SUBJECT: BOTANY

UNIT-I: DIVERSITY IN THE LIVING WORLD:
The living world: What is living? Diversity in living world, Taxonomic categories.
Biological Classification: Kingdom Monera, Kingdom Protista, Kingdom Fungi, Kingdom Plantae and Kingdom Animalia, Six kingdom classification, Viruses, Viroids, Prions & Lichens.
Science of plants– Botany: Origin, Development, Scope of Botany and Branches of Botany.
Plant Kingdom: Algae, Bryophytes, Pteridophytes, Gymnosperms.

UNIT-II: STRUCTURAL ORGANISATION IN PLANTS- MORPHOLOGY:
Morphology of flowering Plants: The root, The stem, The Inflorescence, The flower

UNIT-III: REPRODUCTION IN PLANTS:
Sexual Reproduction in Flowering Plants: Pre-fertilization structures and events, Pollination, Pollen-pistil interaction, Double fertilization, Post fertilization structures and events, Apomixis and polyembryony.

UNIT-IV: PLANT SYSTEMATICS:
Taxonomy of angiosperms: Systems, Types of classification, Semi- Technical description of a typical flowering plant, Description of Families: Solanaceae and Liliaceae.

UNIT-V: CELL STRUCTURE AND FUNCTION:
Cell- The Unit of Life: What is a Cell? Cell theory, an overview of the cell, Prokaryotic cells, Eukaryotic cells,
Biomolecules: How to analyze chemical composition, Primary and secondary metabolites, Biomacromolecules, Proteins, Polysaccharides, Nucleic acids, Structure of Proteins, Nature of Bond linking Monomers in a polymer, Dynamic state of body constituents-concept of metabolism, metabolic basis for living, The living state.
Cell cycle and Cell Division: Cell cycle, M phase, Significance of Mitosis, Meiosis, significance of Meiosis.

UNIT-VI: INTERNAL ORGANISATION OF PLANTS:
Histology and Anatomy of Flowering Plants: Anatomy of Dicotyledonous and Monocotyledonous plants

UNIT-VII: PLANT ECOLOGY:
Ecological Adaptations, Succession and Ecological Services: Introduction. Plant communities and Ecological adaptations: Plant succession. Ecological services

UNIT-VII: PLANT PHYSIOLOGY
Transport in Plants: Means of Transport, Plant-Water Relations, Long Distance Transport of Water- Transpiration, Uptake and transport of Mineral Nutrients Ions, Phloem transport: Flow from Source to Sink
Enzymes: Chemical Reactions, Enzymatic Conversions, Nature of Enzyme Action, Factors Affecting Enzyme Activity, Classification and Nomenclature of Enzymes, Co-factors.
Photosynthesis in Higher Plants: What do we know? Early experiments, What is site of Photosynthesis, How many Pigments are Involved in Photosynthesis, What is Light Reaction?, The Electron Transport, Where are the ATP and NADPH used?, The C4 Pathway, Photorespiration, Factors affecting Photosynthesis.
Respiration of Plants: Do plants breathe? Glycolysis, Fermentation, Aerobic Respiration, The Respiratory Balance Sheet, Amphibolic Pathway, Respiratory Quotient.
Plant Growth and Development: Plant Growth Regulators

UNIT-IX: MICROBIOLOGY:

Bacteria: Morphology of Bacteria, Bacterial cell structure, Nutrition, Reproduction, The importance of Bacteria to Humans.

Viruses: Discovery, Classification of Viruses, structure of Viruses, Multiplication of Bacteriophages, Viral diseases in Plants, Viral diseases in Humans.

UNIT- X: GENETICS:

Principles of Inheritance and Variation: Mendel's Experiments, Inheritance of one gene (Monohybrid Cross), Deviations from Mendelian concept of dominance, Inheritance of two genes(Dihybrid cross), Chromosomal theory of Inheritance, Linkage and Recombination, Mutations.

UNIT- XI: MOLECULAR BIOLOGY:

Molecular Basis of inheritance: The DNA, The Search for Genetic Material, RNA World, Replication, Transcription, Genetic Code, Translation, Regulation of Gene Expression.

UNIT-XII: BIOTECHNOLOGY

Principles and Processes of Biotechnology: Principles of Biotechnology, Tools of Recombinant DNA Technology, Processes of Recombinant DNA Technology

Biotechnology and its applications: Biotechnological Applications in Agriculture, Other applications of Biotechnology, Transgenic plants, Bio-safety and Ethical issues

UNIT-XIII:

PLANTS, MICROBES AND HUMAN WELFARE

Strategies for enhancement in food production: Plant Breeding, Tissue Culture.

Microbes in Human Welfare: Microbes in Household Products, Microbes in Industrial Products, Microbes in Sewage Treatment, Microbes in Production of Biogas, Microbes as Biocontrol Agents, Microbes as Biofertilisers, Challenges posed by Microbes.

SUBJECT: ZOOLOGY

UNIT-1: ZOOLOGY - Diversity of Living World:
What is life?; Nature, Scope & meaning of zoology; Branches of Zoology; Need for classification- Zoos as tools for study of taxonomy; Basic principles of Classification: Biological system of classification- (Phylogenetic classification only); Levels or Hierarchy of classification; Nomenclature - Bi &Trinominal; Species concept; Kingdom Animalia; Biodiversity- Meaning and distribution, Genetic diversity, Species diversity, Ecosystem diversity(alpha,beta and gama), other attributes of biodiversity, role of biodiversity, threats to biodiveristy, methods of conservation, IUCN Red data books, Conservation of wild life in India -Legislation, Preservation, Organisations, Threatened species.

UNIT-2: STRUCTURAL ORGANIZATION IN ANIMALS:
Levels of organization, Multicellularity: Diploblastic & Triploblastic conditions; Asymmetry,Symmetry: Radial symmetry, and Bilateral symmetry (Brief account giving one example for each type from the representative phyla); Acoelomates, Pseudocoelomates and Eucoelomates: Schizo&Entero coelomates (Brief account of formation of coelom); Tissues: Epithelial, Connective, Muscular and Nervous tissues.

UNIT-3: ANIMAL DIVERSITY-I: INVERTEBRATE PHYLA:
General Characters –Classification up to Classes with two or three examples – (Brief account only). Porifera; Cnidaria; Ctenophora; Platyhelminthes; Nematoda; Annelida (Include Earthworm as a type study adhering to NCERT text book); Arthropoda; Mollusca; Echinodermata; Hemichordata.

UNIT-4: ANIMAL DIVERSITY-II: PHYLUM: CHORDATA:
General Characters – Classification up to Classes - (Brief account only with two or three examples). Phylum: Chordata; Sub phylum: Urochordata; Sub phylum: Cephalochordata; Sub phylum : Vertebrata; Super class: Agnatha, Class Cyclostomata; Super class: Gnathostomata, Super class pisces, Class: Chondricthyes, Class: Osteichthyes; Tetrapoda, Class: Amphibia (Include Frog as a type study adhering to NCERT text book), Class: Reptilia, Class: Aves, Class: Mammalia.

UNIT-5: LOCOMOTION & REPRODUCTION IN PROTOZOA:
Locomotion: Definition, types of locomotor structures pseudopodia (basic idea of pseudopodia without going into different types), flagella & cilia (Brief account giving two examples each); Flagellar& Ciliary movement- Effective & Recovery strokes in Euglena, Synchronal &Metachronal movements in Paramecium; Reproduction: Definition, types. Asexual Reproduction: Transeverse binary fission in Paramecium & Longitudinal binary fission in Euglena. Multiple fission, Sexual Reproduction.

UNIT-6: BIOLOGY IN HUMAN WELFARE:
Parasitism and parasitic adaptation; Health and disease: introduction; Life cycle, Pathogenecity, Treatment & Prevention (Brief account only) 1. *Entamoebahistolytica*2. *Plasmodium vivax*3. *Ascarislumbricoides*4. *Wuchereriabancrofti*; Brief account of pathogenecity, treatment & prevention of Typhoid, Pneumonia, Common cold, & Ring worm; **Tobacco**, Drugs and Alcohol abuse.

UNIT-7: ECOLOGY & ENVIRONMENT:
Organisms and Environment: Ecology, population, communities, habitat, niche, biome and ecosphere (definitions only); Ecosystem: Elementary aspects only, Abiotic factors- Light, Temperature & Water, (Biological effects only),Ecological adaptations Population interactions Population attributes: Growth, Natality and Mortality, Age distribution, Population regulation;

UNIT-8: HUMAN ANATOMY AND PHYSIOLOGY-I:

Breathing and Respiration: Respiratory organs in animals; Respiratory system in humans; Mechanism of breathing and its regulation in humans - Exchange of gases, transport of gases and regulation of respiration, Respiratory volumes; Respiratory disorders: Asthma, Emphysema, Occupational respiratory disorders - Asbestosis, Silicosis, Siderosis, Black Lung Disease in coal miners.

UNIT-9: HUMAN ANATOMY AND PHYSIOLOGY-II:

9-A) Body Fluids and Circulation: Lymphatic system, Clotting of blood; **Circulating pathways,** Human circulatory system - structure of human heart and blood vessels; Cardiac cycle, cardiac output, double circulation, regulation of cardiac activity; Disorders of circulatory system: Hypertension, coronary artery disease, angina pectoris, heart failure.

9-B) Excretory products and their elimination: Modes of excretion- Ammonotelism, Ureotelism, Uricotelism, Human excretory system - structure of kidney and nephron; Urine formation, osmoregulation; Regulation of kidney function -Renin-Angiotensin - Aldosterone system, Atrial Natriuretic Factor, ADH and diabetes insipidus; Role of other organs in excretion; Disorders: Uraemia, renal failure, renal calculi, nephritis, dialysis using artificial kidney.

UNIT-10: HUMAN ANATOMY AND PHYSIOLOGY-III:

10-A) The Muscle - ultra structure; Contractile proteins & muscle contraction,

10-B) Neural control and co-ordination: Nervous system in human beings - Central nervous system, Peripheral nervous system and Visceral nervous system, Generation and conduction of nerve impulse;

UNIT-11: HUMAN ANATOMY AND PHYSIOLOGY-IV:

11-A) Endocrine system and chemical co-ordination: Endocrine glands and hormones; Human endocrine system - Hypothalamus, Pituitary, Pineal, Thyroid, Parathyroid, Adrenal, Pancreas, Gonads; Mechanism of hormone action, Role of hormones as messengers and regulators; Hypo and Hyper activity and related disorders: Common disorders - Dwarfism, acromegaly, cretinism, goiter, exophthalmic goiter, diabetes, Addison's disease, Cushing's syndrome.

11-B) Immune system: Basic concepts of Immunology - Types of Immunity - Innate Immunity, Acquired Immunity, Active and Passive Immunity, Cell mediated Immunity and Humoral Immunity, **Vaccination or Immunization, Immunological disorders**, , HIV and AIDS.

UNIT-12: HUMAN REPRODUCTION:

12-A) Human Reproductive System: Male and female reproductive systems; Microscopic anatomy of testis & ovary; Gametogenesis, Spermatogenesis & Oogenesis; Menstrual cycle; Fertilization, **Gastrulation,** Embryo development upto blastocyst formation, Implantation; Pregnancy, placenta formation, Parturition, Lactation.

12-B) Reproductive Health: Need for reproductive health and prevention of sexually transmitted diseases (STD); Birth control - Need and methods, contraception and Pharmacy termination of pregnancy (MTP); Amniocentesis; infertility and assisted reproductive technologies - IVF-ET, ZIFT, GIFT.

UNIT-13: GENETICS:

Heredity and variations. Mendel's laws of inheritance with reference to *Drosopila*(*Drosophila melanogaster*- Grey, Black body colour; Long, Vestigial wings), Pleiotropy, Multiple alleles and inheritance blood groups, Rh-factor, Codominance (Blood groups as example), elementary idea of polygenic inheritance, skin colour in humans, sex- determination- in humans, birds, *Fumea*, genic balance theory of sex determination, Haplodiploidy in honey bees; Sex linked inheritance- Haemophilia and colorblindness, Mendelian disorders in humans- Thalassemia, Haemophilia, Sickle cell anaemia, cystic fibrosis, Phenylketonuria, Alkaptonuria; Chromosomal disorders- Down

syndrome, Turner's syndrome, Kleinfiltersyndrome; Genome, Human genome project, and DNA finger printing.

UNIT-14: APPLIED BIOLOGY:

Bio-medical applications, Vaccines, **Molecular Diagnosis** Gene Therapy; Transgenic animals; ELISA; MABs, Cancer biology, stem cells. Bio- Medical Technology, Diagnostic Imaging (X-ray, CT scan, MRI), ECG, EEG,

SUBJECT: PHYSICS

1. **PHYSICAL WORLD:** What is physics? Scope and excitement of physics. Physics, technology and society Fundamental forces in nature. Nature of physical laws

2. **UNITS AND MEASUREMENTS: Introduction,**The international system of units, Measurement of Length, Measurement of Large Distances, Estimation of Very Small Distances, Size of a Molecule, Range of Lengths, Measurement of Mass, Range of Masses, Measurement of time, Accuracy, precision of instruments and errors in measurement, Systematic errors, random errors, least count error, Absolute Error, Relative Error and Percentage Error, Combination of Errors, Significant figures, Rules for Arithmetic Operations with Significant Figures, Rounding off the Uncertain Digits, Rules for Determining the Uncertainty in the Results of Arithmetic Calculations, Dimensions of Physical Quantities, Dimensional Formulae and dimensional equations, Dimensional Analysis and its Applications, Checking the Dimensional Consistency of Equations, Deducing Relation among the Physical Quantities.

3. **MOTION IN A STRAIGHT LINE: Introduction,** Position, path length and displacement, average velocity and average speed, instantaneous velocity and speed, acceleration, kinematic equations for uniformly accelerated motion, relative velocity.

4. **MOTION IN A PLANE: Introduction,** Scalars and vectors, position and displacement vectors, equality of vectors, multiplication of vectors by real numbers, addition and subtraction of vectors - graphical method, resolution of vectors, vector addition - analytical method, motion in a plane, position vector and displacement, velocity, acceleration, motion in a plane with constant acceleration, relative velocity in two dimensions, projectile motion, equation of path of a projectile, time of maximum height, maximum height of a projectile, horizontal range of projectile, uniform circular motion.

5. **LAWS OF MOTION: Introduction,** Aristotle's fallacy, Equilibrium of a particle, Common forces in mechanics, friction, types of friction, static, kinetic and rolling frictions, Circular motion, Motion of a car on a level road, Motion of a car on a banked road, solving problems in mechanics.

6. **WORK, ENERGY AND POWER: Introduction,** The Scalar Product, Notions of work and kinetic energy, The work-energy theorem, Work, Kinetic energy, Work done by a variable force, The work-energy theorem for a variable force, The concept of Potential Energy, The conservation of Mechanical Energy, The Potential Energy of a spring, Various forms of energy, Heat, Chemical Energy, Electrical Energy, The Equivalence of Mass and Energy, Nuclear Energy, The Principle of Conservation of Energy, Power, Collisions, Elastic and Inelastic Collisions, Collisions in one dimension, Coefficient of Restitution and its determination, Collisions in Two Dimensions.

7. **SYSTEM OF PARTICLES AND ROTATIONAL MOTION: Introduction,** Rigid body motion, Centre of mass, Centre of Gravity, Motion of centre of mass, Linear momentum of a system of particles, Vector product of two vectors, Angular velocity and its relation with linear velocity, Angular acceleration, Kinematics of rotational motion about a fixed axis, Moment of force (Torque), Angular momentum of particle, Torque and angular momentum for a system of a particles, conservation of angular momentum, Equilibrium of a rigid body, Principle of moments, Moment of inertia, Dynamics of rotational motion about a fixed axis, Angular momentum in case of rotation about a fixed axis, Rolling motion, Kinetic Energy of Rolling Motion.

8. **OSCILLATIONS: Introduction,** Periodic and oscillatory motions, Period and frequency, Displacement, Simple harmonic motion (S.H.M.), Simple harmonic motion and uniform circular motion, Velocity and acceleration in simple harmonic motion, Force law for Simple harmonic Motion, Energy in simple harmonic motion, some systems executing Simple Harmonic Motion, Oscillations due to a spring, The Simple Pendulum, damped simple harmonic motion, Forced oscillations and resonance.

9. **GRAVITATION: Introduction,** Universal law of gravitation, central forces, the gravitational constant, Acceleration due to gravity of the earth, Acceleration due to gravity below and above the surface of earth, Gravitational potential energy, Escape speed, Orbital Speed, Earth satellites, Energy of an orbiting satellite, Geostationary and polar satellites, Weightlessness.

10. **MECHANICAL PROPERTIES OF SOLIDS: Introduction,** Elastic behavior of solids, Stress and strain, Hooke's law, Stress-strain curve, Elastic moduli, Young's Modulus, Determination of

Young's Modulus of the Material of a Wire, Shear Modulus, Bulk Modulus, Applications of elastic behavior of materials.

11. **MECHANICAL PROPERTIES OF FLUIDS: Introduction,** Pressure, Pascal's Law, Variation of Pressure with Depth, Atmospheric Pressure and Gauge Pressure, Hydraulic Machines, Archimedes' Principle, Streamline flow, Bernoulli's principle, Speed of Efflux, Torricelli's Law, Venturi- meter, Blood Flow and Heart Attack, Dynamic Lift, Viscosity, Variation of Viscosity of fluids with temperature, Stokes' Law, Reynolds number, Critical Velocity, Surface tension and Surface Energy, Angle of Contact, Drops and Bubbles, Capillary Rise, Detergents and Surface Tension.

12. **THERMAL PROPERTIES OF MATTER: Introduction,** Temperature and heat, Measurement of temperature, Ideal-gas equation and absolute temperature, Thermal expansion, Specific heat capacity, Calorimetry, Change of state, Triple Point, Regelation, Latent Heat, Newton's law of cooling and its experimental verification.

13. **THERMODYNAMICS: Introduction,** Thermal equilibrium, Zeroth law of thermodynamics, Heat, Internal Energy and work, First law of thermodynamics, Specific heat capacity, Specific heat capacity of water, Thermodynamic state variables and equation of State, Thermodynamic processes, Quasi-static process, Isothermal Process, Adiabatic Process, Isochoric Process, Isobaric process, Cyclic process, Second law of thermodynamics, Reversible and irreversible processes, Carnot engine, Carnot's theorem.

14. **KINETIC THEORY: Introduction,** Molecular nature of matter, Behaviour of gases, Boyle's Law, Charles' Law, Kinetic theory of an ideal gas, Pressure of an Ideal Gas, Kinetic interpretation of temperature, Law of equipartition of energy, Specific heat capacity, Monatomic Gases, Diatomic Gases, Polyatomic Gases, Specific Heat Capacity of Solids, Specific Heat Capacity of Water, Mean freepath.

15. **WAVES: Introduction,** Transverse and longitudinal waves, displacement relation in a progressive wave, amplitude and phase, wavelength and angular wave number, period, angular frequency and frequency, the speed of a travelling wave, speed of a transverse wave on stretched string, speed of a longitudinal wave (speed of sound), the principle of superposition of waves, reflection of waves, standing waves and normal modes, beats.

16. **RAY OPTICS AND OPTICAL INSTRUMENTS: Introduction,** Sign convention, refraction, total internal reflection, total internal reflection in nature and its technological applications, refraction at spherical surfaces and by lenses, power of a lens, combination of thin lenses in contact, refraction through a prism, dispersion by a prism, optical instruments, the eye, the simple and compound microscopes, refracting telescope and Cassegrain reflecting telescope.

17. **WAVE OPTICS: Introduction,** Huygens principle, refraction and reflection of plane waves using Huygens principle, refraction in a rarer medium (at the denser medium boundary), reflection of a plane wave by a plane surface, the Doppler effect, coherent and incoherent addition of waves, interference of light waves and Young's experiment.

18. **ELECTRIC CHARGES AND FIELDS: Introduction,** Electric charge, conductors and insulators, charging by induction, basic properties of electric charges, additivity of charges, conservation of charge, quantization of charge, Coulomb's law, forces between multiple charges, electric field, electric field due to a system of charges, physical significance of electric field, electric field lines, electric flux, electric dipole, the field of an electric dipole for points on the axial line and on the equatorial plane, physical significance of dipoles, dipole in a uniform external field, continuous charge distribution, Gauss's law.

19. **ELECTROSTATIC POTENTIAL AND CAPACITANCE: Introduction,** Electrostatic potential, potential due to a point charge, potential due to an electric dipole, potential due to a system of charges, equipotential surfaces, relation between field and potential, potential energy of a system of charges, potential energy in an external field, potential energy of a single charge, potential energy of a system of two charges in an external field, potential energy of a dipole in an external field, electrostatics of conductors, electrostatic shielding, dielectrics and polarisation, electric displacement, capacitors and capacitance, the parallel plate capacitor, effect of dielectric on capacitance, combination of capacitors, capacitors in series, capacitors in parallel, energy stored in a capacitor, Van de Graaff generator.

20. **CURRENT ELECTRICITY: Introduction,** Electric current, electric current in conductors, Ohm's law, drift of electrons and the origin of resistivity, mobility, limitations of Ohm's law, Temperature dependence of resistivity, electrical energy, power, Cells, EMF, internal resistance, cells in series and in parallel, Kirchhoff's rules, Wheatstone Bridge, Meter Bridge, Potentiometer.

21. **MOVING CHARGES AND MAGNETISM: Introduction,** Magnetic force, sources and fields, magnetic field, Lorentz force, magnetic force on a current carrying conductor, motion in a magnetic field, helical motion of charged particles, , magnetic field due to a current element, Biot – Savart's law, Magnetic field on the axis of a circular current loop, Ampere's circuital law, the solenoid and the toroid, force between two parallel current carrying conductors, the ampere (UNIT), torque on current loop, magnetic dipole, torque on a rectangular current loop in a uniform magnetic field, circular current loop as a magnetic dipole, the magnetic dipole moment of a revolving electron, the Moving Coil Galvanometer; conversion into ammeter and voltmeter.

22. **MAGNETISM AND MATTER: Introduction,** The bar magnet, the magnetic field lines, the electrostatic analog, Magnetism and Gauss's Law, The Earth's magnetism, magnetic declination and dip.

23. **ELECTROMAGNETIC INDUCTION: Introduction,** The experiments of Faraday and Henry, magnetic flux, Faraday's Law of induction, Lenz's law and conservation of energy, motional electromotive force, energy consideration - a quantitative study, Eddy currents, inductance, mutual inductance, self-inductance, AC generator.

24. **ALTERNATING CURRENT: Introduction,** AC voltage applied to a resistor, representation of AC current and voltage by rotating vectors - Phasors, AC voltage applied to an inductor, AC voltage applied to a capacitor, AC voltage applied to a series LCR circuit, Phasor – diagram solution, analytical solution, resonance, sharpness of resonance, LC oscillations, transformers.

25. **ELECTROMAGNETIC WAVES: Introduction,** electromagnetic waves, sources of electromagnetic waves, nature of electromagnetic waves, electromagnetic spectrum: radio waves, microwaves, infrared waves, visible rays, ultraviolet rays, X-rays, gamma rays.

26. **DUAL NATURE OF RADIATION AND MATTER: Introduction,** Electron emission, Photoelectric Effect, Hertz's observations, Hallwachs and Lenard's observations, experimental study of photoelectric effect, effect of intensity of light on photocurrent, effect of potential on photoelectric current, effect of frequency of incident radiation on stopping potential, Photoelectric effect and Wave theory of Light, Einstein's Photoelectric equation, Energy Quantum of Radiation, particle nature of light, the photon, wave nature of matter, photocell.

27. **ATOMS: Introduction,** Alpha particle scattering and Rutherford's nuclear model of atom, alpha particle trajectory, electron orbits, atomic spectra, spectral series, Bohr model of the hydrogen atom, energy levels, Franck – Hertz experiment, the line spectra of the hydrogen atom, deBroglie's explanation of Bohr's second postulate of quantization, LASERlight.

28. **NUCLEI: Introduction,** Atomic masses and composition of nucleus, discovery of neutron, size of the nucleus, Mass - Energy, Nuclear Force, Nuclear Energy, Fission, Nuclear reactor, nuclear fusion, energy generation in stars, controlled thermonuclear fusion.

29. **SEMICONDUCTOR ELECTRONICS: MATERIALS, DEVICES AND SIMPLE CIRCUITS: Introduction,** Classification of metals, conductors, and semiconductors on the basis of conductivity and energy bands, Band theory of solids, Intrinsic semiconductor, Extrinsic semiconductor, p-type semiconductor, n-type semiconductor, Optoelectronic junction devices, Photodiode, light emitting diode, solar cell. Junction transistor, structure and action, Basic transistor circuit configurations and transistor characteristics, transistor as a switch and as an amplifier (CE – Configuration), Feedback amplifier and transistor oscillator, Digital Electronics and Logic gates, NOT, OR, AND, NAND and NOR Gates, Integrated circuits.

30. **COMMUNICATION SYSTEMS: Introduction,** Elements of a Communication system, basic terminology used in electronic communication systems, bandwidth of signals, bandwidth of transmission medium, propagation of electromagnetic waves, ground waves, sky waves, space wave, modulation and its necessity, size of the antenna or aerial, effective power radiated by an antenna, mixing up of signals from different transmitters, amplitude modulation, production of amplitude modulated wave, detection of amplitude modulated wave.

SUBJECT: CHEMISTRY

Unit-1: ATOMIC STRUCTURE: Developments to the Bohr's model of atom; Wave nature of electromagnetic radiation; Particle nature of electromagnetic radiation- Planck's quantum theory; Bohr's model for Hydrogen atom; Explanation of line spectrum of hydrogen; Limitations of Bohr's model; Quantum mechanical considerations of sub atomic particles; Dual behaviour of matter; Heisenberg's uncertainty principle; Quantum mechanical model of an atom. Important features of Quantum mechanical model of atom; Orbitals and quantum numbers; Shapes of atomic orbitals; Energies of orbitals; Filling of orbitals in atoms. Aufbau Principle, Pauli's exclusion Principle and Hund's rule of maximum multiplicity; Electronic configurations of atoms; Stability of half-filled and completely filled orbitals.

Unit-2: CLASSIFICATION OF ELEMENTS AND PERIODICITY IN PROPERTIES: Modern periodic law and present form of the periodic table; Nomenclature of elements with atomic number greater than 100; Electronic configuration of elements and the periodic table; Electronic configuration and types of elements s,p,d.and f blocks; Trends in physical properties:(a) Atomic radius, (b) Ionic radius (c) Variation of size in inner transition elements, (d) Ionization enthalpy,(e) Electron gain enthalpy, (f) Electro negativity; Periodic trends in chemical properties: (a) Valence or Oxidation states, (b) Anomalous properties of second period elements - diagonal relationship; Periodic trends and chemical reactivity.

Unit-3: CHEMICAL BONDING AND MOLECULAR STRUCTURE: Kossel - Lewis approach to chemical bonding, Octet rule, Lewis representation of simple molecules, formal charges, limitations of octet rule; Ionic or electrovalent bond - Factors favourable for the formation of ionic compounds-Crystal structure of sodium chloride, General properties of ionic compounds; Bond Parameters - bond length, bond angle, and bond enthalpy, bond order, resonance-Polarity of bonds dipole moment-Fajan rules; Valence Shell Electron Pair Repulsion (VSEPR) theory; Predicting the geometry of simple molecules; Valence bond theory-Orbital overlap concept-Directional properties of bonds-overlapping of atomic orbitals-types of overlapping and nature of covalent bonds-strength of sigma and pi bonds-Factors favouring the formation of covalent bonds; Hybridisation- different types of hybridization involving s, p and d orbitals- shapes of simple covalent molecules; Coordinate bond - definition with examples; Molecular orbital theory - Formation of molecular orbitals, Linear combination of atomic orbitals (LCAO)-conditions for combination of atomic orbitals - Energy level diagrams for molecular orbitals -Bonding in some homo nuclear diatomic molecules- H2, He2, Li2, B2, C2, N2 and O2; Hydrogen bonding-cause of formation of hydrogen bond - Types of hydrogen bonds-inter and intra molecular- General properties of hydrogen bonds.

Unit-4: STATES OF MATTER: GASES AND LIQUIDS: Intermolecular forces; Thermal Energy; Intermolecular forces Vs Thermal interactions; The Gaseous State; The Gas Laws; Ideal gas equation;Graham's law of diffusion - Dalton's Law of partial pressures; Kinetic molecular theory of gases; Kinetic gas equation of an ideal gas (No derivation) deduction of gas laws from Kinetic gas equation;; Behaviour of real gases - Deviation from Ideal gas behaviour - Compressibility factor Vs Pressure diagrams of real gases;

Unit-5: STOICHIOMETRY: Laws of Chemical Combinations - Law of Conservation of Mass, Law of Definite Proportions, Law of Multiple Proportions, Atomic and molecular masses-mole concept and molar mass. Concept of equivalent weight; Percentage composition of compounds and calculations of empirical and molecular formulae of compounds; Stoichiometry and stoichiometric calculations-limiting reagent; Methods of Expressing

concentrations of solutions-mass percent, mole fraction, molarity, molality and normality; Redox reactions-classical idea of redox reactions, oxidation and reduction reactions-redox reactions in terms of electron transfer; Oxidation number concept; Types of Redox reactions-combination, decomposition, displacement and disproportionationreactions; Balancing of redox reactions - oxidation number method Half reaction (ion-electron)method;.

Unit-6: THERMODYNAMICS: Thermodynamic Terms; The system and the surroundings; Types of systems and surroundings; The state of the system; The Internal Energy as a State Function. (a) Work (b) Heat (c) The general case, the first law of Thermodynamics; Applications; Work; Enthalpy, H- a useful new state function; Extensive and intensive properties; The relationship betweenC_p and C_v; Measurement of ΔU and ΔH: Calorimetry; Enthalpy change, $\Delta_r H$ of reactions - reaction Enthalpy (a) Standard enthalpy of reactions, (b) Enthalpy changes during transformations, (c) Standard enthalpy of formation, (d) Thermo chemical equations (e) Hess's law of constant Heat summation; Enthalpies for different types of reactions. (a) Standard enthalpy of combustion ($\Delta_c H^0$), (b) Enthalpy of atomization ($\Delta_a H^0$), phase transition, sublimation and ionization, (c) Bond Enthalpy ($\Delta_{bond} H^0$), (d) Enthalpy of solution ($\Delta_{sol} H^0$) and dilution-lattice enthalpy; Spontaneity. (a) Is decrease in enthalpy a criterion for spontaneity? (b) Entropy and spontaneity, the second law of thermodynamics, (c) Gibbs Energy and spontaneity; Absolute entropy and the third law ofthermodynamics.

Unit-7: CHEMICAL EQUILIBRIUM AND ACIDS-BASES: Equilibrium in Physical process; Equilibrium in chemical process - Dynamic Equilibrium; Law of chemical Equilibrium - Law of mass action and Equilibrium constant; Homogeneous Equilibria, Equilibrium constant in gaseous systems. Relationship between K_P and K_c; Heterogeneous Equilibria; Applications of Equilibrium constant; Relationship between Equilibrium constant K, reaction quotient Q and Gibbs energy G; Factors affecting Equilibria.-Le-chatlier principle application to industrial synthesis of Ammonia and Sulphur trioxide; Ionic Equilibrium in solutions; Acids, bases and salts- Arrhenius, Bronsted-Lowry and Lewis concepts of acids and bases; Ionisation of Acids and Bases - Ionisation constant of water and its ionic product- pH scale-ionisation constants of weak acids-ionisation of weak bases-relation between $K_a$and K_b-Di and poly basic acids and di and poly acidic Bases-Factors affecting acid strength- Commonion effect in the ionization of acids and bases- Buffer solutions- Solubility Equilibria of sparingly soluble salts. Solubility product constant Common ion effect on solubility of Ionic salts.

Unit-8: HYDROGEN AND ITS COMPOUNDS: Position of hydrogen in the periodic table; Dihydrogen- Occurrence and Isotopes; Hydrides: Ionic, covalent, and non-stoichiometric hydrides; Water: Physical properties; structure of water, ice. Chemical properties of water; hard and soft water, Temporary and permanent hardness of water; Heavy Water; Hydrogen as a fuel.

Unit-9: THE s - BLOCK ELEMENTS (ALKALI AND ALKALINE EARTH METALS):
Group 1 Elements : Alkali metals; Electronic configurations; Atomic and Ionic radii; Ionization enthalpy; Hydration enthalpy; Physical properties; Chemical properties; Uses; General characteristics of the compounds of the alkali metals: Oxides; Halides; Salts of oxo Acids; Anomalous properties of Lithium: Differences and similarities with other alkali

metals, Diagonal relationship; similarities between Lithium and Magnesium; Some important compounds of Sodium: Sodium Chloride

Group 2 Elements: Alkaline earth elements; Electronic configuration; Ionization enthalpy; Hydrationenthalpy; Physical properties, Chemical properties; Uses; General characteristics of compounds of theAlkaline Earth Metals: Oxides, hydroxides, halides, salts of oxoacids (Carbonates; Sulphates and Nitrates); Anomalous behavior of Beryllium; its diagonal relationship with Aluminium; Some important compounds of calcium: Preparation and uses of Calcium Hydroxide, Plaster of Paris; Cement;

Unit-10: p- BLOCK ELEMENTS GROUP 13 (BORON FAMILY): General introduction - Electronic configuration, Atomic radii, Ionization enthalpy, Electro negativity; Physical & Chemical properties (Note: Aluminum reactivity towards acids & alkalies is deleted) Important trends and anomalous properties of boron; Uses of boron, aluminium and their compounds.

Uni-11: p-BLOCK ELEMENTS - GROUP 14 (CARBON FAMILY): General introduction - Electronicconfiguration, Atomic radii, Ionization enthalpy, Electro negativity; Physical & Chemical properties; Important trends and anomalous properties of carbon; Allotropes of carbon; Uses of carbon;

Unit-12: **ORGANIC CHEMISTRY-SOME BASIC PRINCIPLES AND TECHNIQUES AND HYDROCARBONS:** General introduction; Tetravalency of Carbon: shapes of organic compounds; Structural representations of organic compounds; Classification of organic compounds; Nomenclature of organic compounds; Isomerism; Fundamental concepts in organic reaction mechanisms; Fission of covalent bond; Nucleophiles and electrophiles; Electron movements in organic reactions; Electron displacement effects in covalent bonds: inductive effect, resonance, resonance effect, electromeric effect, hyper conjugation; Types of Organic reactions;

Hydrocarbons: Classification of Hydrocarbons; **Alkanes** - Nomenclature, isomerism (structural and conformations of ethane only); Preparation of alkanes; Properties - Physical properties and chemical Reactivity, Substitution reactions – Halogenation (free radical mechanism is deleted), Controlled Oxidation, Isomerisation, Aromatization, and reaction with steam; **Alkenes-** Nomenclature, structure of ethene, Isomerism (structural and geometrical); Methods of preparation; Properties- Physical and chemical reactions: Addition of Hydrogen, halogen, water, sulphuric acid, Hydrogen halides (Mechanism-ionic and peroxide effect, Markovnikov's, anti-Markovnikov's or Kharasch effect). Oxidation, Ozonolysis and Polymerization; **Alkynes -** Nomenclature and isomerism, structure of acetylene. Methods of preparation of acetylene; Physical properties, Chemical reactions- acidic character of acetylene, addition reactions- of hydrogen, Halogen, Hydrogen halides and water. Polymerization; **Aromatic Hydrocarbons:** Nomenclature and isomerism, Structure of benzene, Resonance and aromaticity; Preparation of benzene. Physical properties. Chemical properties: Mechanism of electrophilic substitution. Electrophilic substitution reactions- Nitration, Sulphonation, Halogenation, Friedel-Craft's alkylation and acylation; Directive influence of functional groups in mono substituted benzene, Carcinogenicity and toxicity.

Unit-13: SOLID STATE: General characteristics of solid state; Amorphous and crystalline

solids; Classification of crystallinesolids based on different binding forces (molecular, ionic, metallic and covalent solids); Probing the structure of solids: X-ray crystallography; Crystal lattices and unit cells. Bravais lattices primitive and centered unit cells; Number of atoms in a unit cell (primitive, body centered and face centered cubic unit cell); Close packed structures: Close packing in one dimension, in two dimensions and in three dimensions- tetrahedral and octahedral voids- formula of a compound and number of voids filled- locating tetrahedral and octahedral voids; Packing efficiency in simple cubic, bcc and in hcp, ccp lattice; Calculations involving unit cell dimensions-density of the unit cell; Imperfections in solids-types of point defects-stoichiometric and non-stoichiometric defects;.

Unit-14: SOLUTIONS: Types of solutions; Expressing concentration of solutions - mass percentage,volume percentage, mass by volume percentage, parts per million, mole fraction, molarity and molality; Solubility: Solubility of a solid in a liquid, solubility of a gas in a liquid, Henry's law; Vapour pressure of liquid solutions: vapour pressure of liquid- liquid solutions. Raoult's law as a special case of Henry's law -vapour pressure of solutions of solids in liquids; Ideal and non-ideal solutions; Colligative properties and determination of molar mass-relative lowering of vapour pressure- elevation of boiling point-depression of freezing point-osmosis and osmotic pressure- reverse osmosis and water purification;.

Unit-15: ELECTROCHEMISTRY AND CHEMICAL KINETICS:

Electrochemistry: Electrochemical cells; Galvanic cells: measurement of electrode potentials; Nernstequation- equilibrium constant from Nernst equation- electrochemical cell and Gibbs energy of thecell reaction; Conductance of electrolytic solutions- measurement of the conductivity of ionic solutions-variation of conductivity and molar conductivity with concentration-strong electrolytes and weak electrolytes-applications of Kohlrausch's law; Electrolytic cells and electrolysis: Faraday's lawsof electrolysis-products of electrolysis; Hydrogen economy.

Chemical Kinetics: Rate of a chemical reaction; Factors influencing rate of a reaction: dependence ofrate on concentration- rate expression and rate constant- order of a reaction, molecularity of a reaction; Integrated rate equations-zero order reactions-first order reactions- half-life of a reaction; Pseudo first order reactions; Temperature dependence of the rate of a reaction -effect of catalyst;

Unit-16: SURFACE CHEMISTRY: Adsorption : Distinction between adsorption and absorption- mechanism of adsorption-types of adsorption- characteristics of physisorption-characteristics of chemisorption-adsorption isotherms-adsorption from solution phase-applications of adsorption; **Colloids**; Classification of colloids: Classification based on physical state of dispersed phase and dispersion medium- classification based on nature of interaction between dispersed phase and dispersion medium- classification based on type of particles of the dispersed phase- multi molecular, macromolecular and associated colloids-cleansing action of soaps- preparation of colloids-purification of colloidal solutions-properties of colloidal solutions: Colligative properties, Tyndal effect, colour, Brownian movement-charge on colloidal particles, electrophoresis; coagulation-precipitation methods-coagulation of lyophilic sols and protection of colloids- Colloids around us- application of colloids.

Unit-17: p-BLOCK ELEMENTS: **Group-15 Elements:** Occurrence- electronic configuration, atomic and ionic radii, ionisation enthalpy, electronegativity, physical and chemical properties; Dinitrogen-preparation, properties and uses; Compounds of nitrogen-preparation, properties and uses of ammonia; Oxides of nitrogen (note: only structures are deleted); Preparation and properties of nitric acid;

Group-16 Elements: Occurrence- electronic configuration, atomic and ionic radii, ionisation enthalpy, electron gain enthalpy, electronegativity, physical and chemical properties; Dioxygen- preparation, properties and uses; Simple oxides; Ozone-preparation, properties, structure and uses; Sulphur-allotropic forms; Sulphur dioxide-preparation, properties and uses; Oxoacids of sulphur;Sulphuric acid- properties and uses.

Group-17 Elements: Occurrence, electronic configuration, atomic and ionic radii, ionisation enthalpy, electron gain enthalpy, electro negativity, physical and chemical properties; Chlorine- preparation, properties and uses; Hydrogen chloride- preparation, properties and uses; Oxoacids of halogens; Interhalogen compounds- preparation, properties and uses.

Group-18 Elements: Occurrence, electronic configuration, ionization enthalpy, atomic radii, electron gain enthalpy, physical and chemical properties(a) Xenon-fluorine compounds- XeF_2, XeF_4 and XeF_6 -preparation, hydrolysis and formation of fluoro anions-structures of XeF_2, XeF_4 and XeF_6 (b) Xenon- oxygen compounds XeO_3 and $XeOF_4$ - their formation and structures-

Unit-18: d AND f BLOCK ELEMENTS & COORDINATIONCOMPOUNDS: d and f block elements: Position in the periodic table; Electronic configuration of the d-block elements; General properties of the transition elements (d-block) -physical properties, variation in atomic and ionic sizes of transition series, ionisation enthalpies, oxidation states, trends in the M^{2+}/M and M^{3+}/M^{2+} standard electrode potentials, trends in stability of higher oxidation states, chemical reactivity and E^{θ} values, magnetic properties, formation of coloured ions, formation of complex compounds, catalytic properties, formation of interstitial compounds, alloy formation;; Inner transition elements(f-block)-lanthanoids- electronic configuration-atomic and ionic sizes-oxidation states- Some applications of d and f block elements.

Coordination compounds: Werner's theory of coordination compounds; Definitions of some terms used in coordination compounds; Nomenclature of coordination compounds-IUPAC nomenclature; Bonding in coordination compounds. (a)Valence bond theory - magnetic properties of coordination compounds- limitations of valence bond theory (b) Crystal field theory (i) Crystal field splitting in octahedral and tetrahedral coordination entities (ii) Colour in coordination compounds- limitations of crystal field theory; Bonding in metal carbonyls; Stability of coordination compounds; applications of coordination compounds.

Unit-19: BIOMOLECULES: Carbohydrates - Classification of carbohydrates-Monosaccharides:preparation of glucose from sucrose and starch- Properties and structure of glucose- D,L configurations and (+), (-) configurations of glucose-Structure of fructose; Disaccharides: Sucrose- preparation, structure; Invert sugar- Structures of maltose and lactose- Polysaccharides: Structures of starch, cellulose and glycogen- Importance of carbohydrates (Note: Sucrose, lactose, maltose, starch, carbohydrates importance is deleted); **Proteins:** Aminoacids: Natural aminoacids-classification of aminoacids - structures and D and L forms-Zwitter ions; Proteins- Structures, classification, fibrous and

globular- primary, secondary, tertiary and quarternary structures of proteins- Denaturation of proteins; **Vitamins:** Explanation-names- classification of vitamins - sources of vitamins-deficiency diseases of different types of vitamins; **Nucleic acids:** chemical composition of nucleic acids, structures of nucleic acids, DNA finger printing biological functions of nucleic acids;

Unit-20: HALOALKANES AND HALOARENES: Classification and nomenclature; Nature of C-Xbond; Methods of preparation: Alkyl halides and aryl halides- from alcohols, from hydrocarbons (a) by free radical halogenation (b) by electrophilic substitution (c) by replacement of diazonium group (Sandmeyer reaction) (d) by the addition of hydrogen halides and halogens to alkenes-by halogen exchange reactions; Physical properties-melting and boiling points, density and solubility; Chemical reactions: Reactions of haloalkanes (i) Nucleophilic substitution reactions (a) SN^2 mechanism (b)SN^1 mechanism (c) stereochemical aspects of nucleophilic substitution reactions- optical activity (ii) Elimination reactions (iii) Reaction with metals-Reactions of haloarenes: (i) Nucleophilic substitution (ii) Electrophilic substitution and (iii) Reaction with metals;

Unit-21: ORGANIC COMPOUNDS CONTAINING C, H AND O (ALCOHOLS, PHENOLS, ETHERS, ALDEHYDES, KETONES AND CARBOXYLIC ACIDS):

Alcohols, Phenols and Ethers: Alcohols, phenols and ethers -classification; Nomenclature: (a)Alcohols, (b)phenols and (c) ethers; Structures of hydroxy and ether functional groups; Methods of preparation: Alcohols from alkenes and carbonyl compounds, from Grignard reagents; Phenols from haloarenes, benzene sulphonic acid, diazonium salts, cumene; Physical properties of alcohols and phenols; Chemical reactions of alcohols and phenols (i) Reactions involving cleavage of O-H bond in alcohols-Acidity of alcohols and phenols, esterification (ii) Reactions involving cleavage ofC- O bond- reactions with HX, PX_3, dehydration and oxidation (iii) Reactions of phenols-electrophilic aromatic substitution, Kolbe's reaction, Reimer - Tiemann reaction, reaction with zinc dust, oxidation; Ethers-Methods of preparation: By dehydration of alcohols, Williamson synthesis-Physical properties-Chemical reactions: Cleavage of C-O bond and electrophilic substitution of aromatic ethers(anisole).

Aldehydes and Ketones: Nomenclature and structure of carbonyl group; Preparation of aldehydes and ketones-(1) by oxidation of alcohols (2) by dehydrogenation of alcohols (3) from hydrocarbons -Preparation of aldehydes (1) from acyl chlorides (2) from nitriles and esters(3) from hydrocarbons-Preparation of ketones(1) from acyl chlorides (2)from nitriles (3)from benzene or substituted benzenes; Physical properties of aldehydes and ketones; Chemical reactions of aldehydes and ketones-nucleophilic addition, reduction, oxidation, reactions due toα-Hydrogen and other reactions (Cannizzaro reaction, electrophilic substitution reaction); Uses of aldehydes and ketones.

Carboxylic acids: Nomenclature and structure of carboxylgroup; Methods of preparation of carboxylic acids (1)from primary alcohols and aldehydes (2) from alkylbenzenes(3)from nitriles and amides (4)from Grignard reagents (5) from acyl halides and anhydrides (6) from esters; Physical properties; Chemical reactions: (i) Reactions involving cleavage of O-H bond-acidity, reactions with metals and alkalies (ii) Reactions involving cleavage of C-OH bond- formation of anhydride, reactions with PCl_5, PCl_3, $SOCl_2$, esterification and reaction with ammonia (iii) Reactions involving-COOH group-reduction, decarboxylation (iv) Substitution reactions in the hydrocarbon part - halogenation and ring substitution; Uses of carboxylicacids.

Unit-22: ORGANIC COMPOUNDS CONTAINING NITROGEN:

Amines: Structure of amines; Classification; Nomenclature; Preparation of amines: reduction of nitro compounds, ammonolysis of alkyl halides, reduction of nitriles, reduction of amides, Gabriel

phthalimide synthesis and Hoffmann bromamide degradation reaction; Physical properties; Chemical reactions: basic character of amines, alkylation, acylation, carbyl amine reaction, reaction with nitrousacid, reaction with aryl sulphonyl chloride, electrophilic substitution of aromatic amines (aniline)- bromination, nitration and sulphonation.

Cyanides and Isocyanides:

Structure and nomenclature of cyanides and isocyanides; Preparation, physical properties and chemical reactions of cyanides and isocyanide