

APPENDIX – 1

WEST BENGAL JOINT ENTRANCE EXAMINATIONS BOARD

SYLLABUS FOR JEM - 2010

PHYSICS

Mechanics & General properties of matter

- (i) Units and dimensions : Units of measurement, system of units, fundamental and derived units, S I units, dimensional analysis

Methods of measurement: Vernier scale, screw gauge, analysis of errors, significant figures.

- (ii) Scalars and vectors: Addition, subtraction, multiplication of vectors
- (iii) Kinematics in one, two and three dimensions, projectiles, uniform circular motion, centripetal force, centrifugal force, relative velocity
- (iv) **Dynamics** : Newton's laws of motion; inertial frames, uniformly accelerated frame (pseudo-forces), conservation of linear momentum, rocket motion, centre of mass, impulsive forces, friction.
- (v) Work, Power and Energy , conservative and non-conservative forces, conservation of energy, collision(elastic and inelastic).
- (vi) Rotational motion : Torque, Torque, angular momentum and conservation of angular momentum, moment of inertia, radius of gyration, moment of inertia of objects with simple geometrical shapes, rotational kinetic energy and rolling on horizontal surface

Gravitation : Laws of gravitation, gravitational field and potential, acceleration due to gravity and its variation, escape velocity, Kepler's laws and planetary motion, motion of satellites, Geostationary orbit.

Elasticity : Hooke's law, elastic moduli, Poisson's ratio, elastic energy.

Hydrostatics and Fluid Mechanics : Pressure in a fluid, Pascal's law, Archimedes' principle, hydraulic press .

Surface energy and surface tension, capillary rise.

Viscosity, streamline and turbulent motion, critical velocity, Reynold's number, Stoke's law, Bernoulli's theorem.

Vibrations : Simple Harmonic Motion, equation of motion, damped and forced vibrations, resonance, superposition of SHM.

Wave motion : Elastic waves, longitudinal and transverse waves. progressive waves, superposition of waves: interference, stationary waves, beats, vibration of strings, air columns, velocity of elastic waves in different media, Doppler effect

Thermal Physics : Scales of temperature, thermal expansion of solids, liquids and gases, calorimetry, change of state of matter, latent heat, transition temperature, Transmission of heat: conduction, convection, radiation, Black body radiation, absorptive and emissive powers: Kirchoffs law, Wien's law, Stefan's law, Newton's law of cooling, Kinetic theory : mean free path, pressure of an ideal gas, mean and rms velocity of molecules of a gas, kinetic interpretation of temperature, degrees of freedom, equipartition of energy(statement only) — application to monoatomic and diatomic gases.

Thermodynamics : First law of thermodynamics, equivalence of heat and work, intensive and extensive thermodynamic variables, reversible and irreversible processes, specific heats of gases, relation between C_p and C_v .

Optics : Reflection and refraction at plane and spherical surfaces, total internal reflection, thin lenses, power of a lens, combination of lenses and mirrors, deviation and dispersion by prisms

Simple and compound microscopes, astronomical telescope, human eye: defects and remedies.

Coherent sources, interference of light, Young's double slit.

Electrostatics : Coulomb's law, electric field and potential, flux of electric field, Gauss' law, electric field and potential due to an infinite line charge, charged infinite sheet, solid spheres and spherical shells. Electric dipole and field due to dipole.

Capacitance, spherical and parallel plate capacitors, energy stored in a capacitor, series and parallel combination of capacitors,

Current Electricity : Electric current, drift velocity and mobility, Ohm's law, resistivity, combination of resistances in series and parallel, combination of cells.

Kirchoffs laws, Wheat stone bridge, Metre bridge, potentiometer.

Heating effect of current, thermoelectricity, see beck and Peltier effect.

Chemical effect of current, Faraday's law of electrolysis, primary and secondary cells.

Electromagnetism : Magnetic effects of Current, Biot Savart's law, magnetic field due to an infinite line charge, circular coil and solenoid, Ampere's circuital law, Lorentz force, Fleming's left hand rule, force between two current carrying conductors, magnetic moment of a current loop, magnetic dipole, torque experienced by a current carrying coil in a uniform magnetic field, galvanometer, current sensitivity, conversion of galvanometer to voltmeter and ammeter.

Magnetic field of earth, tangent galvanometer, magnetic properties of materials : Dia, para and ferromagnet , permeability, susceptibility.

Electromagnetic induction : Magnetic flux, Faraday's laws of electromagnetic induction, Lenz's law, self and mutual induction, , Flemings right hand rule, Alternating current, peak and rms value of alternating current; generator, D.C. motor and transformer

Qualitative idea of electromagnetic wave and its spectrum.

Modern Physics : Bohr's atomic model for hydrogen like atom, hydrogen spectrum, x-ray emission, Moseley's law, wave particle duality, de Broglie's hypothesis, photo-electric effect .

Constituents of atoms, isotopes, mass defect, mass-energy equivalence, binding energy. radioactivity - α , β , γ radiation, half life, mean life, fission, fusion.

Energy bands in solids, intrinsic and doped semiconductors, p-n junction diode, rectifier, pnp and npn transistors, common emitter characteristics.

Binary number, AND, OR, NOT, NAND and NOR gates.

MATHEMATICS

Algebra

A.P., G.P., H.P. : Definitions of A. P. and G.P.; General term; Summation of first n-terms; A.M.and G.M.; Definitions of H.P. (only 3 terms) and H.M.; Finite arithmetico-geometric series.

Logarithms : Definition; General properties; Change of base.

Complex Numbers : Definition and properties of complex numbers; Complex conjugate; Triangle inequality; Square root of complex numbers; Cube roots of unity; D'Moivre's theorem (statement only) and its elementary applications.

Quadratic Equations : Quadratic equations with real coefficients; Relations between roots and coefficients; Nature of roots; Formation of a quadratic equation, sign and magnitude of the quadratic expression ax^2+bx+c (a,b,c are rational numbers and $a \neq 0$).

Permutation and combination : Permutation of n different things taken r at a time ($r \leq n$). Permutation of n things not all different. Permutation with repetitions (circular permutation excluded).

Combinations of n different things taken r at a time ($r \leq n$). Combination of n things not all different. Basic properties.

Problems involving both permutations and combinations.

Principle of Mathematical Induction : Statement of the principle. Proof by induction for the sum of squares, sum of cubes of first n natural numbers, divisibility properties like $2^{2n} - 1$ is divisible by 3 ($n \geq 1$), 7 divides $3^{2n+1} + 2^{n+2}$ ($n \geq 1$).

Binomial theorem (positive integral index) : Statement of the theorem, general term, middle term, equidistant terms, properties of binomial co-efficients.

Infinite series : Binomial theorem for negative and fractional index. Infinite G.P. series, Exponential and Logarithmic series with range of validity (statement only), simple applications.

Matrices : Concepts of $m \times n$ ($m \leq 3, n \leq 3$) real matrices, operations of addition, scalar multiplication and multiplication of matrices. Transpose of a matrix. Determinant of a square matrix. Properties of determinants (statement only). Minor, cofactor and adjoint of a matrix. Nonsingular matrix. Inverse of a matrix. Finding area of a triangle. Solutions of system of linear equations. (Not more than 3 variables).

Sets, Relations and Mappings : Idea of sets, subsets, power set, complement, union, intersection and difference of sets, Venn diagram, De Morgan's Laws, Inclusion / Exclusion formula for two or three finite sets, Cartesian product of sets.

Relation and its properties. Equivalence relation – definition and elementary examples, mappings, range and domain, injective, surjective and bijective mappings, composition of mappings, inverse of a mapping.

Probability : Classical definition, addition rule, conditional probability and Bayes' theorem, independence, multiplication rule.

Trigonometry

Trigonometric ratios, compound angles, multiple and submultiple angles, general solution of trigonometric equations. Properties of triangles, inverse trigonometric functions.

Co-ordinate geometry of two dimensions

Basic Ideas : Distance formula, section formula, area of a triangle, condition of collinearity of three points in a plane.

Polar coordinates, transformation from Cartesian to polar coordinates and vice versa. Parallel transformation of axes, concept of locus, elementary locus problems.

Straight line : Slope of a line. Equation of lines in different forms, angle between two lines. Condition of perpendicularity and parallelism of two lines. Distance of a point from a line. Distance between two parallel lines. Lines through the point of intersection of two lines.

Circle : Equation of a circle with a given center and radius. Condition that a general equation of second degree in x, y may represent a circle. Equation of a circle in terms of endpoints of a diameter . Parametric equation of a circle. Intersection of a line with a circle. Equation of common chord of two intersecting circles.

Conics : Definition, Directrix, Focus and Eccentricity, classification based on eccentricity.

Parabola : Standard equation. Reduction of the form $x = ay^2+by+c$ or $y = ax^2+bx+c$ to the standard form $y^2 = 4ax$ or $x^2 = 4ay$ respectively. Elementary properties and parametric equation of a parabola.

Ellipse and Hyperbola : Reduction to standard form of general equation of second degree when xy term is absent. Conjugate hyperbola. Simple properties. Parametric equations. Location of a point with respect to a conic.

Differential calculus : Functions, composition of two functions and inverse of a function, limit, continuity, derivative, chain rule, derivatives of implicit functions and of functions defined parametrically.

Rolle's Theorem and Lagrange's Mean Value theorem (statement only). Their geometric interpretation and elementary application. L'Hospital's rule (statement only) and applications.

Second order derivative.

Integral calculus : Integration as a reverse process of differentiation, indefinite integral of standard functions. Integration by parts. Integration by substitution and partial fraction.

Definite integral as a limit of a sum with equal subdivisions. Fundamental theorem of integral calculus and its applications. Properties of definite integrals.

Differential Equations : Formulation and solution of differential equations of the forms.

- 1) $dy / dx = f(x).g(y)$
- 2) $dy / dx = f(y/x)$
- 3) $dy / dx = (ax+by) / (cx+dy)$
- 4) $dy / dx = (a_1x+b_1y+c_1) / (a_2x+b_2y+c_2)$, $(a_1/a_2 = b_1/b_2)$
- 5) $dy / dx + p(x)y = Q(x)$
- 6) $d^2y / dx^2 + p_1 dy/dx + p_2y = 0$ with p_1 and p_2 constants.
- 7) $d^2y/dx^2 = f(x)$

Application of Calculus : Tangents and normals, conditions of tangency. Determination of monotonicity, maxima and minima. Differential coefficient as a measure of rate.

Motion in a straight line with constant acceleration.

Geometric interpretation of definite integral as area, calculation of area bounded by elementary curves and straight lines. Area of the region included between two elementary curves.

BIOLOGICAL SCIENCES

Unit of Life : Definition of life, Cell as the basic unit of life. Cell theory, Prokaryotic and Eukaryotic cell – structure and differences.

Ultrastructure and functions of cellular components : Cell wall, Plasma membrane, Plastid, Endoplasmic reticulum, Golgi bodies, Mitochondria, Ribosomes, Lysosomes, Nucleus, Centrosomes, Cilia, Flagella.

Microscopy : Components and principles of Simple and Compound Microscope;

Electron Microscope : Basic functional principles.

Physical and Chemical principles involved in maintenance of life processes : Diffusion, Osmosis, Absorption, Osmoregulation.

Biomolecules : Classification and structural properties of carbohydrates, lipids, aminoacids, proteins and nucleic acids.

Carbohydrates : Monosaccharides, digosaccharides, and polysaccharides (starch, glycogen, cellulose).

Proteins : Simple (albumins, globulins, collagen) and conjugated proteins (only examples).

Nucleic acids : Structure of DNA, RNA, types of RNA.

Enzymes : Definition & properties, Examples; Mechanism of Action, Allosterism and Regulation.

Chromosomes and Cell Division : Morphology of **of chromosomes; Euchromatin and Heterochromatin.** Nucleic acid as genetic material (Examples: Bacterial Transformation and Viral Transduction).

Brief idea of Polytene Chromosomes : Cell cycle and phases (excluding control mechanism). Characters of malignant cell; Process & significance of Meiosis.

Genetics : Laws of Heredity : (Monohybrid and dihybrid crosses; Mendel's laws). Back cross, Test cross, Linkage, Crossing over, Sex linked inheritance – Colour blindness, Haemophilia.

Mutation : Definition and Types; Replication of DNA, Transcription and Translation (Brief idea).

Origin, Evolution and Diversity of Life : Haldane and Oparin's concept on origin of life. Modern concept of Natural selection, Biological Species concept.

Human evolution : An outline.

Taxonomy and Classification : Definition; Importance of Taxonomy, Binomial Nomenclature, Law of Priority (Homonym & Synonym).

Concept of Biodiversity : Definition of Biodiversity ; Genetic diversity; Species diversity and Ecosystem diversity. Five kingdom classification (only distinct characters).Salient features of major animal phyla with common examples, classification of Chordates (up to Sub Class) with distinctive characters only.

Population Biology : Concept of population growth (logistic and exponential) and population control.

Ecosystem : Concept of ecosystem and Biosphere, Wetland.

Brief idea of Ecological pyramids, Energy flow, Biogeochemical cycle (concept only).

Environmental pollution : Air, water and noise pollution – sources effects and probable control strategies; Biomagnification and Bioaccumulation. Cause of Dyslexia, Minamata and Etai etai diseases. Green house effect, BOD, COD, Acid rain and Ozone hole.

Virus and Bacteria : Morphological characteristics of Bacteriophage (T2),Plant virus (TMV);Animal virus (influenza), Bacterial cell (*E. coli*).

Staining : Gram staining for bacteria.

Biotechnological application of microbes : (a)Agricultural – *Rhizobium* and other Nitrogen fixing bacteria, Biofertilizers and Bio-pesticides ; (b) Industrial – Production of curd; tanning and brewery; synthesis of antibiotics, vitamin. (c) Cloning of microbial genes.

Tissue and tissue system : (a)Plant Tissues–Meristematic and permanent (types with characterization and function). (b)Animal Tissue – outline classification and examples.

Functions of life :

Photosynthesis :

Major photosynthetic pigments, outline concept of light and dark reaction phases, basic idea of bacterial photosynthesis, C₂, C₃, C₄ pathways, CAM (in brief), photorespiration.

Respiratory System :

- (a) Definition of respiration, Mechanisms of glycolysis, Krebs's cycle (Flow chart only; calculation for ATP, CO₂ & H₂O) ; Outline idea of Electron Transport system, Relationships of photosynthesis and respiration. (b) Respiratory system in human : Respiratory tract, Mechanism of breathing, Role of intercostals muscles and diaphragm;

Significance of physiological and anatomical dead space.

Tidal volume, inspiratory and expiratory reserve volumes, residual volume, vital capacity. Composition of inspired, expired and alveolar air. Common respiratory diseases – definition and causes – Asthma, Tuberculosis, Hypoxia, Anoxia, Apnoea, Dyspnoea.

Cardiovascular System & Blood :

Anatomy of Heart – junctional tissues of the heart; origin and propagation of cardiac impulse. Histological structures of arteries, veins and capillaries.

Cardiac cycle – Atrial and ventricular events only; cardiac cycle time, Heart sound.

Cardiac output – definition, Stroke and Minutes volume.

Blood Pressure : factors controlling & measurement.

Blood – Composition and functions of blood.

Blood coagulation and anticoagulants, Blood group and Rh factor, Blood Transfusion, Lymph and tissue fluid formation and functions, Portal circulation.

Nutrition and Digestive System : Basic constituents of food and their nutritional significance. Vitamins – dietary sources, functions and deficiency symptoms of water and fat soluble vitamins. Structure and functions of the alimentary canal and the digestive glands. Functions of the digestive juices (saliva, gastric juice, pancreatic juice, intestinal juice), Biles.

Digestion and absorption of carbohydrates, lipids and proteins. Diseases – Peptic and Gastric ulcers, Gastritis; fasting and obesity.

Metabolism : Definition; B.M.R. – Controlling factors; elementary idea of metabolic pathways; glycogenesis, glycogenolysis, gluconeogenesis, Oxidation of fatty acids, Ketone body formation and its significance.

Deamination, Transamination and Decarboxylation of aminoacids (definition only).

Excretory System : Histology and function of the nephron (brief idea)

Normal and abnormal constituents of urine.

Nervous and Muscular system : Brief outline of human brain structure.

Cranial Nerves : Distribution and Function. Spinal cord – Structure and major functions, Reflex arc (types) and reflex action : Conditional and unconditional reflexes.

Autonomic : sympathetic and parasympathetic (definition only) nervous system.

Synapse : Structure and mechanism of synaptic transmission.

Different types of muscles and their structure, properties of muscles

(i) Excitability (ii) Contractility (iii) All or none law (iv) Refractory period (v) Summation of stimuli (vi) Tetanus (vii) Rigor mortis; Mechanism of muscle contraction.

Endocrine system and animal hormones :

Definition of endocrine glands and hormones, functions of hormones released from (i) pituitary (ii) thyroid (iii) pancreas (iv) adrenal (v) gastrointestinal gland, An outline mechanism of action of protein & steroid hormones.

Causes and symptoms of Acromegaly, Diabetis insipidus, Diabetis mellitus, Goiter, Cushing's disease.

Growth, Reproduction, and Ageing :

A. In Plants :

Different parts of a typical flower (China rose). Types of flower : regular and irregular, actinomorphic, zygomorphic. Aestivation in Musaceae & Malvaceae. Floral formula : Definition, symbols used in floral formulae in Musaceae (e.g. Banana) and Malvaceae (eg. China rose) ; Pollination – Definition, self and cross pollination; Merits and demerits of self and cross pollination. Fertilization – Process of double fertilization. Dispersal of fruits and seeds – Types with examples. Phases and factors of Growth, Differences between growth and development, Abscission senescence, ageing and growth of seeding and the role of gibberellic acid.

B. In Animals :

Primary and secondary sex organs and secondary sex characters – Testis – Histology, Functions of Testosterone. Spermatogenesis (outline). Ovary – Histology : Functions of estrogen and progesterone; Oogenesis (outline); structure of mature Graafian follicle.

Menstrual cycle (brief idea). Fertilization and Implantation.

Immunology : A brief idea of antigen and antibody. Elementary knowledge of inherited, acquired, humoral, cell mediated immunity. Active and passive immunity. Prevention of AIDS and Hepatitis B.

Medical, Agricultural and Economic Zoology :

A. Outline idea of diseases, their causative organism, mode of infection, symptoms and preventive measures of :

- (i) Malaria
- (ii) Filariasis
- (iii) Ascariasis

Distinguishing features of Culex, Anopheles and Aedes

Life cycle and comparative study of Culex and Anopheles;

Causative agents of encephalitis and kalaazar and control of their vectors.

B. Characteristic features of major and minor carps and examples of exotic carps. Mechanism of induced breeding – hypophysation.

Composite culture of carps, common diseases of carp – Gillrot, fin rot and Dropsy.

Definition of pest, Damage symptoms and control of *Scirpophaga incertulus* and *Leptocorisa acuta*.

C. Poultry – Types of poultry birds ; high yielding varieties of poultry birds. Species of honey bees in India and different castes in a colony. Composition and uses of honey.

Chemical composition of silk, types of silk and silk worms.

Life cycles of mulberry silk worm. Structure of silk gland.

Symptoms of Flacherie, Muscardine, Grassarie and Pebrine.

Application of Biology :

Pesticides and Biological Pest Control – Benefit and hazards, Basic principles of *ex situ* and *in situ* conservation. Red Data Book, Green Data Book.

Role of phytohormones in horticulture and agriculture.

Hybridization in plants – Definition and techniques.

Idea about plant cell and tissue culture – Micropropagation.

Principles and application of transgenic plants and animal, Test tube baby.

Biomedical Engineering :

Application - ECG & EEG

Imaging – USG, CT Scan, X-ray, MRI

Therapeutic - Pacemaker, Dialyzer.

CHEMISTRY

Atoms, Molecules and Chemical Arithmetic :

Dalton's atomic theory; Gay Lussac's law of gaseous volume; Avogadro's Hypothesis and its applications.

Atomic mass; Molecular mass; Equivalent weight; Valency; Gram atomic weight; Gram molecular weight; Gram equivalent weight and mole concept; Chemical formulae; Balanced chemical equations; Calculations (based on mole concept) involving common oxidation-reduction, neutralization, and displacement reactions; Concentration in terms of mole fraction, molarity, molality and normality.

Percentage composition, empirical formula and molecular formula; Numerical problems.

Atomic Structure

Concept of Nuclear Atom – electron, proton and neutron (charge and mass), atomic number; Rutherford's model and its limitations; Extra nuclear structure; Line spectra of hydrogen atom.

Quantization of energy (Planck's equation $E = h\nu$); Bohr's model of hydrogen atom and its limitations, Sommerfeld's modifications (elementary idea); The four quantum numbers, ground state electronic configurations of many electron atoms and mono-atomic ions; The Aufbau Principle; Pauli's Exclusion Principle and Hund's Rule.

Uncertainty principle; The concept of atomic orbitals, shapes of *s*, *p* and *d* orbitals (pictorial approach)

Radioactivity and Nuclear Chemistry

Radioactivity – α -, β -, γ -rays and their properties; Artificial transmutation; Rate of radioactive decay, decay constant, half-life and average life period of radio-elements; Units of radioactivity; Numerical problems.

Stability of the atomic nucleus – effect of neutron–proton (*n/p*) ratio on the modes of decay, group displacement law, radioisotopes and their uses (C, P, Co and I as examples) isobars and isotones (definition and examples), elementary idea of nuclear fission and fusion reactions.

The Periodic Table and Chemical Families

Modern periodic law (based on atomic number); Modern periodic table based on electronic configurations, groups (Gr. 1–18) and periods. Types of elements–representative (*s*-block and *p*-block), transition (*d*-block) elements and inner transition (*f*-block / lanthanides and actinides) and their general characteristics. Periodic trends in physical and chemical properties–atomic radii, valency, ionization energy, electron affinity, electronegativity, metallic character, acidic and basic characters of oxides and hydrides of the representative elements (up to *Z* = 36). Position of hydrogen and the noble gases in the periodic table; Diagonal relationships.

Chemical Bonding and Molecular Structure

Valence electrons, the Octet rule, electrovalent, covalent and coordinate covalent bonds with examples; Properties of electrovalent and covalent compounds. Limitations of Octet rule (examples); Fajan's Rule.

Directionality of covalent bonds, shapes of poly-atomic molecules (examples); Concept of hybridization of atomic orbitals (qualitative pictorial approach) : sp , sp^2 , sp^3 and dsp^2 .

Molecular orbital energy diagrams for homonuclear diatomic species – bond order and magnetic properties.

Valence Shell Electron Pair Repulsion (VSEPR) concept (elementary idea) – shapes of molecules. Concept of resonance (elementary idea), resonance structures (examples). Elementary idea about electro negativity, bond polarity and dipole moment, inter- and intra- molecular hydrogen bonding and its effects on physical properties (mp, bp and solubility); Hydrogen bridge bonds in diborane.

Double salts and complex salts, co-ordination compounds (examples only), co-ordination number (examples of co-ordination number 4 and 6 only).

Gaseous state

Measurable properties of gases. Boyle's Law and Charles Law, absolute scale of temperature, kinetic theory of gases, ideal gas equation – average, root mean square and most probable velocities and their relationship with temperature.

Dalton's Law of partial pressure, Graham's Law of gaseous diffusion. Deviations from ideal behavior.

Liquefaction of gases, real gases, van der Waal's equation; Numerical problems.

Chemical Energetics and Chemical Dynamics

Chemical Energetics – Conservation of energy principle, energy changes in physical and chemical transformations. First law of thermodynamics; Internal energy, work and heat, pressure-volume work; Enthalpy. Internal energy change (ΔE) and Enthalpy change (ΔH) in a chemical reaction. Hess's Law and its applications (Numerical problems). Heat of reaction, fusion and vapourization; Second law of thermodynamics; Entropy; Free energy; Criterion of spontaneity.

Chemical Equilibria – The Law of mass action, dynamic nature of chemical equilibria. Equilibrium constants, Le Chatelier's Principle. Equilibrium constants of gaseous reactions (K_p and K_c) and relation between them (examples). Significance of ΔG and ΔG° .

Chemical Dynamics – Factors affecting the rate of chemical reactions (concentration, pressure, temperature, catalyst). Arrhenius equation and concept of activation energy.

Order and molecularity (determination excluded); First order reactions, rate constant, half-life (numerical problems), examples of first order and second order reactions.

Physical Chemistry of Solutions

Colloidal Solutions – differences from true solutions; Hydrophobic and hydrophilic colloids (examples and uses); Coagulation and peptization of colloids; Dialysis and its applications; Brownian motion; Tyndall effect and its applications; Elementary idea of emulsion, surfactant and micelle.

Electrolytic Solutions – Specific conductance, equivalent conductance, ionic conductance, Kohlrausch's law, Faraday's laws of electrolysis, applications. Numerical problems.

Non-electrolytic Solutions – Types of solution, vapour pressure of solutions. Raoult's Law; Colligative properties – lowering of vapour pressure, elevation of boiling point, depression of freezing point, osmotic pressure and their relationships with molecular mass (without derivations); Numerical problems.

Ionic and Redox Equilibria

Ionic equilibria – ionization of weak electrolytes, Ostwald's dilution law. Ionization constants of weak acids and bases, ionic product of water, the pH – scale, pH of aqueous solutions of acids and bases; Buffer solutions, buffer action and Henderson equation.

Acid-base titrations, acid-base indicators (structures not required).

Solubility and Solubility Products.

Common ion effect (no numerical problems).

Redox Equilibria – Oxidation-Reduction reactions as electron transfer processes, oxidation numbers, balancing of redox reactions by oxidation number and ion-electron methods.

Standard electrode potentials (E°), Electrochemical series, feasibility of a redox reaction.

Significance of Gibb's equation : $\Delta G^\circ = -nF\Delta E^\circ$ (without derivation), no numerical problems.

Redox titrations with (examples); Nernst equations (Numerical problems).

Chemistry of Non-metallic Elements and their Compounds

Carbon – occurrence, isotopes, allotropes (graphite, diamond, fullerene); CO and CO₂ production, properties and uses.

Nitrogen and Phosphorus – occurrence, isotopes, allotropes, isolation from natural sources and purification, reactivity of the free elements. Preparation, properties, reactions of NH₃, PH₃, NO, NO₂, HNO₂, HNO₃, P₄O₁₀, H₃PO₃ and H₃PO₄.

Oxygen and Sulfur – Occurrence, isotopes, allotropic forms, isolation from natural sources and purification, properties and reactions of the free elements. Water, unusual properties of water, heavy water (production and uses). Hydrogen peroxide and ozone (production, purification, properties and uses).

Halogen

Halogens – comparative study, occurrence, physical states and chemical reactivities of the free elements, peculiarities of fluorine and iodine; Hydracids of halogens (preparation, properties, reactions and uses), inter-halogen compounds (examples); Oxyacids of chlorine.

Chemistry of Metals :

General principles of metallurgy – occurrence, concentration of ores, production and purification of metals, mineral wealth of India.

Typical metals (Na, Ca, Al, Fe, Cu and Zn) – occurrence, extraction, purification (where applicable), properties and reactions with air, water, acids and non-metals.

Manufacture of steels and alloy steel (Bessemer, Open-Hearth and L.D. process).

Principles of chemistry involved in electroplating, anodizing and galvanizing.

Chemistry in Industry

Large scale production (including physicochemical principles where applicable omitting technical details and uses of individual items).

Heavy Chemicals : Sulfuric acid (contact process), Ammonia (Haber's process), Nitric acid (Ostwald's process), sodium bi-carbonate and sodium carbonate (Solvey process).

Polymers, Polythene, Nylon-66, rubber from natural source, vulcanization.

Electrochemicals – sodium hydroxide, chlorine, bleaching powder as by-products.

Fuel Gases – LPG, CNG.

Silicon carbide and silicones.

Environmental Chemistry

Common modes of pollution of air, water and soil. Ozone layer, ozone hole – important chemical reactions. Green House effect; Smog; Pollution of water by domestic and industrial effluents; Pollutants–pesticides, fertilizers and plastics.

Chemistry of Carbon Compounds

Hybridization of carbon – σ - and π -bonds.

Isomerism –constitutional and stereoisomerism; Geometrical and optical isomerism of compounds containing upto two asymmetric carbon atoms. IUPAC nomenclature of simple organic compounds–hydrocarbons, mono and bifunctional molecules only (alicyclic and heterocyclic compounds excluded). Conformations of ethane and n-butane (Newman projection only).

Electronic Effects – inductive, resonance and hyperconjugation. Stability of carbocation, carbanion and free radicals; Rearrangement of carbocation; Electrophiles and nucleophiles, tautomerism in α -dicarbonyl compounds, acidity and basicity of simple organic compounds.

Aliphatic Compounds

Alkanes – Preparation from alkyl halides and carboxylic acids; Reactions – halogenation and combustion.

Alkenes and Alkynes – Preparation from alcohols; Formation of Grignard reagents and their synthetic applications for the preparation of alkanes, alcohols, aldehydes, ketones and acids; S_N1 and S_N2 reactions (preliminary concept).

Markownikoff's and anti-Markownikoff's additions; Hydroboration; Oxymercuration – demercuration, reduction of alkenes and alkynes (H_2 /Lindler catalyst and Na in liquid NH_3), metal acetylides.

Alkyl halides – Preparation from alcohols; Formation of Grignard reagents and their synthetic applications for the preparation of alkanes, alcohols, aldehydes, ketones and acids; S_N1 and S_N2 reactions (preliminary concept).

Alcohols – Preparation from carbonyl compounds and esters. Reaction – dehydration, oxidation, esterification, reaction with sodium, $ZnCl_2/HCl$, phosphorous halides.

Ethers – Preparation by Williamson's synthesis; Cleavage with HCl and HI.

Aldehydes and Ketones – Preparation from esters, acid chlorides, gem-dihalides, Ca-salt of carboxylic acids. Reaction – Nucleophilic addition with HCN, hydrazine, hydroxyl amines, semi carbazides, alcohols; Aldol condensation, Clemmensen and Wolff-Kishner reduction, haloform, Cannizzaro and Wittig reactions.

Carboxylic Acids – Hydrolysis of esters (mechanism excluded) and cyanides; Hunsdicker and HVZ reactions.

Aliphatic Amines – Preparation from nitro, cyano and amido compounds. Distinction of 1°, 2° and 3° amines (Hinsberg method); Reaction with HNO_2 ; Carbyl amine reaction.

Aromatic Compounds

Benzene – Kekule structure, aromaticity and Huckel rule. Electrophilic substitution – halogenation, sulfonation, nitration, Friedel Crafts reaction, ozonolysis. Directive influence of substituents in monosubstituted benzenes.

Amines – Preparation from reduction of nitro compounds; Formation of diazonium salts and their stability; Replacement of diazonium group with H, OH, X (halogen), CN and NO_2 , diazocoupling and reduction.

Haloarenes – Nucleophilic substitution, cine substitution (excluding mechanism).

Phenols – halogenation, sulfonation, nitration, Reimer-Tiemann and Kolbe reactions.

Aromatic Aldehydes – Preparation by Gattermann, Gattermann – Koch, Rosenmund and Stephen's method. Reactions – Perkin, Benzoin and Cannizzaro.

Application Oriented Chemistry

Main ingredients, their chemical natures (structures excluded) and their side effects, if any, of common antiseptics, analgesics, antacids, vitamin-C.

Introduction to Bio-Molecules

Carbohydrates – Pentoses and hexoses. Distinctive chemical reactions of glucose.

Aminoacids – glycine, alanine, aspartic acid, cysteine (structures). Zwitterion structures of amino acids, peptide bond.

ADP and ATP – structures and role in bioenergetics; Nucleic acids – DNA and RNA skeleton structures. Names of essential elements in biological system.

Principles of Qualitative Analysis

Detection of water soluble noninterfering Acid and Basic Radicals by dry and wet tests from among :

(a) Acid Radicals : Cl^- , S^{2-} , SO_4^{2-} , NO_3^- , CO_3^{2-}

(b) Basic Radicals: Cu^{2+} , Al^{3+} , Fe^{3+} , Fe^{2+} , Zn^{2+} , Ca^{2+} , Mg^{2+} , Na^+ , NH_4^+

Detection of special elements (N, Cl, Br, I and S) in organic compounds by chemical tests. Identification of functional groups in : phenols, aromatic amines, aldehydes, ketones and carboxylic acids.