

## SCHOOL ASSISTANT - PHYSICAL SCIENCES SYLLABUS

### Part – I

#### GENERAL KNOWLEDGE AND CURRENT AFFAIRS (Marks: 10)

### Part - II

#### PERSPECTIVES IN EDUCATION (Marks: 10)

1. History of Education : Pre-Vedic and Post-Vedic period, Medieval Education, Recommendations of various committees during British period with special reference to Woods Despatch (1854), Hunter Commission (1882), Hartog Committee (1929), Sargent Committee (1944), Recommendations of various committees during post independent period with special reference to Mudaliar Commission (1952-53), Kothari Commission(1964-66), Ishwarbhai Patel committee (1977), NPE-1986, POA-1992
2. Teacher Empowerment: Meaning, interventions for empowerment, Professional code of conduct for teachers, Teacher motivation, Professional development of Teachers and Teacher organizations, National / State Level Organizations for Teacher Education, Maintenance of Records and Registers in Schools.
3. Educational Concerns in Contemporary India: Environmental Education, Meaning and scope of Environmental Education, Concept of sustainable development, Role of Teacher, School and NGOs in development and protection of environment, Democracy and Education, Equality, Equity, Quality in Education, Equality of Educational opportunities, Economics of Education, Meaning and scope, Education as Human Capital, Education and Human Resource Development, Literacy – Saakshar Bharat Mission, Population Education, Significance of Population Education, Population situation, policies and programmes in India, Approaches to Population Education and role of school and teacher, Themes of population Education, Family life Education, Sustainable development, Adolescence Education, Health Education, Gender – Equality, Equity and Empowerment of Women, Urbanization and migration, Life skills, Inclusive Education, Conceptual Clarification and Definition, Prevalence, Myths & Facts, Characteristics, Classification & Types, Importance of Early Identification and assessment, Planning Inclusive Education, Classroom Management in Inclusive Education, Evaluation, Documentation and Record Maintenance, Psycho-Social management, Awareness & Sensitization Strategies, Liberalization, Privatization and Globalization, Value Education, Sarva Siksha Abhiyan, National Programme for Education of Girls at Elementary Level (NPEGEL), Mid-day-meals, Rashtriya Madhyamika Siksha Abhiyan(RMSA), KGBVs and SUCCESS Schools.
4. Acts / Rights: Right of Children to Free and Compulsory Education Act, 2009, Right to Information Act, 2005, Child Rights, Human Rights

5. National Curriculum Framework, 2005: Perspective, Learning and Knowledge, Curricular Areas, School Stages and Assessment, School and Classroom Environment, Systemic Reforms

### **Part - III**

#### **CONTENT (Marks: 44)**

1. MEASUREMENT, UNITS AND DIMENSIONS: Systems of Measurement, Units of Measurements, Measurement of Length, Triangulation Method, Measuring Instruments, Vernier calipers, Screw Gauge Measurement of Area, Volume, Time, Measurement of Mass and Density, Measuring instruments. Units and Dimensions Fundamental and derived physical quantities, Systems of units, Multiples and submultiples of SI units. Dimensions Dimensional formulae and dimensional equations, dimensional constants and dimensionless quantities, principle of homogeneity of dimensions. Application of dimensional method of analysis. Conversion of one system of units into another, derivation of relationship between different physical quantities.
2. NATURAL RESOURCES AIR AND WATER: Air, Composition of air, Measurement of Atmospheric Pressure, Air Pollution, Volumetric Composition of Water, Hardness of Water, Drinking Water and Supply Water Pollution, Cyclone, Pascal's Law, Archimedes' Principle, Boyle's Law, Bernoulli's Principle, Wind, Rainfall.
3. OUR UNIVERSE: Constellations, Zodiac, Solar System, Stars, Meteors and Comets, Light year, Life on the Planet – Earth.
4. NATURAL PHENOMENA
  - A. Light - Sources & Nature of Light, Propagation of Light, Reflection, Refraction, Laws of Reflection, Image formed by Plane Mirror, Reflection on Spherical Mirrors, Refraction of Light through Prism and lenses (convex, concave), camera and the human eye, Refractive index of material of prism, critical angle, Total Internal Reflection – Relation between Critical angle and Refractive Index, application of total internal reflection to Optical fibers. visual photometry, LASERS. Newton's Corpuscular Theory, Huygens' Wave Theory, Electromagnetic spectrum. Huygens' Explanation of Reflection, Refraction, interference and diffraction of plane waves at a plane surface, Optical Instruments-Microscope, Telescope, Formula for magnification of microscope, Astronomical and Terrestrial Telescopes.
  - B. Sound-Wave motion :Wave Motion, Longitudinal and transverse waves, Equation for a progressive wave, principle of superposition of waves, reflection of waves, Formation of waves on stretched string. Sound - Propagation of sound, Musical Instruments, Velocity of Sound in Gases, Solids & Liquids, Progressive & stationary waves, Characteristics of sound. Forced Vibrations, Natural Vibrations – Resonance with examples, standing waves in Organ Pipes, Open Pipes, Closed Pipes. Sound Reflection, Echoes, Absorption of sound waves, Reverberation – Reverberation Time. Fundamentals of building Acoustics, Sound Pollution.

C. Heat - Sources of Heat, Transmission of Heat, Heat and Temperature its Units, Measurement of Temperature, Fahrenheit and Centigrade scales, Different types of thermometers, Effects of Heat Expansion of solids, liquids, gaseous, Change of state, Calorimetry – specific heat of solids and liquids, calorific values of fuels, latent heat of fusion and latent heat of vaporization, Change of density with temperature, Examples in daily life. Expansion of liquids-coefficients of real and apparent expansion of liquids. Determination of coefficient of apparent expansion of liquid by specific gravity bottle method. Anomalous expansion of water, its significance in nature. Expansion of Gases-Volume and pressure coefficients of gases. Kelvin scale of temperature, Boyle's and Charles's laws. Ideal gas equation. Heat capacity, specific heat, experimental determination of specific heat by method of mixtures. Specific heat of gas ( $C_p$  and  $C_v$ ), External work done by a gas during its expansion. Relation between  $C_p$  and  $C_v$  (derivation) Latent heat, Determination of latent heat of vaporization of water.

#### 5. KINEMATICS AND DYNAMICS

Kinematics: Motion-Types of Motion, Speed, Velocity, Velocity-time and position-time graphs, Scalars and Vectors, laws of addition of vectors, subtraction of vectors. Acceleration, Newton's law's of Motion, Newton's Universal Gravitation, Centre of Gravity, Stability, Applications, Equations of Motion, Motion of a body under gravity – Acceleration due to Gravity "g", Equations of Motion for a freely falling body, Equations of Motion for a body thrown upwards. Equations, applications and problems. DYNAMICS - Work, Power, Energy, Conservation of Energy and Transformation of Energy, Renewable and Non-Renewable sources of Energy, Impulse, Law of conservation of linear momentum, Potential Energy (PE), Kinetic Energy (KE). Relation between KE and Linear momentum. Circular Motion, uniform circular motion, angular displacement, angular velocity, and angular acceleration, relationship between linear velocity and angular velocity, centripetal and centrifugal force, torque, couple, vector representation of torques, Banking of Roads & Rail Tracks, Simple Harmonic Motion, Simple Pendulum, Law of conservation of energy in case of a simple pendulum. Elasticity - Elasticity and plasticity, stress and strain, Hooke's law, Moduli of elasticity. Fluid Mechanics Laws of Floatation, Principle of Buoyancy, pressure in a fluid. Stream line flow Bernoulli's theorem and its applications. Simple Machines and Moments Moment of a Force, Wheel and Axle, Screw Jack, Gears, Friction, Causes of friction, advantages of friction, disadvantages of friction, methods of reducing friction.

#### 6. MAGNETISM - Natural and Artificial Magnets, Properties of Magnets, Magnetic Induction. Terrestrial magnetism, Magnetic field around a magnet, elements of terrestrial magnetism, Theory of Magnetism, Inverse square of magnetism, Magnetic field due to a bar magnet, Mapping of magnetic lines of force due to a bar magnet : neutral points, magnetic properties of materials.

Coulomb's Inverse Square Law, Definition of Magnetic Field, Magnetic Lines of Force, Uniform and Non-Uniform Magnetic Fields. Couple acting on a bar magnet placed in a uniform magnetic field, Definition of magnetic moment of magnet. Magnetic Induction due to a bar magnet on axial and equatorial lines. Types of magnetic material, Para, Dia, and Ferro magnetism, Definition and properties.

## 7. ELECTRICITY

Electrostatics - Electrification by friction, Charges, Coulomb's Law: Permittivity of Free Space and Medium, Electric Field – Electric lines of force, their properties – Electric intensity, Electrostatic Potential, Relation between electrostatic potential and electric intensity. Capacitance and capacitors, Dielectric constant, Condenser, its uses –Dielectric Strength – Effect of dielectric on capacitance of capacitors. Current electricity - Primary Cells-Series and Parallel connection-Electric circuits, Electrical Resistance, Ohm's Law and its verification, Ohmic and Non Ohmic elements, Resistance Resistances in Series and Parallel, Heating Effects of Electric Current- Joule's Law, Faraday's Laws of Electrolysis, Magnetic Effects of Electric Current, Principle and Working of an Electric Motor, Electro – Magnetic Induction. Electric current – Flow of Electric charges in a metallic conductor – Drift velocity and mobility – Relation between electric current and drift velocity, Conductance, Electrical Energy – Power.

## 8. ELECTROMAGNETISM - Electromagnetic Waves, Spectrum Oersted's Experiment, Ampere's Law, Magnetic field near a long straight wire and magnetic field at the Center of a circular coil carrying current, Field on the axis of circular coil carrying current, Force on a moving charge in a magnetic field – Force on a current carrying conductor placed in a magnetic field. Force between two long straight parallel conductors carrying current, Definition of Ampere. Fleming's Left Hand Rule. Current loop as magnetic dipole, force and Torque on Current loop in an uniform magnetic field, magnetic dipole moment of a revolving electron. Electromagnetic induction, Magnetic Flux, Induced EMF, Faraday's and Lenz's Law. Fleming's Right Hand Rule, Self Inductance, Mutual Inductance, Principle of Transformer.

## 9. MODERN PHYSICS:

Atomic physics - Discharge of Electricity through gases, X-rays. Atomic structure, atomic number, atomic mass and mass defect, radioactivity, artificial transmutation. Discovery of electron – E/M of electron by Thomson's method. X-Rays- Production of X-Rays – Coolidge tube. Nuclear physics - Composition and size of nucleus, mass defect and binding energy and their relation. Radio Activity- Artificial Transmutation of elements, Nuclear Radiation Hazards, Protective shielding. Nuclear Fusion – Energy of sun and stars.

Semi conductor devices - Band theory of solids, Intrinsic and Extrinsic Semiconductors, Junction Diodes and Transistors, Properties and Uses,

Basic Principles of Working Intrinsic and Extrinsic semi conductors (n and p type). Junction diode – p–n junction, depletion layer and barrier potential, Forward and Reverse bias, Transistor Function of Emitter, base and Collector, p-n-p and n-p-n Transistors.

10. COMMUNICATION SYSTEMS: Computer-Parts of Computer-Uses of Computer, Telephone, Wireless System-Radio Broad Casting, Recording and Reproduction of Sound, Cine projector, Elements of communication systems (block diagrams only), Television, Bandwidth of signals (speech TV and digital data) bandwidth of Transmission medium – Propagation of electromagnetic waves in the atmosphere sky and space wave propagation. Modulation – Need for modulation.
11. States of Mater - Gases and Liquids: Measurable Properties of Gases, Gas Laws, Graham's law of diffusion – Daltons law of partial pressures, Avagadro's law, Ideal behavior, empirical derivation of gas equation, ideal gas equation, Kinetic molecular theory of gases, Kinetic gas equation (No derivation) – deduction of gas laws.
12. Atomic Structure: Matter – Its Structure, Cathode Rays, Canal Rays, Discovery of Neutron, Atomic Models – Arrangement of Sub Atomic Particles, Rutherford's model of atom and its drawbacks, Bohr's model of atom and its limitations, Sommerfeld's elliptical model, Sub Energy Levels – Quantum Numbers, Atomic Orbitals, Relative energies of the atomic orbitals, Electronic configuration of Atoms, Some Physical Quantities of Atoms, Nature of Electromagnetic Radiation, Planck's Quantum theory. Explanation of Photo electric effect. Features of Atomic Spectra. Characteristics of Hydrogen Spectrum. Bohr's explanation of Spectral Lines, Wave-particle nature of electron, De Brogile's hypothesis, Heisenberg's uncertainty principle, Important feature of the quantum mechanical model of an atom, Electronic configurations of atoms – Explanation of stability of half filled and completely filled orbitals.
13. Classification of Elements And Periodicity in Properties: Symbols and formulae, Radicals and their formulae, Chemical equation, Meaning, Calculations based on equations and relationship of reactants and products by weights, Classification of Elements, The Periodic Law, Modern Periodic Table, The significance of atomic number and electronic configuration, Classification of elements into s, p, d, f blocks and their characteristics, Period trends in physical and chemical properties of elements, Periodic trends of elements with respect to atomic radii, ionic radii, inert gas radii, ionization energy, electron gain energy, electro negativity, Valency, Variation of atomic radii in inner transition elements.

#### Alkali and Alkaline Earth Metals

Alkaline Earth Metals, Electronic configuration, occurrence, Trends in properties of alkaline earth metals, Reactions of alkaline earth metals,

General methods of preparation of Alkaline Earth Metals, Anomalous properties of the first element in each group, Diagonal relationship. Trends in properties like ionization, enthalpy, atomic and ionic radii, reactivity with oxygen, hydrogen, halogens and water, uses, Preparation and properties of some important compounds by different methods: Sodium hydroxide, Salts of oxo acids, Sodium carbonate and Sodium hydrogen carbonate, Sodium chloride, Biological importance of sodium and potassium,  $\text{CaO}$ ,  $\text{CaCO}_3$  and  $\text{CaSO}_4$  preparation and uses, Industrial uses of lime and lime stone, Biological importance of Mg and Ca

P-Block Elements; Group 15 Elements (VA)

Occurrence – physical states of Nitrogen and Phosphorous, allotropy, catenation, capacity, electronic configuration, oxidation states, General Characteristics of Hydrides, Structure of hydrides, General Characteristics of Oxides, General Characteristics of Halides, Oxoacids of Nitrogen, Oxoacids of Phosphorous, Preparation and uses of Nitric acid and Ammonia, Superphosphate of lime. Group 16 Elements: Group (VI A) Elements) : Extraction of Sulphur, Allotropic forms of Sulphur, Physical and Chemical properties of Sulphur, Uses of Sulphur, Preparation of Sulphur dioxide, Manufacture of Sulphuric acid, Properties of Sulphuric acid, Sulphuric acid as oxidizing and dehydrating agent, Laboratory preparation of Hydrogen Sulphide, Properties of Hydrogen Sulphide, Occurrence, electronic configuration, oxidation states, Physical states of oxygen and sulphur and their structure, allotropy, General characteristics of hydrides, oxides and halides, Structural aspects of oxy-acids of halogens, Ozone, uses of ozone. Sodium thiosulphate, Sulphuric acid – industrial process of manufacture. Group 17 Elements : (Group VII A Elements) : Occurrence, electronic configuration and oxidation states, Physical states of halogens, I.P. Values, electro-negativity and electron affinity, bond energies, chemicals reactivity, oxidizing power of chlorine, Structural aspects of oxy acids of chlorine, Preparation, properties and uses of chlorine and bleaching powder. Hydrogen and its Compounds - Volumetric composition of water, Industrial and other uses of water, Laboratory preparation, Properties and Uses of Hydrogen including as a fuel, Laboratory preparation, Properties and Uses of Oxygen, Position of hydrogen in the periodic table, Occurrence, isotopes of hydrogen, Reactions of Hydrogen with different types of elements leading to ionic, molecular hydrides, Physical and Chemical properties of water and heavy water.

#### 14. Chemical Bonding and Molecular Structure

Types of Bonds, Inter Molecular Attractions, Energy changes during a chemical reaction, Exothermic and Endothermic Relations, ionic bond, energy changes in ionic bond formation, Properties of ionic Compounds, Covalent Bond, Multiple Covalent Bonds, Shapes of some molecules. VSEPR theory, The valence bond approach for the formation of covalent bonds, Directional nature of covalent bond, Properties of covalent bond, Different types of

hybridization involving s, p and d orbitals and draw shapes of simple covalent molecules, Definition of coordinate covalent bond with examples, Description of molecular orbital theory of homo nuclear diatomic molecules, Bonding, antibonding molecular orbitals,  $\sigma$ ,  $\pi$  bond orbitals, their symmetry.

#### 15. Chemical Kinetics, Energetics, Chemical Calculations And Stoichiometry

Chemical combination, Chemical decomposition, Chemical displacement, Chemical Double decomposition, Slow and Fast reactions, Rate of a Reaction, Factors affecting the reaction rate, Reversible and Irreversible Reactions, Law of conservation of mass, Law of definite proportions, Law of multiple proportions, Rate law, units of rate constant, Collision theory of reaction rates (elementary ideas), concepts of activation energy. Stoichiometry - Meaning of Chemical Equations, Thermochemical Equations, Problems Based on Equations, Laws of chemical combination, principles and examples, Molar mass, concept of equivalent weight with examples, Percentage composition of compounds and calculations of empirical and molecular formula of compounds, Oxidation number concept, Balancing of redox reactions by ion electron method and oxidation number method, Types of redox reactions, Applications of redox reactions in titrimetric quantitative analysis and redox reactions in electrode process, Numerical calculations based on equations. Equilibrium - Differences between Physical and Chemical change, Equilibrium in physical and chemical process, Dynamic nature of equilibrium, law of mass action, Equilibrium Constant, Factors affecting equilibrium.

#### 16. Solutions, Acids And Bases

Solutions, Types, Solubility and Factors affecting concentration of solutions, Ionization of Substances in Water, Classification of solutions – Methods of expressing concentration of solutions – Molarity, Normality, Molality, Mole Fraction, Preparation of Acids and Bases, General properties of Acids and Bases, Arrhenius Theory, The Strengths of Acids and Bases, Neutralisation and Heat of Neutralisation, Ionization of acids and bases, strong and weak electrolytes, degree of ionization, ionic product of water, Concept of pH., pH of some common fluids, Common Salt, Electrolysis of brine, Chlorine, Properties of Chlorine, Uses of Chlorine, Hydrogen Chloride

#### 17. Chemistry of Carbon Compounds

Allotropic forms of Carbon, Oxides of Carbon, Uniqueness of Carbon and Source of Carbon Compounds, Anomalous behavior of first element namely Carbon, Carbon-catenation, allotropic forms, physical and chemical properties and uses, Fuel gases – producer gas and water gas manufacture and uses. Hydrocarbons -Classification : Alkanes – Nomenclature, isomerism, conformations, Methods of preparation of ethane, Physical properties, chemical reactions including free radical mechanism of Halogenation, combustion and Pyrolysis of Ethane, Cycloalkanes, preparation and properties of cyclohexane. Alkenes – Nomenclature, structure of double bond (Ethene), Geometrical isomerism, physical properties, Methods of preparation of

ethylene, Physical properties, chemical reactions : Addition of hydrogen, halogen, Water, Hydrogen halides (Markownikoff's addition and Peroxide Effect), Ozonolysis, Oxidation, Mechanism of Electrophilic addition. Alkynes – Nomenclature, Structure of triple bond, Methods of preparation of acetylene, Physical properties, Chemical reactions: Acidic character of acetylene, addition reaction of hydrogens, 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 mono-substituted benzenes; carcinogenicity and Toxicity.

#### 18. Carbohydrates, Proteins, Vitamins & Lipids

Carbohydrates, Manufacture of Cane-sugar, Manufacture of Alcohol, Classification (aldoses and ketoses), Monosaccharides (glucose and fructose), Oligosaccharides (sucrose, lactose, maltose), Polysaccharides (starch Cellulose, Glycogen – Preparation, properties and structure, Importance. Proteins - Elementary idea of amino acids, peptide bond, Poly peptides, Proteins, Primary Structure, secondary structure, Tertiary structure and quaternary structure (qualitative ideas only), De-naturation of proteins, enzymes. Vitamins - Classification, Functions in biosystems. Lipids - Classification, structural features, Functions in biosystems.

#### 19. Chemistry & Industry

Uses of Oils and Fats, Hydrogenation of Oils, Manufacture of Soap, Portland Cement, Glass Industry, Plastics, Adhesives and Man-made Fibres, Cosmetics, Dyes, Drugs and Pharmaceuticals, Petroleum Industry, Common Fertilizers, Classification of polymers, Addition, condensation, copolymerization, Natural rubber, vulcanization of rubber, synthetic rubber Molecular weights of polymers – number average and weight average, molecular weights – definitions only, Bio-Polymers, bio-degradable polymers Some commercially important polymers like polythene, nylon, polyesters and Bakelite.

#### 20. General Principles Of Metallurgy

Occurrence and Relative Abundance of metals in earth's crust, The Metallurgy of Iron & Extraction, Protection of Metals and Prevention of Corrosion, Principles and methods of extraction – concentration, reduction by chemical and electrolytic methods and refining

#### 21. Environmental Chemistry

Pollution: Air, Water and Soil Pollution, Oxides of Carbon, Carbon Monoxide, Oxides of nitrogen and Sulphur, Chlorofluoro carbons, Chemical reactions in atmosphere, smogs, major atmospheric pollutants, acid rain, Ozone and its reactions, effects of depletion of ozone layer, Green house effect and global warming, Pollution due to industrial wastes, Green chemistry as an alternative tool for reducing pollution with two examples.

### Part – IV



**Teaching Methodology (Marks: 16)**

1. The Nature of Science: Nature and scope of science, Science, ideology and Society, Structure of Science (a) Substantive structure – Empirical knowledge, Theoretical Knowledge – (Facts, Concepts, hypothesis, theory, Principle Law), (b) Syntactic Structure of Science – Scientific inquiry, Processes of Science, Attitudes of inquiry
2. The History and Development of Science: A brief introduction to oriental and western science, Contribution of the following Scientists in the Development of Science: Aryabhata, BhaskaraCharya, Aristotle, Copernicus, Newton, Einstein, C.V.Raman, Various organizations working for the development of science in India
3. Aims and Values of teaching Physical Sciences: Aims of teaching Physical Sciences, Values of teaching Physical Science, Correlation of Physics and Chemistry with other subjects
4. Objectives of teaching Physical Sciences: Meaning and importance of objectives, Bloom's Taxonomy of Educational objectives, Specific / Behavioral objectives / (Instructional objectives), Critique on Bloom's Taxonomy
5. Approaches and Methods of teaching Physical Sciences: Inductive and Deductive Approaches, Micro Teaching, Team Teaching, Lecture Method, Lecture cum Demonstration Method, Historical Method, Heuristic Method, Project Method, Laboratory method, Problem Solving Method, Scientific Method, Multimedia Approach in Teaching Learning process, Programmed Learning, CAI and CAL
6. Planning for effective instruction in Science: Year Plan, Unit Plan, Lesson Plan, Learning experience, characteristics, classification, source and relevance.
7. Teaching Learning Material (TLM): Characteristics and Importance of TLM, Classification and Types of TLM, Hardware and Software in TLM, TLM-Principles to be followed, Edgar Dale's cone of learning experience.
8. Science laboratories: Importance of Practical work in science, Planning of Science laboratories, Procurement, care and maintenance of laboratory equipment, Registers, Management of safety and science kits, Development of improvised Apparatus.
9. Physical Science Curriculum: Principles of Curriculum Construction, Defects in the existing school science curriculum, Qualities of a good Science Text Book.
10. Non-formal Science Education: Science Clubs, Science Fairs – purposes, levels, organization, advantages, Science Library, Role of NGOs and State in popularizing Science
11. Evaluation: Concept and Process of Evaluation, Tools of Evaluation, Preparation of Scholastic Achievement Test (SAT), Analysis and interpretation of Scores