BIOLOGY (BOTANY AND ZOOLOGY)

Unit : 1 The Living World

Nature and scope of Biology. Methods of Biology. Our place in the universe. Laws that govern the universe and life. Level of organization. Cause and effect relationship.

Being alive. What does it mean? Present approaches to understand life processes, molecular approach; life as an expression of energy; steady state and homeostasis; self duplication and survival; adaptation; death as a positive part of life.

Origin of life and its maintenance. Origin and diversity of life. Physical and chemical principles that maintain life processes. The living crust and interdependence. The positive and negative aspects of progress in biological sciences. The future of the living world, identification of human responsibility in shaping our future.

Unit : 2 Unit of Life

Cell as a unit of life. Small biomolecules; water, minerals, mono and oligosaccharides, lipids, amino acids, nucleotides and their chemistry, cellular location and function. Macromolecules in cells - their chemistry, cellular location and functional significance. Polysaccharides, proteins and nucleic acids. Enzymes; chemical nature, classification, mechanism in action-enzyme complex, allosteric modulation (brief), irreversible activation. Biomembranes; Fluid mosaic model of membrane, role in transport, recognition of external information (brief). Structural organization of the cell; light and electron microscopic views of cell, its organelles and their functions; nucleus mitochondria, chloroplasts, endoplasmic reticulum. Golgi complex, lysosomes, microtubules, cell wall, cilia and flagella, vacuoles, cell inclusions. A general account of cellular respiration. Fermentation, biological oxidation (A cycle outline), mitochondrial electron transport chain, high energy bonds and oxidative phosphorylation, cell reproduction; Process of mitosis and meiosis.

Unit : 3 Diversity of Life

Introduction. The enormous variety of living things, the need for classification to cope with this variety; taxonomy and phylogeny; shortcomings of a two kingdom classification as plants and animals; the five kingdom classification, Monera, Protista, Plantae, Fungi and Animalia; the basic features of five kingdom classification. modes of obtaining nutrition-autotrophs and heterotrophs. Life style producers, consumers and decomposers. Unicellularity and multicellularity, phylogenetic relationships. Concepts of species, taxon and categories - hierarchical levels of classification; binomial nomenclature; principles of classification and nomenclature; identification and nature of viruses and bacteriophages; kingdom Monera-archeabacteria - life in extreme environments; Bacteria, Actinomycetes, Cyanobacteria. Examples & illustration of autotrophic and heterotrophic life; mineralizes-nitrogen fixers; Monera in cycling matter; symbiotic forms; disease producers. Kingdom Protista-Eukaryotic unicellular organisms, development of flagella and cilia; beginning of mitosis; syngamy and sex. Various life styles shown in the major phyla. Evolutionary precursors of complex life forms. Diatoms, dinoflagellates, slime moulds, protozons; symbiotic forms. Plant kingdom-complex autotrophs, red brown and green algae; conquest of land, bryophytes, ferns, gymnosperms and angiosperms. Vascularization; development of flower, fruit and seed. Kingdom fungi-lower fungi (Zygomycetes), higher fungi (Ascomycetes and Basidiomycetes); the importance of fungi. Decomposers; parasitic forms; lichens and mycorrhizae. Animal kingdom-animal body pattern and symmetry. The development of body cavity in invertebrate vertebrate physia. Salient features with reference to habitat and example of phylum porifera, coelenterata, helminthis, annelids, mollusca, arthropoda, echinoderms; chordata - (classes-fishes, amphibians, reptiles, birds and mammals) highlighting major characters.

Unit : 4 Organisms and Environment

Species: Origin and concept of species population, interaction between environment and population community. Biotic community, interaction between different species, biotic stability. Changes in the community. Succession. Ecosystem; interaction between biotic and abiotic components; major ecosystems, manmade ecosystem- Agro ecosystem. Biosphere; flow of energy, trapping of solar energy, energy pathway, food chain, food web, biogeochemical cycles, calcium and sulphur, ecological imbalance and its consequences. Conservation of natural resources; renewable and non-renewable (in brief). Water and land management, wasteland development. Wild life and forest conservation; causes for the extinction of some wild life, steps taken to conserve the remaining species, concept of endangered species-Indian examples, conservation of forests; Indian forests, importance of forests, hazards of deforestation, concept of afforestation. Environmental pollution;

air and water pollution, sources, major pollutants of big cities of our country, their effects and methods of control, pollution due to nuclear fallout and waste disposal, effect and control, noise pollution; sources and effects.

Unit : 5 Multicellularity : Structure and Function - Plant Life

Form and function. Tissue system in flowering plants; meristematic and permanent. Mineral nutrition-essential elements, major functions of different elements, passive and active uptake of minerals. Modes of nutrition, transport of solutes and water in plants. Photosynthesis; photochemical and biosynthetic phases, diversity in photosynthetic pathways, photosynthetic electron transport and photophosphorylation, photorespiration. Transpiration and exchange of gases. Stomatal mechanism. Osmoregulation in plants: water relations in plant cells, water potential. Reproduction and development in Angiosperms; asexual and sexual reproduction. Structure and functions of flower: development of male and female gametophytes in angiosperms, pollination, fertilization and development of endosperm, embryo seed and fruit. Differentiation and organ formation. Plant hormones and growth regulation; action of plant hormones in relation to seed dormancy and germination, apical dominance, senescence and abscission. Applications of synthetic growth regulators. A brief account of growth and movement in plants.

Unit : 6 Multicellularity : Structure and Function - Animal Life

Animal tissues, epithelial, connective, muscular, nerve. Animal nutrition, organs of digestion and digestive process, nutritional requirements for carbohydrates, proteins, fats, minerals and vitamins; nutritional imbalances and deficiency diseases. Gas exchange and transport: Pulmonary gas exchange and organs involved, transport of gases in blood, gas exchange in aqueous media circulation: closed and open vascular systems, structure and pumping action of heart, arterial blood pressure, lymph. Excretion and osomoregulation. Ammonotelism, Ureotelism, urecotelism, excretion of water and urea with special reference to man. Role of kidney in regulation of plasma, osmolarity on the basis of nephron structure, skin and lungs in excretion. Hormonal coordination; hormones of mammals, role of hormones as messengers and regulators. Nervous coordination, central autonomic and peripheral nervous systems, receptors, effectors, reflex action, basic physiology of special senses, integrative control by neuroendocrinal systems. Locomotion: joints, muscle movements, types of skeletal muscles according to types of movement, basic aspects of human skeleton. Reproduction; human reproduction, female reproductive cycles. Embryonic development in mammals (upto three germs layers), growth, repair and ageing.

Unit : 7 Continuity of Life

Heredity and variation: Introduction, Mendel's experiments with peas and concepts of factors. Mendel's laws of inheritance. Genes: Packaging of heredity material in prokaryotes-bacterial chromosome and plasmid; and eukaryote chromosomes. Extranuclear genes, viral genes. Linkage (genetic) maps. Sex determination and sex linkage. Genetic material and its replication, gene manipulation. Gene expression; genetic code, transcription, translation, gene regulation. Molecular basis of differentiation.

Unit : 8 Origin and Evolution of Life

Origin of life: living and non-living, chemical evolution, organic evolution; Oparin ideas, Miller-Urey experiments. Interrelationship among living organisms and evidences of evolution: fossil records including geological scale, Morphological evidence - hematology, vestigeal organs, embryological similarities and biogeographical evidence.

Darwin's two major contributions. Common origin of living organisms and recombination as source of variability, selection and variation, adaptation (Lederberg's replica plating experiment for indirect selection of bacterial mutants), reproductive isolation, speciation. Role of selection, change and drift in determining composition of population. Selected examples: industrial melanism; drug resistance, mimicry, malaria in relation to G-6-PD deficiency and sickle cell disease. Human evolution: Palcontological evidence, man's place among mammals. Brief idea of Dryopithecus, Australopithecus, *Homo erectus*, *H.neanderthlensis*, Cro-Magnon man and *Homo sapiens*. Human chromosomes, similarity in different racial groups. Comparison with chromosomes of non-human primates to indicate common origin; Cultural vs. biological evolution.

Mutation: origin and types of mutation, their role in speciation.

Unit : 9 Application of Biology

Introduction, role of biology, in the amelioration of human problems. Domestication of plant- a historical account, improvement of crop plants; Principles of plant breeding and plant introduction. Use of fertilizers, their economic and ecological aspects.

Use of pesticides: advantages and hazards. Biological methods of pest control. Crops today. Current concerns, gene pools and genetic conservation. Underutilized crops with potential uses of oilseeds, medicines, beverages, spices, fodder, New crops-Leucaena (Subabul), Jojoba, Guayule, winged bean, etc. Biofertilizers - green manure, crop residues and nitrogen fixation (symbiotic, non symbiotic). Applications of tissue culture and genetic engineering in crops. Domestication and introduction of animals. Livestock, poultry, fisheries (fresh water, marine, aquaculture). Improvement of animals: principles of animal breeding. Major animal diseases and their control. Insects and their products (silk, honey, wax and lac). Bioenergy-biomass, wood (combustion; gasification, ethanol). Cow dung cakes, gobar gas, plants as sources of hydrocarbons for producing petroleum, ethanol from starch and lignocellulose. Biotechnology, application in health and agriculture, genetically modified (GM) organisms, bio-safety issues. A brief historical account-manufacture of cheese. yoghurt, alcohol, yeast, vitamins, organic acids, antibiotics, steroids, dextrins. Scaling up laboratory findings to Industrial production, sewage treatment. Production of insulin, human growth hormones, interferon. Communicable diseases including STD and diseases spread through 'blood transfusion (hepatitis, AIDS, etc) Immune response, vaccine and antisera. Allergies and Inflammation. Inherited diseases and dysfunctions, sex-linked diseases, genetic incompatibilities, and genetic counseling. Cancer-major types, causes, diagnosis and treatment. Tissue and organ transplantation. Community health services and measures; blood banks; mental health, smoking, alcoholism and drug addiction-physiological symptoms and control measures. Industrial wastes, toxicology, pollution-related diseases. Biomedical engineering - spare parts for man, instruments for diagnosis of diseases and care. Human population related diseases. Human population, growth, problems and control, inequality between sexes, control measures; test-tube babies aminocentesis. Future of Biology.

MATHEMATICS

Unit-1: Sets and Functions

1. **Sets :** Sets and their representations. Empty set. Finite & Infinite sets. Equal sets. Subsets, Subsets of the set of real numbers especially intervals (with notations). Power set. Universal set. Venn diagrams. Union and Intersection of sets. Difference of sets. Complement of a set.

2. **Relations & Functions:** Ordered pairs, Cartesian product of sets. Number of elements in the cartesian product of two finite sets. Cartesian product of the reals with itself (upto R x R x R). Definition of relation, Types of relations: reflexive, symmetric, transitive and equivalence relations. One to one and onto functions, composite functions, inverse of a function. Binary operations, Pictorial representation of a function, domain. Co-domain and range of a relation. Function as a special kind of relation from one set to another. Real valued function of the real variable, domain and range of these functions, constant, identity, polynomial, rational, modulus, signum and greatest integer functions with their graphs. Sum, difference, product and quotients of functions.

3. **Trigonometric Functions:** Positive and negative angles. Measuring angles in radians & in degrees and conversion from one measure to another. Definition of trigonometric functions with the help of unit circle. Truth of the identity $\sin^2 x + \cos^2 x = 1$, for all x. Signs of trigonometric functions and sketch of their graphs. Expressing sin $(x+y)$ and cos $(x+y)$ in terms of $\sin x$, $\sin y$, $\cos x$&$\cos y$. Deducing the identities like the following: