UNIT -I : Matter : Its Nature and Behaviour

CHAPTER - 1 : MATTER IN OUR SURROUNDINGS

TOPIC-1
Matter-Solid, Liquid and Gas; Characteristics of Solid, Liquid and Gas

Quick Review

- Matter is not continuous but rather consists of a large number of particles.
- **Characteristics of particles :**
  - **(i)** Large number of particles constitute matter.
  - **(ii)** Particles of matter are very small in size.
  - **(iii)** Particles of matter have spaces between them.
  - **(iv)** Particles of matter are continuously in motion.
  - **(v)** Particles of matter attract each other.
- Matter around us exists in three states-solid, liquid and gas.
- **Solid state :**
  - **(i)** All solids have definite shape, distinct boundaries and fixed volumes, that is, have negligible compressibility.
  - **(ii)** Solids have a tendency to maintain their shape when subjected to outside force.
  - **(iii)** Solids are rigid.
- **Liquid state :**
  - **(i)** Liquids have no fixed shape but have a fixed volume. They take up the shape of the container in which they are kept.
  - **(ii)** Liquids flow and change shape, so they are not rigid but can be called fluid.
  - **(iii)** The rate of diffusion of liquids is higher than that of solids. This is due to the fact that in the liquid state, particles move freely and have greater space between each other as compared to particles in the solid state.
- **Gaseous state :**
  - **(i)** Gases are highly compressible as compared to solids and liquids.
  - **(ii)** The liquefied petroleum gas (LPG) cylinder that we get in our home for cooking or the oxygen supplied to hospitals in cylinders is compressed gas.
  - **(iii)** In the gaseous state, the particles move around randomly at high speed. Due to this random movement, the particles hit each other and also the walls of the container. Pressure of gas is applied on the walls of the vessel by the irregular moving gas particles.

Know the Terms

- **Matter :** Anything that has mass and occupies space is called matter.
- **Solid :** Solid is defined as that form of matter which possesses rigidity, is incompressible and hence has a definite shape and a definite volume.
- **Liquid :** Liquid is defined as that form of matter which possesses fluidity but is almost incompressible and hence has a definite volume but no definite shape.
- **Gas :** Gas is defined as that form of matter which possesses fluidity but is highly compressible and hence has neither definite shape nor definite volume.

TOPIC-2
Change in State of Matter, Evaporation, Condensation Sublimation

Quick Review

- Water can exist in three states of matter–
  (i) Solid, as ice,
  (ii) Liquid, as water, and
  (iii) Gas, as water vapour.
- The states of matter are inter-convertible. The state of matter can be changed by changing temperature or pressure.
- SI unit of temperature is Kelvin. T (K) = T (°C) + 273.
- The temperature at which solid melts to form liquid at atmospheric pressure is called melting point. Melting point of ice is 273.16 K (O°C)
- The melting point of a solid is an indication of the strength of the force of attraction between its particles.
- The temperature at which a liquid starts boiling at the atmospheric pressure is known as boiling point. Boiling point of water is 373 K (100° C).
- Latent heat of vapourization is the heat energy required to change 1 kg of liquid to gas at atmospheric pressure at its boiling point. Boiling is a bulk phenomenon.
- Latent heat of fusion is the amount of heat energy required to change 1 kg of solid into liquid at its melting point.
- Evaporation takes place only at the surface of the liquid while boiling can take place in all parts of the liquid.
- Evaporation is surface phenomenon. Particles from the surface gain enough energy to overcome the forces of attraction present in the liquid and change into the vapour state.
- Evaporation is a continuous or ongoing process. Evaporation causes cooling.
- The rate of evaporation is affected by the surface area exposed to atmosphere, temperature, humidity and wind speed.
- Since evaporation is a surface phenomenon, therefore, it increases with an increase in surface area.
- Evaporation increases with an increase in temperature.
- Evaporation decreases with an increase in humidity.
- Evaporation increases with the increase in wind speed.

Know the Terms

- **Humidity :** The amount of water vapour present in the air.
- **Density :** It is the mass occupied by a solid per unit volume and is obtained by dividing the mass of a particular solid by the volume occupied.
- **Fusion :** The process in which a solid changes to liquid state by absorbing heat at constant temperature.
- **Diffusion :** The process in which particles of one substance occupy the vacant spaces present in the particles of the other substance, is called diffusion.
- **Condensation :** The process in which a gas changes into liquid state by giving out heat at constant temperature.
- **Latent heat :** The hidden heat which breaks the force of attraction between the molecules during change of state.
- **Latent heat of fusion :** The amount of heat energy that is needed to convert one kg of a solid into the liquid state at atmospheric pressure at its melting point is termed as latent heat of fusion.
- **Boiling point :** The temperature at which a liquid starts boiling at the atmospheric pressure is known as boiling point.
- **Freezing point :** The temperature at which a liquid changes to solid by giving out heat at the atmospheric pressure.
- **Latent heat of vaporization :** The amount of heat energy that is needed to convert one kg of a liquid at its boiling point temperature into its vapour state without any rise in temperature, is termed as latent heat of vaporization.
- **Melting point :** The melting point of a solid may be defined as the temperature at which a solid melts to become a liquid at the atmospheric pressure.
- **Sublimation :** Sublimation is the change of a solid directly into the gaseous state without passing through the liquid state upon heating and back to the solid state when the temperature is lowered.
- **Evaporation :** The phenomenon of change of liquid to the vapour state at any temperature below the boiling point of the liquid is termed as evaporation.
- **Transpiration :** The process of evaporation of water from the aerial parts of plants especially leaves is called transpiration.

❑❑

CHAPTER - 2 : IS MATTER AROUND US PURE?

TOPIC-1
Elements, Compounds, Mixtures, Heterogeneous and Homogeneous Mixtures

Quick Review

- Matter can be classified as pure substances or mixtures.
- A pure substance may either contain constituent particles of only one kind or of different kinds. A pure substance has a fixed composition.
- An element is a basic form of matter which cannot be broken down into simpler substances by any physical or chemical means.
- Elements can be broadly classified as metals, non-metals and metalloids.
- Metals are one category of elements that have lustre. They conduct heat and electricity. They are sonorous. They are malleable and ductile.
- Non-metals do not have lustre, are not sonorous and are bad conductors of heat and electricity.
- Metalloids are elements having properties intermediate between those of metals and non-metals.
- A compound is a pure substance composed of two or more elements chemically combined in a fixed proportion. It can be broken down into simpler substances by chemical or electrochemical methods.
- Properties of compounds are different from those of its constituent elements, whereas a mixture shows the properties of its constituent elements or compounds.
- A mixture contains two or more elements or compounds which are mixed together in any proportion. From a mixture no new compound is formed. A mixture shows the properties of the constituent substances.
- Mixtures are classified as homogeneous and heterogeneous mixtures.
- Mixtures whose components mix completely with each other to make a uniform composition are called homogeneous mixtures.
- A heterogeneous mixture has a non-uniform composition.
- Alloys are mixture of two or more metals or a metal and a non-metal and cannot be separated by physical methods.
- The ability of a substance to dissolve in another substance is called solubility.
- Homogeneous mixture of two or more substances is called a solution.
- Component of a solution present in small quantity is called a solute.
- Component of a solution present in large quantity is called a solvent.
- Particles of a solution are smaller than 1 nm in diameter. They cannot be seen by naked eyes.
- Particles of solution do not scatter beam of light.
- Solute particles cannot be separated from the mixture by filtration.
- Solution with high solute concentration is called concentrated solution and those with low concentration is called dilute solution.
- The concentration of a solution is the amount of solute present in a given amount (mass or volume) of solvent or solution. Concentration of a solution $= \frac{\text{Amount of solute}}{\text{Amount of solution}}$
- Percentage by mass is one method of expressing concentration of solution.
- There are two kinds of heterogeneous mixtures :– colloids and suspensions.
- Colloids are mixtures with particle sizes from 1 nm to 100 nm.
- The component of colloid present in small amount is called dispersed phase.
- The medium in which colloidal particles disperse or suspend themselves is called dispersion medium.
- In a colloidal system particles are always suspended and do not settle down. This constant colliding of the particles in continuous motion is called Brownian movement.
- Scattering of a beam of light when light is passed through a colloidal solution is called the Tyndall effect.
- Colloids are classified according to the state (solid, liquid or gas) of the dispersed medium or dispersing medium and the dispersed phase.
- Colloid in which dispersed medium is a liquid and dispersed phase is solid is called as solution.
- Colloid in which both dispersed phase and dispersed medium are in liquid state is called as an emulsion.

- Colloid in which dispersed phase is either liquid or a solid and dispersed medium is a gas is called as aerosol.
- A suspension is a heterogeneous mixture in which the solute particles do not dissolve but remain suspended throughout the bulk of medium. Particles of suspension are visible to naked eye. Suspensions are heterogeneous mixtures with particles that have a size greater than 1000 nanometers.

Know the Terms

- **A pure substance** consists of particles of only one kind of matter which are similar to one another and which cannot be separated into other kinds of matter by any physical process.
- **An element** is defined as a basic form of matter which cannot be broken down into simpler substances by any chemical method. For example, hydrogen, oxygen, mercury, gold, iron, copper, etc.
- **Metals :** Possess lustre. They are malleable and ductile, good conductors of heat and electricity and are sonorous. For example, iron, copper, aluminium, silver, etc.
- **Non-metals :** Are neither malleable nor ductile. They are not lustrous and non-conductors of heat and electricity. For example, hydrogen, oxygen, bromine, sulphur, phosphorus, etc.
- **Metalloids or semi-metals :** Have intermediate properties between those of metals and non-metals. For example, silicon, germanium, arsenic and antimony.
- **A compound** is defined as a pure substance made up of two or more elements chemically combined in a fixed proportion by mass. For example, water, carbon dioxide, limestone, etc.
- **Mixtures :** A mixture contains two or more substances (elements or compounds) which are physically mixed in any proportion but not chemically combined.
- **A solution** is a homogeneous mixture of two or more substances. The major component of the solution is called the solvent and the minor component is called the solute.
- **Alloys** are homogeneous mixtures. They may also be regarded as solid in solid solution.
- **Concentration of a solution** is the amount of solute present per unit volume or per unit mass of the solution/ solvent.
- **Concentration of Solution :**

  1. Mass by mass percentage $= \frac{\text{mass of solute}}{\text{mass of solution}} \times 100$

  2. Mass by volume percentage $= \frac{\text{mass of solute}}{\text{volume of solution}} \times 100$

- **Saturated solution** is a solution which contains the maximum amount of the solute dissolved in a given quantity of the solvent at the given temperature and which cannot dissolve any more solute at that temperature.
- **Unsaturated solution** is a solution which can dissolve more amount of solute in it at the given temperature.
- **Supersaturated solution** is a solution which temporarily contains more solute than the saturation level is called a supersaturated solution.
- **A suspension** is a heterogeneous mixture in which the solute particles do not dissolve but remain suspended throughout the bulk of the medium.
- **Colloids** are heterogenous mixtures in which the size of the particles lies in between those of true solutions and suspension.

TOPIC-2

Separation Techniques, Physical and Chemical Change

Quick Review

- Heterogeneous mixtures can be separated by simple physical methods like handpicking, sieving, filtration etc.
- Magnetic impurities can be separated from non-magnetic impurities by magnetic separation.
- Volatile compounds can be separated from non-volatile compounds by sublimation.
- Mixtures of two or more liquid components can be separated by simple or fractional distillation or by using a separating funnel.
- Simple distillation is used for separating liquids having a difference in boiling points of more than or equal to 25° C.
- Fractional distillation is used for separating liquids having a difference in boiling points of less than 25° C.
- Liquids that are immiscible in each other differ in their densities and so can be separated by making use of a separating funnel.
- Chromatography is used for separation of those solutes which dissolve in same solvent.
- Chromatography is a method of separating and identifying various components in a mixture, which are present in small trace quantities.

- Mixture containing two solid substances out of which one is soluble in a particular solvent and other is insoluble, can be separated by dissolving the soluble constituent in a suitable solvent and then separating the insoluble substance through filtration.
- The change in which the shape, size, appearance or state of a substance may alter but its chemical composition remains the same is called a physical change. In a physical change, no new substance is formed.
- Any change that involves the formation of a new substance and leads to a transformation of chemical identity is called chemical change.
- Chemical changes are usually accompanied with heat exchanges. Chemical changes are permanent changes which are usually irreversible.
- Applications of crystallisation : Purification of salt from sea water and separation of crystals of alum from impure samples.

Know the Terms

- **Magnetic separation :** A method to separate magnetic impurities from non-magnetic impurities as substance.
- **Distillation :** A technique to separate two miscible liquids.
- **Fractional distillation :** A technique to separate more than two miscible liquids.
- **Chromatography :** Chromatography is a method of separating and identifying various components in a mixture, which are present in small trace quantities.
- **Centrifugation :** The process of separating the suspended particles of an insoluble substance, from a liquid, by rotating it at high speed is called centrifugation.
- **Crystallisation** is a process that separates a pure solid in the form of its crystals from a solution.
- **Decantation** is a process of separating mixtures by removing a layer of liquid, generally one from which precipitate has settled.
- **Winnowing** is an agricultural method to separate grains from lighter particles like chaff, dirt etc., by throwing a forced current of air.
- **Evaporation :** The process by which a soluble solid can be obtained from a solution by allowing the solvent to vapourize.

❑❑

CHAPTER - 3 : ATOMS AND MOLECULES

TOPIC-1

Laws of Chemical Combination, Atom and Molecules, Valency, Chemical Formula of Common Compounds

Quick Review

- **Laws of chemical combination :** There are two laws of chemical combination as mentioned below :
  (i) Law of conservation of mass : Mass can neither be created nor destroyed in a chemical reaction.
  (ii) Law of constant proportions or Law of definite proportions : In a chemical substance, the elements are always present in a definite proportions by mass.
- **Postulates of Dalton's atomic theory :**
  (i) Every matter is made up of very tiny particles called atoms.
  (ii) Atoms are indivisible particles, which cannot be created or destroyed in a chemical reaction.
  (iii) Atoms of a given element are identical in mass and chemical properties.
  (iv) Atoms of different elements have different masses and chemical properties.
  (v) Atoms combine in the ratio of small whole numbers to form compounds.
  (vi) The relative number and kinds of atoms are constant in a given compound.
- Atoms are building blocks of all matters.
- Atomic radius is measured in nanometers (1 m = 10^9 nm).
- Each element has a unique name and a unique symbol.
- IUPAC (International Union of Pure and Applied Chemistry) approves names of the elements.
- **Rules for assigning symbols for atoms of various elements are as follows :**
  (i) The abbreviation used to represent an element is generally the first letter of the element's name in English.

English name of element	Symbol
Hydrogen	H
Boron	B
Oxygen	O
Nitrogen	N
Fluorine	F

(ii) When the names of two or more elements are beginning with the same initial letter, the initial letter is followed by the letter appearing later in the name :

Name of element	Symbol
Barium	Ba
Bismuth	Bi
Bromine	Br
Silicon, Sulphur	Si
Cadmium, Calcium	Cd

(iii) Symbols of some elements are derived from their Latin / German or Greek names :

Name of element	Latin/German/Greek name	Symbol
Sodium	Natrium	Na
Potassium	Kalium	K
Copper	Cuprum	Cu
Iron	Ferrum	Fe
Gold	Aurum	Au
Silver	Argentum	Ag

- One atomic mass unit is a mass unit exactly equal to $1/12^{th}$ the mass of one C-12 atom.
- Atoms of most elements are not able to exist independently. Atoms form molecules and ions.
- Molecules of an element are formed by the atoms of the same type.
- Atoms of same or different elements join together in definite proportions to form molecules of compounds.
- The number of atoms constituting a molecule is known as its atomicity.
- An ion is a charged particle and can be negatively or positively charged.
- Ions may consist of a single charged atom or a group of atoms that have a net charge on them.
- Ionic compounds contain charged species called ions as their smallest unit.
- A group of atoms carrying a fixed charge on them are called polyatomic ions or radicals.
- The chemical formula of a compound is a symbolic representation of its composition.
- Valency is the combining capacity of an element.
- Valency can be used to find out how the atom(s) of an element will combine with the atom(s) of another element to form a chemical compound.
- **Names and symbols of some ions :**

Valency	Name of ion	Symbol	Non-metallic element	Symbol	Polyatomic ions	Symbol
1	Sodium Potassium Silver Copper (I)*	Na^+ K^+ Ag^+ Cu^+	Hydrogen Hydride Chloride Bromide Iodide	H^+ H^- Cl^- Br^- I^-	Ammonium Hydroxide Nitrate Hydrogen Carbonate	NH_4^+ OH^- NO_3^- HCO_3^-
2	Magnesium Calcium Zinc Iron (II)* Copper (II)*	Mg^{2+} Ca^{2+} Zn^{2+} Fe^{2+} Cu^{2+}	Oxide Sulphide	O^{2-} S^{2-}	Carbonate Sulphite Sulphate	CO_3^{2-} SO_3^{2-} SO_4^{2-}
3	Aluminium Iron (III)*	Al^{3+} Fe^{3+}	Nitride	N^{3-}	Phosphate	PO_4^{3-}

* Some elements show variable valency which is represented by a roman numerical brackets.

- **Rules for writing the formula of a compound :**
  - **(i)** Formula of compound is given by writing side by side the symbols of constituent elements.
  - **(ii)** Symbol of the more metallic element is written first in the formula.
  - **(iii)** Number of atoms of each of the constituent element present in the molecule is indicated by subscript.
  - **(iv)** When either of the ions or both the ions are polyatomic and their valency is more than 1, we enclose the polyatomic ions in brackets. No brackets are necessary if the valency(ies) of polyatomic ion (s) is (are) 1.
  - **(v)** While writing the formula of a compound if the valency numbers have a Highest Common Factor (H.C.F), divide the valency numbers by H.C.F so as to get the simplest ratio between the combining elements.
- The charges or valancies on the ion must be balanced.
- Formula of a binary compound is written by criss-crossing the valencies of elements present in a molecule of the compound.
- A chemical compound is always electrically neutral; hence the positive and negative valencies or charges of the ions in the compound must add upto zero.

Know the Terms

- **Atom :** Smallest particle of an element that shows all the properties of an element.
- **Atomic number :** Number of protons in an atom of an element.
- **Molecule :** Smallest particle of an element/compound that is capable of an independent existence and shows all the properties of that substance.
- **Anion :** Negatively charged ion.
- **Cation :** Positively charged ion.
- **Atomicity :** Number of atoms present in one molecule of an element.
- **Radical :** An atom or a group of atoms carrying positive or negative charge that behave as a single unit in a chemical reaction.
- **Mole :** Amount of substance that contains the same number of units as there are atoms in exactly 12 gm of carbon-12 isotope.
- **Chemical formula :** Expression of the composition of a substance by chemical symbols and numerical subscript.
- **Diatomic :** A molecule which contains two atoms.
- **Triatomic :** A molecule which contains three atoms.
- **Polyatomic :** A molecule which contains more atoms.
- **Valency :** Measure of combining capacity of an element with other atoms when it forms compounds or molecules.
- **Binary compound :** Simplest compounds made up of two different elements. *e.g.,* : HCl, H_2O.

TOPIC-2
Atomic and Molecular Masses, Mole Concept,Relationship of Mole to Mass of the Particles and Numbers

Quick Review

- Scientists use the relative mass scale to compare the masses of different atoms of elements.
- Atoms of C-12 isotopes are assigned a relative atomic mass of 12 and the relative masses of all other atoms are obtained in comparison with the mass of a C-12 atom.
- Relative mass of a molecule is expressed in atomic mass unit (u).
- 1 mole of any substance = 6.022×10^{23} units (Avogadro's number.)
- The mole is the amount of substance that contains the same number of particles (atoms/ ions/ molecules/ formula units, etc.) as there are atoms in exactly 12 g of carbon-12.
- Mass of 1 mole of a substance is called its molar mass. It is expressed in g/mol.
- Mass of 1 mole of a particular substance is also fixed.
- Atoms of different elements are of different sizes and masses. A mole of one type of atoms will have a different mass from a mole of another type of atoms.

Know the Terms

- **Molar mass :** Mass of one mole of a substance.
- **Gram atomic mass :** Atomic mass of an element expressed in terms of grams.
- **Molecular mass :** Sum of the atomic masses of all the atoms in a molecule of the substance.
- **Formula unit mass :** Sum of the atomic masses of all the atoms in a formula unit of a compound.
- **Mole :** One mole of any species (atoms, molecules, ions or particles) is that quantity in number having a mass equal to its atomic or molecular mass in grams.
  Mole can also be defined as the amount of substance that contains Avogadro number (6.022×10^{23}) of particles.
- **Avogadros constant :** Number of atoms in exactly 12 gm of carbon – 12.

❑❑

CHAPTER - 4 : STRUCTURE OF ATOM

Quick Review

- An atom is divisible and consists of charged particles.
- Ionisation of gases in the discharge tube proved that atoms have subatomic particles.
- **Summary of characteristics of electrons, protons and neutrons :**

Particle	Electron	Proton	Neutron
Symbol	e	p	n
Relative charge	– 1	+ 1	0
Nature	Negatively charged	Positively charged	Neutral
Discovered by	J. J. Thomson	E. Goldstein	James Chadwick
Mass	1/2000 times mass of hydrogen atom	1 unit	Mass is nearly equal to that of proton

- **Thomson's model of atom :**
  (i) An atom is a uniform sphere of positive charges (due to the presence of protons) as well as negative charges (due to the presence of electrons) which are embedded in it. This model is often called the 'Water Melon Model'.
  (ii) An atom, as a whole, is electrically neutral because the negative and positive charges are equal in magnitude.
- **Limitations of Thomson's model of atom :**
  The model failed to explain how protons and electrons could be arranged in an atom so close to each other.
- α-particles are charged particles having two units of positive charge and four units of mass, *i.e.,* they are doubly-charged helium ions (He^{2+}).
- **Observations predicted from α-particle scattering experiment by Rutherford based on Thomson's model of atom :**
  (i) Rutherford expected that if the model proposed earlier by **J. J. Thomson**, according to which there is uniform distribution of positive and negative charge, was correct then α-particles striking the gold atoms would be uniformly deflected which was not the case.
  (ii) Since the α-particles were much heavier than the protons, he did not expect to see large deflections.
- **Selection of gold metal for Rutherford's α-particle scattering experiment :**
  Gold is easily malleable and can be beaten into very thin sheets.
- **Observations made by Rutherford from α-particle scattering experiment :**
  (i) Most of the α-particles passed straight through gold foil without suffering any deflection from their original path.
  (ii) Some of the α-particles were deflected by the foil at small angles.
  (iii) One out of every 12000 particles appeared to rebound.
- **Conclusions from Rutherford's α-particle scattering experiment :**
  (i) Most of the space inside the atoms is empty. Hence it allows the α-particles to pass straight through it without any deflection.
  (ii) Very few particles were deflected from their path, which suggests that the positive charge of the atom occupies very little space.
  (iii) The total volume occupied by a nucleus is very small compared to the total volume of the atom, as very few α-particles are reflected by 180^{o}, and all the positive charge and mass of the gold atom were concentrated in a very small volume within the atom.
- **Rutherford's nuclear model of an atom :**
  (i) There is a positively charged centre in an atom called the nucleus and the entire mass of atom resides in the nucleus.
  (ii) Electrons revolve around the nucleus in well-defined circular orbits.
  (iii) Size of the nucleus is very small as compared to the size of an atom.
- **Defects in Rutherford's model of atom :**
  (i) Rutherford had proposed that electrons move around a positively charged nucleus at a very high speed in circular orbits. Electron would have to be accelerated centripetally (tending to move toward a center) to remain in a circular orbit, but according to electromagnetic theory, if charged body (electron) is accelerated around another charged body (nucleus) then there would be continuous radiation of the moving body (*i.e.* electron). This loss of energy would slow down the speed of electron and eventually electron would fall into nucleus. But Rutherford's model could not explain such a collapse.
  (ii) Rutherford had proposed that electrons revolve around the nucleus in fixed orbits. He did not specify the number of electrons in each orbit.

- **Postulates put forward by Bohr regarding model of atom :**
  - **(i)** Electrons revolve around the nucleus in a limited number of orbits called discrete orbits of electrons that are also called as permissible orbits.
  - **(ii)** While revolving in discrete orbits, the electrons does not radiate energy *i.e.*, energy of an electron remains constant so long as it stays in a given orbit. Electrons present in different orbits have different energies.
  - **(iii)** When an electron jumps from lower energy level to higher energy level, some energy is absorbed, while energy is released when electron jumps from higher energy level to lower one.

  Orbits or shells are represented by the letters K, L, M, N... or the numbers, $n = 1, 2, 3, 4....$
- **Bohr-Bury scheme for distribution of electrons in different orbits :**
  - **(i)** Maximum number of electrons that can be accommodated in a shell is given by $2n^2$, where n is the shell number *i.e.*, first shell can accommodate two electrons, second shell can accommodate eight electrons, third shell can accommodate 18 electrons and so on.
  - **(ii)** Outermost orbit of an atom can accommodate a maximum number of eight electrons.
  - **(iii)** Electrons are not accommodated in a given shell, unless the inner shells are filled *i.e.* the shells are filled in a step-wise manner.
- Outermost shell of an atom is called valence shell.
- Neutrons are situated in the nucleus of all the atoms, except hydrogen.
- If the outermost shell of an atom is completely filled, its valency is 0.
- **Valency of elements having 1 to 4 electrons in the outermost shell are generally determined by the rule :** Valency = Number of electrons in the outermost shell.
- **Valency of elements having number of electrons in outermost shell close to 8 is determined by the formula :** Valency = 8 – Number of electrons in the outermost shell.
- **Significance of valence electrons :**
  - **(i)** Valence electrons are responsible for chemical changes.
  - **(ii)** Elements having same number of valence electrons in their atoms possess similar chemical properties because chemical properties of an element are determined by the number of valence electrons in an atom.
  - **(iii)** Elements having different number of valence electrons in their atoms possess different chemical properties.
- Protons and neutrons together are called nucleons.
- All atoms of an element have the same atomic number.
- Atomic number is denoted by 'Z' ($Z = n_p$)
- For a neutral atom, no. of protons and electrons are equal.
- Mass number is denoted by 'A' ($A = n_p + n_N$)

  n_p = No. of protons

  n_N = No. of neutrons
- **Isotopes :**
  - **(i)** Isotopes are the atoms of same element having same atomic number but different mass number.
  - **(ii)** Isotopes have similar chemical properties because they have same number of valence electrons.
  - **(iii)** Isotopes have different physical properties such as boiling point and melting point because they have different mass numbers.
  - **(iv)** Atomic masses of elements are fractional, due to the fact that all elements have isotopes.
  - **(v) Applications of isotopes :**
    1. An isotope of uranium is used in nuclear reaction.
    2. An isotope of cobalt is used to remove brain tumors and their treatment.
    3. Isotope of sodium has been used to diagnose restricted circulation of blood.
  - **(vi)** Example : 3 isotopes of hydrogen–protium, deuterium and tritium.
- **Isobars :** Isobars are the atoms of different elements with different atomic numbers, but same mass number. Example : $_{20}Ca^{40}$, $_{18}Ar^{40}$.

Know the Terms

- **Canal rays :** Positively charged radiations discovered by Goldstein in a gas discharge tube at low pressure and high voltage.
- **Electron :** Negatively charged particle.
- **Proton :** Positively charged particle.
- **Neutron :** Neutral particle.
- **Energy level :** Possible locations around an atom where electrons having specific energy values may be found.
- **Octet :** Shell which has eight electrons in the outermost shell.
- **Valency :** Combining capacity of an atom.
- **Valence shell :** Outermost shell of an atom.
- **Valence electrons :** Electrons present in the valence shell.
- **Atomic number :** Total number of protons present in the nucleus of an atom.
- **Nucleons :** A nucleon is one of the particles that make up the atomic nucleus.
- **Mass number :** Sum of the total number of protons and neutrons present in the nucleus of an atom.

❑❑

UNIT -II : Organization in the Living World

CHAPTER - 5 : CELL—A BASIC UNIT OF LIFE

TOPIC-1
Cell as a Basic Unit of Life, Prokaryotic and Eukaryotic Cell, Multicellular Organisms

Quick Review

- In 1665, Robert Hook first discovered and introduced the term cell.
- Cell is the structural and functional unit of all living organisms.
- Organisms may be unicellular or multicellular. A single cell constitutes the unicellular organism whereas many cells coordinately function in case of multicellular organism.
- The size, shape and volume of the cell are related to the specific function that they perform.
- A cell generally shows plasma membrane, nucleus and cytoplasm.
- In 1674, Leeuwenhoek observed the cells in a cork slice with the help of primitive microscope.
- In 1831, Robert Brown discovered the nucleus in the cell.
- Cell theory given by Schleiden and Schwann stated that all the plants and animals are composed of cells and cell is the basic unit of life.
- Virchow (1855) expanded the cell theory by suggesting that all cells arise from pre-existing cells.

Know the Terms

- **Cell :** An autonomous self-replicating structure that forms the structural, functional and biological unit of all living organisms.
- **Prokaryotic cell :** A cell characterized by the absence of a distinct, membrane-bound nucleus or membrane-bound organelles, and by DNA that is not organized into chromosomes.
- **Nucleoid :** An undefined nuclear region of the prokaryotic cell, containing the genetic material (nucleic acids).
- **Eukaryotic cell :** A cell containing a membrane-bounded nucleus and membrane-bounded organelles.
- **Unicellular organism :** Organism having only one cell.
- **Multicellular organism :** Organism consisting of more than one cell, where in the differentiated cells perform specialized functions in the organism.
- **Plasmolysis :** When a plant cell loses water through osmosis, there is shrinkage or contraction of contents of the cell away from cell wall. This phenomenon is known as plasmolysis.

TOPIC-2
Cell Wall, Cell Membrane, Cell Organelles—Structure and Functions, Chromosomes—Basic Structure and Number

Quick Review

- Plasma membrane is a thin, selectively permeable membrane, covering the cell and is made up of lipids and proteins.
- **Functions of plasma membrane :**
  (i) It separates the contents of a cell from its outside environment.
  (ii) It regulates the flow of substances to and from the cell through diffusion, facilitated diffusion, active transport and endocytosis.
- Osmosis is diffusion of water through a selectively permeable membrane.

- **A cell placed in different solutions :**
  - **(i)** Hypotonic solution : A cell placed in it will gain water.
  - **(ii)** Hypertonic solution : A cell placed in it will lose water, also known as plasmolysis.
  - **(iii)** Isotonic solution : A cell placed in it will neither gain nor lose water.
- Cells of plants, fungi & bacteria : Contain both plasma membrane and cell wall. Cell wall is rigid, non-living and outer most covering, composed mainly of cellulose.
- When placed in hypertonic solution, a living plant cell shows plasmolysis.
- Cell wall provides mechanical strength to the cell. It permits the cell to withstand huge changes in the surrounding medium.
- Nucleus is an important, spherical, usually centrally located constituent of the cell and is bounded by double layered nuclear envelope.
- The nucleus of a dividing cell shows rod-shaped chromosomes, made up of DNA and proteins. In a non-dividing cell, the chromosomes elongate and take the form of thread-like chromatin.
- DNA molecules are responsible for transmitting hereditary information from one generation to the next.
- Nucleus controls all metabolic activities of the cell.
- Depending on the presence or absence of nucleus, cells may be prokaryotic or eukaryotic.
  - **(i)** Prokaryotic cells lack a well-defined nucleus and instead show nucleoid, an undefined nuclear region containing the genetic material.
  - **(ii)** Eukaryotic cells possess a proper nucleus with nuclear membrane.
- Cytoplasm is the fluid content of the cell, occurring between nucleus and plasma membrane. It stores several vital chemicals and is the site of certain important metabolic pathways.
- Several specialized cell organelles are present in the cytoplasm. These organelles perform different kinds of metabolic activities and are kept separate from each other.
- The various cell organelles include endoplasmic reticulum, golgi apparatus, lysosomes, mitochondria, plastids, vacuoles and centrosome.
- Endoplasmic reticulum (ER) is an extensive, interconnected, membrane bound network of tubes and sheets.
- Ribosomes are attached to the surface of Rough Endoplasmic Reticulum (RER) and are absent in Smooth Endoplasmic Reticulum (SER).
- **Functions of Endoplasmic Reticulum (ER) :**
  - **(i)** It synthesizes important proteins (RER) and lipids (SER).
  - **(ii)** It provides a pathway for intracellular transport of materials.
  - **(iii)** SER of liver cells is important for detoxification.
- Golgi apparatus is a network of stacked, flattened, membrane bound sacs and vesicles.
- Golgi apparatus carries out the storage, modification and packaging of substances manufactured in the cell and is also involved in lysosome formation.
- The spherical, sac-like lysosomes contain powerful digestive enzymes and form the waste disposal system of the cell. They are also known as 'suicide bags'.
- Mitochondria and plastids are covered by two membranes and possess their own DNA and ribosomes.
- Mitochondria are the 'power houses of the cell', providing energy for various metabolic activities.
- Chromoplasts and leucoplasts are the two types of plastids present in plant cells.
- Chloroplasts are chromoplasts containing chlorophyll and carry out photosynthesis in plants.
- Leucoplasts store starch, oil and protein granules.
- The large central vacuole of mature plant cells provides turgidity to the cell and also stores important substances.
- In unicellular organisms, vacuoles play important roles in nutrition and osmo-regulation.
- Ribosomes are sites of protein synthesis.
- Centrosome is found only in animal cells and consists of 2 centrioles. Centrosome helps in cell division.
- The membrane-bound cell organelles are absent in prokaryotic cells.
- The basic structural organization of the cell helps it to perform important functions like respiration, nutrition, excretion and protein synthesis.

Know the Terms

- **Diffusion :** The spontaneous movement of a substance from a region of its higher concentration to a region of its lower concentration.
- **Osmosis :** The movement of water through a semi-permeable membrane from a region of high water concentration to a region of low water concentration.
- **Hypertonic solution :** A solution that has a higher solute concentration than the one to which it is compared.
- **Hypotonic solution :** A solution that has a lower solute concentration than the one to which it is compared.
- **Isotonic solution :** A solution that has the same tonicity as another solution with which it is compared.
- **Plasmolysis :** Shrinkage or contraction of the protoplasm away from the wall of a living plant or bacterial cell, caused by loss of water through osmosis.
- **Cell organelle :** A specialized subunit within a cell that has a specific function, and is usually enclosed within its own membrane.

- **Genes :** A hereditary unit consisting of a sequence of DNA that occupies a specific location on a chromosome and determines a particular characteristic in an organism.
- **Membrane biogenesis :** The process of synthesizing the biological membranes.
- **Plasma membrane :** The thin, selectively permeable membrane composed of lipids and proteins which surrounds an entire cell and regulates the flow of substances to and from the cell.
- **Cell wall :** The rigid, non-living, outer covering of certain cells (like plant and bacteria), composed mainly of cellulose. It provides the cell with structural support and protection.
- **Cytoplasm :** The jelly like material of a cell that is enclosed within the plasma membrane, except the nucleus and contains the cell organelles.

❑❑

CHAPTER - 6 : TISSUES

TOPIC-1
Plant Tissues : Structure and Functions

Quick Review

- Tissues ensure division of labour in multi-cellular organisms.
- The tissues present in plants and animals are different owing to variations in their body organization and mode of living.
- Plants show two main types of tissues – meristematic tissues and permanent tissues.
- Meristematic tissues may be apical, lateral or intercalary, depending on their location in the plant.
- Permanent tissues are classified into simple and complex tissues. Simple tissue shows only one type of cells whereas complex tissues consist of more than one type of cells, functioning as a unit.
- Three types of simple permanent tissues are parenchyma, collenchyma and sclerenchyma.
- Parenchyma is a supporting and storing tissue, composed of unspecialized, thin-walled cells with large intercellular spaces.
- Collenchyma cells are elongated, with irregularly thickened cell walls. It provides mechanical support and elasticity to the plant.
- The main supporting tissue, sclerenchyma, consists of long and narrow cells with thick and lignified cell walls.
- Parenchyma and collenchyma are living tissues whereas sclerenchyma is a dead tissue.
- Epidermis is the outer protective covering of the plant and is usually layered by cuticle.
- Stomatal pores, present in the epidermis, are essential for transpiration and gaseous exchange.
- In older plants, many layered cork is seen, made up of dead and compactly arranged cells.
- Xylem and phloem are important types of complex tissues in plants.
- Xylem is composed of tracheids, vessels, xylem parenchyma and xylem fibres. It conducts water and minerals from roots to aerial parts of the plant.
- Phloem consists of sieve tubes, companion cells, phloem fibres and phloem parenchyma. It transports food from leaves and storage organs to all other parts of the plant.

Know the Terms

- **Tissues :** A group of specialized cells with similar structure, working together to perform a common function.
- **Meristematic tissue :** Tissue made up of actively dividing cells, present in the growing areas of the plant body.
- **Apical meristem :** Meristem present at the growing tips of stem and root that cause the stem and root to increase in length.
- **Lateral meristem :** Meristem located on the lateral portion of the plant and responsible for increasing the girth of its stem and root.
- **Intercalary meristem :** Meristem found between already differentiated tissues, in locations such as the base of leaves or internode.
- **Permanent tissue :** A well-differentiated plant tissue derived from meristematic tissue, which has lost its ability to divide.
- **Differentiation :** The process by which a cell attains a permanent shape, size and function.
- **Simple permanent tissue :** A permanent tissue composed of only one cell type.

- **Complex permanent tissue :** A permanent tissue composed of more than one type of cells which coordinates to perform a common function.
- **Chlorenchyma :** Parenchyma whose cells contain chloroplasts and hence performs photosynthesis.
- **Aerenchyma :** Parenchyma containing large air cavities, providing buoyancy to aquatic plants and allowing the circulation of gases.
- **Xylem :** The complex tissue that conducts water and minerals in vascular plants and composed of tracheids, vessels, fibres, and parenchyma.
- **Phloem :** The food-conducting tissue of vascular plants, consisting of sieve tubes, companion cells, fibres and parenchyma.
- **Epidermis :** The outermost, protective layer of cells covering the surface of a plant.

TOPIC-2

Animal Tissues : Structure and Functions

Quick Review

- Animal tissues are grouped into 4 basic types – epithelial, connective, muscular and nervous tissue.
- Epithelial tissues are the covering or protective tissues which act as a barrier between the various systems of the body. It rests on a basement membrane and is composed of tightly packed cells.
- Connective tissue is the binding and supporting tissue of the animal body. Matrix forms the main bulk of this tissue, whereas the cells are loosely spaced and less in number.
- Blood, bone, ligament, tendon, cartilage, areolar tissue and adipose tissue are important connective tissues present in our body.
- Blood is a fluid connective tissue in which RBCs, WBCs and platelets are suspended and plays a significant role in the process of transportation.
- Functions of protection, providing skeletal framework and anchoring are carried out by the strong and hard bone tissue.
- Ligaments connect bones to bones whereas tendons connect bones to muscles.
- Cartilage provides support and flexibility to the body parts.
- Areolar tissue repairs the injured tissues and fills spaces within organs. These are found between the skin and muscles, around blood vessels and nerves and in bone marrow.
- Adipose tissue serves as a fat reservoir and also carries out the function of insulator. It is found below the skin and between internal organs.
- All movements in our body are brought about by the muscular tissue through the contraction and relaxation of their contractile proteins.
- Striated, unstriated and cardiac are three types of muscle tissues.
- Nervous tissue is present in the brain, spinal cord and nerves.
- Neuron is made up of cell body, dendrites and axon.
- Neurons are specialized to receive and conduct impulses rapidly.

Know the Terms

- **Stratified epithelium :** An epithelium composed of multiple layers of cells, with only the basal layer being in contact with the basement membrane.
- **Ligament :** A fibrous connective tissue that connects (or binds) bones to bones.
- **Tendon :** A fibrous connective tissue that connects bones to muscles.
- **Voluntary muscles :** Muscles which can be controlled according to our will.
- **Involuntary muscles :** Muscles which are not under the control of our will.
- **Multinucleate cell :** Cell containing more than one nucleus.
- **Uninucleate cell :** Cell containing only one nucleus.
- **Neuron :** A cell of the nervous system specialized to conduct nerve impulses and made up of cell body, axon and dendrites.
- **Impulse :** An electrical signal transmitted along a nerve fibre in response to a stimulus.

❑❑

CHAPTER - 7 : BIOLOGICAL DIVERSITY

TOPIC-1
Diversity of Plants and Animals, Basic Issues in Scientific Naming, Basis of Classification, Hierarchy of Categories/Groups

Quick Review

- Every living organism is unique and this uniqueness is the basis of the vast diversity displayed by the organisms in our world.
- This huge diversity is the result of evolution, which has occurred over millions of years.
- The massive biological diversity can only be studied by classification *i.e.,* arranging organisms into groups based on their similarities and differences.
- Different characteristics are used to determine the hierarchy of classification.
- The primary characteristics that determine the broadest divisions in classification are independent of any other characteristics. The secondary characteristics depend on and are related to the primary ones.
- Prokaryotic or eukaryotic cell organization is the primary characteristic of classification, as this feature influences every detail of cell design and capacity to undertake specialized functions.
- Being a unicellular or multicellular organism, forms the next basic feature of classification and causes huge differences in the body design of organisms.
- The next level of classification depends on whether the organism is autotrophic or heterotrophic. Further classification depends on the various levels of organization of the bodies of these organisms.
- Classification of plants differs from those of animals as the basic designs are different, based on the need to make their own food (plants) or acquire it (animals).
- The evolution of organisms greatly determines their classification.
- The organisms that evolved much earlier have simple and ancient body designs whereas the recently evolved younger organisms have complex body designs.
- Older organisms are also referred to as 'primitive' or 'lower' organisms whereas the younger organisms are referred to as advanced or higher organisms.
- The region of mega diversity is found in the warm and humid tropical regions of the Earth.
- Aristotle classified organisms depending on their habitat.
- Charles Darwin first described the idea of evolution in his book 'The Origin of Species'.
- Robert Whittaker proposed the five-kingdom scheme of classification, based on the cell structure, nutrition and body organization of the organisms.
- **The main characteristics considered in the five-kingdom scheme of classification are :**
  (i) presence of prokaryotic or eukaryotic cells.
  (ii) if eukaryote, whether the organism is unicellular or multicellular.
  (iii) whether the cells possess or lack cell wall and whether they can prepare their own food.
- The categories used in the classification of organisms are Kingdom, Phylum (for animals)/Division (for plants), Class, Order, Family, Genus and Species. The smallest unit of classification is Species whereas the highest unit is Kingdom.
- The five kingdoms proposed by Whittaker are Monera, Protista, Fungi, Plantae and Animalia. Carl Woese, further divided Monera into Archaebacteria and Eubacteria.
- Prokaryotic, unicellular organisms such as bacteria, cyanobacteria (blue-green algae) and mycoplasma are included in Monera.
- Monerans show either autotrophic or heterotrophic nutrition. Cell wall may be present or absent. They do not have defined nucleus or organelles.
- Unicellular eukaryotic organisms such as protozoans, unicellular algae and diatoms are grouped under Protista. They may be autotrophic or heterotrophic and may use hair like appendages for locomotion.
- Fungi, such as yeast and mushrooms, include heterotrophic, eukaryotic organisms, which are normally saprophytes. Their cell walls are composed of chitin.
- Lichens have symbiotic associations with blue-green algae.
- Multicellular, autotrophic eukaryotes possessing cell wall are included under kingdom Plantae. They use chlorophyll for photosynthesis.
- Animalia includes multicellular heterotrophic eukaryotes without cell walls.

Know the Terms

- **Classification :** The assignment of organisms to groups within a system of categories separated on the basis of structure, origin etc.
- **Eukaryotic cell :** A cell which has membrane bound organelles, including a nucleus.
- **Prokaryotic cell :** A cell which have no organized nucleus as well as any organelles.
- **Biodiversity :** Variety of life forms found in a particular region.
- **Evolution :** A process of development of life forms by an accumulation of changes in body design that leads to help the organism possessing them to survive better.
- **Hierarchy :** A series of ordered groupings and arrangement within a system such as arrangement of plants and animals into classes, orders, families, etc.
- **Autotrophic :** Any organism capable of manufacturing or synthesizing their own food from inorganic sources such as carbon dioxide, water and nitrates.
- **Heterotroph :** Any organism that cannot manufacture its own food and obtain its food and energy by taking in organic substances like plants or animal matter.
- **Saprophyte :** Any organism that lives on dead organic matter, as certain fungi and bacteria.
- **Symbiotic :** A close, prolonged association between two or more different organisms of different species that may, but does not necessarily benefit each other.
- **Lichen :** A composite organism that arises from algae or cyanobacteria (or both) living in a mutually beneficial relationship.
- **Habitat :** The natural abode of an animal or plant.
- **Species :** It refers to a group of closely related organisms that are very similar to each other and are usually capable of interbreeding and producing fertile offspring.
- **Binomial nomenclature :** The scientific system of naming each species of organism with two names, first a genus name followed by a species name.

TOPIC-2
Major Groups of Plants

Quick Review

- **Classification of plants is done at three levels on the basis of :**
  (i) presence or absence of well-differentiated distinct body.
  (ii) presence or absence of special tissues for the transportation of water and other substances.
  (iii) ability to bear seeds, that could be naked or enclosed in fruits.
- The important divisions of Plantae are Thallophyta, Bryophyta, Pteridophyta, Gymnosperms and Angiosperms.
- Thallophytes, Bryophytes and Pteridophytes possess inconspicuous reproductive organs and are called Cryptogams. Gymnosperms and Angiosperms are grouped under Phanerogamae, since they possess well-differentiated, seed-producing reproductive tissues.
- Thallophytes (or algae) are the simplest plants lacking well-differentiated body design. *e.g.*, *Spirogyra*.
- Bryophytes such as Moss and *Riccia* show differentiated plant body lacking vascular tissue.
- Plants grouped under Pteridophytes show well-differentiated plant body with vascular tissues for conduction *e.g.,* Ferns.
- Gymnosperms, *e.g.*, pines and deodar, are phanerogams bearing naked seeds.
- In Angiosperms/flowering plants, the seeds are enclosed in fruits.
- Cotyledons are present in the embryos of the seeds and are called as 'seed leaves' because in many instances they emerge and become green on germination.
- Monocot plants possess seeds with single cotyledons whereas dicots are plants with two cotyledons in each seed.
- Monocots show fibrous root system, parallel venation of leaves and flowers with three (or multiple of three) petals.
- Tap root system, reticulate venation of leaves and flowers with five (or multiple of five) petals are the features of dicots.

Know the Terms

- **Cotyledon :** Embryonic leaf in seed-bearing plants.
- **Monocots :** Plants with seeds having a single cotyledon.
- **Dicots :** Plants with seeds having two cotyledons.
- **Algae :** Plants that do not have well differentiated body designs and belongs to group Thallophyta.
- **Spores :** Naked *embryos* present in thallophytes, bryophytes and pteridophytes.
- **Cryptogams :** Plants that reproduces by spores, without flowers or seeds.
- **Phanerogams :** Plants with well differentiated reproductive tissues that finally make seeds.
- **Embryo :** Part of seeds which develops into a plant, consisting of a plumule, a radicle and one or two cotyledons.

TOPIC-3
Major Groups of Animals

Quick Review

- Organisms grouped under Animalia are eukaryotic, multicellular, heterotrophic and lack cell wall.
- Kingdom Animalia is further divided into ten groups – Porifera, Coelenterata, Platyhelminthes, Nematoda, Annelida, Arthropoda, Mollusca, Echinodermata, Protochordata and Vertebrata.
- In Porifera, also called sponges, the body is perforated by numerous pores and it shows cellular level of organization. In addition, a hard exoskeleton and a canal system is present. Sponges are non-motile, *e.g.*, Sycon.
- Coelenterates are radially symmetrical and show a cavity called coelenteron between epidermis and gastrodermis. Some coelenterates such as *Hydra* are solitary forms whereas others such as corals live in colonies.
- Platyhelminthes includes the flat worms which are bilaterally symmetrical, dorsoventrally flattened, triploblastic and acoelomate. They may be free-living (*e.g.*, *Planaria*) or parasitic (*e.g.*, Tapeworm).
- The body of nematode worms is cylindrical, bilaterally symmetrical, triploblastic and pseudocoelomate. They are usually parasitic, *e.g.*, *Ascaris*.
- Annelids are triploblastic, bilaterally symmetrical with true coelom and found in diverse habitats. Segmentation and extensive organ differentiation is seen, *e.g.*, Earthworm and *Nereis*.
- The largest phylum of animal kingdom Arthropoda, contains triploblastic, bilaterally symmetrical and segmented animals. These animals possess jointed legs and open circulatory system, *e.g.*, Butterfly, centipede, crab, spider.
- In phylum Mollusca (*e.g.*, snail and octopus), organisms show bilateral symmetry, soft body, open circulatory system and reduced coelom.
- Echinodermata includes spiny skinned organisms with calcareous skeleton. They are triploblastic, coelomate, marine and free-living. Water vascular system is an important feature. Starfish and *Holothuria* are examples of this phylum.
- All chordates have a notochord, dorsal nerve cord and paired pharyngeal gill slits/pouches. Also they are triploblastic, coelomic and bilaterally symmetrical.
- Vertebrates and protochordates are grouped under Chordata.
- The protochordates possess notochord at some or the other stage of their life, *e.g.*, *Balanoglossus*, *Amphioxus*.
- Vertebrates show true vertebral column and endoskeleton. Complex body organization and differentiation is seen.
- The five classes of vertebrates are Pisces, Amphibia, Reptilia, Aves and Mammalia.
- The endoskeleton in fish may be cartilaginous or bony.
- Mammary glands produce milk in mammals to nourish the young ones.

Characters	Pisces	Amphibian	Reptilia	Aves	Mammalia
1. Habitat	Aquatic	Both land and water	Some Terrestrial, others aquatic	Terrestrial (aerial)	Usually terrestrial, few aquatic
2. Skin	Covered with scales/plates	Smooth skin with mucus glands and lacking scales	Water-proof skin with scales	Mostly covered with feathers	Covered with hair and contains sweat and oil glands.
3. Control of body	Cold-blooded	Cold-blooded	Cold-blooded	Warm-blooded	Warm-blooded
4. Number of heart chambers	2	3	3 (except crocodiles)	4	4
5. Respiration	Gills	Gills, lungs or skin	Lungs	Lungs	Lungs
6. Mode of reproduction	Oviparous	Oviparous	Oviparous	Oviparous	Viviparous
7. Locomotion	Tail and fins	Limbs	Limbs	Wings	Limbs
8. Examples	Rohu, shark, sea-horse, sting ray	Frog, Salamander, toad	Crocodile, snake, turtle, lizard	Pigeon, ostrich, hen, duck	Human, bat, lion

Know the Terms

- **Bilateral symmetry :** Symmetrical arrangement of an organism along a central axis, so that the body is divided into equivalent right and left halves by only one plane.
- **Radial symmetry :** A type of symmetry having only one body axis, through which the body can be divided into multiple planes to give mirror-image.

OR

A form of symmetry, in which dividing the animal's body in any direction along the central axis would always result in two identical halves.

- **Notochord :** A long flexible rod-shaped support structure that runs along the back of the animal separating the nervous tissue from the gut.
- **Nerve cord :** A dorsal tubular cord of nervous tissue above the notochord of a chordate and develops into the spinal cord and brain.
- **Diploblastic animals :** Animals having two primary germ layers *i.e.*, ectoderm and endoderm in the embryo.
- **Triploblastic animals :** Animals having three primary germ layers *i.e.*, ectoderm, mesoderm and endoderm in the embryo.
- **Ectoderm :** The outermost germ layer of multicellular animals that develops into skin and nervous tissue and develops into the spinal cord and brain.
- **Endoderm :** The innermost germ layer of multicellular animals that develops into the lining of the digestive and respiratory systems
- **Mesoderm :** The middle germ layer that develops into muscle, bone, cartilage, blood and connective tissue.
- **Acoelomates :** Animals lacking a coelom between their gut and body wall. *e.g.*, Coral jelly fish.
- **Coelom :** A fluid filled cavity located between the interstitial canal and body wall, in which well-developed organs can be accommodated.
- **Pseudocoelom :** An internal body cavity of some primitive invertebrates, similar to a coelom, but lacking a mesodermal lining.
- **Coelenteron :** The central gastrovascular cavity of a coelenterate animal.
- **Cold-blooded organisms :** Organisms whose body temperature varies according to the external environmental temperature. *e.g.*, fish, reptiles.
- **Warm-blooded organisms :** Organisms whose internal body temperature is dependent upon its metabolic processes and is maintained at a constant level.
- **Oviparous animals :** Animals that lay eggs. *e.g.*, fish, amphibians.
- **Viviparous animals :** Animals giving birth to live young ones. *e.g.*, leopard.
- **Binomial nomenclature :** The scientific system of naming each species of organism with two names, a genus name and a species name.

❑❑

CHAPTER - 8 : HEALTH AND DISEASES

TOPIC-1
Health and its Failure : Disease and its Causes and Means of Spread

Quick Review

- The well being of our body is dependent on the proper functioning of its cells and tissues.
- All our body parts and activities are greatly interconnected. Hence, disfunction of any body part can affect the entire body.
- When we are healthy, we are able to perform our physical, mental and social functions well.
- Our physical and social environment plays an important role in maintaining good health.
- In addition to personal hygiene, public cleanliness should also be maintained to ensure that we remain healthy.
- Many other factors such as financial conditions, availability of nutritious food and social equality also influence the health of an individual.

- A person suffering from a disease is in a state of discomfort.
- Being in poor health is different from being diseased.
- Symptoms and signs of the disease appear as a result of disfunction of the affected body parts. These help to identify the disease that a person is suffering from.
- Depending on their duration, diseases may be classified as acute or chronic.
- Acute diseases last for a short time and do not cause major health effects. *e.g.*, common cold.
- On the other hand chronic diseases persist for a long time, and hence, cause prolonged ill health. *e.g.*, TB of lungs.
- Causes of diseases may be immediate (first-level cause) or contributory. *e.g.*, the immediate or direct cause of a person suffering from diarrhoea is the causative agent.
  The contributory causes could be :
  (i) lack of adequate nourishment or genetic difference (second-level cause).
  (ii) poverty or lack of public services (third-level cause).
- Diseases may be infectious or non-infectious. Infectious diseases are caused by microbes or other infectious agents (*e.g.*, Malaria) whereas non-infectious diseases have internal, non-infectious causes (*e.g.*, High blood pressure).
- The infectious agents may be viruses, bacteria, fungi, protozoans or multicellular organisms such as worms.

Category of infectious agent	Examples of diseases caused
Virus	Common cold, influenza, dengue fever, AIDS
Bacteria	Typhoid, cholera, tuberculosis, anthrax
Fungi	Skin infections
Protozoans	Malaria, kala-azar
Worms	Intestinal worm infections, elephantiasis

- Many infectious diseases are called 'communicable diseases' since they can spread from one person to another.
- Communicable diseases can spread through air, water, food, sexual contact or vectors.
- The droplets released during coughing or sneezing of an infected person can spread air-borne diseases such as common cold, pneumonia and tuberculosis.
- Air-borne diseases spread quickly in overcrowded and poorly-ventilated living conditions.
- Water-borne diseases such as cholera spread when drinking water gets contaminated with the infectious agents.
- Sexual contact causes the spread of diseases such as AIDS and syphilis from the infected person to a healthy one.
- AIDS virus can also spread through blood transfusions, use of infected needles or during pregnancy and breast-feeding by an infected mother.

Know the Terms

- **Health :** A state of being well enough to function well physically, mentally and socially.
- **Disease :** Lack of feeling of ease or distress due to impairment of health or a condition of abnormal functioning or structural disorder.
- **Symptoms :** A series of events occurring that often point to a disease or condition.
- **Acute disease :** Disease lasting for a short period of time.
- **Chronic disease :** Disease lasting for a long time, even as much as a lifetime.
- **Vectors :** The intermediate animals causing the spread of infecting agents from a sick person to another potential host.
- **Infectious diseases :** Disease where pathogenic microbes are the immediate causes.
- **Non-infectious diseases :** Diseases where internal causes result in the distressed disorder.
- **Communicable disease :** A disease capable of being transmitted from an infected person to a healthy person.
- **Sign :** Objective evidence of disease perceptible to the examining physician.
- **Immediate cause of disease :** The cause which immediately kindles a disease into action, when there is a predisposition towards it or the first cause or factors which are directly responsible for a particular disease.
- **Contributory cause of disease :** A cause or condition whose presence makes it more probable that a particular disorder will occur, but that cause is neither necessary nor sufficient for the occurrence of the disease.
- **Host :** An organism that is infected with or is fed upon by a parasitic or pathogenic organism.
- **Antibiotic :** Anti-microbial agent made from microorganisms and can kill and inhibit the growth of microorganisms, especially those which are infectious or disease causing.

TOPIC-2
Manifestation, Treatment and Prevention of Diseases

Quick Review

- The type of treatment of a disease depends on the category of the infectious agent.
- Organisms belonging to the same category will share several important life processes, which will be different from those of organisms belonging to other categories.
- Drugs working by interfering with life processes of one category of organisms will not be effective against members of another category. *e.g.*, antibiotics act against bacteria, but not against viruses, because viruses do not share bacterial pathways.
- Penicillin interferes with bacterial cell wall production and thus, kills the bacteria. Due to lack of cell walls, penicillin does not affect human cells.
- Vectors are intermediate animals causing the spread of disease-causing agents from an infected person to a healthy person. For example – Female Anopheles mosquitoes transmit many diseases like malaria when they feed on the blood of animals and humans.
- On entering the body, the infectious agents reach their specific target organs. In certain cases, the target organ is related to their point of entry. For example – Typhoid-causing bacteria enter through mouth and reside in gut lining.
- In other instances, the target organ of the microbe has no relation to their point of entry. For example, HIV enters through the sexual organs, but spreads to all the lymph nodes.
- The symptoms of a disease depend on the target organ infected by the microbe. *e.g.*, cough and breathing problems are seen when lungs are infected. Thus, we can get an idea of the target organ of the microbe, from the signs and symptoms of a disease.
- During infection, the activated immune system of the body sends specialized cells to destroy the microbes causing inflammation with associated local effects.
- The AIDS-causing virus destroys the functioning of the immune system, due to which the body becomes unable to fight even minor infections. Ultimately the patient succumbs to such infections.
- The severity of a disease is directly proportional to the number of infectious agents present in the body.
- An infectious disease can be treated in two ways : **(i)** Reduce the symptoms of the disease by providing treatment. **(ii)** Kill the infectious agent causing the disease.
- Medicines used in killing an infectious agent aim to disrupt some pathway of a vital life function peculiar to that group of organisms. These pathways are not present in other microbial groups or in humans.
- On entering human cells, viruses use our cellular machinery for carrying out all their life processes. There are very few virus-specific biochemical pathways that can be targeted to produce anti-viral drugs.
- The approach of treatment of an infectious disease has three drawbacks :
  (i) Recovery of the patient may not be complete in certain cases.
  (ii) Treatment requires time and hence, the patient suffers from the disease and may be bed ridden.
  (iii) The patient serves as the source of infection to others.
- It is desirable to prevent a disease than to treat it completely.
- There are general and specific ways of preventing diseases.
- Infectious diseases can be generally prevented by public health hygiene methods, which aim to reduce exposure to infectious microbes. Public hygiene measures include providing safe drinking water, clean environment and adequately spacious conditions for living.
- Another general method of preventing infectious diseases requires the availability of sufficient and balanced diet for the proper functioning of the immune system. The immune system ensures that we do not develop a disease each time we are exposed to an infectious agent, by destroying the agent before it multiplies greatly extensively.
- During small pox epidemics, it was noted that people who survived after suffering from small pox, did not get infected with it again. Such observations led to the birth of immunization, which is a specific method of preventing infectious diseases.
- The principle of immunization is based on the memory of the immune system on encountering an infectious agent. On subsequent encounters with the same or related microbe, the response of the immune system is multiplied extensively, leading to quick elimination of the infection.
- During immunization, a vaccine (containing weakened or killed pathogen or a specific part of the pathogen) is introduced into the body to fool the immune system in remembering a particular infection. Hence, the body does not suffer even on further exposures to that of pathogen or its close relatives.
- Nowadays, vaccines preventing many infectious diseases including tetanus, polio and measles are used extensively used especially in child health immunization programmes.
- Everyone in the community should have access to public hygiene and immunization for effective prevention of infectious diseases.

Know the Terms

- **Antibiotics :** A substance produced by bacteria or fungi that destroys or prevents the growth of infectious or disease causing-organisms.
- **Immunisation :** The process of inducing immunity by administering a vaccine to allow the immune system to prevent infection or illness when it subsequently encounters the infectious agent.
- **Vaccine :** A preparation of a weakened or killed pathogen or of a portion of the pathogen's structure that upon administration stimulates the immune system to fight against the pathogen, but is incapable of causing severe infection.
- **Pathogen :** Any disease-producing agent such as a virus or bacteria or other micro-organism.
- **Inflammation :** The recruitment process by an active immune system of recruiting many cells to the affected tissue to kill off the disease causing microbes.
- **Hygiene :** Condition and practices that help to maintain health and prevent the spread of diseases.
- **Epidemic :** Rapid spread of infectious disease to a large number of people in a given population within a short period of time.

❑❑

CHAPTER - 9 : MOTION

TOPIC-1
Motion, Force and Work

Quick Review

- If the position of an object does not change with time, it is said to be at rest.
- If the position of an object changes as time passes, it is said to be in motion.
- Reference point is a fixed point with respect to which a body is at rest or in motion.
- Rest and motion are relative terms.
- Distance is the length of the actual path travelled by a body in a given time.
- Displacement is the shortest distance between the initial and final positions of the body in a known direction.
- A physical quantity which has both magnitude and direction is known as vector quantity. *e.g.*, velocity, force.
- A physical quantity which has only magnitude is known as scalar quantity. *e.g.*, time, speed.
- The S.I unit of distance and displacement is metre.
- A body is said to be in uniform motion, if it travels equal distances in equal intervals of time.
- A body is said to have non-uniform motion if it travels unequal distances in equal intervals of time.
- Speed is the ratio of distance travelled to the time taken to cover that distance.
- In non-uniform motion, speed of an object is not constant. The S.I. unit of speed is m/s.
- Average speed of a body is the total distance travelled divided by the total time taken.
- Velocity is displacement per unit time. The S.I. unit of velocity is metre per second.
- Average velocity is displacement divided by the time taken.
- Speed is a scalar quantity and velocity is a vector quantity.
- Time is an independent variable, plotted along X-axis. Distance is a dependent variable, plotted along Y-axis in the distance time graph.
- Graphs are designed to make it easier for the reader to interpret and understand numerical data.
- The distance-time graph is a straight line parallel to time axis when the object is at rest.
- The nature of distance-time graph is a straight line when the object is in the state of uniform motion.
- Slope of the distance-time graph gives the speed of the object.
- A more steeply inclined distance-time graph indicates greater speed. The nature of distance-time graph is a curve having varying slope when the object has non-uniform motion.
- If the velocity of a body remains constant, the velocity-time graph is a horizontal line parallel to the time axis.
- If the velocity of the body changes uniformly at a constant rate, the velocity-time graph is a straight line.
- If the velocity of the object changes non-uniformly, the velocity-time graph is a curve having increasing slope.
- The area enclosed by the velocity-time graph and the time axis represents the displacement.
- The slope of the velocity-time graph gives the acceleration.
- When a body travels along a circular path of constant radius with a constant speed then its motion is uniform circular motion.
- In a uniform circular motion, velocity of a particle is not constant but its speed is constant, hence it is an accelerated motion.

Know the Terms

- **Distance :** The distance covered by a moving object is the actual length of the path followed by the object. Distance is a scalar quantity. SI unit of distance is Metre .
- **Displacement :** Displacement is the shortest distance covered by a moving object from the point of reference (initial position of the body), in a specified direction. SI unit of displacement is metre. Displacement is a vector quantity, *i.e.*, the displacement is given by a number with proper units and direction.
- **Uniform speed :** An object is said to be moving with uniform speed if it covers equal distances in equal intervals of time.
- **Non-uniform speed :** An object is said to be moving with variable speed or non-uniform speed if it covers equal distances in unequal intervals of time or vice-versa.
- **Average speed :** The speed of a moving body at any particular instance of time, is called instantaneous speed. When we travel in a vehicle the speed of the vehicle changes from time to time depending upon the conditions existing on the road. In such a situation, the speed is calculated by taking the ratio of the total distance travelled by the vehicle to the total time taken for the journey. This is called the average speed.
- **Instantaneous speed :** When we say that the car travels at an average speed of 60 km/h it does not mean that the car would be moving with the speed of 60 km/h throughout the journey. The actual speed of the car may be less than or greater than the average speed at a particular instance of time.
- **Velocity :** It is defined as the distance covered by a moving object in a particular direction in unit time or speed in a particular direction.

$$\text{Velocity} = \frac{\text{distance travelled in a specified direction}}{\text{time taken}}$$

$$v = \frac{s}{t} \qquad [\text{where } 's' \text{ is the distance covered and } 't' \text{ is the time taken}]$$

- **Acceleration** is defined as the rate of change of velocity of a moving body with time.

$$\text{Acceleration} = \text{Rate of change of velocity with time}$$

$$= \frac{\text{change in velocity}}{\text{time}}$$

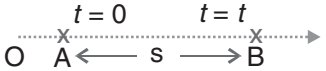
$$a = \frac{v-u}{t}$$

- **Uniform Acceleration :** If the change in velocity in equal intervals of time is always the same, then the object is said to be moving with uniform acceleration. Example : a body falling from a height towards the surface of the earth.
- **Non-uniform or Variable Acceleration :** If the change in velocity in equal intervals of time is not the same, then the object is said to be moving with variable acceleration.
- **Uniform velocity :** A body is said to be moving with uniform velocity if it covers equal distances in equal intervals of time in a specified direction.
- **Variable velocity :** A body is said to be moving with variable velocity if it covers unequal distances in equal intervals of time and vice-versa in a specified direction or if it changes the direction of motion.
- **Circular motion :** Motion along circular track is called circular motion. An object moving along a circular track with uniform speed is an example for a non-uniform motion because the direction of motion of the object goes on changing at every instant of time. Example : A car negotiating a curve with uniform speed. A circle can be considered as a polygon with infinite sides and hence motion along a circular path is classified as non-uniform motion.

TOPIC-2
Equations of Motion

Quick Review

- **First Equation of Motion :**
  Consider a particle moving along a straight line with uniform acceleration 'a'. At $t = 0$, let the particle be at A and u be its initial velocity and when $t = t$, v be its final velocity.



$$\text{Acceleration} = \frac{\text{change in velocity}}{\text{time}} = \frac{v-u}{t}$$

$$\Rightarrow \quad a = \frac{v-u}{t}$$

$$v - u = at$$

$$v = u + at \qquad \text{(I equation of motion)}$$

➢ **Second Equation of Motion :**

$$\text{Average velocity} = \frac{\text{total distance travelled}}{\text{total time taken}}$$

$$\text{Average velocity} = \frac{s}{t} \qquad ...(i)$$

Average velocity can also be written as $\frac{u+v}{2}$ ...(ii)

From equations (i) and (ii) $\frac{s}{t} = \frac{u+v}{2}$ ...(iii)

The first equation of motion is $v = u + at$. Substituting the value of v in equation (iii), we get

$$\frac{s}{t} = \frac{u+u+at}{2}$$

or $$s = \frac{(u+u+at)t}{2}$$

or $$s = ut + \frac{1}{2}at^2 \qquad \text{(II equation of motion)}$$

➢ **Third Equation of Motion :**

The first equation of motion is $v = u + at$

$$v - u = at \qquad ...(i)$$

$$\text{Average velocity} = \frac{s}{t} \qquad ...(ii)$$

$$\text{Average velocity} = \frac{u+v}{2} \qquad ...(iii)$$

From equation (ii) and equation (iii) we get,

$$\frac{u+v}{2} = \frac{s}{t} \qquad ...(iv)$$

Multiplying equation (i) and equation (iv) we get,

$$(v-u)(v+u) = at \times \frac{2s}{t}$$

$$(v-u)(v+u) = 2as \qquad [a^2 - b^2 = (a+b)(a-b)]$$

$$v^2 - u^2 = 2as \qquad \text{(III equation of motion)}$$

❑❑

CHAPTER - 10 : FORCE AND LAWS OF MOTION

TOPIC-1
Force, Motion and Acceleration

Quick Review

- Force is a push or pull acting upon an object.
- **Balanced forces :** The resultant of all the forces acting on a body is zero.
- **Unbalanced forces :** The resultant of all the forces acting on a body is not zero.
- **Newton's first law of motion** states that a body at rest will remain at rest and a body in motion will remain in uniform motion unless acted upon by an unbalanced force.

- The net force acting on the object is zero, whenever balanced forces act on it.
- The momentum of an object is the product of its mass and velocity and has the same direction as that of the velocity. Its SI unit is kg-m-s^{-1}.
- **Newton's second law of motion** states that the rate of change of momentum of a body is directly proportional to the force and takes place in the same direction as the force.
- Force is also defined as the product of mass and acceleration.
- The SI unit of force is kg-m-s^{-2}. This is also known as Newton and represented by the symbol N.
- A force of one Newton produces an acceleration of 1 m-s^{-2} on an object of mass 1 kg.
- Force of friction always opposes motion of objects.
- Two forces resulting from the interaction between two objects are called action and reaction forces respectively.
- Action and reaction forces act on two different bodies but they are equal in magnitude.
- **Newton's third law :** For every action there is an equal and opposite reaction; but action and reaction act on different bodies.

Know the Terms

- **Force :** A force is a physical quantity which causes or tends to cause a motion in an object at rest or changes or tends to change the direction of motion of a moving object or changes or tends to change the size and shape of an object or changes or tends to change the speed of an object.
- **Balanced Force :** When two forces of equal magnitude acts in opposite directions on an object simultaneously, then the object continues in its state of rest or a uniform motion in a straight line. Such forces acting on the object are known as balanced force.
- **Unbalanced Force :** When two forces of unequal magnitudes act in opposite directions on an object simultaneously, then the object moves in the direction of the larger force. These forces acting on the object are known as unbalanced force.
- **Momentum :** Momentum of a body is equal to the product of the mass (m) of the body and the velocity $\vec{v}$ of the body. It is denoted by $\vec{p}$.
  Momentum = mass × velocity.
- **Recoil Velocity :** The velocity with which the gun moves backward after firing a bullet is known as recoil velocity.
- **Friction :** Whenever a body slides or rolls over the surface of another body, a force comes into action which acts in the opposite direction of the motion of a body. This opposing force is called 'friction'.
- **Resultant Forces :** The resultant force or resultant of several forces acting simultaneously on a body is that single force which produces the same effect on a body as all these forces together produce.

TOPIC-2
Inertia and Conservation of Momentum

Quick Review

- The property by the virtue of which an object tends to remain in the state of rest or of uniform motion unless acted upon by some force is called inertia.
- The mass of a body is a measure of inertia.
- Inertia is the inability of a body to change its state of rest or of uniform motion in a straight line by itself.
- The inherent property of a body by virtue of which it cannot change its state of rest is called inertia of rest.
- Law of conservation of momentum : The sum of momentum of the two objects before collision is equal to the sum of momentum after the collision provided there is no external unbalanced force acting on them.
- **Effects of force are :**
  (i) It can produce motion in stationary bodies.
  (ii) It can stop moving bodies.
  (iii) It can change the speed and direction of motion of bodies.
  (iv) It can also bring about change in dimensions of a body.
- By law of conservation of momentum,
  $m_1u_1 + m_2u_2 = m_1v_1 + m_2v_2$

Know the Terms

- **Inertia :** The tendency of a body to oppose or resist any change in its state of rest or uniform motion is called inertia of the body.
- **Inertia of Motion :** The tendency of a body to oppose any change in its state of uniform motion is known as inertia of motion.
  e.g. : The passengers fall forward when a fast moving bus stops suddenly.

- **Inertia of Direction :** The tendency of a body to oppose any change in its direction of motion is known as inertia of direction

  e.g. : When a fast moving bus negotiates a curve on the road, passengers fall towards the centre of the curved road.
- **Recoil velocity :** The velocity with which gun moves in the backward when fired.

❑❑

CHAPTER - 11 : GRAVITATION

Quick Review

- According to the law of gravitation, the force of attraction between any two objects is proportional to the product of their masses and inversely proportional to the square of the distance between them. The law applies to objects anywhere in the universe. Such a law is said to be universal.
- Universal gravitational constant $G = 6.67 \times 10^{-11}\ Nm^2\,kg^{-2}$.
- Gravitation is a weak force unless large masses are involved.
- Acceleration with which a body falls towards the centre of the earth is called acceleration due to gravity (g).
- The force of gravity decreases with altitude. It also varies on the surface of the earth, decreasing from poles to the equator.
- Mass is the quantity of matter contained in the body.
- Weight of the body is the force with which the earth attracts the body.
- The weight is equal to the product of mass and acceleration due to gravity.
- Mass of a body does not change but weight of a body is different at different places.
- The upward force exerted by a liquid when a body is immersed in the liquid is called up thrust or buoyant force.
- All objects experience a force of buoyancy when they are immersed in a fluid.
- Objects having density less than that of the liquid in which they are immersed, float on the surface of liquid. If the density is more, it sinks in the liquid.
- Inverse square rule states that F is inversely proportional to the square of d.
- Weight of an object on the moon is one-sixth time of its weight on the earth.
- Archimedes principle can be stated as when a body is immersed fully or partially in a fluid, it experiences an upward force that is equal to the weight of the fluid displaced by it.
- Applications of Archimedes' principle - use in designing ships and submarines, lactometers, hydrometers.
- The relative density is a ratio of similar quantities, thus has no unit.

Know the Terms

- **Density :** Mass of a unit volume. Its unit is $kg\ m^{-3}$.
- **Relative density** of a substance is the ratio of its density to that of water.
- **Thrust :** Upward force acting on a body perpendicular to its surface.
- **Gravitation :** It is the force of attraction between any two bodies in the universe.
- **Gravity :** It is the force of attraction between the earth and any object lying on or near its surface.
- **Pressure :** Force acting per unit area of the object.
- **Newton's universal law of gravitation :** This law states that everybody in this universe attracts every other body with a force which is directly proportional to the product of their masses and inversely proportional to the square of the distance between them.

Mathematically,

$$F = G\frac{m_1 m_2}{r^2}.$$

where, G is universal gravitational constant.

- **Universal gravitational constant :** It is equal to the force of attraction between two bodies of unit mass each placed at a unit distance apart. It is denoted by G and its value is 6.67×10^{-11} Nm^2/kg^2.
- **Centripetal acceleration of the moon :** If the moon is revolving with speed v in a circular orbit of radius r, then acceleration acting on it along the radius and towards the centre of its orbit is

$$a_c = \frac{v^2}{r}.$$

- **Free fall :** The motion of a body under the influence of force of gravity alone is called a 'free fall'.
- **Acceleration due to gravity :** The acceleration produced in the bodies due to earth's force of gravity is called acceleration due to gravity. Its value on earth's surface is 9.8 m/s^2.
- **Centre of mass :** The centre of mass of a body may be defined as the point at which whole mass of the body may be assumed to be concentrated.
- **Centre of gravity :** The centre of gravity of a body is a point at which the resultant of all the parallel forces due to gravity experienced by various particles of the body acts or at which whole of the body acts.
- **Projectile :** Any object thrown into space with some initial velocity and which moves thereafter under the influence of gravity alone is called a 'projectile'. The path of a projectile is a parabola. Its horizontal range is maximum when the angle of projection is 45°.
- **Weightlessness :** The state when an object does not weight anything during free fall.
- **Buoyancy :** An upward force exerted by a fluid that opposes the weight of an immersed object.

❑❑

CHAPTER - 12 : FLOATATION

Quick Review

- Motion of moon around the earth is due to centripetal force.
- Mass of an object is constant.
- **Universal law of Gravitation :** The force of attraction between any two objects is inversely proportional to the square of the distance between them.
- All objects experience a force of buoyancy when they are immersed in a fluid.
- Objects having density less than that of the liquid in which they are immersed, float on the surface of the liquid. If the density of the object is more than the density of the liquid in which it is immersed then it sinks in the liquid.
- **Archimedes' principle :** When a body is immersed partially or completely in a fluid (or liquid), it experiences an upthrust that is equal to the weight of the fluid displaced by the body.
- Lactometers are used to determine the purity of a sample of milk.
- Hydrometers are used for determining the density of liquids.
- Density of different substances are different.
- Relative density is a ratio of similar quantities, and thus has no unit.

Know the Terms

- **Weight :** Force by which an object is attracted towards the earth. SI unit is Newton (N).
- **Upthrust / buoyant force :** The upward force exerted by a liquid on the body that is immersed in the liquid.
- **Density :** It is the mass of a unit volume. Its unit is kilogram per metre cube (kgm^{-3}).
- **Relative density :** It is the ratio of the density of a substance to that of water. It is also called specific gravity.
- **Pressure :** Force per unit area. SI unit is N/m^2 or Nm^{-2} or Pascal.
- **Gravity :** Force of attraction due to earth.

❑❑

CHAPTER - 13 : WORK AND ENERGY

TOPIC-1
Work

Quick Review

- Work is done when a force acting on a body produces displacement in in.
- Work done = Force × Displacement in the direction of force
- Work is a scalar quantity.
- Work has only magnitude and no direction.
- The SI unit of work is joule (J).
- Work done is positive if the angle between force and displacement is acute or when the displacement is in the direction of the applied force.
- Work done is negative if the angle between force and displacement is obtuse or when the force acts opposite to the direction of displacement.
- Work done on an object by a force would be zero if the displacement of the object is zero.
- When a body moves along a circular path, the force acts along the radius of the circular path and the motion of the body is along the tangential direction. Therefore, the angle between the direction of motion and the force is 90°. Hence, no work is done on a body when it moves in a circular path.
- An object having a capacity to do work is said to possess energy.

Know the Terms

- **Joule :** One joule (J) is the amount of work done by an object when a force of one Newton displaces it by one meter along the line of action of force.
- **Motion :** A change in position of an object with respect to time.
- **Force :** Any interaction that tends to change or try to change the motion of an object.
- **Displacement :** The shortest distance from the initial to the final position.

TOPIC-2
Energy, Types of Energy and Law of Conservation of Energy

Quick Review

- The change of one form of energy into another is called transformation of energy.
- Law of conservation of energy states that energy can neither be created nor be destroyed, but can be transformed from one form to another.
- Energy exists in nature in several forms such as kinetic energy, potential energy, heat energy and chemical energy. The sum of the kinetic and potential energies of an object is called its total mechanical energy.
- The unit of energy is same as that of work, that is Joule.
- An object of mass 'm' moving with a velocity 'v' has a kinetic energy of $\frac{1}{2}mv^2$.
- The gravitational potential energy of an object of mass 'm' raised through a height 'h' from the earth's surface is given by mgh.

Know the Terms

- **Energy :** Capacity of an object / system to perform work.
- **Kinetic energy :** Energy possessed by a body by virtue of its motion.
- **Potential energy :** Energy possessed by a body by virtue of its position or change in configuration.
- **Gravitational potential energy :** Work done in raising an object from the ground to a point against gravity.
- **Mechanical energy :** Energy associated with the motion and position of an object.

TOPIC-3
Power

Quick Review

- Power is the ratio of work and time.
- It is a scalar quantity.
- In power, time is important but in work, time is not relevant.
- The S.I. unit of power is watt.
- The power of an agent may vary with time.
- Commercial unit of energy is kilowatt hour (kWh).
- Average power is obtained by dividing the total energy consumed by the total time taken.
- Energy used in households, industries and commercial embellishments are expressed in kWh.

Know the Terms

- **Power :** Rate at which work is done.
- **1 kWh :** One kilowatt hour is the amount of electrical energy consumed when an electrical appliance of 1000 watt is used for 1 hour.
- **1 W of power :** When one joule of work is done in one second.

❑❑

CHAPTER - 14 : SOUND

TOPIC-1
Sound : Its Nature, Production, Propagation, Speed and Reflection

Quick Review

- Sound is a wave motion, produced by a vibrating source.
- A medium is necessary for the propagation of sound waves.
- Sound is a longitudinal wave in which the particles of medium move along the direction of motion of wave.
- Sound travels as successive compression and rarefactions in the medium.
- Wave velocity depends upon the nature of the medium through which it passes.
- The speed of sound depends primarily on the nature and the temperature of the transmitting medium.
- Sound can not travel in vacuum.
- Sound travels faster in solids than in air. The speed of sound in solids is much more than the speed of sound in liquids or gases.
- Propagation of sound can be visualised as propagation of density variations or pressure variations in the medium.
- SI unit of time period is second (s).
- SI unit of frequency is hertz (Hz).
- Sound properties such as pitch, loudness and quality are determined by the corresponding wave properties.
- Objects of different sizes and conditions vibrate at different frequencies to produce sound of different pitch.
- Sound gets reflected and follows the same law as the reflection of light.
- Loud sound can travel a larger distance as it is associated with higher energy.
- **Law of reflection of energy :** The directions in which the sound is incident and is reflected make equal angles with the normal to the reflecting surface at the point of incidence and the three are in the same plane.
- The speed v, frequency υ, and wavelength λ of sound are related by equation $v = \lambda\upsilon$.

Know the Terms

- **Compression :** It can also be explained as a part of a longitudinal wave in which the particles of the medium are closer to one another.

- **Rarefaction :** It is also written as the part of a longitudinal wave in which the particles of the medium are farther than normal.
- **Crest :** The point of maximum positive displacement on a transverse wave.
- **Trough :** The point of maximum negative displacement on a transverse wave.
- **Pulse :** A wave of short duration, which is confined to small portion of a medium at any given time.
- **Amplitude :** Maximum displacement of particles of the medium from their mean positions during the propagation of a wave.
- **Wave velocity :** Distance travelled by a wave in one second.
- **Wavelength :** Distance between two consecutive compressions or two consecutive rarefactions or between two consecutive crests or troughs.
- **Frequency :** Number of oscillations per second.
- **Time period :** Time taken by the wave to complete one oscillation.
- **Pitch :** The way the brain interprets the frequency of an emitted sound.
- **Loudness :** The degree of sensation of sound produced.
- **Intensity :** Amount of sound energy passing each second through unit area.
- **Transverse wave :** Displacement of the medium is perpendicular to the direction of propagation of the wave. *e.g.*, a ripple on a pond.
- **Longitudinal wave :** Displacement of the medium is parallel to the propagation of the wave. *e.g.*, sound waves in air.
- **Tone :** A sound of single frequency.

TOPIC-2
Echo, Applications of Sound, Range of Hearing and Structure of Human Ear

Quick Review

- To hear a distinct echo the time interval between the original sound and the reflected one must be at least 0.1 sec.
- For hearing distinct echoes, the minimum distance should be 17.2 m.
- Auditorium or halls have roof and walls covered with sound absorbent materials and seats made with the sound absorbent properties.
- **Uses of multiple reflection of sound are :**
  (i) Megaphones, horns, musical instruments,
  (ii) Stethoscope,
  (iii) Curved ceilings of concert halls, conference halls and cinema halls.
- Audible range = 20 Hz to 20000 Hz
- **Application of ultrasound :**
  (i) To clean parts located in hard-to-reach places,
  (ii) Detect cracks and flaws in metal blocks,
  (iii) Medical devices,
  (iv) SONAR.
- Human ear has 3 parts–outer ear, middle ear and inner ear.
- Outer ear 'pinna' collects sound from the surroundings and passes through the auditory canal. When a compression of the medium reaches the ear drum the pressure increases on the outside of the membrane and forces the eardrum inward. Eardrum vibrates and transmits amplitude vibrations to inner ear.
- Three bones of ear–hammer, anvil and stirrup.

Know the Terms

- **Echo :** Repetition of sound due to the reflection of original sound by a large and hard obstacle.
- **Intensity of sound :** Amount of sound energy passing each second through unit area.
- **Ultrasound :** Sound of frequency greater than 20 kHz.
- **Infrasound :** Sound of frequency less than 20 Hz.
- **Reverberation :** The persistence of sound due to repeated reflection and its gradual fading away.
- **Pinna :** Outer ear.
- **SONAR :** Device that uses ultrasonic waves to measure the distance, direction and speed of underwater objects **SONAR** stands for Sound Navigation And Ranging.

❑❑

UNIT -IV : Our Environment

CHAPTER - 15 : NATURAL RESOURCES

TOPIC-1

The Breath of Life : Air, Role of Atmosphere in Climate Control, Movement of Air : Winds, Rain,Air Pollution, Water : A Wonder Liquid, Water Pollution, Mineral Riches in the Soil

Quick Review

- All life-forms on earth require solar energy as well as the resources on earth like land, water and air to survive.
- Life is possible only in the biosphere, where the atmosphere, lithosphere and hydrosphere interact.
- Biosphere comprises biotic and abiotic factors, which interact with each other and maintains a balance.
- Life on earth is responsible for the present atmosphere of earth, consisting of gases like nitrogen, oxygen, carbon dioxide and water vapour.
- Atmosphere plays a significant role in climate control. It prevents undue fluctuations in temperature during day and night as well as throughout the year.
- **Formation of wind occurs as follows :**
  - **(i)** As the sun unevenly heats the various regions on the earth's surface, air expands and rises over the hotter regions; and condenses and sinks over the cooler regions.
  - **(ii)** During daytime, air above land gets heated faster than air above water; whereas during night, air above land cools faster than air above water. This results in formation of regions of low and high pressure.
  - **(iii)** Air moves from the high pressure region to the low pressure region to balance the differences in pressure, thereby resulting in wind formation.
- **Evaporation of water from water bodies followed by condensation of the vapours results in rain formation, the steps of which are as follows :**

  Heat of sun—Evaporation of water from water bodies—Rising of hot air carrying water vapour—Expansion and subsequent cooling of air—Condensation of water vapour as droplets on condensation nuclei—Increase in size of water droplets—Formation of rain.
- The wind patterns in a particular region direct the rainfall patterns of that region.
- Burning of fossil fuels releases harmful oxides of sulphur and nitrogen, which gives rise to acid rain.
- Increased suspended particles in atmosphere released due to fossil fuel burning causes reduced visibility, smog (in cold weather) and health hazards.
- Water exists in solid, liquid and gaseous forms. It occurs in atmosphere, on land surface as well as underground.
- **Water is important to living organisms because :**
  - **(i)** All cellular processes require an aqueous medium.
  - **(ii)** Dissolved substances are needed for body reactions as well as for transportation.
- Osmoregulation is carried out by all organisms to sustain life.
- There is direct relationship between availability of water and the species richness as well as members of each species present in a given region.
- **Water pollution is caused by addition of following to water bodies :**
  - **(i)** Fertilizers and pesticides
  - **(ii)** Sewage
  - **(iii)** Waste from factories
  - **(iv)** Heated water from factories
  - **(v)** Cold water from dams.
- Both, addition of undesirable substances to as well as removal of desirable substances from water bodies constitutes water pollution.
- Reducing the dissolved oxygen and nutrients from water bodies is harmful for the aquatic organisms.
- Aquatic organisms survive best in their optimum temperatures; hence significant sudden changes in water temperatures can disrupt their life processes and / or breeding activities.

- Weathering of rocks due to physical, chemical and biological processes finally produces the fine particles of soil over long periods of time.
- The continuous, uneven expansion and contraction of different parts of the rocks during day and night leads to crack formation, followed by breakdown of the large rock pieces into smaller ones.
- Freezing of water in cracks of rocks causes widening of the cracks.
- Continuous friction between the various rock pieces carried by flowing water also results in soil formation.
- Strong wind is another factor resulting in soil formation.
- Both water and wind deposit soil away from the parent rocks.
- Soil formation is also carried out by living organisms. Materials released by lichens growing on rock surface, powder down the surface, forming soil. Further breakdown of rocks is caused by growth of other small plants in such soil as well as the entry of tree roots into the cracks of rocks.
- Soil is a mixture of rock particles, humus and microscopic and small organisms.
- Humus creates the soil and keeps it porous.
- The nutrient and humus content of the topsoil influences the biodiversity of a region.
- An important cause of soil pollution is the recent agricultural methods, which destroys soil structure by killing the nutrient recycling soil micro-organisms as well as the earthworms.
- Trees and other plants prevent soil erosion and helps in deep percolation of water. Hence deforestation accelerates soil erosion greatly.

Know the Terms

- **Lithosphere :** The outer crust of the earth.
- **Hydrosphere :** The region which includes all the earth's liquid water, frozen water and small amounts of water vapour in the earth's atmosphere.
- **Atmosphere :** The mass of air surrounding the earth.
- **Biosphere :** The life-supporting zone of the earth where the atmosphere, hydrosphere and lithosphere interact and make life possible.
- **Biotic factors :** The living components of the environment.
- **Abiotic factors :** The non-living components of the environment.
- **Wind :** Movement of air from an area of high pressure to an area of low pressure.
- **Air pollution :** The presence of particulates, toxic gases, or other impurities in the air that harm human or environmental health.
- **Smog :** The combination of smoke particles with the tiny droplets of fog.
- **Acid rain :** Rain that has become acidic due to mixing with gases like SO_2 and NO_2 that are released into the atmosphere by the burning of fossil fuels.
- **Osmoregulation :** Control of water and electrolyte balance in the body.
- **Humus :** The highly decomposed residue of living materials that is a part of soil.
- **Topsoil :** The topmost layer of soil that contains humus and living organisms in addition to soil particles.
- **Soil pollution :** Removal of useful soil components and addition of substances which adversely affect the soil fertility and harm the biodiversity living in it.

TOPIC-2

Biogeochemical Cycles—Water Cycle, Nitrogen Cycle, Carbon Cycle, the Greenhouse Effect, Oxygen Cycle, Ozone Layer

Quick Review

- Biogeochemical cycles make possible the transfer of energy and matter among the various components of the biosphere, leading to a balance between them.
- In addition to evaporation of water from water bodies, water is also added to atmosphere through transpiration and respiration carried out by living organisms.
- Condensation of atmospheric water leads to rain and snow.
- Underground water comes to surface through springs, wells and tube wells.
- Flowing water transport nutrients from one place to another and eventually to the sea.

- Nitrogen is a vital element found in all living organisms.
- Most life forms cannot use atmospheric oxygen directly, except a few nitrogen fixing bacteria found mainly in root nodules of leguminous plants.
- Combination of lightning and rain also creates usable forms of nitrogen.
- Plants utilise nitrates and nitrites to produce proteins, nucleic acids and vitamins, which are then passed on to the consumers.
- Certain soil bacteria convert the nitrogen compounds of dead organisms into nitrites and nitrates.
- Denitrification, carried out by certain bacteria, releases nitrogen back to atmosphere.
- Carbon occurs in elemental form as well as in organic and inorganic compounds. The basic structure of all life molecules like carbohydrates, proteins, fats, nucleic acids and vitamins is composed of carbon.
- Carbon dioxide is fixed by green plants during photosynthesis as well as by marine animals during shell formation.
- Photosynthesis converts carbon dioxide to glucose, which is converted back to carbon dioxide through respiration.
- Combustion of fuels also releases carbon dioxide to atmosphere.
- Carbon dioxide is an important green house gas that prevents the escape of heat from earth and causes global warming.
- Oxygen exists on earth in elemental form as well as in combined form.
- Vital life molecules like proteins, lipids, carbohydrates and nucleic acids are also composed of oxygen.
- The process of respiration, combustion and formation of nitrogen oxides utilizes atmospheric oxygen.
- Photosynthesis returns oxygen back to atmosphere.
- Ozone is present in the upper atmospheric strata and contains three atoms of oxygen.
- The ozone layer absorbs the sun's harmful ultraviolet radiations, thus preventing them from reaching the Earth's surface and damaging life.
- CFCs and other man-made compounds react with the ozone molecules and causes ozone layer depletion.
- We should work towards preventing ozone layer depletion.
- Our natural resources should be used in a sustainable manner so as to prevent their depletion and pollution.

Know the Terms

- **Biogeochemical cycle :** The cyclic transformation of chemicals through interacting biological, geological and chemical processes that causes transfer of energy and matter amid the various components of the biosphere, leading to a balance between them.
- **Water cycle :** The whole process in which water evaporates and falls on the land as rain and later flows back into the sea via rivers.
- **Nitrification :** The process of converting reduced nitrogen (as ammonia or ammonium) to its more oxidized forms (nitrite or nitrate ions).
- **Denitrification :** A process in which anaerobic bacteria convert nitrate ions into nitrogen gas.
- **Ammonification :** The process in which organic forms of nitrogen are converted into ammonia or ammonium ion by heterotrophic bacteria.
- **Green house effect :** The process in which green house gases like carbon dioxide, cause thermal radiation emitted by the Earth's surface to be reflected back down, therefore causing the increase in worldwide average temperatures.
- **Global warming :** An increase in the average temperature of the earth's atmosphere, brought about by the enhanced greenhouse effect.

❑❑

CHAPTER - 16 : IMPROVEMENT IN FOOD RESOURCES

TOPIC-1
Plant and Animal Breeding, Selection for Quality Improvement and Management

Quick Review

- Agriculture and animal husbandry provide us with all our animal and plant food.
- Capacity of producing crop plants and managing livestock should be increased through various efforts like green revolution and white revolution. But this should be done by employing sustainable practices without destroying our environment.
- Improving the financial status of people, especially those involved in agricultural practices is essential to provide food security to everyone.

- The optimum requirement of temperature, water, light and other conditions varies for different crops.
- Kharif crops like paddy and cotton are grown in rainy season whereas Rabi crops like wheat and mustard are grown in winter season.
- Crop variety improvement, crop production improvement and crop protection management help to increase the crop yields.
- Hybridization and genetic modification techniques introduce the useful characters into crop plants.
- It is desirable to develop crops that can survive and give good yields in different climatic conditions and areas.
- The characteristics desirable in crop plants are **(i)** Increased yield **(ii)** Improved quality (such as baking quality in wheat, protein quality in pulse) etc. **(iii)** Resistance to biotic and abiotic factors, especially those harming the plant. **(iv)** Reduction in duration of plant maturity. **(v)** Broad range adaptability of the crop plant under various environmental conditions. **(vi)** Desired agronomic characteristics particular to a plant. Variety improvement may be done for one or several of these characteristics.
- In India, the land holding, financial conditions and use of modern technologies vary among different farmers. Hence the inputs of farmers are also different, leading to different production practices and yields.
- The sixteen nutrients required by plants are obtained through air, water and soil.
  - **(i)** There are 9 macronutrients. Macronutrients : Nitrogen, phosphorus, potassium, calcium, magnesium and sulphur, carbon, oxygen, hydrogen.
  - **(ii)** There are 7 micronutrients. Micronutrients : Iron, manganese, boron, zinc, copper, molybdenum and chlorine.
  - **(iii)** Air supplies carbon and oxygen and hydrogen comes from water.
- Due to the food needs of the ever increasing human population, animal husbandry, especially of cattle, goat, sheep, poultry and fish, is gaining a lot of importance.
- In India, cows and buffaloes are used for draught labour and producing milk and are called draught animals and milch animals respectively.
- Long lactation period is a desirable quality in milch animals.
- Exotic breeds showing long lactation is cross bred with local breeds showing resistance to diseases to obtain high quality breeds.
- For good health and milk production, proper cattle management is required such as shelter, feeding, breeding and disease control.
- The cattle shelter should be well-ventilated, hygienic and dry.
- Cattle food should include roughage and concentrates in balanced amounts and are required for the healthy maintenance as well as milk production of the cattle.
- Cattle diseases are caused by external and internal parasites as well as by bacteria and viruses. These affect the health as well as milk production of the animals and can be largely controlled through vaccinations.
- Poultry farming targets egg production and broiler production for chicken meat.
- Cross-breeding is done between the Indian and foreign breeds of poultry to obtain improved varieties containing desirable traits such as tolerance to high temperature, dwarf broiler parent, low maintenance requirements and reduction in size of the layers.
- The shelter, feeding and other requirements of broilers and layers differ from each other.
- The diet of broilers is planned with the aim of achieving good growth rate and quality of carcass whereas the diet of layers is aimed to achieve large number and high quality of eggs.
- Broiler diet is rich in proteins and vitamins, along with the required amount of fat.
- The poultry shelter should be hygienic, well-lighted and maintained at appropriate temperatures.
- Poultry need to be protected from various diseases caused by bacteria, fungi, viruses, parasites and nutritional deficiencies, through proper treatment, sanitation and vaccination.
- In fish production, both the true fish as well as shellfish are obtained from marine or fresh water through capture fishing or culture fishery.
- India's marine fishery resources are the vast coastlines and extensive seas; the freshwater resources are canals, ponds, reservoirs and rivers whereas the brackish water fishery resources are estuaries and lagoons.
- In India, marine fishes such as pomfret, tuna, mackerel and sardines are located through satellites and echo sounders and captured using fishing nets.
- Marine fish farming of high economic value fishes like mullets, oysters and prawns are done in sea water.
- Freshwater fish production is mainly carried out through aquaculture.
- Composite fish culture system is used commonly for fresh water fish farming. In this system, five or six fish species with different food habits are farmed together in a single pond, so as to increase the yield of fish.
- Since high quality fish seed is not always available, fish are now-a-days bred using hormonal stimulation, thus ensuring continuous supply of the seed.
- Bee-keeping is a low investment activity carried out by farmers to obtain honey and wax.

- *Apis cerana indica, Apis dorsata* and *Apis florae* are the Indian bee varieties whereas *Apis mellifera* is an Italian variety used for commercially producing honey.
- The availability of sufficient amount of pasturage as well as the type of flowers decide the quality of honey.

Know the Terms

- **Hybridization :** Cross between genetically dissimilar plants.
- **Intervarietal hybridization :** Hybridization between different varieties of plants.
- **Interspecific hybridization :** Hybridization between parent of the same species but of different population. Also known as interspecific hybridization.
- **Intergeneric hybridization :** Hybridization between plants of different genera.
- **Macronutrients :** Nutrients required by plants in large quantities.
- **Micronutrients :** Nutrients required by plants in small quantities.
- **Broiler :** Gallinaceous domesticated fowl, bred and raised specifically for meat production.
- **Composite fish culture :** Polyculture system in which compatible fishes of different species having different feeding habits are selected and grown in the pond to exploit all types of available food.
- **Livestock :** Domesticated animals raised in an agricultural setting to produce commodities such as food, fiber and labour.

TOPIC-2
Use of Fertilizers and Manures; Irrigation, Protection from Pests and Diseases; Organic Farming, Types of Farming

Quick Review

- Manures and fertilizers supplement the soil with the required nutrients to increase crop yield.
- Manures contain decomposed animal and plant wastes and increase soil nutrition and fertility.
- The bulk organic matter present in manure improves soil structure.
- In composting, the biological waste material is decomposed in pits. Composting done using earthworms is called vermi-composting.
- In green manuring, green crops are grown, mulched by ploughing and mixed with soil to improve soil structure and fertility.
- The commercially produced fertilizers provide macronutrients like N, K and P and ensure healthy growth of plants.
- Excessive use of fertilizers causes water pollution and loss of soil fertility.
- A best crop yield is obtained by a balance between the use of fertilizers and manures.
- In organic farming, use of chemicals is discouraged whereas use of organic manures, bio-agents and healthy cropping systems is encouraged.
- Irrigation is essential to ensure agricultural success in India since our agriculture is mainly rain-fed.
- Wells, canals, rivers and tanks are some important irrigation systems in our country.
- The source of wells is underground water whereas canals get water from rivers or reservoirs. River lift systems draw water directly from rivers.
- Rainwater harvesting and watershed management increase storage of rain water for later use in agriculture.
- Risk of crop failure is reduced in mixed cropping wherein two or more crops are grown together on the same field.
- Two or more crops with different nutritional requirements are grown on the same farm in inter-cropping so as to utilize maximum nutrients and prevent spread of diseases and pests.
- In crop rotation, different crop combinations are grown on the same field in a pre-planned succession so as to get maximum returns.
- Weeds, pests and diseases can destroy large amounts of crop plants.
- Weed removal from crop fields is essential since they use up the requirements of crop plants like food, space, light etc.
- Insect pests and plant pathogens attack different parts of the plant and thus reduce crop yields.

- Pesticides are used to control weeds, insects and diseases, but they should be used only as much as needed to avoid environmental pollution and health hazards.
- Several preventive methods can be adopted to carry out pest and weed control.
- Biotic and abiotic factors can cause huge storage losses of food grains that can be taken care of by proper treatment.
- It is better to use preventive and control methods for protecting crops such as proper cleaning and drying of the crops followed by fumigation, rather than treatment measures.

Know the Terms

- **Composting :** The process in which farm waste material like livestock excreta, vegetable waste, animal refuse, domestic waste, sewage waste etc is decomposed in pits.
- **Vermicompost :** Compost prepared by using earthworms to hasten the decomposition process of plant and animal refuse.
- **Manure :** Organic substances of animal or plant origin that is added to the soil to increase its fertility and structure.
- **Fertilizer :** Commercially produced plant nutrients that enrich the soil fertility and increase the crop yield.
- **Organic farming :** A farming system with minimal or no use of chemicals as fertilizers, pesticides etc. and with a maximum input of organic manures, recycled farm-wastes, along with use of bio-agents and healthy cropping systems.
- **Mixed cropping :** The practice of growing two or more crops simultaneously on the same field.
- **Inter-cropping :** The practice of growing two or more crops simultaneously on the same field in a definite pattern.
- **Crop rotation :** The growth of different crops on a piece of land in a pre-planned succession.
- **Weeds :** Unwanted plants in the cultivated field.
- **Watershed Management :** Scientific conservation of soil and water.
- **Pest :** Unwanted plants, animals, insects, germs or other organisms that interfere with human activity through bite, destroy food crops, damage property or make our lives more difficult.
- **Biotic factor :** Any living component that affects another organism, including animals, which consume the organism for food. *e.g.*, plants, animals.
- **Abiotic factor :** Non-living components of a habitat which facilitate the thriving of the organisms. *e.g.*, climate, temperature.

❑❑