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**SYLLABUS  
FOR THE POST OF**

**PRAYOGSHALLA SAHAYAK (RASAYAN VIGYAN), MUSHROOM PRAVEKSHAK,  
PRAYOGSHALLA SAHAYAK (VANASPATI VIGYAN), PRAYOGSHALA SAHAYAK  
UDHYAAN VIBHAG (UDHYAAN AIVAM KHADYA PRASHANSKARAN), PRAYOGSHALA  
SAHAYAK (PASHUPALAN VIBHAG), PASHUDHAN PRASAAR ADHIKARI.**

**PART I  
CHEMISTRY**

- I. Atomic, molecular and molar mass. Mole concept. Stoichiometry. Atomic number, isotopes and isobars.
- II. Bohr's atomic model & its limitation. de Broglie's equation. Heisenberg's uncertainty principle, concept of orbitals. Quantum numbers. Aufbau principle, Pauli's exclusion principle and Hund's rule. Electronic configuration of atoms.
- III. Modern periodic law. Periodic table & periodic properties: atomic & ionic radii, ionization enthalpy, electron gain enthalpy and electronegativity.
- IV. Ionic bond, Lattice enthalpy. Covalent bond, Valence bond theory, VSEPR theory, Concept of Hybridization, Structure & shape of simple molecules. Molecular orbital theory, Bond order. Electronic configuration of homonuclear diatomic molecules ( $H_2$ ,  $He_2$ ,  $C_2$ ,  $N_2$  &  $O_2$ ). Hydrogen bonding.
- V. d and f block elements- Electronic configuration, general trends in properties (metallic character, ionization enthalpy, oxidation state, ionic radii, catalytic property and colour. Magnetic properties, interstitial compounds, alloy formation). Preparation and properties of  $KMnO_4$  and  $K_2Cr_2O_7$ . Lanthanoids & Actinoids: Electronic configuration and Oxidation state. Lanthanoid contraction.
- VI. Coordination compounds: Difference between double salt and coordination compounds. Ligands, coordination number. IUPAC nomenclature of simple coordination compounds. Isomerism. Werner theory. Valence bond theory. Crystal Field theory, Electronic arrangement in Octahedral and Tetrahedral complexes, CFSE, Spectrochemical series. Importance of Coordination compounds (qualitative analysis, extraction of metals & biological system).
- VII. General Organic Chemistry: Classification of organic compounds, IUPAC Nomenclature. Isomerism. Electronic displacement in covalent bond: Inductive effect, Electromeric effect, Hyperconjugation & Resonance. Covalent bond cleavage. Attacking reagents (Electrophile & Nucleophile), Reaction intermediates (Carbocation, Free radical and Carbanion). Types of organic reactions. Methods of Purification of Organic Compounds. Qualitative and Quantitative analysis of Organic Compounds.
- VIII. Hydrocarbons- Alkanes: Conformational analysis of Ethane. Halogenation, Combustion & Pyrolysis. Alkenes-Geometrical isomerism. Method of preparation of alkenes. Chemical reactions of alkenes (with hydrogen, halogen, water, HX, oxidation

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- & ozonolysis). Alkynes- Acidic nature, Method of preparation of alkynes. Chemical reactions of alkynes (with hydrogen, halogen, water & HX). Aromatic Compounds- Structure of benzene, Aromaticity, Mechanism of Electrophilic Substitution reactions (Nitration, Sulphonation, Halogenation and Friedel Craft's alkylation & acylation). Directive effect of functional group in monosubstituted benzene. Carcinogenicity & toxicity.
- IX. General methods of preparation, Physical, Chemical properties & uses of haloalkenes, haloarenes, alcohol, phenol, ether, aldehyde, ketones, carboxylic acid & amines. Uses and environmental effects of Dichloromethane, trichloromethane, iodoforms, freons & DDT. Importance of Diazonium salts in synthetic organic chemistry.
- X. Some important name reaction (Hunsdieker reaction, Hoffmann Ammonolysis, Wurtz reaction, Sandmeyer reaction, Gattermann reaction, Esterification reaction, Reimer Teimann reaction, Aldol Condensation, Cannizaro reaction, Benzoin Condensation, Carbylamine reactions).
- XI. Biomolecules: Classification, properties and importance of Carbohydrates (mono-, oligo & Polysaccharides), Proteins, Vitamins & Nucleic acid. Structure of proteins. Denaturation. Elementary idea of Enzymes & Hormones.
- XII. Thermodynamics- Types of systems. Extensive and Intensive properties. State function. First law of thermodynamics. Heat capacity and specific heat capacity. Hess's law. Enthalpy of dissociation, combustion, formation, atomization, sublimation, phase transition and ionization. Concept of Entropy. Free energy, spontaneity and equilibrium. Third law of Thermodynamics (brief introduction).
- XIII. Solution- Method of expression of concentration. Solubility of gases in liquids and solid solutions. Raoult's law. Colligative properties. Abnormal molar mass.
- XIV. Equilibrium- Law of mass action. Equilibrium constant. Le- Chatelier's principle. Ionization of acid and base. Strong and weak electrolytes. Acidic strength, pH, Buffer solutions, Solubility product, Hydrolysis of salts & Common Ion Effect.
- XV. Electrochemistry- Oxidation number. Redox reactions & its application. Conductance, Specific & Molar Conductivity and their variation with concentration. Kohlrausch's law. Electrolysis. Laws of electrolysis. Galvanic Cell, EMF of cell, Standard electrode potential, Nernst equation. Relation between Gibb's energy change & EMF of a cell. Dry cell, Pb-accumulator & Fuel cell. Corrosion.
- XVI. Chemical Kinetics- Rate of reaction. Factors affecting rate of reactions (Concentration, temperature, catalyst). Order and Molecularity. Rate law and rate constant. Integrated rate equation and half life (Zero and First order reactions). Concept of Collision theory. Activation energy and Arrhenius equation.
- XVII. Laboratory methods: Volumetric analysis (Preparation of standard solution of oxalic acid, sodium carbonate; Determination of strength of NaOH & HCl). Inorganic salt analysis. Detection of N, S and Cl in Organic compounds. Determination of pH of solutions, acids, bases and salts using pH meter and universal indicator. Chromatography analysis (Paper chromatography, Rf value) of leave & flower extracts and inorganic mixture. Inorganic compound preparation (Ferrous Ammonium Sulphate, Potash Alum & Potassium Ferric Oxalate). Organic compound preparation (Acetanilide, Di-benzalacetone & p-Nitroacetanilide). Functional group determination (Unsaturation, Alcohol, Phenol, Aldehyde, Ketone, Carboxylic and Primary amine). Characteristic tests of Carbohydrates, fats and proteins.

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## **PART II BIOLOGY**

### UNIT-1

#### ORIGIN OF LIFE AND EVOLUTION

Origin of life. Evolution, theories and evidences of evolution. Variations and causes of variations. Neo-Lamarckism and Neo-Darwinism. Adaptations and adaptive radiations. Human Evolution. Speciation.

### UNIT-2

#### CELL BIOLOGY

Cell Theory. Prokaryotic and Eukaryotic cell. Cell membrane and cell wall. Cell organelles (Plastids, Mitochondria, Endoplasmic reticulum, Golgi Bodies/Dictyosomes, Lysosomes, Vacuoles, Centrioles). Nucleus and Chromosomes. Cell Cycle. Mitosis and Meiosis.

Biomolecules: Structure, Classification and function of Proteins, Carbohydrates, Lipids. Metabolism of Carbohydrates. Enzymes, classification and enzyme action. Nucleic Acids.

### UNIT-3

#### DIVERSITY OF LIVING ORGANISMS

Taxonomy and Systematics. Concept of species. Nomenclature of species. History of Classification. Taxonomical hierarchies. Classification of Organisms (5- Kingdom System Classification). Salient features of various groups of plants (Algae, Fungi, Bryophyta, Pteridophyta, Gymnosperms and Angiosperms) and animals (Non-Chordata up to Phylum and Chordata up to Classes) with examples and economic importance. Microbial Diversity (Viruses, Viroids, Bacteria). Lichens.

Botanical gardens, Herbaria, Zoological Parks and Museums.

### UNIT-4

#### STRUCTURAL ORGANIZATION IN PLANTS AND ANIMALS

Plants and Animal Tissue systems. Morphology, Anatomy and Functions of different Parts of Flowering Plants (Stem, Root, Leaf, Inflorescence, Flower). Coelom and segmentation in animals.

Morphology, Anatomy and functions of various systems of Earthworm. Cockroach, Frog and Man.

### UNIT-5

#### PHYSIOLOGY

PLANT PHYSIOLOGY: Transportation. Mineral Nutrition. Photosynthesis. Respiration. Plant Growth and development. Plant Movements. Seed Germination. Photoperiodism. Vernalization.

HUMAN PHYSIOLOGY: Types of Nutrition. Digestion and Absorption. Nutritional digestive disorders. Breathing and exchange of gases. Body fluids and circulation. Working of heart, heart sounds, cardiac cycle. Nitrogenous excretion, working of Kidney and osmoregulation.

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Locomotion and movement. Neural control and co-ordination. Receptors (Eye, ear and chemical sense organs). Chemical co-ordination integration.

UNIT-6  
REPRODUCTION

ASEXUAL AND SEXUAL REPRODUCTION.

SEXUAL REPRODUCTION IN FLOWERING PLANTS: Flower and its types. Structure and development of anther and male gametophyte. Structure and development of ovule and female gametophyte. Pollination. Fertilization. Post-fertilization events. Endosperm. The embryo. Parthenocarpy. Polyembryony. Apomixis. Development of fruits and seeds. Dehiscence of fruits and dispersal of seeds.

HUMAN REPRODUCTION: Gametogenesis. Menstrual Cycle. Fertilization. Embryo Development. Implantation. Placenta. Parturition. Reproductive health. Population explosion and Birth Control. Contraception and Medical Termination of Pregnancy. Sexually transmitted diseases. Infertility. Amniocentesis. Test Tube baby.

UNIT-7  
MOLECULAR BIOLOGY, GENETICS AND BIOTECHNOLOGY

MOLECULAR BASIS OF INHERITANCE: Nucleic acids. Genes. Evidences of Genetic material. Replication of DNA. Genetic Code. Transcription, Translation and gene regulation.

GENETICS: Heredity and variation. Mendel's Laws of inheritance. Post-mendelian Genetics. Gene Interaction. Chromosomal theory of inheritance. Linkage. Crossing-over. Sex Determination. Sex-linked inheritance. Mutations. Human genetic disorders. Pedigree analysis.

BIOTECHNOLOGY: Principals of biotechnology. Genetic engineering. Tools of recombinant DNA technology. Restriction enzymes. DNA fingerprinting. Gene library. Cloning. Application of biotechnology in Agriculture, health and medicine. Human genome project. ELISA.

UNIT-8  
BIOLOGY AND HUMAN WELFARE

Human health and diseases. Communicable and non-communicable diseases. Cancer. Pathogens. The Immune system. Antigen and Antibodies. Types of Immunity. Autoimmunity. Role of stem cells in medical treatment.

MICROBES IN HUMAN WELFARE: Microbes in household products. Microbes as food. Microbes in industries. Microbes in sewage treatment. Biofertilizers.

UNIT-9  
ECOLOGY AND ENVIRONMENT

Major Biomes of India. Abiotic and Biotic Factors. Bio-geochemical cycles. Food chain and Food-web. Ecological pyramids. Adaptation to environment in plants and animals. Population (density, natality, Mortality, biotic potential, age distribution, sex ratio). Interaction between organisms (Predation, parasitism, mutualism, ammensalism). Ecosystem and its components. Pond, forest, grassland, desert, mountain ecosystems. Ecotone and edge effects. Biotic community and succession. Types of biodiversity. In-situ and ex-situ conservation. Hot spots

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of biodiversity. Wild life and its conservation. Biosphere reserves, national parks, sanctuary. Red data book. Ramsar convention. Project Tiger.

ENVIRONMENTAL ISSUES: Environmental pollution. Pollutants, kinds of pollution; prevention and their control. Pollution related diseases. Land degradation. Sewage and sewage treatment. Solid waste management. Hospital waste management. Remedy for plastic waste. Organic farming. Environmental Acts/laws/legislations.

#### UNIT-10

#### ECONOMIC BOTANY, ZOOLOGY AND BIostatISTICS

ECONOMIC BOTANY: Green revolution. Main objectives of plant breeding. Cereals and pulses. Non-cereal crops. Methods of crop improvement. Fibre, timber, oil, spices, condiment-yielding plants. Plant tissue culture. Single cell protein (SCP). Biofortification.

ECONOMIC ZOOLOGY: Sericulture, Apiculture, Lac culture. Pisciculture. Poultry and Piggery. Animal husbandry (Dalry, Artificial insemination, Multiple and embryo transfer technology).

BIostatISTICS: Data (Primary and secondary), data collection and data classification. Principles and application of measures of central tendency (Mean, Mode and Median).

Note: Current general knowledge of scientific advancements in all the above units is deemed to have been included.

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