Aryabhatta Talent Search Test in Mathematics and Science (TSTMS)
SYLLABUS
SCIENCE
CLASSES VI to XII & UG. and PG.

The Aryabhatta Talent Search Test in Mathematics and Sciences (ATSTMS) is a prestigious competition organised by **the Indian Mathematics and Science Association** that challenges students to enhance their knowledge and skills in various areas of Science and Mathematics. The exam pattern consists of multiple-choice questions and problem-solving tasks to assess understanding of students scientific temperament. The syllabus for TSTMS covers a variety of topics. Participants must apply theoretical knowledge to solve real-world problems and think critically about complex problems.

Junior Aryabhatta Talent Search Test in Science (VI-XII)

Class 6

Physics
Physical Quantities of Measurement, Motion and Measurement of Distances, Light, Shadows and Reflections, Electricity and Circuits, Fun with Magnets, Our Environment.

Chemistry

Sorting and Separation of Materials, States of Water, Compounds and Mixture, Changes Around Us, Fibre to Fabric, Garbage in Garbage Out, Natural Resources (Air, Water, Forests, Sun: The Source of Energy, Soil, Rocks and Minerals, Fossil Fuels, Renewable and Non-Renewable Resources).

Biology

Living Organisms and Their Surroundings, Healthy diet: The foundation of healthy body, Food and its Components, The Cell, Living Organisms and Their classifications, Movement in living beings, Life Cycle of Plants and Animals), Nature's invaluable wealth.

CLASS 7

Physics
Heat, Motion and Time, Electric Current and its Effects, Winds, Storms and Cyclones, Light.
Chemistry
Acids, Bases and Salts, Physical and Chemical Changes, Fibre to Fabric.
Biology
Nutrition in Plants and Animals, Respiration in Organisms, Transportation in Plants and Animals, Reproduction in Plants and Animals, Natural Resources and Their Conservation, Forest: Our life line, Weather, Weatherr and Adaptations of Animals to Climate.

CLASS 8

Physics

Force and Pressure, Friction, Sound, Chemical Effects of Electric Current, Some Natural Phenomena, Light, Stars and the Solar System.

Chemistry

Metals and Non-metals, Coal and Petroleum, Combustion and Flame, Pollution of Air and Water, Synthetic Fibres and Plastics.

Biology

Crop Production and Management, Microorganisms: Friend and Foe, but Conservation of Plants and Animals, Cell-Structure and Function, Reproduction in Animals, Reaching the age of Adolescence.

CLASS 9

Physics

Motion, Force and Laws of Motion, Gravitation, Work and Energy, Sound.

Chemistry

Matter in our Surroundings, Is Matter Around Us Pure, Atoms and Molecules, Structure of Atoms.

Biology

Cell - The Fundamental Unit of Life, Tissues, Diversity in Living Organisms, Why Do We Fall ill , Natural Resources, Improvement in Food Resources.

CLASS 10

Physics

Light-Reflection and Refraction, Human Eye and Colourful World, Electricity, Magnetic Effects of Electric Current.

Chemistry

Chemical Reactions and Equations, Acids, Bases and Salts, Metals and Non-metals, Carbon and its Compounds, Periodic Classification of Elements, .

Biology

Life Processes, Reproduction in Organisms, Control and Coordination in plants and animals, Heredity and Evolution, Our Environment and Its Management.

Chapter–1: Units and Measurements

UNIT 1: Units and Measurements Units of measurements, System of units, SI Units, fundamental and derived units, Dimensions of Physics quantities, dimensional analysis and its applications.

Unit 2-Kinematics

Motion in a Straight Line

The frame of reference, motion in a straight line, speed and velocity, uniform and non-uniform motion, average speed and instantaneous velocity, uniformly accelerated motion, velocity-time, position-time graph, relations for uniformly accelerated motion, relative velocity. Motion in a plane, projectile motion, uniform circular motion.

Chapter–3: Motion in a Plane

Scalar and vector quantities; position and displacement vectors, general vectors and their notations; equality of vectors, multiplication of vectors by a real number; addition and subtraction of vectors, relative velocity, Unit vector; resolution of a vector in a plane, rectangular components, Scalar and Vector product of vectors.
Motion in a plane, cases of uniform velocity and uniform acceleration-projectile motion, uniform circular motion.

Chapter–5: Laws of Motion

Force and inertia, Newton's first law of motion, momentum, Newton's second Law of motion, impulse, Newton's third Law of motion. Law of conservation of linear momentum and its applications, equilibrium of concurrent forces. Static and Kinetic friction, laws of friction, rolling friction. Dynamics of uniform circular motion, centripetal force and its applications: vehicle on a level circular road, vehicle on a banked road.

Chapter–6: Work, Energy and Power

Work done by a constant force and a variable force, kinetic and potential energies, work-energy theorem, power. The potential energy of a spring, conservation of mechanical energy,

conservative and non- conservative forces, motion in a vertical circle. Elastic and inelastic collisions in one and two dimensions

Chapter–7: System of Particles and Rotational Motion

Centre of mass of a two-particle system, centre of mass of a rigid body. Basic concepts of rotational motion, moment of a force, torque, angular momentum, conservation of angular momentum and its applications. The moment of inertia, the radius of gyration, values of moments of inertia ,radius of gyration, value of moments of inertia for simple geometrical objects, parallel and perpendicular axes theorems and their applications. Equilibrium of rigid bodies, rigid body rotation and equations of rotational motion, comparison of linear and rotational motions

Chapter–8: Gravitation

The universal law of gravitation. Acceleration due to gravity and its variation with altitude and depth. Kepler's law of planetary motion. Gravitational potential energy, gravitational potential. Escape velocity, motion of a satellite, orbital velocity, time period and energy of satellite

Chapter–9: Mechanical Properties of Solids

Stress-strain relationship, Hooke's law, Young's modulus, bulk modulus

Chapter–10: Properties of Solid and Fluids

Elastic behaviour, stress-strain relationship, Hooke's Law, Young's modulus, bulk modulus and modulus of rigidity. Pressure due to a fluid column, Pascal's law and its applications, effect of gravity on fluid pressure, viscosity, Stoke's law, terminal velocity, streamline and turbulent flow, critical velocity, Bernoulli's principle and its applications. Surface energy and surface tension, angle of contact, excess of pressure across a curved surface, application of surface tension: drops, bubbles and capillary rise. Heat, temperature, thermal expansion, specific heat capacity, calorimetry, change of state, latent heat. Heat transfer: conduction, convection and radiation.

Chapter–11: Thermal Properties of Matter
Heat, temperature,(recapitulation only) thermal expansion; thermal expansion of solids, liquids and gases, anomalous expansion of water; specific heat capacity; Cp, Cv - calorimetry; change of state - latent heat capacity.
Heat transfer-conduction, convection and radiation (recapitulation only), thermal conductivity, qualitative ideas of Blackbody radiation, Wein's displacement Law, Stefan's law, Greenhouse effect.

Chapter–12: Thermodynamics

Thermal equilibrium and the concept of temperature, zeroth law of thermodynamics, heat, work and internal energy. The first law of thermodynamics, isothermal and adiabatic processes. The second law of thermodynamics: reversible and irreversible processes

Chapter–13: Kinetic Theory

Equation of state of a perfect gas, work done on compressing a gas, kinetic theory of gases: assumptions, the concept of pressure, kinetic interpretation of temperature, RMS speed of gas molecules, degrees of freedom, law of equi-partition of energy and applications to specific heat capacities of gases, mean free path, Avogadro's number.

Chapter–14: Oscillations and Wave

Oscillations and periodic motion: time period, frequency, displacement as a function of time, periodic functions. Simple harmonic motion (S.H.M.) and its equation, phase, oscillations of a spring: restoring force and force constant, energy in S.H.M.:

kinetic and potential energies, simple pendulum: derivation of expression for its time period.

Wave motion, longitudinal and transverse waves, speed of the travelling wave, displacement relation for a progressive wave, principle of superposition of waves, reflection of waves, standing waves in strings and organ pipes, fundamental mode and harmonics, beats.

(PHYSICS)

CLASS 12

Unit I: Electrostatics

Electrostatics Electric charges: conservation of charge, Coulomb's law forces between two point charges, forces between multiple charges, super position principle and continuous charge distribution.

Electric field: electric field due to a point charge, electric field lines, electric dipole, electric field due to a dipole, torque on a dipole in a uniform electric field. Electric flux, Gauss's law and its applications to find field due to infinitely long uniformly charged straight wire, uniformly charged infinite plane sheet and uniformly charged thin spherical shell.

Electric potential and its calculation for a point charge, electric dipole and system of charges, potential difference, equipotential surfaces, electrical potential energy of a system of two point charges and of electric dipole in an electrostatic field. Conductors and insulators, dielectrics and electric polarization, capacitors and capacitance, the combination of capacitors in series and

parallel and capacitance of a parallel plate capacitor with and without dielectric medium between the plates, energy stored in a capacitor.

Unit II: Current Electricity

Current Electricity Electric current: drift velocity, mobility and their relation with electric current, Ohm's law, electrical resistance, I-V characteristics of Ohmic and non-ohmic conductors, electrical energy and power, electrical resistivity and conductivity, series and parallel combinations of resistors, temperature dependence of resistance. Internal resistance, potential difference and emf of a cell, a combination of cells in series and parallel. Kirchhoff's laws and their applications, Wheatstone bridge, Metre Bridge.

Unit III: Magnetic Effects of Current and Magnetism

Magnetic Effects of Current and Magnetism Biot - Savart law and its application to the current carrying circular loop, Ampere's law and its applications to infinitely long current carrying straight wire and solenoid. Force on a moving charge in uniform magnetic and electric fields, force on a current-carrying conductor in a uniform magnetic field, the force between two parallel currents carrying conductors-definition of ampere, torque experienced by a current loop in a uniform magnetic field: Moving coil galvanometer, its sensitivity and conversion to ammeter and voltmeter. Current loop as a magnetic dipole and its magnetic dipole moment, bar magnet as an equivalent solenoid, magnetic field lines, magnetic field due to a magnetic dipole (bar magnet) along its axis and perpendicular to its axis, torque on a magnetic dipole in a uniform magnetic field, para-, dia- and ferromagnetic substances with examples, the effect of temperature on magnetic properties.

Unit IV-Electromagnetic Induction and Alternating Currents

Electromagnetic induction: Faraday's law, induced emf and current, Lenz's law, eddy currents, self and mutual inductance. Alternating currents, peak and RMS value of alternating current/voltage, reactance and impedance, LCR series circuit, resonance, power in AC circuits, wattless current, AC generator and transformer.

UNIT V: Electromagnetic Waves

Displacement current, electromagnetic waves and their characteristics, transverse nature of electromagnetic waves, electromagnetic spectrum (radio waves, microwaves, infrared, visible, ultraviolet, X-rays, Gamma rays), applications of electromagnetic waves.

UNIT VI-Optics

Reflection of light, spherical mirrors, mirror formula. Refraction of light at plane and spherical surfaces, thin lens formula and lens maker formula, total internal reflection and its applications, magnification, power of a lens, combination of thin lenses in contact, refraction of light through a prism, Scattering of light-blue colour of sky and reddish appearance of the sun at sunrise and sunset, microscope and astronomical telescope (reflecting and refracting) and their magnifying powers.

Wave optics: wavefront and Huygens 'Principle, laws of reflection and refraction using Huygens principle. Interference: Young's double-slit experiment and expression for fringe width, coherent sources and sustained interference of light. Diffraction due to a single slit, width of central maximum. Polarization: plane-polarized light, Brewster's law, uses of plane- polarized light and Polaroid

Unit VII: Dual Nature of Radiation and Matter

Dual Nature of Matter and Radiation Dual nature of radiation, Photoelectric effect, Hertz and Lenard's observations, Einstein's photoelectric equation, particle nature of light. Matter waves: wave nature of particle, de- Broglie relation.

Unit VIII: Atoms and Nuclei
Alpha-particle scattering experiment, Rutherford's model of atom, Bohr model, energy levels, hydrogen spectrum. Composition and size of nucleus, atomic masses, mass-energy relation, mass defect, binding energy per nucleon and its variation with mass number, nuclear fission and fusion.

Unit IX: Electronic Devices

Semiconductors, semiconductor diode: I-V characteristics in forward and reverse bias, diode as a rectifier; I-V characteristics of LED, the photodiode, solar cell, Zener diode, Zener diode as a voltage regulator. Logic gates (OR. AND. NOT. NAND and NOR).

Chapter–14: Semiconductor Electronics: Materials, Devices and Simple Circuits Energy bands in conductors, semiconductors and insulators (qualitative ideas only) Semiconductor diode - I-V characteristics in forward and reverse bias, diode as a rectifier; Special purpose p-n junction diodes: LED, photodiode, solar cell and Zener diode and their characteristics, zener diode as a voltage regulator.

1.PHYSICAL CHEMISTRY
Unit I:

Some Basic Concept in Chemistry: Matter and its nature, Dalton's atomic theory, Concept of atom, molecule, element and compound, Laws of chemical combination, Atomic and molecular masses, mole concept, molar mass, percentage composition, empirical and molecular formulae, Chemical equations and stoichiometry.

Unit II: Atomic Structure

Nature of electromagnetic radiation, photoelectric effect, spectrum of the hydrogen atom, Bohr model of a hydrogen atom - its postulates, derivation of the relations for the energy of the electron and radii of the different orbits, limitations of Bohr's model, dual nature of matter, de Broglie's relationship, Heisenberg uncertainty principle, elementary ideas of quantum mechanics, the quantum mechanical model of the atom and its important features, concept of

atomic orbitals as one-electron wave functions, variation of ψ and ψ^2 with r for 1s and 2s

orbitals, various quantum numbers (principal, angular momentum and magnetic quantum numbers) and their significance, shapes of s, p and d - orbitals, electron spin and spin quantumnumber, rules for filling electrons in orbitals – Aufbau principle, Pauli's exclusion principle and Hund'srule, electronic configuration of elements and extra stability of half-filled and completely filled orbitals.

Unit III: Classification of Elements and Periodicity in Properties

Modern periodic law and the present form of periodic table, periodic trends in properties of elements -atomic radii, ionic radii, inert gas radii, Ionization enthalpy, electron gain enthalpy, electronegativity, valency. Nomenclature of elements with atomic number greater than 100.

Unit IV: Chemical Bonding and Molecular Structure:

Kossel-Lewis approach to chemical bond formation, the concept of ionic and covalent bonds. Ionic Bonding: Formation of ionic bonds, factors affecting the formation of ionic bonds; calculation of lattice enthalpy. Covalent Bonding: Concept of electronegativity, Fajan's rule, dipole moment, Valence Shell Electron Pair Repulsion (VSEPR) theory and shapes of simple molecules. Quantum mechanical approach to covalent bonding: Valence bond theory - its important features, the concept of hybridization involving s, p and d orbitals, resonance. Molecular Orbital Theory - Its important features, LCAOs, types of molecular orbitals (bonding, antibonding), sigma and pi-bonds, molecular orbital electronic configurations of homonuclear di atomic molecules, the concept of bond order, bond length and bond energy. Elementary idea of metallic bonding, hydrogen bonding and its application.

Unit V: States of Matter: Gases and Liquids

JEE-Three states of matters, Gas laws and ideal gas equation, absolute scale of temperature;Boyle's law, Charles law, Gay Lussac's law, Avogadro's law, ideal behaviour, empirical derivation of gas equation, Avogadro's number,ideal gas equation and deviation from ideal behavior. Deviation from ideality, van der Waals equation; Kinetic theory of gases, average, root mean square and most probable velocities and their relation with temperature; Law of partial pressures; Diffusion of gases. Intermolecular interactions: types, distance dependence, and their effect on properties; Liquids: vapour pressure, surface tension, viscosity.

Unit VI: Chemical Thermodynamics

JEE-Fundamentals of thermodynamics: System and surroundings, extensive and intensive properties, state functions, entropy, types of processes. The first law of thermodynamics - Concept of work, heat, internal energy and enthalpy, heat capacity, molar heat capacity, Hess's law of constant heat summation, Enthalpies of bond dissociation, combustion, formation, atomization, sublimation, phase transition, hydration, ionization and solution. The Second law of thermodynamics; Entropy; Gibbs energy; Criteria of equilibrium and spontaneity.

Unit VII: Chemical and Ionic Equilibrium

Chemical and Ionic Equilibrium Law of mass action; Significance of ΔG and $\Delta G^{\ominus}$ in chemical equilibrium; Equilibrium constant (K_p and K_c) and reaction quotient, Le Chatelier's principle (effect of concentration, temperature and pressure); Solubility product and its applications, common ion effect, pH and buffer solutions; Acids and bases (Brønsted and Lewis concepts); Hydrolysis of salts.

Unit VIII: Redox Reactions

Concept of oxidation and reduction, redox reactions, oxidation number, balancing redox reactions, in terms of loss and gain of electrons and change in oxidation number.

Unit IX: Hydrogen

Position of hydrogen in periodic table, occurrence, isotopes, preparation, properties and uses of hydrogen; hydrides – ionic, covalent and interstitial; physical and chemical properties of water, heavy water; hydrogen peroxidepreparation, reactions, use and structure; hydrogen as a fuel.

Unit X: s-Block Elements (Alkali and Alkaline Earth Metals)

General introduction, electronic configuration, occurrence, anomalous properties of the first element of each group, diagonal relationship, trends in the variation of properties (such as ionization enthalpy, atomic and ionic radii), trends in chemical reactivity with oxygen, water, hydrogen and halogens, uses.
Alkali and alkaline earth metals-reactivity towards air, water, dihydrogen, halogens, acids; their reducing nature including solutions in liquid ammonia; uses of these elements; general characteristics of their oxides, hydroxides, halides, salts of oxoacids; anomalous behaviour of lithium and beryllium; preparation, properties, and uses of compounds of sodium (sodium carbonate, sodium chloride, sodium hydroxide, sodium hydrogen carbonate) and calcium (calcium oxide, calcium hydroxide, calcium carbonate, calcium sulphate).

Unit XI: Some p-Block Elements

p-Block Elements Oxidation state and trends in chemical reactivity of elements of groups 13-17; anomalous properties of boron, carbon, nitrogen, oxygen, and fluorine with respect to other elements in their respective groups.

Group 13: Reactivity towards acids, alkalis, and halogens; preparation, properties, and uses of borax, orthoboric acid, diborane, boron trifluoride, aluminium chloride, and alums; uses of boron and aluminium.

Group 14: Reactivity towards water and halogen; allotropes of carbon and uses of carbon; preparation, properties, and uses of carbon monoxide, carbon dioxide, silicon dioxide, silicones, silicates, zeolites.

Unit XII: Organic Chemistry -Some Basic Principles and Techniques

General introduction, classification and IUPAC nomenclature of organic compounds .Electronic displacements in a covalent bond: inductive effect, electromericeffect, resonance and hyper conjugation. Homolytic and heterolytic fission of a covalent bond: free radicals, carbocations, carbanions, electrophiles andnucleophiles, types of organic reactions.

Hybridisation of carbon; σ and π-bonds; Shapes of simple organic molecules; aromaticity; Structural and geometrical isomerism; Stereoisomers and stereochemical relationship (enantiomers, diastereomers, meso) of compounds containing only up to two asymmetric centres (R,S and E,Z configurations excluded); Determination of empirical and molecular formulae of simple compounds by combustion method only; Acidity and basicity of organic compounds.

Unit XIII: Hydrocarbons

Classification of Hydrocarbons Aliphatic Hydrocarbons:

Alkanes-Nomenclature, isomerism, conformation (ethane and butane only), physical properties, chemical reactions.

Alkenes - Nomenclature, structure of double bond (ethene), geometrical isomerism, physical properties, methods of preparation, chemical reactions: addition of hydrogen, halogen, water, hydrogen halides (Markovnikov's addition and peroxide effect), ozonolysis, oxidation, mechanism of electrophilic addition.

Alkynes - Nomenclature, structure of triple bond (ethyne), physical properties, methods of preparation, chemical reactions: acidic character of alkynes, addition reaction of - hydrogen, halogens, hydrogen halides and water.

Aromatic Hydrocarbons:

Introduction, IUPAC nomenclature, benzene: resonance, aromaticity, chemical properties: mechanism of electrophilic substitution. Nitration, sulphonation, halogenation, Friedel Craft's alkylation and acylation, directive influence of functional group in monosubstituted benzene. Carcinogenicity and toxicity.

Unit I: Solutions

Different methods for expressing the concentration of solution - molality, molarity, mole fraction, percentage (by volume and mass both), the vapour pressure of solutions and Raoult's Law- Ideal and nonideal solutions, vapour pressure - composition, plots for ideal and non- ideal solutions, Colligative properties of dilute solutions - a relative lowering of vapour pressure, depression of freezing point, thee elevation of boiling point and osmotic pressure, determination of molecular mass using colligativ eproperties, abnormal value of molar mass, van't Hoff factor and its significance. Henry's law;

Unit II: Electrochemistry

Redox reactions, conductance in electrolytic solutions, specific and molar conductivity, variations of conductivity with concentration, Kohlrausch's Law, electrolysis and law of electrolysis (elementary idea), dry cell-electrolytic cells and Galvanic cells, lead accumulator, EMF of a cell, standard electrode potential, Nernst equation and its application to chemical cells, Relation between Gibbs
energy change and EMF of a cell, fuel cells, corrosion.

Unit III: Chemical Kinetics

Rate of a chemical reaction, factors affecting the rate of reactions: concentration, temperature, pressure and catalyst, elementary and complex reactions, order and molecularity of reactions, rate law and specific rate constant and its units, differential and integral forms of zero and first-order reactions, their characteristics and half-lives, the effect of temperature on the rate of reactions, Arrhenius theory, activation energy and its calculation, collision theory of bi-molecular gaseous reactions (no derivation). Catalysis: Homogeneous and heterogeneous, activity and selectivity of solid catalysts, enzyme catalysis and its mechanism.

Unit IV: Surface Chemistry

Elementary concepts of adsorption: factors affecting adsorption of gases on solids, catalysis, homogenous and heterogenous activity and selectivity; enzyme catalysis colloidal state distinction between true solutions, colloids and suspension; lyophilic, lyophobic multi-molecular and macromolecular colloids; properties of colloids; Tyndall effect, Brownian movement, electrophoresis, coagulation, emulsion - types of emulsions.

Unit V: General Principles and Processes of Isolation of Elements

Principles and methods of extraction - concentration, oxidation, reduction -electrolytic method and refining; occurrence and principles of extraction of aluminium, copper, zinc and iron

Unit VI: p -Block Elements

Group 15: Reactivity towards hydrogen, oxygen, and halogen; allotropes of phosphorous; preparation, properties, and uses of dinitrogen, ammonia, nitric acid, phosphine, phosphorus trichloride, phosphorus pentachloride; oxides of nitrogen and oxoacids of phosphorus.

Group 16: Reactivity towards hydrogen, oxygen, and halogen; simple oxides; allotropes of sulfur; preparation/manufacture, properties, and uses of dioxygen, ozone, sulfur dioxide, sulfuric acid; oxoacids of sulfur.

Group 17: Reactivity towards hydrogen, oxygen, and metals; preparation/manufacture, properties, and uses of chlorine, hydrogen chloride and interhalogen compounds; oxoacids of halogens, bleaching powder.

Group 18: Chemical properties and uses; compounds of xenon with fluorine and oxygen

Unit VII: 'd' and 'f' Block Elements

Transition Elements: General introduction, electronic configuration, occurrence and characteristics of transition metals, general trends in properties of the first row transition metals -metallic character, ionization enthalpy, oxidation states, ionic radii, colour, catalytic property, magnetic properties, interstitial compounds, alloy formation, preparation and properties of $K_2Cr_2O_7$ and $KMnO_4$.

Lanthanoids - Electronic configuration, oxidation states, chemical reactivity and lanthanoid contraction and its consequences.

Unit VIII: Coordination Compounds

Coordination compounds - Introduction, ligands, coordination number, colour, magnetic properties and shapes, IUPAC nomenclature of mononuclear coordination compounds. Bonding, Werner's theory, Valence Bond Theory and Crystal Field Theory; structure and stereo isomerism, importance of coordination compounds (in qualitative inclusion, extraction of metals and biological system).

Unit IX: Haloalkanes and Haloarenes

Haloalkanes: Nomenclature, nature of C-X bond, physical and chemical properties, mechanism of substitution reactions, optical rotation.

Haloarenes: Nature of C-X bond, substitution reactions, Reactions: Fittig, Wurtz-Fittig; Nucleophilic aromatic substitution in haloarenes and substituted haloarenes (excluding benzyne mechanism and cine substitution).

Uses and environmental effects of - dichloromethane, trichloromethane, tetrachloromethane, iodoform, freons, DDT.

Unit X: Alcohols, Phenols and Ethers

Alcohols: Nomenclature, methods of preparation, physical and chemical properties (of primary alcohols only), identification of primary, secondary and tertiary alcohols, mechanism of dehydration, uses with special reference to methanol and ethanol.Reactions with: sodium, phosphorus halides, $ZnCl_2$/concentrated HCl, thionyl chloride; Conversion of alcohols into aldehydes, ketones and carboxylic acids.

Phenols: Nomenclature, methods of preparation, physical and chemical properties, acidic nature of phenol, Electrophilic substitution reactions of phenol (halogenation, nitration, sulphonation); Reimer-Tiemann reaction, Kolbe reaction; Esterification; Etherification; Aspirin synthesis; Oxidation and reduction reactions of phenol.

Ethers: Nomenclature, methods of preparation, physical and chemical properties, uses. Preparation by Williamson's synthesis; C-O bond cleavage reactions

Unit XI: Aldehydes, Ketones and Carboxylic Acids

Aldehyde and Ketones: methods of preparation, physical and chemical properties, mechanism of nucleophilic addition, reactivity of alpha hydrogen in aldehydes, uses.

Nature of carbonyl group, nucleophilic addition to >C=Ogroup, relative reactivities of aldehydes and ketones, important reactions such as - Nucleophilic addition reactions (addition of HCN, NH3 and its derivatives), Grignard reagent, oxidation, reduction (Wolf Kishner and Clemmensen), the acidity of � -hydrogen. Aldol condensation, Cannizzaro reaction, Haloform reaction, chemical tests to distinguish between aldehydes and ketones. Carboxylic Acids: Physical properties; Preparation: from nitriles, Grignard reagents, hydrolysis of esters and amides; Preparation of benzoic acid from alkylbenzenes; Reactions: reduction, halogenation, formation of esters, acid chlorides and amides.

Unit XII: Organic compounds containing Nitrogen
General methods of preparation, properties, reactions and uses. Amines: Nomenclature, classification, structure, basic character and identification of primary, secondary and tertiary amines and their basic character.

Diazonium Salts: Importance in synthetic organic chemistry.
Cyanides and Isocyanides - will be mentioned at relevant places in text.
Diazonium salts: Preparation, chemical reactions and importance in synthetic organic chemistry.

Verify: Preparation from nitro compounds, nitriles and amides; Reactions: Hoffmann bromamide degradation, Gabriel phthalimide synthesis; Reaction with nitrous acid, Azo coupling reaction of diazonium salts of aromatic amines; Sandmeyer and related reactions of diazonium salts; Carbylamine reaction, Hinsberg test, Alkylation and acylation reactions.

Unit XIII: Biomolecules

Carbohydrates- Classification (aldoses and ketoses), monosaccahrides (glucose and fructose), D-L configuration oligosaccharides (sucrose, lactose, maltose), polysaccharides (starch, cellulose, glycogen); Importance of carbohydrates.

Proteins -Elementary idea of - amino acids, peptide bond, polypeptides, proteins, structure of proteins - primary, secondary, tertiary structure and quaternary structures (qualitative idea only), denaturation of proteins; enzymes. Hormones - Elementary idea excluding structure.

Vitamins- Classification and functions. Nucleic Acids – Chemical constitution and structure of DNA and RNA, biological functions of nucleic acids.

Unit XIV: Polymers

Types of polymerization (addition, condensation); Homo and copolymers; Natural rubber; Cellulose; Nylon; Teflon; Bakelite; PVC; Bio-degradable polymers; Applications of polymers.

Unit XV: Chemistry in Everyday life

Chemicals in medicines - analgesics, tranquilizers antiseptics, Therapeutic action, analgesics,disinfectants, antimicrobials, antifertility drugs, antibiotics, antacids, antihistamines. Chemicals in food - preservatives, artificial sweetening agents, elementary idea of anti oxidants. Cleansing agents- soaps and detergents, cleansing action.

Unit I: Diversity of Living Organisms

Chapter 1: The Living World Characteristics of living organisms. Taxonomy and systematics. Binomial nomenclature. Concept of species and taxonomic hierarchy. Taxonomical aids: herbaria, botanical gardens, museums, and zoological parks.

Chapter 2: Biological Classification Five Kingdom classification by R.H. Whittaker. Features of Monera, Protista, Fungi, Plantae, and Animalia. Viruses, viroids, and lichens.

Chapter 3: Plant Kingdom Classification and characteristics of algae, bryophytes, pteridophytes, gymnosperms, and angiosperms. Life cycle patterns (alternation of generations).

Chapter 4: Animal Kingdom

Basis of classification: symmetry, coelom, segmentation, notochord. Features of non-chordates (up to phyla) and chordates (up to classes) (salient features and distinguishing features of a few examples of each category). **(No live animals or specimens should be displayed.)**

Unit II: Structural Organisation in Animals and Plants

Chapter 5: Morphology of Flowering Plants Root, stem, leaf, inflorescence, flower, fruit, and seed morphology. Description of families: Fabaceae, Solanaceae, and Liliaceae.

Chapter 6: Anatomy of Flowering Plants Tissues: meristematic and permanent. Anatomy of dicot and monocot roots, stems, and leaves. Secondary growth.

Chapter 7: Structural Organisation in Animals Animal tissues: epithelial, connective, muscular, and nervous. Morphology and anatomy of earthworm, cockroach, and frog.

Unit III: Cell: Structure and Function

Chapter 8: Cell – The Unit of Life Cell theory, prokaryotic and eukaryotic cells. Cell organelles and their functions. Plasma membrane structure and transport mechanisms.

Chapter 9: Biomolecules Structure and function of carbohydrates, proteins, lipids, nucleic acids. Enzymes, their properties, and mechanism of action.

Chapter 10: Cell Cycle and Cell Division, Phases of the cell cycle. Mitosis and meiosis: stages, significance, and differences.

Unit IV: Plant Physiology

Chapter 11: Transport in Plants Transport mechanisms: diffusion, facilitated diffusion, active transport. Water potential and osmotic relations. Transpiration and long-distance transport.

Chapter 12: Mineral Nutrition Essential minerals and their roles. Mineral deficiency symptoms.

Nitrogen cycle and nitrogen fixation.

Chapter 13: Photosynthesis in Higher Plants Photosynthetic pigments. Light and dark reactions. C4 pathway and photorespiration. Factors affecting photosynthesis.

Chapter 14: Respiration in Plants

Glycolysis, Fermentation, Krebs cycle, and electron transport system. Aerobic and anaerobic respiration. Energy production and respiratory quotient, Amphibolic pathway.

Chapter 15: Plant Growth and Development. Phases and rate of growth. Plant growth regulators- Auxin, Cytokinin, Gibberellin, Ethylene and Absissic acid. Photoperiodism and vernalization.

Unit V: Human Physiology

Chapter 16: Digestion and Absorption Human digestive system. Digestive enzymes. Absorption of nutrients and associated disorders.

Chapter 17: Breathing and Exchange of Gases.

Respiratory system anatomy. Mechanism of breathing and its regulation in humans. Exchange of gases and regulation of respiration, respiratory volume. Disorders related to respiration - asthma, emphysema, occupational respiratory disorders.

Chapter 18: Body Fluids and Circulation

Composition of blood and lymph and its function. Idea of blood group and coagulation of blood. Anatomy of the circulatory system. Cardiac cycle and ECG. Structure of human heart and blood vessels; cardiac cycle, double circulation; disorders of circulatory system - hypertension, coronary artery disease, angina pectoris, heart failure.

Chapter 19: Excretory Products and Their Elimination. Human excretory system. Urine formation. Regulation of kidney function. Modes of excretion - ammonotelism, ureotelism, uricotelism.

Osmoregulation; regulation of kidney function.

Chapter 20: Locomotion and Movement Types of movement. Human skeletal system. Joints and muscle contraction. Skeletal muscle, contractile proteins.

Chapter 21: Neural Control and Coordination Structure and functions of neurons. Human nervous system. Reflex actions. Generation and conduction of nerve impulse, Neurotransmitters.

Chapter 22: Chemical Coordination and Integration Endocrine glands – Hypothalamus, pituitary, pineal, thyroid, parathyroid, adrenal, pancreas, gonads;

Role of hormones in body functions as messengers and regulators, hypo - and hyperactivity and related disorders; dwarfism, acromegaly, cretinism, goitre, exophthalmic goitre, diabetes, Addison's disease

Unit I: Reproduction

Chapter 1: Reproduction in Organisms

Asexual Reproduction: Understanding methods like binary fission, budding, fragmentation, and spore formation.

Sexual Reproduction: Comprehending the phases of sexual reproduction -pre-fertilization, fertilization, and post-fertilization events.

Life Cycles: Studying different life cycle patterns—haplontic, diplontic, and haplodiplontic.

Chapter 2: Sexual Reproduction in Flowering Plants

Flower Structure: Detailed study of the parts of a flower and their roles in reproduction.

Gametogenesis: Development of male (pollen grains) and female (embryo sac) gametophytes.

Pollination: Types (self and cross), agents (wind, water, insects), and mechanisms promoting outbreeding.

Fertilization: Process of double fertilization unique to angiosperms.

Post-Fertilization Events: Formation of endosperm, embryo, seed, and fruit.

Chapter 3: Human Reproduction

Reproductive Systems: Anatomy and functions of male and female reproductive systems.

Gametogenesis: Spermatogenesis and oogenesis processes.

Menstrual Cycle: Phases and hormonal regulation.

Fertilization and Pregnancy: Events from fertilization to implantation, embryonic development, and parturition.

Chapter 4: Reproductive Health

Reproductive Health: Importance and strategies for maintaining reproductive health.

Contraception: Various methods and their significance.

Infertility and ART: Causes of infertility and assisted reproductive technologies like IVF and ICSI.

Unit II: Genetics and Evolution

Chapter 5: Principles of Inheritance and Variation Mendelian Genetics: Laws of inheritance, monohybrid and dihybrid crosses.

Chromosomal Theory: Linkage and recombination concepts.

Sex Determination: Mechanisms in humans and other organisms.

Genetic Disorders: Understanding disorders like hemophilia, thalassemia, and color blindness.

Chapter 6: Molecular Basis of Inheritance DNA and RNA: Structure, function, and differences.

Replication: Semi-conservative method of DNA replication.Transcription and Translation: Processes of protein synthesis. Genetic Code: Features and significance. Gene Expression Regulation: Operon concept and its applications.

Chapter 7: Evolution

Origin of Life: Theories and experiments supporting abiogenesis.Evolution Theories: Lamarckism, Darwinism, and modern synthetic theory.Evidence of Evolution: Fossils, embryology, and molecular evidence.Human Evolution: Evolutionary trends and fossil records.

Unit III: Biology and Human Welfare

Chapter 8: Human Health and Disease Diseases: Types, causes, and prevention of common diseases.

Immunity: Innate and acquired immunity, vaccines, and immunization. Pathogens: Study of bacteria, viruses, and other pathogens causing diseases.

Chapter 9: Strategies for Enhancement in Food Production Plant Breeding: Objectives and methods for crop improvement. Animal Husbandry: Techniques in dairy, poultry, and fishery management.

Biotechnology in Agriculture: Use of GMOs and biofortification.

Chapter 10: Microbes in Human Welfare Microbes in Industry: Role in fermentation and antibiotic production.

Microbes in Environment: Use in sewage treatment and biocontrol agents.

Biofertilizers: Importance in sustainable agriculture.

Unit IV: Biotechnology and Its Applications

Chapter 11: Biotechnology – Principles and Processes; Genetic Engineering: Tools like restriction enzymes, cloning vectors, and PCR. Recombinant DNA Technology: Steps involved in gene cloning.

Chapter 12: Biotechnology and Its Applications; Agricultural Applications: Development of pest-resistant and high-yield crops. Medical Applications: Production of insulin, vaccines, and gene therapy. Ethical Issues: Concerns related to GMOs and biopiracy.

Unit V: Ecology and Environment

Chapter 13: Organisms and Populations; Ecological Adaptations: Behavioral and physiological adaptations in organisms. ; Population Ecology: Growth models, life history variations, and population interactions.

Chapter 14: *Ecosystem*:- Ecosystem Structure: Components and energy flow.

Ecological Pyramids: Types and significance. Nutrient Cycles: Carbon and nitrogen cycles.

Chapter 15: *Biodiversity and Conservation*; Biodiversity Levels: Genetic, species, and ecosystem diversity.

Conservation Strategies: In-situ and ex-situ methods.

Biodiversity Hotspots: Importance and examples.

Chapter 16: *Environmental Issues:-*

Pollution: Types, causes, and control measures. Global Environmental Changes: Ozone depletion, global warming, and deforestation. Waste Management: Strategies for sustainable development.