with a uniform angular velocity.

Translational equilibrium: A body will be in translational equilibrium if and only if
           the vector sum of external forces acting on a body equal to zero.

Rotational equilibrium: An object is in rotational equilibrium if and only if the vector sum of external torque about any axis acting on it equals to zero.

Rigid body: A body is said to be rigid, if it is not possible to change its shape by the application of a force, however large.

Equilibrium of forces: If a body, under the action of a number of forces, is at rest or moving with uniform velocity, it is said to be in equilibrium.

First condition of equilibrium: Sum of all the force acting on a body along x-axis and along y-axis should be equal to zero. Mathematically
$$F_x = 0 \quad \text{and} \quad F_y = 0$$

Second condition of equilibrium: The algebraic sum of all the torques acting on the body should be zero. Mathematically: $\Sigma \tau = 0$

Astride: With the legs wide apart.

Polygon: A closed figure having many side and angles.

Rotation: Turning around its own axis or centre.

Configuration: Structured arrangement; figure; the spatial arrangement of atoms in a molecule or nucleons and electrons in an atom.

Span: The distance between two definite ends.

MOTION AND FORCE (Chapter 3)

Dynamics: The branch of Mechanics which deals with the motion of bodies under the influence of one or more forces.

Motion: Continuous change of location of a body with respect to its surroundings.

Linear motion: Motion in a straight line.

Translational motion (or Rectilinear motion): A body moves with translational motion if each particle of the body undergoes the same displacement in a straight line in a given time.

Rotational motion: A body moves with rotational motion if each particle of the body moves in a circle about a straight line called the axis of rotation.

Vibratory motion: If the motion is back and forth over the same path about a mean position, it is called vibratory or oscillatory motion.

Rest: The position of the body with respect to its surroundings when it does not change.

Relative motion: The difference of two motions.

Relative velocity: The vector difference of the two velocities.

Trajectory: The path of a moving particle.

SR-71(reconnaissance jet): **The Lockheed SR-71 Blackbird is the world's fastest airplane. Originally designed for high-altitude military spy missions. Now used by NASA [National Aeronautical and Space Administration] for scientific research.**

Falcon: Fighter-bombers aircraft. They are dual purpose aircraft that can drop bombs and also fight enemy planes. e.g. F-16 fighting Falcon.

Leopard: A large catlike beast of prey, with a beautiful spotted skin of yellow and black.

Cheeta: An animal of the cat family, resembling the leopard, found in Pakistan, Persia, India and Northern Africa, often tamed and trained to hunt gazelles.

Porpoise: Any of several small friendly whales from 5 to 8 feet long; commonly the dolphin.

Displacement: Distance moved from a reference point in certain direction.

Speed: i) The distance covered in unit time.
ii) When a body moves, the rate of change of its position.

Velocity: The distance covered in unit time in a particular direction.

Acceleration: i) Rate of change of velocity.
ii) Change of velocity in unit time.

Average speed: Total distance covered divided by total time.

Instantaneous Speed: The speed of a body in a particular instant.

Uniform Speed: If a body moves over equal distances in equal intervals of time, however small, it is said to move with uniform speed.

Variable Speed: When a body traverses unequal distances in equal intervals of time, it is said to move with variable speed.

Uniform Velocity (or Constant Velocity): If a body moves over equal distances in equal intervals of time, however small, in a particular direction, it is said to move with uniform velocity.

Variable Velocity: When a body traverses unequal distances in equal intervals of time, or when its direction of motion changes, it is said to move with a variable velocity.

Gradient: The degree of inclination of a slope. Mathematically, it is the ratio of vertical distance to horizontal distance.

Average Velocity: Total distance covered divided by total time taken in a particular direction.

Root mean square velocity: Square root of average of the square of molecular velocities.

Instantaneous Velocity: Velocity of a body in a particular instance. Symbolically it is defined as :

$$V = \lim_{\Delta t \to 0} \frac{\Delta S}{\Delta t}$$

Average Acceleration: If the change in velocity of a moving body during the time interval Δt is ΔV, then the average acceleration is defined as :

$$a_{av} = \frac{\Delta V}{\Delta t}$$

Instantaneous Acceleration: The rate of change of velocity in a particular instant, symbolically,

$$a_{inst} = \lim_{\Delta t \to 0} \frac{\Delta V}{\Delta t}$$

Uniform Acceleration: If the velocity increases by equal amounts in equal intervals of time, it is said to be uniform acceleration.

Variable Acceleration: If the velocity increases by unequal amounts in equal intervals of time, it is said to be variable acceleration.

Deceleration (or Retardation): Rate of change of decrease of velocity; negative acceleration.

Wobble: To move unsteadily as a top (children's toy) while rotating at a low speed.

First Law of Motion: A body continues its state of rest or uniform motion in a straight line unless it is compelled to change that state of motion by a force impressed upon it.

Inertia: 1) The resistance of matter to any acceleration of its state of rest or motion.
2) The mass of the object is a quantitative measure of its inertia.

Second Law of Motion: The effect of an applied force on a body is to cause it to accelerate in the direction of the force. The acceleration is in direct proportion to the force and is inversely proportional to the mass of the body.

Third Law of Motion: To every action (force) there is always an equal and opposite reaction (force).

Impulse: The product of force and time for which it acts on a body.

Impulsive force: A large force but acts for a short time; it is time rate of change of momentum of a body.

Crumple: To press into wrinkles.

Skull: The bones forming the head and the face.

Cranium: The skull especially the bony part inclosing the brain.

Momentum: In a moving body, the product of its mass and velocity.

Linear momentum: In a body moving along a straight line, the product of its mass and linear velocity.

Isolated system: A system for which there is no transfer of mass and energy across the boundary.

Law of conservation of linear momentum: The total linear momentum of an isolated system remains constant.

Wind shield: Front transparent screen of a motor car.

Elastic collision: The collision in which the momentum and the kinetic energy of the system is conserved.

Inelastic collision: The collision in which the momentum of the system is conserved and not the kinetic energy.

Dimension: A measurement of any sort; especially length, height and width.

One dimension: A measurement which needs a single reference point; e.g.
a point on a line.

Two dimensions: Measurement which needs two references; e.g. a point on a plane (x-y
plane).

Three dimensions: Measurement which needs three references; e.g. a point in space (x-
y-z coordinate system).

Four dimensions: Measurement which needs four reference; e.g. a point in space + time
coordinates (relativistic frame of reference).

Missile: A thing thrown to injure another; a projectile.

Rocket: A missile or space vehicle powered by ejecting gas that carries both its own fuel and
oxidant. They are independent of the earth's atmosphere and are the power system
used in space flights.

Chamber: An enclosed space, such as, of a rocket, containing the explosive chemicals.

Fuel: Inflammable material for supplying a fire or explosion.

Liquid oxygen: Condensed gaseous oxygen to a pale blue liquid that is strongly magnetic.

Liquid hydrogen: Condensed gaseous hydrogen. It is colourless in small amounts but light
blue in thick samples.

Propeller: Such thing which drives forward especially a device with blades for causing an
airplane or a ship to progress.

Rocket propulsion: Rocket driving or pushing obtained from thrust of hot gases from engine
exhaust.

Thrust: The forward reaction force of a jet or rocket engine.

Helicopter: A flying machine lifted and held up by horizontal propellers (rotating wings).

Aeroplane: An aircraft or flying machine, kept aloft by the reaction of motor-propelled
planes upon the air also moves to wing borne flight.

Jet: Abbreviation for Joint European Torus.

Jet propulsion: Propulsion of aircraft or other vehicles in which one or more jets of hot
gases are ejected at high speed from backwardly directed nozzles.

Rocket motion: The motion due to jet propulsion, i.e. due to thrust of hot gases from
backwardly directed nozzles.

Aeroplane motion: The motion due to aeroplane's wings designed to deflect the air and the
propellers for causing the plane to move forward.

Helicopter motion: The motion due to the moving fans at the top of a helicopter.

Projectile motion: Projectile motion is two dimensional motion under constant acceleration
due to gravity.

Projectile: i) An object launched in an arbitrary direction in space with the initial
velocity having no mechanism of propulsion is called a projectile.

ii) Any particle in the gravitational field of the earth, whose trajectory is
assumed to be sufficiently short to consider the earth flat, and the effects of
air resistance and the rotation of the earth are neglected.

Propulsion: A mechanism for driving forward with the mixture of fuel, engine or some
shaft.

Simultaneously: Happening, done, or existing at the same time..

Trajectory: The path of a projectile.

Height of the projectile: The highest point a projectile attains during its flight.

Time of flight of projectile : The time taken by body to cover the distance from the place of
its projection to the place where it hits the ground.

Range of the projectile: Maximum distance which a projectile covers in the horizontal
direction.

Parabola: It is the locus of all
points whose distance
from a fixed point
equals their distance
from a fixed line.

Ellipse: A smooth oval curve
as followed by planet
Mars round the Sun.
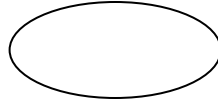
Circle: It is the locus of points
whose distance from a
given fixed point (centre)
is constant, (constant distance
is called radius).
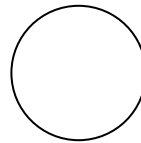
Ballistic: Of an instrument. Designed to measure an impact or brief flow of charge.
Ballistic motion: A motion in which a projectile is given an initial push and is then allowed
to move freely due to inertia and under the action of gravity.
Ballistic missile: An un-powered and un-guided missile is called a ballistic missile.
Ghori Missile: On 25 May 2002, Pakistan marks the third successful test fire of
surface-to- surface ballistic Ghori Missile with a range of 1,500 km and the
Shaheen Missile with 800 km range.
On May 28 1998, Pakistan successfully tested its nuclear capability.
Abdali: Short range domestically developed surface-to-surface missile having a range of
180 kilometers, and would be able to reach most border positions in India.
Ghaznavi: The missile capable of carrying warheads accurately up to a range of 290 km.
Aerodynamics: The study of the motion of gases (particularly air) and the motion and
control of solid bodies in air.
Aerodynamic forces: Forces exerted upon a body when it moves in air, such as, air friction.
Parallel: Having a like course, lines lying in the same direction and being equidistant at all
points from another.
Anti-parallel: Lines lying in the opposite direction and being equidistant all points from
another line.
Plausible: Seeming to be true without necessary being so; having the appearance of truth.
Amoeba: A one-celled, microscopic animal found in ponds; one of the simplest
forms of life.
Propel: To drive onward; push as a bicycle.
SLBM (Submarine launched ballistic missile): Ballistic missile submarines carry up to

24 SLBMs tipped with nuclear warheads. These missiles are stored in vertical launch

tubes within the submarine, and can be launched while the sub is hidden underwater.

WORK AND ENERGY (Chapter 4)

Work: i) The work is done on a body when it is moved or stopped through a certain distance by the action of an applied force.

ii) The product of force and component of displacement in the direction of force.

Joule: **The amount of work done, when a force of one Newton acting on a body displaces it through a distance of 1 meter along the direction of force.**

Gravitation: Universal attraction between masses.

Gravitational field: The space around the earth within which it exerts a force of attraction on or near the surface of a celestial object.

Gravitational force (or Force of gravitational attraction): The mutual force of attraction which acts universally between two bodies of matter.

Conservative field: In which the work done between two points in the field is independent of the path followed between the two points.

Gravitational field: The space around the earth within which it exerts a force of attraction on other bodies.

Electric field: The region in which an electric force acts on a charge brought into the region.

Magnetic field: The region or space near a magnet where the effects of magnetism such as the deflection of a compass needle can be detected.

Elastic spring force: A weighing spring normally spiral coils, and its elongation is proportional to the applied force, so that the spring can be calibrated to measure this force.

Electric force (Electrostatic force): Force between two charged bodies. It is proportional to the product of charges, divided by the square of the distance that separates them;

$$F = K \frac{q_1 q_2}{r^2}$$

Frictional force: Tangential force exerted by a surface on a body in contact which tend to prevent or retard motion.

Propulsion force: The force to drive onward.

Conservative force: A force is conservative if the work done by that force when moving an object from one point to another is independent of the path taken between those two points; e.g. gravitational force.

Non-conservative force: The force by which work done is <u>dependent</u> on the path followed.

Jumbo Jet: Massive airplanes capable of carrying hundreds of passengers. e.g. Concorde commercial jet, to fly faster than the speed of sound.

Fission (or Nuclear fission): The disintegration of an atomic nucleus into two or more large fragments.

Uranium: A hard heavy, white metallic element which possesses radioactive properties, having three isotopes $_{92}U^{238}$, $_{92}U^{235}$, $_{92}U^{234}$.

Ton: Any of various relatively large measures of weight.

Long ton: The weight of 2,240 pounds used in Great Britain.

Short ton: The weight of 2000 pounds used in America.

Metric ton: The weight of 2,204.6 pounds (or 1000 kg).

Power (P): The time rate of doing work.

Instantaneous power: The ratio of work done to the time interval, which is extremely   small.

Average power: The uniform rate of doing work.

Watt : It is the power of an agency which does work at the rate of 1 joule per second.

Horsepower (hp): The power is said to be a hp if 550 ft-lb of work is done per second.

Energy: The ability or capacity for doing work.

Kinetic Energy: The energy possessed by a body due to its motion.

Potential energy: It is the energy possessed by a body due to its position.

Gravitational potential energy: The energy possessed by a body due to its position in the gravitational field.

Elastic potential energy: The amount of work done against the elastic force or in compressing an elastic spring.

Absolute potential energy: Energy required to move a mass from the earth up to an infinite distance.

Work-Energy Principle: Work done on the body equals change in its kinetic energy. Mathematically;

$$\text{F.d} = \tfrac{1}{2}\, m\, v_f^2 - \tfrac{1}{2}\, m\, v_i^2$$

Fossil: Any trace, impression or remains of a plant or animal preserved in earth, clay, or rock from a past age.

Fossil fuel: Remains of a plant or animal preserved in earth and is used for producing heat or energy..

Escape velocity: The initial velocity, which a projectile must have at the earth's surface in order to go out of earth's gravitational field.

Law of conservation of energy: The total energy of a system cannot change unless energy is taken from or given to the outside. The law is equivalent to the first law of thermodynamics.

Methanol (Methyl alcohol) [CH₃OH]: A colourless liquid. It is made by catalytic oxidation of methane (from natural gas) using air.

Dam: A bank or wall built so as to hold water.

Tidal energy: Electricity obtained from the power plant that uses the 'head' of water created by the rise and fall of the ocean tides to spin the water turbines.

Solar energy: The energy produced by nuclear fusion and comprises almost entirely electromagnetic radiation.

Solar cell: A device which converts solar energy or artificial light into electrical energy.

Photo voltaic cell: An electronic device that uses the photovoltaic effect to produce an e.m.f.

Photovoltaic effect: The production of an e.m.f. between two layers of different materials by incident electromagnetic radiation.

Electromotive force (e.m.f.): A measure of the energy supplied by a source of electric current. The unit of e.m.f. is the volt.

Satellite: A smaller body that revolves around a larger body.

Turbine: An engine in which a shaft is rotated by fluid impinging upon a system of blades or buckets mounted upon it.

Turbine generator: A generator which produces electric current with the help of turbines.

Hydroelectric plant: An electricity-generating plant powered by water falling under gravity through water turbine.

Electric generator: Machine that drives electric current when it itself is driven mechanically.

Hydal energy: Electricity produced from water power by the arrangement of machinery.

Wind energy: Mechanical energy obtained from wind mills installed in windy regions to be used in tube wells or flour mills.

Wind mills: A plant consisting of shafts to produce mechanical energy, work by the action of the wind.

Biomass energy: Energy taken from plant material or vegetation as a source of fuel.

Combustion: The act of burning, or the state of being burned.

Fermentation: A slow breaking down of organic substances (vegetable and animal origin) by yeasts and bacteria usually accompanied by evolution of heat and gas.

Organic material: A material containing carbon combined with hydrogen , and often also with oxygen, and other elements.

Fertilizer: Any material put in or on the ground , which contains plant food.

Geothermal energy: Energy generated by tapping the energy of the hot, molten areas inside the earth crust.

Methane (CH_4): A colourless odourless gas. It is the simplest hydrocarbon, being the first member of the alkane series.

Nuclear energy: The energy liberated by a nuclear reaction (fission or fusion) or by radioactive decay.

Radioactivity: The spontaneous, uncontrollable decay of an atomic nucleus with the emission of particles and gamma rays.

Radioactive: Describing an element or nuclide that exhibits natural radioactivity.

Radioactive decay: The spontaneous disintegration of unstable (radioactive) nuclei to give other a lighter more stable nuclei, accompanied by the emission of particles and/or photons.

Volcano: An opening in the earth's surface, usually surrounded by a mass of ejected material forming a conical hill or mountain from which molten rock, fire, and steam are, or have been, exploded.

Volcanic region: The area or region in which the mass of ejected material of volcano can have affect.

Spring: A natural fountain or supply of water rising to the surface of the earth.

Hot springs: Supply or explode or discharge suddenly hot water from a spring.

Geyser: 1) A natural spring that spouts a column of hot water and steam into the air at frequent and irregular intervals.
2) A hot spring which frequently throws forth jets of water, mud, etc.

Aquifer: A layer of rock holding water that allows water to pass through it with pressure.

Percolate: To pass, as a liquid, through very small spaces; as, water percolate through sand.

Magma (or lava): Semi-fluid material within the earth from which a volcanic rock results by cooling.

Catapult: A forked stick with an elastic band by which stones are thrown.

CIRCULAR MOTION (Chapter 5)

Linear motion: Motion in a straight line.
Rectilinear motion (or Translational motion): A body moves with translational motion if each particle of the body undergoes the same displacement in a straight line in a given time.
Rotational motion: A body moves with rotational motion if each particle of the body moves in a circle about a straight line called the axis of rotation.
Curvilinear motion: Motion along a curved path.
Circular motion (or Angular motion): Motion of a body along a curved path of constant radius.
Angular displacement: Angle subtended at the center of a circle by a particle moving along the circumference in a given time.
Instantaneous angular velocity: Angular velocity of a body in a particular instance. Symbolically it is defined as

$$\omega = \lim_{\Delta t \to 0} \frac{\Delta \theta}{\Delta t}$$

Angular displacement: Change of position in circular path.
Radian: The angle subtended at the centre of a circle by an arc equal in length to its radius.
Arc: A part or section of a curved line, as an arc of a circle.
Chord: A string or straight line, as between two points of a curve.
Angular velocity (ω): The rate of change of angular displacement.
Average angular velocity: i) Average angular displacement per second.
                ii) The total angle turned per unit time.
                Symbolically

$$\omega_{av} = \Delta \theta / \Delta t$$

Time period (or Period of motion): Time to complete one revolution.
Angular acceleration (α): The rate of change of angular velocity with time.
Centripetal acceleration: The instantaneous acceleration of an object traveling with uniform speed in a circle is directed towards the center of the circle.
Roller coaster: A circular switchback railway with many steep inclines, over which small cars are run; common at amusement parks.

Tangential distance: Taking distance along the direction of its tangent.
Centripetal force: The force needed to bend the normally straight path of the particle into a circular path.
Tension: A force experienced by a certain body through the string.
Centrifugal force: The outward force acting on an object that is moving along a curve path.
Stunt: A sensational or remarkable feat or undertaking.
Stunt man: In motion pictures, a man employed to perform dangerous actions, such as falling, jumping etc.
Moment of inertia: The rotational analogue of mass in angular motion.
Pivot: A fixed pin or short shaft on which some object, as a ball or wheel, turns; fulcrum; axis of rotation.
Rigid body: A body is said to be rigid, if it is not possible to change its shape by the application of a force, however large.
Tangential velocity: Velocity at a point along the direction of its tangent at that point.
Spin angular momentum: It is the angular momentum of a spinning body.
Orbital angular momentum: It is the angular momentum associated with the motion of a body along a circular path.

Angular momentum: 1) A particle is said to posses an angular momentum about a reference axis if it so moves that its angular position changes relative to that reference axis.
2) The product of the moment of inertia of a body and its angular velocity.
3) The cross product of position vector and linear momentum.

Law of conservation of angular momentum: When the net external torque acting on a system about a given axis is zero, the total angular momentum vector of the system about that axis remain constant.

Gymnastics: Bodily exercises for developing the physical powers.

Skate: A metallic runner attached to a frame shaped to fit a shoe and used for gliding rapidly over ice.

Ice skating: To skate on the ice.

Clutch: Any of variously constructed and operated devices for coupling two working parts; the appliance suitable for seizing and holding.

Rotational kinetic energy: Energy due to rotation of a body; it is equal to the half of the product of moment of inertia and the square of the angular velocity. Mathematically, $KE_{rot} = \frac{1}{2} I \omega^2$

Disc: A flat circular plate or anything resembling it.

Hoop: A circular band such like a ring; anything curved like a ring.

Satellite: A smaller body that revolves around a larger body.

Artificial satellite: An artificial body orbiting the earth. Many have been launched falling under two classes; i) Information satellites, ii) Communication satellites.

Information satellites: They are designed to provide information concerning the earth, other celestial objects, or space itself, and to relay it back by radio.

Communications satellites: They are designed to provide high-capacity communications links between widely separated locations on the earth's surface.

Critical velocity: The minimum velocity necessary to put a satellite into the orbit.

Global positioning system (GPS): GPS is a satellite Navigation System. Four GPS satellite signals are used to compute position, velocity and time. The system was designed for and is operated by the U.S. military. While there are many thousands of civil users of GPS world-wide.

Intelsat (ITSO): ITSO is the world's largest commercial satellite communication services provider. Currently it has over 100 members and provides service to over 600 Earth stations in more than 149 countries. Intelsat maintains it headquarters in Washington DC. Spacecraft operations are controlled through ground stations in Italy, USA, Germany and Australia. Launched new satellite IS-907 on 15 February 2003. it will provide enhanced (circular frequency) coverage from 5850 to 6425 MHz and (linear) high power from 14.00 to 14.50 GHz.

Orbital velocity: The tangential velocity to put a satellite in orbit around the Earth.

Artificial gravity: The gravity like effect produced in orbiting space ship to overcome weightlessness.

Spaceship: A manned spacecraft, especially one making a journey between planets or stars.

Space station: A place that lies beyond the Earth's atmosphere, in which the density of matter is very low, used as base for scientific experiments.

Geostationary orbit: A circular orbit around the earth that lies in the plane of the equator and has a period of the earth's rotation on its axis, i.e. nearly 24 hours.

Geostationary satellite: The satellite whose orbital motion is synchronized with the rotation of the Earth.

Synchronization: Sameness in time of two or more events; happening at the same time rate; having the same rate of vibration.

Navigation: The act of traveling by water; steering or managing (a ship) in sailing.

Communication satellites: They are designed to provide high-capacity communications links between widely separated locations on the earth's surface.

Intrinsic: Pertaining to the very nature of a thing.

Geodesics: The path with minimum length between two points in a mathematically defined space. In three dimensions it is a straight line. In four dimensions (Einstein's theory), it is the path of electromagnetic radiation, or of a particle that is subject to no non-gravitational force.

Eclipse: The 'hiding' of one heavenly body behind another. The eclipsed object, the eclipsing object, and the observer are in a straight line.

Solar eclipse: It occurs when the shadow of the moon passes over the surface of the earth.

Space time curvature: Einstein's view of gravitation that space time is curved especially locally near massive bodies.

Analogy: Likeness between things somewhat different.

Dumb-bell: One of a pair of weights of wood or iron, used for muscular exercise.

Divergence: Moving apart or deviation from a standard.

Gramophone: An instrument for recording and reproducing sound.

FLUID DYNAMICS (Chapter 6)

Dynamics: The branch of Mechanics which deals with the motion of bodies under the influence of one or more forces.

Fluid: A substance that takes the shape of the vessel containing it; a collective term including liquids and gases.

Fluid dynamics: The study of gases and liquids in motion.

Acetone (or propane) [$CH_3 CO CH_3$]: A colourless flammable volatile compound.

Methanol (Methyl alcohol) [CH_3OH]: A colourless liquid. It is made by catalytic oxidation of methane (from natural gas) using air.

Benzene [$C_6 H_6$]: A colourless liquid hydrocarbon. It is now made from gasoline from petroleum. (formerly obtained from coal tar)

Ethanol (or Ethyl alcohol) [$C_2 H_5 OH$]: A colourless water soluble alcohol. It is the active principle in intoxicating drinks, in which it is produced by fermentation of sugar using yeast.

Glycerine (or glycerol) [$HOCH_2CH(OH)$]: A tri-hydric alcohol. It is a colourless sweet-tasting viscous liquid, mixable with water.

Law of conservation of mass (in fluids): The total inward mass flowing through a pipe is equal to the total mass of the fluid that flows outward during the same time interval.

Law of conservation of energy: The energy of the system upon which it does work increases by exactly the same amount so the total energy of the system does not change.

Tar: A thick , brownish black, oily substance obtained by the distillation of wood, coal or peat.

Peat: A substance valuable as a fuel, formed of partly decayed vegetable matter and found principally in swamps and marshy places.

Drag: To pull by force or draw along slowly and heavily.

Drag force: A retarding force experienced by an object moving through a fluid.

Fluid friction: Resistive force experienced by a body when it moves through a fluid.

Laws of friction:
1) The frictional force is independent of the area of contact (for the same force holding the surfaces together).
2) The frictional force is proportional to the force holding the surfaces together. In kinetic friction it is independent of the relative velocities of the surfaces.

Viscosity: The property of fluids by which they resist their flow due to the internal friction.

Coefficient of viscosity: It is equal to the tangential force per unit area required to maintain a unit relative velocity between its two layers, unit distance apart.

Stokes' law: In fluid resistance; The drag force F of a sphere of radius r moving with a velocity v through a fluid of infinite extent is

$$F = 6 \pi \eta r v,$$

where η is the viscosity.

Terminal velocity: Maximum constant velocity of an object falling vertically downward.

Droplet: To fall in a small spherical mass of free liquid.

Density: The ratio of the mass of a substance to its volume.

Laminar flow (or streamline flow): Smooth sliding of layers of fluid past each other.

Turbulent flow: Disorderly and changing flow pattern of fluids.

Incompressible: Which cannot be condense or press together.

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Equation of continuity: The product of cross sectional area of the pipe and the fluid speed at any point along the pipe is a constant. This constant equals to the flow rate.

Bernoulli's equation: In the steady frictionless motion of a fluid acted on by external forces which posses a gravitational potential ρgh , then

$$P + \tfrac{1}{2} \rho\, v^2 + \rho gh = \text{constant}$$

where P and ρ are the pressure and density of the fluid, v is the velocity of the fluid along a streamline.

Bernoulli effect: The relation between the pressure in a steadily flowing fluid, and its velocity.

"Where the speed is high, the pressure will be low".

Torricelli's theorem: The speed of efflux is equal to the velocity gained by the fluid in falling through the distance ($h_1 - h_2$) under the action of gravity.

Speed: i) The distance covered in unit time.

ii) When a body moves, the rate of change of its position.

Pressure: At a point in a fluid, the force exerted per unit area on an infinitesimal plane situated at the point; $P = F/a$

Speed and pressure relation: Where the speed is high, the pressure will be low.

Aeroplane: An aircraft or flying machine, kept aloft by the reaction of motor-propelled planes upon the air.

Venturi relation: It is the following relation:

$$P_1 - P_2 = \tfrac{1}{2}\, \rho v_2{}^2$$

Venturi-meter: A device used to measure speed of liquid flow.

Blood pressure: It is the force of blood against the walls of arteries.

Artery (*pl*: Arteries): One of the tubes, which carry blood from the heart.

Vein: One of the tube-like vessels, which carry the blood to or toward the heart.

Torr: A unit of pressure equal to a pressure of 133.322 pascals. It is equal to the mm of Hg.

Pascal: The SI unit of pressure, equal to a pressure of one Newton per square metre.

Systolic pressure: It is force of blood in the arteries as the heart beats.

Diastolic pressure: It is the force of blood in the arteries as the heart relaxes between beats.

Sphygmomanometer: An instrument used to measure blood pressure dynamically.

Valve: A fold in the wall of a blood vessel, canal, or other organ, which allows the contents to flow through it in one direction only.

Stethoscope: An instrument for examining the heart, lungs, or like organs of the body, by listening to the sounds which they make.

Globular protein: Any of a group of proteins that are generally insoluble in water and present in blood, eggs, milk and as a reserve protein in seeds.

Protein: Any of a large group of organic compounds found in all living organisms. Proteins compromise carbon, hydrogen, oxygen and nitrogen also sulphur.

Aorta: Principal artery of the body that carries oxygenated blood to most other arteries in the body.

Gauge: An instrument for measuring, indicating or regulating the capacity, quantity, dimensions, power, amount of anything.

Duct: A passage or tube by which a fluid is carried.

Nobel Laureate/ prize: A fund of $ 9 million was set up. The interest of which is annually distributed among six important discoveries or inventions in Physics, Chemistry, Medicine, literature, Economics, and for peace among nations. It is according to the will of Alfred Bernhard Nobel (1833 – 1896).

OSCILLATIONS (Chapter 7)

Translatory motion (or Rectilinear motion): A body moves with translational motion if each particle of the body undergoes the same displacement in a straight line in a given time.

Rotatory motion: A body moves with rotational motion if each particle of the body moves in a circle about a straight line called the axis of rotation.

Vibratory motion (or Oscillatory motion): 1) To and fro motion of a body about its mean position.

2) If the motion is back and forth over the same path about a mean position, it is called vibratory or oscillatory motion.

Periodic motion: A motion which repeats itself in equal intervals of time.

Periodic: Pertaining to a definite round of time; occurring or reoccurring at definite intervals.

Bob: A weight, e.g. a cork or small metallic mass, as on a pendulum.

Clamp: Anything that fastens, e.g. a piece of metal used to bring two corks together.

Skyscraper: A very tall building.

Elasticity: The property of a material body to regain its original condition, on the removal of the deforming forces.

Stress: The distorting force per unit area set up inside the body.

Strain: The change produced in the dimensions of a body under a system of forces.

Hook's Law: Within the limits of perfect elasticity stress is directly proportional to strain.

Hooke's law (modified form): Applied force on a body is directly proportional to the displacement.

As stress $\propto$ strain or $F/A \propto l /L_o$ or $F \propto (A/L_o) l$

or $F \propto l$ [A & L_o being constant]

or $F \propto x$ or $\underline{\mathbf{F = k\, x}}$

Simple Harmonic Motion: i) The projection of uniform circular motion upon any diameter of a circle.

ii) A particle is said to posses a simple harmonic motion if

its acceleration is always directed towards the centre and its value is proportional to the displacement of the particle from its central position.

Mean position: In to and fro motion, the central position around which a body moves.

Displacement: Distance from the equilibrium position at certain instant.

Instantaneous displacement: In a vibrating body, the value of its distance from the mean position at any instant of time.

Amplitude: The maximum distance traveled by a vibrating particle from its mean position.

Vibration: One complete round trip of the body.

Time period: It is the time required to complete one vibration.

Frequency: It is the number of vibrations executed by a body in one second.

Angular frequency: The number of complete rotations per unit time.

Sinusoidal waveform: Wave shape made like sine wave or like a curve plot of the function $y = \sin \theta$.

Circular motion: A form of periodic motion, that of an object moving at constant speed in a circle of constant radius.

Trigonometry: The study of triangles, and various relations of sides and angles of triangles.

Algebra: That branch of mathematics which uses letters and other symbols instead of actual numbers and quantities for calculations.

Arithmetic: The branch of mathematics in which we use figures for calculations.

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Trigonometric functions: Relations between the angle and sides of a right angled triangle, such as, $\sin\theta$, $\cos\theta$.

Sine θ: In right angled triangle, sine θ is equal to the opposite side divided by hypotenuse.

Cosine θ: In right angled triangle, cosine θ is equal to the base divided by hypotenuse.

Tangent θ: In right angled triangle, tangent θ is equal to opposite side divided by the base.

Instantaneous velocity: Velocity at a particular instant of time.

Acceleration: i) Rate of change of velocity.
        ii) Change of velocity in unit time.

Phase: 1) The angle $\theta = \omega t$ which specifies the displacement as well as the direction of motion of the point executing SHM is known as phase.
    2) The state or condition as regards its position and direction of motion with respect to the mean position.

Pendulum: A device consisting of a mass , suspended from a fixed point, that oscillates with a known period.

Simple pendulum: It consists of a small mass oscillating to and fro at the end of a very light string.

Second's pendulum: A pendulum whose time period is two seconds.

Elastic potential energy: The amount of work done against the elastic force or in compressing an elastic spring.

Free oscillations: Oscillations of a body at its own frequency without the interference of an external force.

Forced oscillations: The oscillations of a body subjected to an external force.

Oscillator: Any system, which is capable of oscillating about a stable equilibrium position.

Harmonic oscillator: 1) A physical system under going forced vibrations.
    2) A signal oscillator that produces a large number of odd and even harmonics of the fundamental frequency of the input.

Simple Harmonic oscillator(or linear oscillator): It is one in which the restoring force is directly proportional to the displacement with respect to its stable equilibrium position.

Damped harmonic oscillator: An oscillator which moves in a resistive medium.

Magnetron: A type of electron tube used for producing microwaves.

Metal mesh: One of the open spaces between the metal wires of a net.

Elongation: Stretching out to become longer.

Resonance: A specific response of a vibrating system to a periodic force acting with the natural period of the system.

Mechanical resonance: In a mechanical vibrating system, the enhanced response to a driving force as the frequency of this force is increased through a resonant frequency.

Natural frequency: The frequency at which an object or system will vibrate freely.

Natural period: The time period of a body or system for free oscillation.

Electrical resonance: The condition arising when a maximum of current or voltage occurs as the frequency of the electrical source is varied; such as, tuning a radio.

Microwave: An electromagnetic wave with a wavelength in the range 1 mm to 100 mm, i.e. with a frequency in the range 300 to 3GHz.

Oven: A chamber used for baking, heating, or drying.

Microwave oven: An oven in which food is cooked by the heat produced as a result of microwave penetration of the food.

Tacoma Narrow bridge: In November 7, 1940 the first Tacoma Narrows suspension bridge collapsed due to wind-induced vibrations, situated on the Tacoma Narrows in Puget Sound, near the city of Tacoma, Washington, USA. The bridge had only been open for traffic a few months.

Damping: A process whereby energy is dissipated from the oscillatory system.

Damped oscillations: Decreasing in amplitude with time due to the resistance of the medium to the oscillations or vibrations.

Driven Harmonic oscillator: A physical system under going forced vibrations.

Condition for resonance: Resonance occurs when the frequency of the applied force is equal to one of the natural frequencies of vibration of the forced or driven harmonic oscillator.

Dissipation: The removal of energy from a system to overcome some form of resistive force (mechanical or electrical). Without resistance (as in motion in vacuum) there can be no dissipation.

Shock absorber: Any of several devices for absorbing the energy of sudden impulses or shocks in machinery or structure.

Pith ball: A bob or small suspending ball made of some soft , spongy substance.

WAVES (Chapter 8)

Mechanical waves: The waves which require a medium for their movement.
Electromagnetic waves: Transverse waves in spaces having an electric component and a magnetic component.
Matter waves: These waves carry energy and pilot the particle and move along with it.
Wave: A disturbance in the medium.
Water waves: The waves produced in the water.
Ripples: Tiny waves on the surface of water; any slight curling wave.
Ripple tank: An apparatus which consists of a rectangular tray containing water, fitted with glass bottom.
Shock waves: Waves of compression and rarefaction that originate in the neighbourhood of sharp points or roughness on obstacles exposed to the flow of a compressible fluid at high speeds.
Ultrasonic frequency: A sound frequency above the range normally audible by humans, i.e. greater than about 20 KHz.
Ultrasonics: Study and application of mechanical vibrations with frequencies beyond limits of hearing of the human ear, i.e. with frequencies about 20 KHz and upwards.
Ultrasonic waves: Sound waves having frequency greater than 20 KHz.
Radar: (Radio Direction And Ranging) A system for locating distant objects by means of reflected radio waves, usually of microwave frequency.
Radar speed trap: An instrument used to detect the speed of moving object on the basis of Doppler shift.
Oscillation: A vibration; a periodic variation of an electrical quantity, as current or voltage.
Space: That which has length, breadth, and height, and is unlimited in extension.
Guitar: A six stringed instrument played with the fingers.
Music: The art or science of making pleasing or harmonious combinations of sound tones.
Aeroplane: An aircraft or flying machine, kept aloft by the reaction of motor-propelled planes upon the air.
Electric field: Region in which an electric force acts on a charge brought into that region.
Magnetic field: The region or space near a magnet where the effects of magnetism such as the deflection of a compass needle can be detected.
String: A small cord; thick thread.
Spring: An elastic object or device usually of metal of spiral shape, that yields under a distorting force and returns to its original form when the force is removed.
Magnifying glass (or Simple microscope): An ordinary convex lens held close to the eye.
Pebble: A small roundish stone, worn smooth, as by water.
Progressive wave: The wave, which transfers energy away from the source.
Traveling waves: Waves produced by a driving force, and they travel away from the source which produces them.
Longitudinal wave: The wave in which the particles of the medium vibrate parallel to the propagation of the wave.
Hump: To make such shape like the back of a camel; bend or curve as the back
Energy: The ability or capacity for doing work.
Momentum: In a moving body, the product of its mass and velocity.
Wave: A disturbance in the medium.
Pulse: Single unrepeated disturbance.
Jerk: To give a sudden quick pull, twist or push to.
Slinky spring: A loose spring which has small initial length but relatively large extended length.

Sag: T sink or hang down by weight, or under pressure; as the rope sags.

Transverse waves: The waves in which particles of the medium are displaced in a direction perpendicular to the direction of propagation of waves.

Longitudinal waves: The waves in which the particles of the medium have displacements along the direction of propagation of waves.

Periodic motion: Any kind of regularly repeated motion, such as the swinging of a pendulum, the orbiting of a satellite, the vibration of a source of sound, or an electromagnetic wave.

Periodic waves: Any kind of regularly repeated waves.

Snap: To produce a sharp sudden sound; to throw or seize with a jerk.

Snapshot: An instantaneous photograph.

Rhythm (rhythmic *adv.***):** The regular recurrence (i.e. coming back at intervals) as in music, stress, speech, or quantity; movement marked by a regular measured recurrence of sound.

Vibrator: A device for producing an alternating current by periodically interrupting or reversing the current obtained from a direct-current source.

Crest: A region of upward displacement in a transverse wave.

Trough: A region of downward displacement in a transverse wave.

Harmonic motion: A regularly repeated sequence that can be expressed as the sum of a set of sine waves. Each component sine wave represents a possible simple harmonic motion.

Amplitude: The maximum distance traveled by a vibrating particle from its mean position.

Wavelength: The distance between two consecutive wave fronts.

Snapshot: An instantaneous photograph.

Profile: Drawing an outline of a curved or sweeping figure.

Sine curve: The curve made by plotting the function of $y = \sin \theta$.

Transverse periodic waves: The transverse waves which pass one after the other through any point in the medium periodically.

Longitudinal periodic waves: The longitudinal waves in which the particles of the medium vibrate with simple harmonic motion.

Compression: The region of a longitudinal wave in which the vibrating particles are closer than their equilibrium distance.

Rarefaction: The region of a longitudinal wave in which the vibrating particles are farther apart than their equilibrium distance.

Compressional waves (or longitudinal waves): 1) Waves in which the particles of the medium vibrate to and fro along the path which the waves travel through the medium.
2) The waves in which the vibrations are parallel to the direction of travel of the wave.

Sound: The series of disturbances in matter to which the human ear is sensitive. Also similar disturbances in matter above and below the normal range of human hearing.

Inertia: 1) It is a property by virtue of which it is necessary to exert a force on a body at rest if it is to be set into motion.
2) The resistance of matter to any acceleration of its state of rest or motion.

Elastic modulus: The ratio of stress on a body to the strain produced.

Elasticity: The property of a material body to regain its original condition, on the removal of the deforming forces.

Bulk modulus: Elasticity of volume, corresponding to volume strain.

Young's modulus: Linear elasticity, or elasticity of length.

Rigidity modulus: Elasticity of shape.

Density: The ratio of the mass of a substance to its volume.

Boyle's law: The volume of a given mass of a gas in inversely proportional to the pressure, if the temperature is kept constant.

S.T.P. : (Standard temperature and pressure) The standard temperature is 0 $^\circ$C (273 K) and the standard pressure is 1 atm or 760 mm of Hg or 760 torr or 101325 Nm^{-2}.

Newton's formula for the velocity of sound: Velocity of sound is directly proportional to the square root of the elasticity and inversely proportional to the square root of the density of the medium.

Mathematically, $V = \sqrt{E/\rho}$

Laplace's correction: In calculations of the velocity of sound, to use coefficient of adiabatic elasticity and not to use isothermal elasticity.

Molar specific heat at constant volume, C_V: The amount of heat energy required to raise the temperature of one mole of a gas through 1° K at constant volume.

Molar specific heat at constant pressure, C_P: The amount of heat energy required to raise the temperature of one mole of a gas through 1° K at constant pressure.

The ratio (γ): It is the ratio of adiabatic elasticity to isothermal elasticity; it is the ratio of C_p to C_V . or $\gamma = C_p / C_V$

Binomial theorem: It mathematical form is,

$$(1 \pm x)^n = 1 \pm \frac{nx}{1!} + \frac{n(n-1) x^2}{2!} + \ldots\ldots (x < 1)$$

Mono-atomic: Describing a molecule that consists of a single atom. The rarer gases are mono-atomic.

Diatomic: Describing a molecule that consists of two atoms; e.g. H_2 , O_2 & N_2 .

Polyatomic: Describing a molecule that consists of several atoms (three or more) e.g. Benzene $C_6 H_6$.

Bat: Any of an order of insect-eating animals, with soft, furry body, and wings formed by skin stretched between the fingers, legs, and tail, which fly by night.

Coefficient of volume expansion (β): The change in unit volume of a substance when its temperature is changed one degree.

Absolute temperature: Temperature measured with respect to absolute zero, i.e. zero of Kelvin scale, a scale which cannot take negative value.

Absolute zero: The least possible temperature for all substances. At this temperature the molecules of any substance possess no heat energy. A figure of –273.15 C is generally accepted as the value of absolute zero.

Supersonic: Pertaining to speed in air with a speed exceeding the speed of sound in air.

Ultrasonic: Sounds of frequency higher than 20,000 hertz which are not audible to human ear.

Infrasonic: Vibrations in matter below 20 cycles per second.

Auditory sensation area: The region of intensity and frequency bounded by the lower and upper curves of frequency verses intensity level for sound waves.

Threshold of hearing: The intensity of the average faintest audible sound; 10^{-12} watt /m^2

Threshold of pain: The upper intensity level for audible sounds.

Supersonic plane: A plane moving in air with a speed exceeding the speed of sound in air. At this speed shock waves are produced.

Sonic barrier (or sound barrier): The sudden sharp increase in aerodynamic drag experienced by aircraft approaching the speed of sound.

Sonic boom : 1) An explosive sound caused by the shock wave preceding an aircraft traveling at or above the speed of sound.
2) The noise originating from the backward projected shock waves set up by an aircraft travelling at greater than the speed of sound. A stationary source of sound emits a series of concentric wave fronts, the radius of which will increase with time.

Shock waves: 1) A large amplitude compression waves, as that produced by an explosion or by supersonic motion of a body in a medium.
2) When an airplane moves relatively slow, air pressure disturbances move faster than the airplane and are able to disperse. However, when an airplane moves faster than the speed of sound, air pressure disturbances are unable to disperse; instead, they amass in front of the airplane. A cone shaped shockwave forms, audible to those on the ground as a sonic boom.

Mach number (Ma): The ratio of the speed of a high-speed aircraft to the speed of sound in air; $Ma = v / c$

An airplane traveling at less than Mach 1 is traveling at **subsonic** speeds; at

about Mach 1, **transonic**, or approximately the speed of sound; and greater

than Mach 1, **supersonic** speeds; in excess of 5 it is said to be **hypersonic**.

An aircraft flying at Mach 2, for example, is traveling at twice the speed of sound.

Cone: A solid body, which tapers uniformly to a point from a circular base.

Conical surface: The surface made like the outer surface of a cone.

Boeing Company: The world's largest manufacturer of commercial airplanes and military aircraft. Boeing controls almost two-thirds of the global market for jet airliners. Its headquarters is in Seattle, Washington.

Boeing 747 (called Jumbo Jet): A cargo transport flight with 490 passengers capacity. Four jet engines propel the plane, which reaches cruising speeds of 885 km/hr.

Concord plane: Concord is the only operating commercial supersonic jet airliners. Its speed is 1400 mile/hr with 128-passenger capacity. Both Air France and British Airways operate it.

Falcon: Fighter-bombers aircraft. They are dual purpose aircraft that can drop bombs and also fight enemy planes. e.g. F-16 fighting Falcon.

F-16 (Fighting Falcon): The F-16 is world's most successful warplane of recent times, over 4000 Falcons have been build. Its speed is 2124 km/hr at 12190 m altitude with range 3890 km. Pakistan have 40 F-16 of A/B model.

Types of planes: a) **Land planes:** Aircraft that take off from and land on the ground.
b) **Seaplanes**: Aircraft that take off from and land on water.
c) **Amphibians**: Aircraft that can operate on both land and sea.
d) **Airplanes:** They can leave the ground using the jet thrust of their engines or rotating wings and then switch to wing borne flight.

Superposition: Combining the displacements of two or more wave motions algebraically to produce a resultant wave motion.

Principle of superposition of waves: 1) When two (or more) waves of the same type pass through the same region, the amplitude of vibration at any point is the algebraic sum of the individual amplitudes.
2) When two waves act upon a body simultaneously they pass each other without disturbing each other, and act upon the particles of the medium quite independent of each other, and their resultant displacement is the resultant of all individual waves.

Beats: 1) The condition whereby two sound waves form an outburst of sound followed by an interval of comparative silence.
2) The periodic alternations of sound between maximum and minimum.

Stationary waves (or standing waves): 1) Waves apparently standing still resulting from the similar wave trains travelling in opposite directions.
2) Resultant of two wave trains of the same wavelength, frequency, and

amplitude travelling in opposite directions through the same medium.

Interference: The phenomenon in which the two waves support each other at some points and cancel at others.

Phase coherence: Producing of two waves of same wavelength and time period at the same instant.

Constructive interference: 1) Whenever path difference is an integral multiple of wavelength displacements, the two waves are added up. This effect is called constructive interference.
2) The interference of two waves, so that they reinforce one another.

Destructive interference: 1) At points where the displacements of two waves cancel each other's effect, the path difference is an odd integral multiple of half the wavelength. This effect is called destructive interference.
2) When two waves overlap each other in opposite phases.

Audio generator: A device to generate electric charges (electrons) to move to and fro repeatedly (A.C. signals) with frequency range of 20 Hz to 20,000 Hz.

Amplifier: A device for reproducing an electrical input at an increased intensity.

Power amplifier: An amplifier producing an appreciable current flow into a relatively low impedance (i.e. the ratio of voltage to current) or a large increase in output power.

Microphone: A device for converting sound energy into electrical energy.

Cathode ray oscilloscope (CRO) : A device used to display input signal into waveform.

Tuning fork: A metal two-prong fork which produces a sound of a definite pitch.

Sonometer: A device consisting of two or more wires or strings stretched over a sounding board, used for testing the frequency of strings and for showing how they vibrate.

Sound waves: Longitudinal wave motion through a material medium produced in matter having frequency range from 20 to 20,000 hertz.

<u>**Laws of transverse vibrations:**</u> from the equation

$$\nu_1 = \frac{1}{2l}\sqrt{\frac{T}{m/l}}$$

Law of length: The frequency of transverse vibration of a stretched string is inversely proportional to its vibrating length under constant stretching force. Mathematically;

$$\nu \propto 1/\ , \quad T \& m \text{ are constants}$$

Law of tension: The frequency of transverse vibration of a stretched string is directly proportional to the square root of its tension for given length.

Mathematically; $\quad \nu \propto \sqrt{T}\ ,\quad l \& m$ are constants

Law of mass: The frequency of transverse vibration of a stretched string is inversely proportional to the square root of its mass per unit length for as given length and constant tension. Mathematically;

$$\nu \propto \sqrt{l/m}\ ,\quad l \& T \text{ are constants}$$

Plasticene: A soft plastic material used, especially by children for modeling.

Organ (or organ pipe): A musical instrument played by means of one or more keyboards. It produces sound by means of a vibrating air column enclosed in one or more pipes.

Sitar: Indian instrument, with seven metal strings, a gourd body, and long neck with moveable frets.

Violin: A four stringed musical instrument played with a bow.

Piano: The largest musical stringed instrument. It is enclosed in a case and played from a keyboard.

Guitar: A six stringed instrument played with the fingers.

Reflection: The turning back of a wave from the boundary of a medium.

Stationary waves (or Standing waves): i) The resultant of two wave trains of the same wavelength, frequency, and amplitude travelling in opposite directions through the same medium.

ii) Waves apparently standing still resulting from two similar wave trains travelling in opposite directions.

Node: A point of no disturbance of a stationary wave.

Antinode: A point which oscillate with the maximum amplitude in stationary waves.

Harmonic series: A series having a sequence of numbers, each of which is obtained from the preceding number of the sequence by adding the same number; such as, f, $2f$, $3f$, etc.

Peg: A small usually cylindrical pointed or tapered piece (as of wood) used to pin down or fasten things or to fit into or close holes.

Organ (or organ pipe): A musical instrument played by means of one or more keyboards. It produces sound by means of a vibrating air column enclosed in one or more pipes.

Flute: A musical wind instrument furnished with finger holes and keys.

Odd: Not exactly divisible by two.

Even: Divisible by two without a remainder.

Stationary longitudinal wave: Stationary waves in which the particles of the medium vibrate parallel to the propagation of the wave.

Fundamental frequency (or Fundamental): The lowest frequency produced by a vibrating object.

Harmonics (or Overtones): The fundamental and the tones whose frequencies are whole number multiples of the fundamental.

Echo: The repetition of sound caused by the reflection of sound waves.

Echolocation: Such location where the echo is heard.

Dolphin: Any of various agile sea mammals, akin to the whales.

Doppler's effect: The change in the pitch of sound caused by the relative motion of either the source of sound or the listener.

Locomotive: Pertaining to motion or travel from one place to another; an engine or motor for drawing railway cars.

Relative velocity: The vector difference of the two velocities.

Doppler shift: Apparent change in frequency due to relative motion of source and observer.

Artery (*pl*: Arteries): One of the tubes, which carry blood from the heart.

Vein: One of the tube-like vessels, which carry the blood to or toward the heart.

Electromagnetic waves: Transverse waves in spaces having an electric component and a magnetic component.

Radar: (Radio Direction And Ranging) A system for locating distant objects by means of reflected radio waves, usually of microwave frequency.

Sonar: (*SO*und *NA*vigational *R*anging) A technique for locating objects underwater by transmitting a pulse of ultrasonic sound and detecting the reflecting pulse.

Satellite: A smaller body that revolves around a larger body.

Echo: The repetition of a sound or of sounds already heard, caused by the throwing back of sound waves.

Acoustics: Study of the production, properties and propagation of sound waves.

Acoustical: Pertaining to acoustics.

Submarine: Something that functions or operates underwater; such as, a warship designed for under sea operation.

Astronomy: The scientific study of the heavenly bodies, their motions, relative positions, and nature.

Astronomer: One who is skilled in astronomy or who makes observations of heavenly bodies and their phenomena.

Astronaut: Somebody from a non-communist country who travels beyond the Earth.

Cosmonaut: Somebody from a communist country who travels beyond the Earth.

Star: Any celestial body visible as a point of light.

Nova: A faint variable star that can undergo a considerable explosion during which the luminosity increases by up to 10^5 times.

Supernova: Stars that suffer an explosion becoming some 10^8 times brighter than the Sun during the process.

Pulsars: Stars that emit radio frequency electromagnetic radiation in brief pulses at extremely regular intervals.

Nebula: A luminous, cloud-like formation seen among the stars. It may represent the initial form of a star cluster that may condense out of it or the final form of a supernova.

Crab Nebula: the name of a star of supernova type.

Black hole: An astronomical body with so high a gravitational field that it causes gravitational self-closer, i.e. a region is formed from which neither particles nor photons can escape, although they can be captured permanently from the outside.

Planet: Any one of the larger celestial bodies of the solar system, revolving round the sun in a nearly circular orbit and shining by reflected light; distinguished from the stars.

Galaxy (or Milky way): The star system to which the Sun and the Solar System belong.

Cosmos: The observed universe regarded as an orderly collection of galaxies, stars, planets, comets, etc.

Spectrum: i) The set colors obtained on the screen by dispersion.
ii) Array of colors arranged according to their wave length.

Blue shift: The shift of received wavelength from a star into the shorter region.

Red shift: The shift in the wavelength of light from a star towards longer wavelength region.

Microwave: An electromagnetic wave with a wavelength in the range 1 mm to 100 mm, i.e. with a frequency in the range 300 to 3GHz.

Transmitter: A device used in a telecommunication system to generate and propagate an electrical signal.

Explosion: A sudden and violent outburst from a solid to a gaseous state with a loud report.

Tremor: Quick vibration or shaking.

Prong: Sharp pointed instrument or branch; such as one leg of a tuning fork.

Absorption spectrum: A spectrum having dark lines because of the absorption of some wavelengths.

PHYSICAL OPTICS (Chapter 9)

Optics: Branch of Physics which deals with the study of the behaviour of light.
Physical optics: It treats the distinctive wave phenomena of light.
Light: The aspect of radiant energy of which an observer is visually aware.
Luminous: Objects that give off light of their own.
Interference: The phenomenon in which the two waves support each other at some points and cancel at others.
Vibration: One complete round trip of the body.
Concentric: Having a common center, as circles.
Wave front: 1) A surface on which all the points have the same phase of vibration.
 2) Locus of all points having the same phase of vibration.
Phase: The state or condition as regards its position and direction of motion with respect to the mean position.
Ray: A single line of light coming from a luminous point.
Luminous: Objects that give off light of their own.
Beam: Several parallel rays of light considered collectively.
Spherical (circular) wave front: In homogeneous medium, from a point source, concentric spheres (circles) of wave fronts with center at the source.
Plane wave front: A small portion of a spherical wave front which is very nearly plane.
Huygen's principle: Every point on a wave front can be considered as a source of secondary spherical wave-lets, and the new position of the wave front after a time t can be found by drawing a plane tangential to the secondary wave-lets.
Tangent: A line, curve, or surface which touches another at a single point.
Diffraction: The bending or spreading of waves around the edge of an opening or obstacle.
Phase: The state or condition as regards its position and direction of motion with respect to the mean position.
Constructive interference: The interference of two waves, so that they reinforce one another.
Destructive interference: The interference of two waves, so that they cancel one another.
Phase coherence: Producing of two waves of same wavelength and time period at the same instant.
Monochromatic: Light consisting of only one colour.
Polychromatic: Light composed of several colours.
Coherent source: Having a source or sources, that are always in phase, i.e. peaks and troughs always come together.
Superposition: Combining the displacements of two or more wave motions algebraically to produce a resultant wave motion.
Fringe: One of various light or dark bands produced by the interference or diffraction of light.
Crest: A region of upward displacement in a transverse wave.
Trough: A region of downward displacement in a transverse wave.
Maxima: The bright fringes made in the interference of light.
Minima: The dark fringes made in the interference of light.
Slit: A narrow opening; to cut lengthwise or into long strips.
Integral multiple: Multiples having a whole number.
White light: Light such as daylight, containing all wavelengths of the visible spectrum at normal intensities so that no coloration is apparent.
Thin film: A thin skin or layer.
Plano-convex lens: A convex lens whose one side is plane.

Refraction: The bending of a wave disturbance at it passes obliquely from one medium into another of different density.

Periphery: The circumference of a circle, ellipse, or similar figure; the outside surface of a rounded solid.

Microscope: An optical instrument for producing an enlarged image of small objects.

Simple microscope: The magnifying glass, or simple magnifier. The small object is viewed between the lens and its focal point.

Compound microscope: A device used for producing large images of close small objects with a combination of lenses.

Concentric rings: Rings having a common center.

Newton's rings: Circular interference fringes formed between a lens and a glass plate with which the lens is in contact.

Michelson's interferometer: The device includes one half silvered mirror and two plane mirrors, using interference of light waves to measure very small distances.

Precision: In measurements considering the magnitude of error. The less magnitude of error gives more precise measurement.

Schematic (schematically, *adv***):** Of or relating to a scheme; diagrammatic presentation; such as a figure, e.g., figure2.

Telescope: A device for collecting and producing an image of distant objects.

Cadmium: ($_{48}Cd^{112}$) A soft bluish metal, used in low-melting point alloys to make solders in some batteries.

Rim: A border, edge, or margin of an object, especially when bound or raised.

Diffraction: 1) The property of bending of light around obstacles and spreading of light waves into the geometrical shadow of an obstacle.

2) The bending or spreading of waves around the edge of an opening or obstacle.

Diffraction grating: An optical surface, either transmitting or reflecting with several thousand equally spaced and parallel lines ruled on it.

Grating element: Distance of the width of slit and the separation between two consecutive slits, which is equal to length of grating divided by number of ruled lines.

X-rays: Electromagnetic radiation of extremely short wave length, having great penetrating power.

Crystal: A (usually transparent) body formed by a substance solidifying so that it has flat surfaces in regular, even arrangement.

Electromagnetic radiation: Energy propagated by vibrating electric and magnetic fields. Electromagnetic radiation forms a whole electromagnetic spectrum, depending upon frequency and ranging from high frequency cosmic rays to low frequency microwaves.

Array: An orderly collection or series of things imposingly displayed.

Bragg equation: The equation setting out the condition for the diffraction of a parallel beam of monochromatic x-rays from a crystal;

$$n \ \lambda \ = \ 2 \ d \ \sin \theta$$

Biology: The science, which deals with the origin and life history of plants and animals including botany and zoology.

Biological: Pertaining to the science, which deals with the origin and life history of plants and animals including botany and zoology.

Hemoglobin: Hemoglobin is a protein that is carried by red cells. It picks up oxygen in the lungs and delivers it to the peripheral tissues to maintain the life of cells.

Helix: Anything in the shape of the thread of a screw, or of a coiled spring.

Analyzer: A device for determining the plane of polarization of plane-polarized radiation

DNA: (Deoxyribonucleic acid) The genetic material of most living organisms, which is a major constituent of the chromosomes within the cell nucleus and plays a central role in the determination of hereditary characteristics by controlling protein synthesis in cells.

Transverse mechanical waves (or Transverse waves): The waves in which particles of the medium are displaced in a direction perpendicular to the direction of propagation of waves.

Electric field: The region in which an electric force acts on a charge brought into the region.

Electric field vector: The vector area in which an electric force acts on a charge brought into the region.

Magnetic field: The region or space near a magnet where the effects of magnetism such as the deflection of compass needle can be detected.

Magnetic field vector: The vector area near a magnet where the effects of magnetism such as the deflection of compass needle can be detected.

Polarization (of light): The limiting of the vibrations of light, usually to vibrations in one plane.

Plane polarized light: A beam of light in which all the vibrations are in one direction.

Polarizer: Crystal which stop light vibrations in all but one direction.

Polaroid filter: A light filter which polarizes the light passing through it.

Optical activity: The property of rotating the plane of polarization of light.

Incandescent: Glowing with heat; white-hot.

Absorption: In radiation. Reduction in the intensity of electromagnetic radiation, or other ionizing radiation, on passage through a medium.

Reflection: The turning back of a wave from the boundary of a medium.

Scattering: The spreading out of a beam of radiation as it passes through matter, reducing the energy moving in the original direction.

Dichroism: The property of some crystals, such as tourmaline, of selectively absorbing light vibrations in one plane while allowing light vibrations at right angles to this plane to pass through.

Dichroic substances: The property of some substances (or crystals), such as tourmaline, of selectively absorbing light vibrations in one plane while allowing light vibrations at right angles to this plane to pass through.

Polaroid: A doubly refracting material that plane-polarizes unpolarized light passed through it.

Crystal: A (usually transparent) body formed by a substance solidifying so that it has flat surfaces in regular, even arrangement.

Amorphous: Describing a solid that is not crystalline; i.e. one that has no long-range order in its lattice.

Quartz: (SiO_2) The most abundant and common mineral, consisting of crystalline silica, crystallizing in the trigonal system.

Sodium chlorate: ($NaClO_3$) A white crystalline solid. It decomposes above its melting point to give oxygen and sodium chloride.

Optically active crystal: The property possessed by some crystals of rotating the plane of vibration of polarized light passing through it.

Organic chemistry: The branch of chemistry concerned with compounds of carbon.

Organic substance: A substance containing carbon compounds; vegetable and animal origin substances.

Sugar: Any of a group of water-soluble carbohydrates of relatively low molecular weight and typically having a sweet taste.

Tartaric acid: [$(CHOH)_2 (COOH)_2$] A crystalline naturally occurring carboxylic acid.

OPTICAL INSTRUMENTS (Chapter 10)

Optical instrument: The device based on the principles of reflection and refraction.

Lens: A portion of a transparent medium such as glass bounded by two faces, one of which is at least curved.

Convex lens (or Converging lens): A lens which converges parallel light rays. It is thicker in the middle than it is at the edge.

Concave lens (or Diverging lens): A lens with concave surfaces which diverges parallel light rays.

Reflection: The turning back of a wave from the boundary of a medium.

Refraction: The bending of a wave disturbance at it passes obliquely from one medium into another of different density.

Principal axis: Line through center of curvature and center of a lens or mirror.

Aperture: The angular portion of a sphere included by the mirror or lens.

Focus: A point at which light rays meet or from which rays of light diverge.

Principal focus: A point to which rays parallel to the principal axis converge, or from which they diverge, after reflection or refraction.

Focal length: Distance from an optical device to the point where it focuses parallel rays.

Refractive index: A measure of the extent to which a ray of light is bent as it passes from one transparent medium to another.

Optical center: A fixed point of a lens lying inside or outside on its axis such that a ray of light passing through it suffers no deviation.

Image: The reproduction of an object formed by lenses or mirrors.

Real image: An image which is formed by actual rays of light.

Imaginary (or Virtual) image: Image formed by rays not actually passing through the position the image appears to occupy.

Least distance of distinct vision: The distance equal to 25 centimeter for a normal person to see clearly an object.

Fuzzy: Not clear; indistinct; moving the camera causes.

Iris: The circular coloured membrane of the eye.

Retina: The inner, sensitive coating of the eye containing the ends of the nerves of sight; that part of the eye which receives images of object.

Pupil: The opening in the iris of the eye, through which rays of light pass to the retina.

Magnification: The ratio of the angle subtended by the image as seen through the optical device to that subtended by the object at the unaided eye.

Linear (or Transverse) magnification: The ratio of the linear dimensions of the image to those of the object.

Magnifying power (or Angular magnification): The ratio of the angle subtended by the image of an object seen through a telescope and the angle subtended by the same object seen without the telescope.

Resolving power: The ability of an instrument to reveal the minor details of the object under examination.

Spectrometer: Optical instrument used for the study of spectra. It consists of collimator, turntable and telescope.

Grating spectrometer: A spectrometer attached with diffraction grating.

Magnifying glass (or Simple microscope): An ordinary convex lens held close to the eye.

Chromatic aberration: The non-focussing of light of different colours.

Spherical aberration: The failure of parallel rays to meet at a single point after reflection or refraction.

Compound microscope: It is used to produce a very large magnification of very small objects. It consists of an objective and an eyepiece.

Telescope: A device for collecting and producing an image of distant objects.

Astronomical telescope: A telescope used to see heavenly bodies; it consists of two converging lenses.

Objective: That part of a telescope or binoculars that faces the objects; it has large focal length and large aperture.

Eye piece: A convex lens of short focal length and small aperture.

Unaided eye: Looking with naked eye without using optical device; such as, telescope or microscope.

Planet: Any one of the larger celestial bodies of the solar system, revolving round the sun in a nearly circular orbit and shining by reflected light; distinguished from the stars.

Star: Any celestial body visible as a point of light.

Reflecting telescope: A device used to see distant objects in which concave mirror is used as an objective.

Light year: A unit of distance. It is the distanc that light travels through space in one year; equal to 9.46×10^{15} meters.

Spectrum: A band of seven colours formed by the dispersion of the components of white light, when it is passed through a prism.

Spectrometer: Optical instrument used for the study of spectra. It consists of collimator, turntable and telescope.

Collimator: The part of the spectrometer consisting of slit and a convex lens, which is called collimating lens.

Turn-table: The part of the spectrometer between collimator and telescope. This turn-table is provided with three leveling screws. It is used for supporting the prism or the diffraction grating.

Grating (or diffraction grating): An optical surface, either transmitting or reflecting with several thousand equally spaced and parallel lines ruled on it.

Speed of light in vacuum: Speed of electromagnetic radiation; a fundamental constant is defined as,

$$c = 2.99792458 \times 10^8 \text{ m s}^{-1}$$

it is recommended since 1975 for universal use. The speed decreases when the radiation enters a material medium.

Photo phone: An instrument for talking along a beam of light instead of telegraph wire; telephoning without wires by varying the intensity of a beam of light by the action of voice, and allowing the light to fall upon a piece of crystalline selenium.

Modulation: 1) Variation of radio frequency waves by means of audio frequency waves.
2) Variation of the amplitude, frequency or phase of electromagnetic waves, especially for carrier waves.

Radio: The process of communication across space by the transmission and reception of an electromagnetic wave of radio frequency without the use of connecting wires or other material link.

Radio frequencies: Frequencies of radio waves above audio frequency; between 3 KHz and 300 GHz (wavelength 1 cm to 100 km).

Audio frequencies: Frequencies to which the ear is sensitive; about 20 Hz to 20 kHz.

Technology: The practice of any or all of the applied sciences that have practical value and/or industrial use.

Bandwidth: 1) The difference between the upper and lower frequency limits of a band, normally measured in hertz.

2) The range of frequencies over which a particular characteristic of an electronic device or system lies within specified limits.

Illumination: A measure of the visible-radiation energy reaching a surface in unit time.

Fibre optics: The use of fine transparent fibres to transmit light. The light passes along the fibres by a series of internal reflections.

Fibre: Raw material, which can be separated into threads for making up textile or some, woven like system.

Internal reflection: Reflection within a medium.

Total internal reflection: 1) The reflection of light at the boundary of two transparent media when the angle of incidence exceeds the critical angle.

2) Reflection which occurs when the angle of incidence is greater than the critical angle.

Refractive index (Absolute index of refraction): The ratio of velocity of light in vacuum to its velocity in a given substance.

$$n = c_1 / c_2$$

Relative refractive index (relative index of refraction): The ratio of velocity of light in one medium to its velocity in another medium.

Critical angle: The angle of incidence for which the angle of refraction is 90° .

Axial: Of, relating to, or having the characteristics of an axis; situated around, in the direction of, on, or along an axis; extending in a direction essentially perpendicular to the plane of a cyclic structure.

Laws of reflection: The angle of incidence equals the angle of reflection, and the incident ray, the reflected ray and the normal to the reflecting surface at the point of incidence lie in the same plane.

Cross section: A cutting or piece of something cut off at right angles to an axis.

Propagation: Spreading or transmitting through a medium.

Hypothetical: Based on supposition, or on something assumed.

Optical fibre: An optical fibre consists of a single flexible rod of high refractive index, less than 1mm in diameter, having polished surfaces coated with transparent material of lower refractive index.

Multi layer fibre: The fibre having many layers.

Core: The central part of a wire.

Cladding: 1) A layer of lower refractive index (less intensity) over the central core of high refractive index (high density).

2) The process of bonding one metal to another to prevent corrosion of one of the metals.

Stepped-index fibre: Here the indexes of both cladding and core are constant throughout.

Graded index fibre: In it the refractive index of the core decreases radially outwards. Light rays then spiral smoothly around the central axis rather than zig zagging.

Single mode fibre: Here the core is very narrow relative to the cladding and rays travel parallel to the central axis; it may be stepped or graded index.

Single (or mono) mode step index fibre: It has a very thin core of about 5 μm diameter and has a relatively larger cladding of glass or plastic.

Multimode step index fibre: Here a core of relatively larger diameter such as 50 μm is used. The fibre core has a constant refractive index such as 1.52.

Multimode graded index fibre: 1) An optical fibre in which the central core has high refractive index which gradually decreases towards its periphery.

2) Its core ranges in diameter from 50 to 1000 μm, which has relatively high refractive index and the refractive index decreases gradually from the middle to the outer surface of the fibre. There is no noticeable boundary between core and cladding.

LED: (Light emitting diode) A semi-conductor diode, made from certain materials (e.g. gallium arsenide), in which light is emitted in response to the forward-bias current.

Ultraviolet light: Light of shorter wavelength than visible light but longer than X-rays; frequencies from 8×10^{14} to 2×10^{16} Hz.

Infra-red light: Light waves longer than waves of ordinary light but shorter than radio-waves; frequencies from 3×10^{11} to 4×10^{14} Hz.

Audio signal: 1) Sound or information transmitted electrically at the normally audible frequencies of 20 to 20,000 cps or Hz.

2) An alternating voltage proportional to the sound pressure produces in an electric circuit by a microphone.

Ear piece: In a signal transmitter, the device nearest the ear which converts electrical signals into sound.

Microphone: A device for converting sound energy into electrical energy.

Modulation: 1) Variation of radio frequency waves by means of audio frequency waves.

2) Variation of the amplitude, frequency or phase of electromagnetic waves, especially for carrier waves.

Digital modulation: 1) A modulation by digital method. The laser is flashed on and off at extremely fast rate. The communication is represented by code of 1s and 0s. the receiver is programmed to decode 1s and 0s.

2) Variation of the amplitude, frequency or phase of electromagnetic waves and sending signals in digital form of zero or one shape, especially for carrier waves.

Laser: (*L*ight *A*mplification by *S*timulated *E*mission of *R*adiation) a device which is able to produce a beam of radiation with unusual properties, generally the beam is coherent, monochromatic, parallel with high intensity.

Stimulate: To rouse and produce greater activity in.

Coherent: Having same phase, i.e. peaks and troughs always come together.

Phase coherence: Producing of two waves at the same instant, having same wavelength and time period.

Monochromatic: Light consisting of only one colour.

Intensity: The energy transmitted per second through a unit area by the light waves.

Repeater: A device used to amplify or regenerate signals in order to extend the transmission between two stations.

Photodiode: A semiconductor diode that produces a significant photo-current when illuminated.

Photo-current: Current produced due to photo electric effect.

Photo electric effect: The emission of electrons by a substance when illuminated by electromagnetic radiation.

Dispersion: i) The separation of polychromatic light into its component wavelengths.
ii) Separation of white light into colours.

Biconvex lens: A type of convex lens whose both sides curved outwards.

HEAT AND THERMODYNAMICS (Chapter 11)

Heat: 1) Heat is a form of energy associated with molecular motion.

2) Heat is energy that flows between a system and its environment by virtue of a temperature difference between them.

Temperature: Degree of hotness as determined by a thermometer.

Absolute zero: The temperature of –273.16 ^{o}C at which the volume of a gas theoretically becomes zero. It is taken as zero on the Kelvin scale of temperature.

Thermodynamics: Study of quantitative relationships between heat and other forms of energy.

Technology: The science of industrial arts and manufactures.

Hypothesis: A theory, which may or may not prove to be true.

Postulate: A statement which is taken for granted as a fact; to assume without proof.

Law: A scientific statement of the action and relation of things in nature, observed to be always the same under given conditions with the same result performed anywhere in the world.

Kinetic theory: A theory explaining physical properties in terms of the motion of particles.

Kinetic theory of gases: The molecules or atoms of a gas are in continuous random motion and the pressure exerted on the walls of a containing vessel arises from the bombardment by these fast moving particles.

Brownian motion: The continuous random motion of microscopic solid particles (of about 1 micrometer in diameter) when suspended in a fluid medium.

Microscopic: Very small; invisible without a microscope.

Macroscopic state: The state of matter characterized by the statistical properties of its components. Kinetic theory is an analysis of the macroscopic state.

Microscopic state: The state of matter characterized by the actual properties of each individual elemental component. Quantum theory is typically an analysis of the microscopic state.

Pressure: At a point in a fluid, the force exerted per unit area on an infinitesimal plane situated at the point..

Density: The ratio of the mass of a substance to its volume.

Pascal's law: Pressure applied at any point of a fluid at rest is transmitted without loss to all other parts of the fluid.

Temperature: Degree of hotness as determined by a thermometer.

Boyle's law: The volume of a given mass of a gas is inversely proportional to the pressure, if the temperature is kept constant.

Charles' law: The volume of a given mass of a gas is proportional to its absolute temperature provided the pressure of the gas is kept constant.

General gas law: The product of pressure and volume of a given mass of a gas is proportional to its absolute temperature.

Ideal gas: A gas, which obeys the gas laws at all temperatures and pressures.

Real gas: A gas, which does not obey the gas laws at all temperatures and pressures.

Mole: 1) The amount of that substance whose mass, expressed in grams, is numerically equal to the molecular weight of the substance.

2) A quantity which contains Avogadro's number of units i.e. atoms, molecules, ions or whatever under consideration.

Avogadro's law: Equal volumes of all ideal gases at same temperature and pressure contain equal number of molecules.

Avogadro's number (or Avogadro constant): The number of atoms or molecules in one mole of a substance. It has the value 6.02252×10^{23} .

Rotation: Turning around its own axis or centre.

Internal energy: Total heat energy retained by the system in the form of potential energy and kinetic energy.

Enthalpy (H): 1) The total heat content of a system is termed as enthalpy of a system.
2) The sum of the internal energy and the product of pressure and volume of a system; $H = U + PV$

Function of state: It is a macroscopic property of a system which has some definite value for each state and which is independent of path in which the state is reached; e.g. P,V,T & U.

Work: The product of magnitude of force and that of displacement in the direction of force.

Mechanical: Pertaining to the laws of matter and motion; produced by machines.

Mechanical equivalent of heat (J): Amount of work obtainable by the complete conversion of unit quantity of heat into mechanical work.

Mechanical work: Work done with some mechanical device, e.g. work done in heat engine.

Mechanical energy: The energy transmitted by a machine; energy in the form of mechanical power; the kinetic plus potential energy, if there is no frictional loss.

Environment: Conditions around something, which influence the working of that thing.

Zeroth law of thermodynamics: If systems A and B are each in thermal equilibrium with a third system C, then A and B are in thermal equilibrium with each other.

First law of thermodynamics: 1) In any thermodynamic process, when heat Q is added to a system, this energy appears as an increase in the internal energy ΔU stored in system plus work W done by the system on its surroundings.
2) When heat is converted to another form of energy, or when other forms of energy are converted into heat, there is no loss of energy.

Thermocouple: 1) Two dissimilar metallic conductors joined at their ends.
2) Junction of two dissimilar metals, in which an emf is generated by reason of a temperature difference.

Piston: A small solid cylinder of metal or wood, fitting exactly, and moving up and down in a cylinder or tube.

Cylinder: A hollow vessel or chamber like empty space in a solid in which force is executed on the piston of a steam engine.

Monitor: A device that observes and records selected activities within a system for analysis.

Millivoltmeter: A meter used to measure electrical voltage whose range is measured in 10^{-3} volts.

Metabolism: 1) Energy transforming processes that occur within an organism.
2) The sum of the chemical reactions occur within living organisms.

Cell: A tiny, usually microscopic , mass of protoplasm, one of the units of structure of living matter in both plants and animals.

Protoplasm: The vital substance from which develops all forms of animal and plant life.

Organism: Anything that has life in itself; a body composed of parts performing special duties, but mutually dependent.

System: A collection of matter which has a distinct boundary.

Surroundings: The remaining portions around a system are called surroundings.

Closed system: A system for which there is no transfer of mass across the boundary.

Isolated system: A system for which there is no transfer of mass and energy across the boundary.

Isothermal process: The process in which the temperature of the system remains constant.

Isotherm: The curve representing an isothermal process in P-V diagram is called isotherm.

Adiabatic process: The process in which no heat flows into or out of the system.

Adiabat: The curve representing an adiabatic process in P-V diagram is called adiabat.
Isobaric process: The process in which the pressure of the system remains constant.
Isochoric process: The process in which the volume of the system remains constant.
Specific heat: The amount of heat energy required to raise the temperature of unit mass through one degree.
Molar specific heat: The amount of heat energy required to raise the temperature of one mole of a substance through 1 K.
Molar specific heat at constant volume (C_v): The amount of heat energy required to raise the temperature of one mole of a gas through 1 K at constant volume.
Molar specific heat at constant pressure (C_p): The amount of heat energy required to raise the temperature of one mole of a gas through 1 K at constant pressure.
Universal gas constant: The constant of proportionality R in the equation of state, $pV = nRT$, of an ideal gas. R has the value 8.2057×10^{-21} atm/mole K.
Reversible process: If the process can be reversed in such a way that the system and its surroundings are both brought back to their original states, then the process is said to be reversible.
Irreversible process: If a process can not be retraced in the backward direction by reversing the controlling factors, it is an irreversible process.
Liquification: Changing into liquid.
Evaporation: A change of state from solid or liquid to gas (or vapour).
Sublimation: It is a process in which a solid, when heated, vapourizes directly without passing through the liquid place.
Engine: A mechanical device that changes a physical force in one form such as heat, into another form more easily used.
Heat engine: A device which transforms heat energy into mechanical energy.
Steam engine: A heat engine in which water is boiled in a vessel covered with a piston, the steam inside tries to push the piston up showing the ability to do work.
Reservoir: A place where anything, as water, is collected and stored up for use; e.g. large trees in a jungle.
Heat reservoir : It is supposed to be so big that its temperature remains constant even if some heat enters or leaves the reservoir.
Hot reservoir (or Source): A hot body, which can supply heat at a high temp. to a cold body.
Cold reservoir (or Sink): A cold body, which can receive heat at a low temperature from a hot body.
Second law of thermodynamics: 1) According to Lord Kelvin's statement, "It is impossible to devise a process which may convert heat, extracted from a single reservoir, entirely into work without leaving any change in the working system".
2) According to Clausius statement, "It is not possible in a cyclical process for heat to flow from one body to another body at higher temperature, with no other change taking place".
Carnot engine: An ideal heat engine, free from all the imperfections of actual engines, and hence never realized in practice.
Carnot cycle: A cycle in which reversible process occurs.
Third law of thermodynamics: It is impossible by any procedure, no matter how idealized, to reduce any system to the absolute zero of temperature in a finite number of operations.
Efficiency: The ratio of the useful work output of a machine to total work input.

Thermal equilibrium: 1) The condition of a system in which the net rate of exchange of heat between the components is zero.
2) If two bodies at different temperatures are placed together, heat transfer occurs until they have the same temperature. They are then at thermal equilibrium.

Mechanical equilibrium: A state of a system in which the properties (e.g. p,V,T, etc) do not change with time.

Carnot Theorem: No heat engine can be more efficient than a Carnot engine operating between the same two temperatures.

Extension of Carnot theorem: All Carnot's engines operating between the same two temp. have the same efficiency, irrespective of the nature of the working substance.

Isothermal expansion: The expansion in which the temp. of the system remains constant.

Triple point: The only point at which the gas, solid, and liquid phases of a substance can coexist in equilibrium. The temperature of the triple point of water is defined to be 273.16 Kelvin.

Petrol engine: An engine based on the principle of Carnot cycle. It undergoes 4 processes;
i) intake of petrol air mixture into the cylinder with a outward piston, ii) adiabatic compression of the mixture with the inward piston, iii) a spark fires the mixture causing its adiabatic expansion that forces the piston to move outward which delivers power to crank shaft to derive the flywheel, iv) the residual gases are expelled from the outlet valves and piston moves inward.

Carburetor: 1) A device used to charge air with gas from petrol for producing light or power.
2) A device in an engine that mixes liquid fuel and air in the correct proportions, vaporizes them, and transfers the mixture to the cylinders.

Valve: A mechanical device for opening and closing the movement of a gas or liquid; a fold which allows the movement in one direction only.

Spark plug: An ignition device, the insulated conductor set in the wall or top of each cylinder. At the inner end of the spark plug is a small gap between two wires. The high voltage current arcs across this gap, yielding the spark that ignites the fuel mixture in the cylinder.

Flywheel: A large heavy wheel, with large moment of inertia, used in mechanical devices.

Piston: A solid cylinder of metal or wood, fitting exactly and moving up and down in a tube.

Crank: Of a boat, easily upset; opposite of stiff.

Shaft: Anything shaped like an arrow, as the stalk of a plant or broken handle of cricket bat.

Crankshaft: A shaft driven by a crank.

Petroleum: Naturally occurring green to black coloured mixtures of crude hydrocarbon oils, found as earth seepages or obtained by boring.

Gas oil: A petroleum distillation fraction intermediate between kerosene and light lubricating oil. Slightly more viscous grades are used as diesel fuels.

Diesel (or diesel fuel): Fuel used for diesel (compression ignition) engines. The composition varies but is near that of gas oil.

Petrol (or gasoline): A light hydrocarbon liquid fuel for spark-ignition engines; a complex mixture consisting mainly of hydrocarbons such as hexane, heptane and octane.

Diesel engine: Its like a petrol engine but without sparkplug. It undergoes four processes;
i) the diesel is sprayed into the cylinder with a outward piston, ii) adiabatic compression of the mixture with the inward piston, iii) fuel mixture ignites on contact with air due to high temperature causing its adiabatic expansion that forces the piston to move outward which delivers power to crank shaft to derive the flywheel, iv) the residual gases are expelled from the outlet valves and piston moves inward.

Entropy: The physical quantity, which describes the ability of a system to do work; describes disorder of a system. Mathematically,

$$\Delta S = \Delta Q / T$$

Electric motor: The machine which converts electrical energy into mechanical energy.

Battery: A number of similar unts, such as electric cells, working togethe.

Power plant (or generating station): A complete assemblage of plant, equipment, and the necessary buildings at a place where electric power is generated on a large scale.

Nuclear power plant: A power plant using a nuclear reactor as the source of energy.

Nuclear reactor: A device in which nuclear reactions take place on a large scale.

Solid state laser: A laser consisting chiefly of semi-conducting materials or compounds.

Internal combustion engine: An engine in which the fuel is burned within the engine cylinders.

External combustion engine: An engine in which the fuel is burned outside the engine cylinders, in a separate boiler.

Fluorescent lamp: A lamp in which light is generated by an electrical discharge through a low pressure gas, causing it to emit radiation.

Incandescent lamp: An electric lamp in which light is produced by the heating effect of a filament.

Incandescence: The radiation of visible light by a surface at high temperature.

Fluorescence: The absorption of energy by atoms, molecules, etc. followed by immediate emission of electromagnetic radiation as the particles make transitions to lower energy states.

Environmental crisis: Global scale problems created by man in the physical environment and by use of physical resources. It concerns with temperature, humidity, atmosphere and contamination.

Thermal pollution: The discharge of heated gases into the surrounding air, causing a rise in air temperature that sometimes affects local weather conditions.

Metabolism: 1) Energy transforming processes that occur within an organism.
2) The sum of the chemical reactions occur within living organisms.

Futile: Useless; of no importance; worthless.

Ecology: The study of the relation of plants and animals to their environment and each other.

Ecological balance: The balance between the relation of plants and animals to their environment and each other.

Fragile: Easily broken; delicate.

Engineering: The application of scientific and mathematical principles to practical ends; such as the design, manufacture, and operation of structures, machines, processes and systems.

Engineer: One who is trained or professionally engaged in a branch of engineering.

Mechanical engineer: The engineer who deals the generation and application of heat and mechanical power and the design, production, and use of machines and tools.

Boiler: A strong metallic vessel in which steam is produced for diving engines.