SECONDARY (CLASSES IX AND X)

PHYSICAL SCIENCE (GRAD)

PHYSICS

MECHANICS AND GENERAL PROPERTIES OF MATTER

Rest and motion, reference frame, displacement, velocity and acceleration, momentum, kinematical equations in one, two and three dimensions, elementary problems.

Review of elementary vector algebra, Newton's laws of motion; inertia, units of force, impulse and impulsive forces; conservation of linear momentum; elastic collision of particles moving in the same line; static and kinetic friction; co-efficient of friction.

Definition of work, relevant units. Mechanical energy, Kinetic and potential, conservation of energy; the case of a freely falling body. Power-definitions, units.

Newton's law of universal gravitation on (Statement and mathematical relation), constant of gravitation (definition and value with units, no experimental determination) Definitions of the terms strees, strain elastic limit, Hooke's law, moduli of elasticity.

Archimedes principal, statement Transmission of fluid pressure, pascals law, principle of multiplication of force.

Viscosity: Definition units, dimension, Poiseulle's equation for flow of liquid in narrow tubes, streamline and turbulent motions, critical velocity, Stoke's law for highly viscous liquids.

Surface Tension: Definition, Surface tension and surface energy. Capillary rise, rise of liquid through a capillary tube of insufficient length.

HEAT

Nature of heat and temperature, Thermal expansion of solids and liquids.: Co-efficient of linear, superficial and cubical expansion of solids; their relation. Real and apparent expansion of liquids; relation between expansion co-efficient. Boyle's law. Equation of state of an ideal gas; volume and pressure co-efficient; Absolute scale of temperature. Heat as a form of energy; relation between calorie and erg; specific heats of gases (elementary ideas). Heat engine, Carnot cycle efficiency, power generation.

Definition and explanation of the terms; conduction, convection and radiation of heat.

LIGHT

Reflection on plane and curved surfaces, Laws of reflection, definition of real and virtual images, definition of centre of curvature, pole, principal axis, principal focus, focal length of a curved surface.

Refraction of light, laws of refraction definition of refractive index (relative and absolute); total internal reflection, critical angle, relationship between refractive index and critical angle. Formation of mirages.

Convex and concave lenses – Different cases of image formation for both types of lenses.

Basic definition – principal axis, principal foci, power of lenses.

Convex lens as a magnifying glass.

Dispersion of light, pure and impure spectra – definition only

Interference: Definition, sustained interference, Newton's ring.

Diffraction: Definition, Fresnel & Fraunhofer class of diffraction. Difference between Fresnel & Fraunhofer class of diffraction.

SOUND

Simple harmonic motion, periodic motion, time period, frequency, amplitude and phase (definition only) Free vibrations-longigudinal and transverse. Characteristics of progressive waves, wavelength, amplitude of wave, time period, frequency, velocity of wave and their relation. Laws of reflection and refraction of sound waves, formation of echo, Characteristics of standing or stationery wave and comparison with progressive wave.

Vibration of air column in a tube closed at one end open at both ends.

Beats-simple explanation.

MAGNETISM, ELECTROSTATICS, CURRENT ELECTRICITY

Permanent and temporary magnet – Explanations only. Definition-magnetic meridian, magnetic field, magnetic intensity. Magnetic lines of force.

Definitions only – Magnetic permeability and susceptibility, dia, para and ferromagnetic substance.

Definition: Declination, Dip and Horizontal component of earth's magnetic field; their explanation.

Coulomb's law of force between two point charges, permittivity, electrostatic unit of charge, electric intensity. Potential difference between two points; e.s.u. of potential, practical unit of potential.

Development of e.m.f. in the cell, defects of cell, Ohm's law, volt, ampere and ohm; resistance, resistivity, factors on which resistance of a conductor depends, combination of resistances in series and parallel. Equivalent resistance. Kirchoff's laws.

Joule's law, Mechanical equivalent of heat (Definition)

Electrical energy, power unit of power and energy, Board of trade unit of electrical energy.

Thermo-electricity, Seebeck and pelitier effect, thermo e.m.f. Thermo current, thermo couple.

Faraday's laws of electrolysis, chemical and electrochemical equivalents.

Ampere's swimming rule, right hand rule, Maxwell's cork-screw rule, Fleming's left hand rule, Fundamental motor rule, Fleming's right hand rule, construction of galvanometer, ammeter and voltmeter, Magnetic induction, Magnetic flux, flux density, Faraday's law of induction, Lenz's law of induction. Definition of rms and mean value of A.C. voltage and current.

MODERN PHYSICS

Induction of electricity through gases, Cathode ray and their principal properties, X-rays properties, nature of X-rays use X-rays.

Photo electric phenomena. Compton effect.

Bohr's Model of atom; fundamental postulates (deduction of Bohr's formula is not required) de Broglie and Planck hypothesis.

Fundamental constituent of atom. Principal constituents of nucleus; atomic number, isotopes. Mass number.

N-type and P-type semiconductor. Diode as rectifier. Zener diode.

Transistor, amplifier, oscillator, communication principal, modulation and demodulation, optical communication and fiber optics.

Radio-active decay law-statement only. Half-life and decay constant. Radio-isotopes-artificial transmutation of elements with simple illustration. Nuclear fission-mention of their importance and uses.

CHEMISTRY

Unit-1: Atomic Structure, Radioactivity, Nuclear Chemistry and Chemical Periodicity

A. Bohr Model of atom. Bohr's theory (including simple mathematical treatment for hydrogen atom); Sommerfeld model (simple idea); Quantum numbers and their significance, Pauli Exclusion Principle, energy order of orbitals, electronic configuration of atoms; nature & shapes of s & p orbitals (qualitative treatment).

B. Nuclear Chemistry – Natural radioactivity, nuclear radioactivity, nuclear stability (neutron-proton) ratio, binding energy); Law of radioactive disintegration, times for fractional disintegrations. The Uranium series, group displacement law, Isotops, Isobars, Isotones. Elementary idea of nuclear reactions (details not required) artificial radioactivity, fission and fusion reactions (simple examples), separation of isotopes (principles of diffusion & thermal methods) and their uses in medicine and agriculture, radio carbon dating.

C. Periodic classification of elements of the basis of electronic configuration. Major periodic properties. Atomic & ionic radii. Ionization potential, electron affinity & elector negativity (qualitative treatment only) and their variation in respect of s- and p- block elements.

Unit-2: Gaseous State of Matter, Ideal and Non-Ideal Solutions, Phase Equalibria and Colloids.

A. The gaseous state, Laws of partial pressure & volumes; Graham's law of diffusion; Kinetic theory of gases; mean, r.m.s. and the most probable velocities, ideal gas laws from kinetic theory; Kinetic energies of gas molecules, specific heats of gases. Dumas' and Victor Meyer's method for determination of vapour densities; limiting densities, abnormal vapour denisities. Real gases, Amagat's Curves, Andrew's curves, Andrew's isothermals, the critical state, van der Waal's equation, its application at the critical state.

B. The colligative properties of dilute solution. Osmosis, osmotic pressure, lowering of vapour pressure, elevation of boiling point & depression of freezing point-experimental determination, relevant laws, their applications & conditions of validity; abnormal colligative effects.

C. Conductance of electrolytic solution – its experimental determination. Specific, equivalent & molar conductances, their variation with concentration; conductance at infinite dilution. Kohlrausch's law. Ion conductance. Ionic mobility; transport number, determination by Hittorf's method. Application of conductance measurement; determination of ionization constants of weak electrolytes, solubility of sparingly soluble salts, Conduct metric titrations.

D. The phase equalibria - The phase rule (derivation not required); phase diagrams of one component systems; water & sulphur; Applications of phase rule; Henry's law, Nernst distribution law; distillation behaviour of completely miscible binary liquid mixtures.

E. The colloidal state- Classification (dispersion, association & macromolecular colloids); preparation purification & stability (lyophobic & lyophilic); peptisation & coagulation; properties – physical, colligative, optical, kinetic & electrical. Protective colloids, gold number, isoelectric point.

Unit-3: Chemical Thermodynamics, Chemical Kinetics and Their Applications, Acid-Base and Redox Equalibria

A. Thermodynamic systems & surroundings, the properties of variables of state, the internal energy & the enthalpy. First law, reversible & irreversible processes, the maximum work, the thermodynamic criteria of ideal gases, P-V-T relationship of ideal gas under isothermal & adiabatic conditions, Joule Thomson effect. Thermo chemistry: Heats of reaction at constant pressure & constant volume; thermo chemical equations in terms of enthalpy changes, the standard heats of combustion, formation & transition; Heat of solution; Hess's Law. The Carnot cycle, second law of thermodynamics, elementary idea of entropy; Helmholtz free energy & Gibb's free energy; their relevance in respect of spontaneity or otherwise of physico chemical processes.

B. Chemical equilibrium: law of mass action, Kp & Kc; Le-Chatelier & Braun's principle of mobile equilibrium; simple illustrations of homogeneous chemical equalibria, variation of equilibrium constant with temperature; van't Hoff equation (derivation not required).

C. Ionic equilibria, water as an ionizing solvent, ionic product of water, pH of aqueous solutions, measurement of pH, (hydrogen electrode & colour maching methods); Acid-Base theory: Bronsted- Lowry concept, Lewis concept, Molecular structural effects on acid-base properties. Ostwald's dilution law; solubility product & its applications, common ion effect. Salt hydrolysis, buffer solutions and their pH. Acid-base indicators.

D. Electromotive force; reversible & irreversible electrodes – chemical cells; standard cells; measurement of e.m.f.; Electrode potentials, type of electrodes; standard electrode potentials (std. hydrogen electrode), their significance; E.M.F. series; Nernst equations for electrode potential (with derivation0, Reference electrodes.

E. Chemical Kinetics – molecularity & order of reactions, rate equations; experimental determination of rate constants, chain reactions & photochemical reactions (simple illustrations only), Catalysis: its criteria, simple illustrations of homogeneous & heterogeneous catalysis, auto & iduced catalysis; catalyst poisons, catalyst promoters; enzyme catalysis.

Unit -4: Chemical Bonding and Structure

A. Chemical bonds – ionic, convalent (polar, non polar) type and nature of bond of carbon with $H_2O_2N_2$ halogen and carbon; co-ordinate bond, hydrogen-bonding and its effect on physical properties, intermolecular forces, hybrid orbials (involving s & p orbitals) of carbon & its stereochemistry; optical and geometrical isomerism (ene unsaturation & two asymmetric centres). Structure of simple binary molecules: AX_1, AX_2, AX_3, AX_4 (relating to [s & p] hybrid orbitals only); bond polarity, simple ideas of electro negativity, dipoe moment, metallic bond.

B. Qualitative ideas of inductive, resonance & electromeric effects, hyper conjugation, simple ideas of mechanisms of electrophilic & nucleophilic substitutions (definition with examples); condensation, free radical, polymerization, and addition reactions.

C. Double & complex salts; perfect & imperfect complexes. .Werner theory of coordination, isomerism for coordination number 4 and 6. IUPAC nomenclature of co-ordination compounds (mononuclear complexes only), chelate complexes and their applications in chemical analysis.

Unit- 5: Chemistry of Elements & their Compounds (1)

A. Noble Gases: Occurrence & isolation of noble gases (from liquid air – no technical detail required); uses of noble gases; Xenon fluorides; preparations, properties & uses.

B. Study of the elements & their compounds (as mentioned below with regard to their preparation, properties bonding and uses unless otherwise mentioned)

(i) Boron and Aluminium: Boron trifluoride & trichloride; borazine, boron nitride; boron trioxide, $NaBH_4$, boric acid & borax, Al_2O_3, $AlCl_3$, $LiALH_4$, alum.

(ii) Carbon, Silicon Germanium, Tin & Lead: General comparative study of carbon & silicon with respect to their normal hydrides, halides, oxides & oxy acids, Silicon carbide; Sodium silicate; Silicate; Silicic acid, Silca gel, Hydrofluosilicic acid, Silicon tetrafluoride and tetrachloride, Calcium carbide.

(iii) Nitrogen, Phosphorus, Arsenic, Antimony and Bismuth: Comparative study of the elements and their compounds (like normal hydrides, halides, oxides and oxyacids) Hydroxylamine, Hydrazine and Hydrazoic acid, Sodium bismuthate.

(iv) Oxygen, Sulphur, Selenium & Telelurium: Comparative study of the elements and their compounds (hydrides, halides, oxides and oxyacids, sodium thiosulphate; Peroxymono- and Peroxydi-sulphuric acids, selenium dioxide. Deuterium and its oxide, hydrogen peroxide, ozone.

(v) Halogens: Comparative study of Fluorine, Chlorine, Bromine and Iodine with respect to their reactivity. Hydracids and their properties; Oxides and oxyacids of chlorine, perchloric acid, interhalogens, pseduohalogens and ploy halides.

Unit – 6 Chemistry of Elements & Their Compounds (2)

A. Metals: Occurrence: principles of extraction , purification and uses of the following metals (with emphasis on the Indian context); Li, Ag, Au, Sn, Pb, Cr, Mn, Co, Ni, Hg. Chemistry of the important compounds of these metals. General characteristics of the first row transition metals. Comparative study: Li-Na-K, Be-Mg-Ca-Sr-Ba, Cr-Mn-Fe, Co-Ni-Fe, Co-Ni-Fe, Co-Ni, Cu-Ag-Au, Zn-Cd-Hg.

B. Redox Reactions: Ion-electron method of balancing equations: Equivalent weight of oxidants and reductans: Chemical problems involving oxidimetry and reductimetry (in relation to the estimation of common metal ions: Fe, Cu, Mon, C_n)

Unit – 7: Chemistry of Carbon Compounds (1)

A. Petrolium as the industrial sources of aliphatic hydrocarbons. General methods of preparation, properties & reactions of alkanes upto five carbon atoms; Alkens upto four carbon. Cis-trans isomerism; Alkadienes; Butadiene, Isoprene; Akynes upto four carbon atoms. Mechanism of chlorination of methane, bromination of ethylene, Markownikoff's rule, haloalkanes, haloform reaction. Detection and estimation of C, H and N in organic compounds.

B. Monohydric alcohols upto four carbon atoms. Dihydiric alcohol: ethylene glycon; Trihydric alcohol: glycerol, Mechanism of dehydration of ethanol to ethylene;

ethers;

C. Aliphatic aldehydes and ketones upto four carbon atoms. Mechanism of bas-catalysed aldol condensation of acetaldehyde.

D. Synthesis and important reactions of aliphatic monobasic carboxylic acids, Acid chlorides, Acid anyhydrides, esters, amides, nitriles. Dicarboxylc acids-Oxalic acid, malonic acid; Hydroxy acids-Lactic acid, Malic acid, Trataric acid.

Unit – 8: Chemistry of Carbon Compounds (2)

A. General Methods of preparation, properties and reactions of Primary, Secondary and Tertiary amines upto four carbon atoms; Quaternary ammounium salts, micelles (examples and uses)

B. Preparation and Synthetic uses of (i) Grignard reagents, (ii) Ethyl acetoacetate and (iii) Diethyl malonate.

C. Classification of carbohydrates; preparation, properties, reactions of glucose and fructose; Conversion of glucose to fructose and vice versa, Constitution of glucose and fructose including pyranose structure, Haworth's structure, Disaccharides, inversion of sucrose.

Unit – 9: Chemistry of Carbon Compounds (3)

A. General Methods of preparation, properties and reactions of Benzene, Toluene, Xylene; modern strusctural idea of benzene; Orientation, Aromaticity; Friedel Craft's reaction and its mechanism.

B. Aromatic nitro compounds, Nitrobenzene, o-, m- and p- Nitroanlines, Aromatic diazo compounds: Benzene diazonium salts, Pheny-hydrazene; Benzene sulfonic acid.

C. Aromatic hydroxyl compounds Phenol, Picric acid: Benzyl Alcohol; Aromatic aldehydes and ketones – Benzaldehyde, Salicylaldehyde, Benzophenone, Acetophenone.

D. Aromatic carboxylic acids and their derivaties – Benzoic acid, Salicylic acid, Phyenyl acetic acid, Cinnamic acid, Phthalilc acid, Benzoyl chloride, Behzoice anhydride, Ethyle benzoate, Methylsalicylate, Acetysalicylic acid, Benzamide, Benzonirile; Mechanism of Cannizzaro reaction of Benzaldehyde.

E. Idea of structural formula (only) of the following compounds: Pyrrole, Furan Thiophene, Pyridine and Quinoline.

Unit – 10: Application Oriented Chemistry

A. Chemical Analyses: Principles & Applications.

Gravimetric and titrimetric (acid-base, redox and complexometric EDTA) estimation of common cations and anions. Analysis of complex materials: ores, alloys, water and air samples, inorganic and organic samples, drugs and pharmaceuticals. Error analysis.

B. Chemistry in Industry.

Production and technical uses of stainless steels, alloy steels, non-ferrous alloy and amalgams. Chemistry of electroplating, anodizing. Galvartizing and photography. Solid, liquid and gaseous fuels, coal based chemicals and petrochemicals (C_1 to C_3 compounds). Glass and ceramic materials, Port-land cement (composition and setting). Chemical fertilizers and biofertilizers. Polymers: Polythene, P.V.C.,

natural and synthetic rubbers, synthetic fibres: Nylon-66, polyesters. Biopolymers and biodegradable polymers.

C. Technical materials:

Drugs, pharmaceuticals and fermentation chemicals: preparation /extraction/isolation/purification and uses of aspirin, paracetamol enovid, sulfadiazine, quinine, chloroquine, vitamin C. Phenobarbital, metronidazole, chlorpromazine; ethyl alcohol, citric acid, lactic acid, Vitamin B_{12}, penicillin.

Constituents and formulations of paints and varnishes, oil-base paints, latex paints and backed-on paints (alkyl resins). Synthetic dyes: methyl orange, congo red, Malachite green, crystal violet, indogo, alizarin, anline yellow.

D. Domestic & Useful Materials:

Fats-oils-detergents, edible and inedible oils of vegetable origin, hydrogenation of unsaturated oils, production of vanaspati and margarine, toilet soaps and washing soaps; Cosmatics and perfumes; Hair dyes, creams suntun lotions, face poweder, talcum powder, tooth powder, tooth paste, shampoos: uses of geraniol, jasmine, civetone amylactate. Pesticides and food additives: Production applications and residual toxicity of gamaxene, DDT, aldrin, parathion, malathion, paraquat, decamethrin. Food flavours, food colours and preservatives, artificial sweetners, acidulants and alkalies, edible emulsifers and foaming agents, sequesterants (uses and abuses of).

E. Environmental Chemistry

Environmental segments: atmosphere, hydrosphere, lithosphere and biosphere. Environmental cycles: hydrologic cycle, carbon-oxygen-, nitrogen-, phosphorus-, and sulfur cycles. Composition and structure of the atmosphere, Ozone layer and its importance, air pollutants and their sources, air pollution control measures. Environmental role of water, major water pollutants, water quality parameters, water treatment (domestic, industrial and waste water)