

SYLLABUS FOR GSAT-2017
FOR ADMISSION TO Integrated M. Sc. Chemistry
(TEST CODE NO: 109)

SECTION – A1: MATHEMATICS

1. Functions, Types of functions, composition of functions, Inverse function, Properties of Inverse function, Extension of Domain, Periodic function, Transformation of graphs. Hyperbolic functions, Surds, Logarithms, Mathematical Induction.
2. **(a) PARTIAL FRACTIONS:** Resolving $f(x)/g(x)$ into Partial fractions when $g(x)$ contains: Non-repeated linear factors; $g(x)$ contains repeated and non repeated linear factors. $g(x)$ contains non-repeated and irreducible quadratic factors, $g(x)$ contains repeated and non-repeated irreducible quadratic factors. (Note: Number of factors of $g(x)$ should not exceed 4).
(b) EXPONENTIAL AND LOGARITHMIC
SERIES: Expansion of e^x for real x ; $\log(1+x)$ expansion, condition on x (Note: Statements of the results and very simple problems such as finding the general term should only be given). **(c) Successive Differentiation:** n^{th} derivative of standard functions, libnitz theorem and its applications. **(d) Partial Differentiation:** Partial derivative of 1^{st} , 2^{nd} orders and Euler's. Theorem on Homogeneous functions.
3. **QUADRATIC EQUATIONS & THEORY OF EQUATIONS:**
Quadratic equations in real and complex number system and their solutions. Remainder and Factor Theorems, common Roots, General Quadratic expression, Finding the range of a function, Location of roots, Solving inequalities using location of roots.
4. **THEORY OF EQUATIONS:** The relation between the roots and coefficients in an equation; Solving the equation when two or more roots of it are connected by certain relations; Equations with real coefficients, imaginary roots occur in conjugate pairs and its consequences; Transformation of equations, Reciprocal equations. **(a) BINOMIAL THEOREM AND ITS SIMPLE APPLICATIONS** Binomial theorem for a positive integral index, general term and middle term, properties of Binomial coefficients and simple applications. **(b) SEQUENCES AND SERIES:** Arithmetic and Geometric progressions, insertion of arithmetic, geometric means between two given numbers. Relation between A.M. and G.M. Sum to n terms of special series
 n, n^2, n^3 Arithmetic - Geometric progression.
5. **MATRICES AND DETERMINANTS:** Matrices, algebra of matrices, types of matrices, determinants and matrices of order two and three. Properties of determinants, evaluation of determinants, area of triangles using determinants. Adjoint and evaluation of inverse of a square matrix using determinants and elementary transformations, Test for consistency and solution of simultaneous linear equations in two or three variables using determinants and matrices, and rank of matrix.

6. **VECTOR ALGEBRA AND 3D:** (a) **VECTOR ALGEBRA:** Algebra of Vectors – angle between two non-zero vectors – Linear combination of vectors – Geometrical applications of vectors. Scalar and vector product of two, three and four vectors and their application. (b) **3-D Geometry:** Co-ordinates in three – dimensions – Distance between two points in the space – section formulas and their applications. DCs and DRs of line, angle between two lines. Cartesian equation of a plane in (i) General form (ii) Normal Form (iii) Intercept Form (iv) Angle between two planes and angle between line and plane. Sphere – cartesian equation – centre and radius. Section of sphere by plane.
7. **TRIGONOMETRY:** Trigonometric ratios, Compound angles, multiple and sub-multiple angle, Transformations, Trigonometric expansions using Demovier's Theorem. Trigonometric equations, Inverse Trigonometry and Heights and distances(only 2D problems). **PROPERTIES OF TRIANGLES:** Sine rule, cosine rule, Tangent rule, projection rule, Half angle formulae and area of triangle. In-circle and ex-circle of a Triangle. Pedal Triangle, Ex-central Triangle, Geometry relation of Ex-centres, Distance between centres of Triangle. m-n Theorem, problems and quadrilateral, regular polygon, solution of Triangle (Ambiguous cases).
8. **LIMITS, CONTINUITY AND DIFFERENTIABILITY (LCD):** Real - valued functions, algebra of functions, polynomials, rational, trigonometric, logarithmic and exponential functions, inverse functions. Graphs of simple functions. Limits, continuity and differentiability. Differentiation of the sum, difference, product and quotient of two functions. Differentiation of trigonometric, inverse trigonometric, logarithmic, exponential, composite and implicit functions; derivatives of order upto two.
9. **APPLICATIONS OF DERIVATIVES:** Rate of change of quantities, Errors and approximations, Tangent and normals, maxima and minima of functions of one variable, mean value theorems (Rolle's, Lagrange's, Intermediate value theorem).
10. **INDEFINITE INTEGRATION:**
 Fundamental Integration formulae, Method of integration, Integration by parts, Integration by substitution, Integration of Rational and Irrational Algebraic functions, Integral of the form $\int (a+x)^p$ Integration using Euler's substitution. Reduction formulae over indefinite integrals, Integration using differentiation. **APPLICATIONS OF INTEGRALS:** Integral as limit of a sum. Fundamental Theorem of integral calculus. Problems on all the properties of definite integrals. Libnitz rule. Determining areas of the regions bounded by curves.
11. **CO-ORDINATE GEOMETRY:** Locus: Definition of locus; Equation of locus and its illustration on complete geometry; Translation & Rotation of axes and its illustrations
12. **STRAIGHT LINES AND PAIR OF STRAIGHT LINES: Straight Lines :**
 Different forms of straight lines, distance of a point from a line, lines through the point of intersection of two given lines, angular bisectors of two lines, Foot of perpendicular, Image point (vs) point, point (vs) line and line (vs) line.
 Concurrences of lines, centroid, orthocenter, incentre and circumcentre of triangle.
Pair of straight lines:
 Concepts related Homogeneous, and Non-Homogeneous pair of lines, Homogenisation of the second degree equation with a first degree equation in x and y.

13. **CIRCLES & SYSTEM OF CIRCLES (a) CIRCLES:** Equation of a circle-Standard form-centre and radius-Equation of a circle with a given line segment as diameter-Equation of circle through three non-colinear points-parametric equations of a circle. Position of a point in the plane of the circle- power of a point-Def. of a tangent-Length of tangent. Position of a straight line in the plane of the circle-condition for a straight line to be a tangent- chord joining two points on a circle - equation of the tangent at a point on the circle – point of contact – Equation of normal. Chord of contact-Pole, Polar-conjugate points and conjugate lines- Equation of chord with given mid point. Relative positions of two circles- circles touching each other, -externally, internally, common tangents-points of similitude-Equation of tangents from an external point. **(b) SYSTEM OF CIRCLES:** Angle between two intersecting circles-conditions for orthogonality. Radical axis of two circles-properties-Common chord and common tangent of two circles, Radical centre. Coaxial system of circles-Equation of the coaxial system in the simplest form-limiting points of a coaxial system. Orthogonal system of a coaxial system of circles.
14. **Differential Equations:** Ordinary differential equations, their order and degree. Formation of differential equations. Solution of differential equations by the method of separation of variables, solution of homogeneous, Non- Homogenous, linear differential equations. Bernoulli's Equation, Orthogonal Trajectory, Differential equation of first order and higher degree and Applications of Differential equations.
15. **PROBABILITIES AND RANDOM VARIABLES AND DISTRIBUTIONS:** **Probability:** Random experiment, random event, elementary events, exhaustive events, mutually exclusive events, Sample space, Sample events, Addition theorem on Probability. Dependent and independent events, multiplication theorem, Baye's theorem. **Random Variables and distributions:** Random variables, Distributive functions, probability distributive functions, Mean, variance of a random variable; Theoretical discrete distributions like Binomial, poisson distribution, Mean and variance of above distributions (without proof).

SECTION-A2: BIOLOGY

BOTANY

1. **Internal Morphology: Histology:** Meristems, Simple tissues, Complex tissues and special tissues. **Tissue System:** Epidermal, Ground and Vascular tissue systems. **Anatomy:** Anatomy of Dicot and monocot root, dicot and monocot stem, dicot and monocot leaf, secondary growth in dicot stem and dicot root.
2. **Cell Biology:** Cell theory and cell as the basic unit of life. Structure of prokaryotic and eukaryotic cell, plant and animal cell. Cell wall, cell membrane, cell organelles structure and function 1 chromosomes. Biomolecules: Structure and function of proteins, carbohydrates, lipids, nucleic acids, enzymes. Cell division: Cell cycle, Mitosis and meiosis.
3. **Plant Taxonomy: Introduction:** Principles of plant classification, brief account of Bentham & Hooker's system. **Families:** Fabaceae, Asteraceae, Solenacrae, Liliaceae poaceae.

4. **Reproduction:** a. Reproduction organisms, Modes of reproduction. Asexual and sexual. Asexual reproduction – Binary fission, Sporulation, Budding, gemmule, Fragmentation, Vegetative propagation in plants. b. Sexual reproduction flowering plants. Development of male and female gametophytes. Pollination types, agents. Out breeding devices, Double fertilization, post fertilization changes. Development of endosperm, embryo and seed. Apomixis, parthenocerypy, polyembryony.
5. **Microbiology:** a. Bacteria and Viruses b. Microbes in human welfare: In household food processing, industrial production, sewage treatment , energy generation and as biocontrol agents and biofertilizers.
6. **Biotechnology and its applications:** a. Principles and process of Biotechnology, Genetic engineering. b. Application of Biotechnology in Agriculture and health. Human insulin and vaccine production, genetherapy, Genetically modified organisms, Bt. Crops, Trasgeric animals, Biosafety issues - Biopiracy and patents.
7. **Plant Physiology:** a. **Transport in plants:** Movement of water, gases and nutrients; cell to cell transport – Diffusion, facilitated diffusion, active transport; plant-water relations – Imbibition, water potential, osmosis, plasmolysis; Long distance transport of water – Absorption, apoplast, symplast, transpiration pull, root pressure and guttation. Transpiration – Opening and closing of stomata; Uptake and translocation of mineral nutrients – Transport of food, phloem transport, Mass flow hypothesis; Diffusion of gases (Brief mention). b. **Mineral nutrition:** Essential minerals, macro and micronutrients and their role; Deficiency symptoms: Mineral Toxicity; Elementary idea of Hydroponics as a method to study mineral nutrition; Nitrogen metabolism; Nitrogen cycle, biological nitrogen fixation. C. **Respiration:** Exchange gases; Cellular respiration-glycolysis, fermentation (anaerobic), TCA cycle and electron transport system (aerobic); Energy relations-Number of ATP molecules generated; Amphibolic pathways; Respiratory quotient. D. **Plant growth and development :** Seed germination; Phases of plant growth and plant growth rate; Conditions of growth; Growth regulators – auxin, gibberellin, cytokinin, ethylene, ABA; Seed dormancy; Vernalisation; Photoperiodism.

ZOOLOGY

8. **Structural Organisation in animals:** (a) **Cockroach:** Brief account of morphology, anatomy and functions of digestive circulatory, respiratory, nervous and reproductive systems. (b) **Animal tissues:** Epithelial, connective, muscular and nervous tissues.
9. **Human Physiology-Digestive and Respiratory systems:** (a) Digestive System : Alimentary canal and digestive glands; Role of digestive enzymes and gastrointestinal hormones; Peristalsis, digestion, absorption and assimilation of proteins, carbohydrates and fats; caloric value of proteins, carbohydrates and fats; Egestion; Nutritional and digestive disorders-PEM, indigestion, constipation, vomiting, Jaundice, diarrhea. (b) Respiratory system: Respiratory organs in animals (recall only);

Respiratory system in humans; Mechanism of breathing and its regulation in humans - Exchange of gases; transport of gases and regulation of respiration; Respiratory volumes; Disorders related respiration-Asthma Emphysema, Occupational respiratory disorders.

10. Human Physiology: Circulatory and Excretory Systems: (a) Circulatory System:

Composition of blood, blood groups, coagulation of blood; composition of lymph and its function; Human circulatory system - Structure of human heart and blood vessels; Cardiac cycle, Cardiac output, ECG, Double circulation; Regulation of Cardiac activity, Disorders of circulatory system – Hypertension, Coronary artery disease, Angina pectoris, Heart failure. (b) **Excretory System** : Modes of Excretion – Ammonotelism, ureotelism, Uricotelism; Human excretory system – Structures and function; Urine formation, Osmoregulation; Regulation of Kidney function – Renin – angiotensin, Atrial Natriuretic Factor; ADH and Diabetes insipidus; Role of other organs in excretion; Disorders; Uremia, Renal Failure, Renal calculi, Nephritis; Dialysis and artificial Kidney.

11. Human Physiology–Locomotion & Movement and Neuro Endocrine System: (a)

Locomotion and Movement: Types of movement – ciliary, Flagellor, muscular; Skeletal muscle – Contractile proteins muscle contraction; Disorder of muscles. Myasthenia gravis, Tetany, Muscular dystrophy. (b) **Skeletal System and its functions:** joints; Disorders of skeletal system –Osteoporosis, Arthritis, Gout. (c) **Nervous System:** Neurons and nerves; Nervous system in humans – central nervous system, Peripheral nervous system and visceral nervous system; Generation and conduction of nerve impulse; Reflex action; Sense organs: Elementary structure and function of eye and ear. (d) **Endocrine System:** Endocrine glands and hormones; Human endocrine system – Hypothalamus, Pituitary, Pineal, Thyroid, Parathyroid, Adrenal, Pancreas, Gonads; Mechanism of hormone action (Elementary idea); Role of hormones as messengers and regulators, Hypo and hyperactivity and related disorders(e.g. Dwarfism, Acromegaly, cretinism, goiter, exophthalmic goiter, diabetes, Addison's disease).

12. Human Physiology – Reproduction: (a) Human Reproduction: Male and Female reproductive systems; Microscopic anatomy of testis and ovary; Gametogenesis – Spermatogenesis & oogenesis; Menstrual Cycle; Fertilization, Embryo development upto blastocyst formation, implantation; Pregnancy and placenta formation (Elementary idea); Parturition (Elementary idea); Lactation (Elementary idea). (b) **Reproductive Health:** Need for reproductive health and prevention of sexually transmitted diseases (STDs); Birth control – Need and Methods, Contraception and Medical Termination of Pregnancy (MTP); Amniocentesis; Infertility and assisted reproductive technologies – IVF, ZIFT, GIFT (Elementary idea for general awareness).

13. Genetics: (a) Heredity and Variations: Mendelian Inheritance; Deviation from Mendelism – Incomplete dominance, co-dominance, multiple alleles and inheritance of blood groups, Pleiotropy; Elementary idea of polygenic inheritance; chromosome Theory of inheritance; chromosomes and genes; Sex determination – In humans, birds, honey bee; Linkage and crossing over; Sex linked inheritance – Hemophilia, Colourblindness; mendelian disorders in humans – Thalassemia; Chromosomal disorders in humans – Down's syndrome, Turner's and Klinefelter's Syndromes.

(b) **Molecular basis of Inheritance** : Search for genetic material and DNA as genetic material; Structure of DNA and RNA; DNA packaging; DNA replication; Central dogma; Transcription; genetic code; translation Gene expression and regulation – Lac operon; Genome and human genome project; DNA finger printing.

14. **Evolution:** Origin of life; Biological evolution and evidences for biological evolution from Paleontology, comparative anatomy, embryology and molecular, evidence - Darwin's contribution , Modern synthetic theory of Evolution, Mechanism of evolution – Variation (Mutation and Recombination) and Natural selection with examples, types of natural selection; Gene flow and genetic drift, Hardy – Weinberg's principle; Adaptive Radiation ; Human evolution.

15. **Human Health and Diseases:** (a) Pathogens; Parasites causing human diseases (Malaria, Filariasis, Ascariasis, Typhoid Pneumonia, Common Cold, Amoebiasis, Ringworm). (b) Basic concepts of immunology – Vaccines; Cancer, HIV and AIDS. (c) Adolescence, Drug and alcohol abuse.

Section-B: PHYSICS

1) **UNITS AND MEASUREMENTS:** Introduction , The international system of units, Measurement of Length, accuracy, precision of instruments and errors in measurement, Systematic errors, random errors, least count error, Absolute Error, Relative Error and Percentage Error, Dimensions of Physical Quantities, Dimensional Formulae and dimensional equations.

2) **MECHANICS:** Introduction, Scalars and vectors, parallelogram law of vectors , Position Vector and Displacement ,Average velocity and average speed, Instantaneous velocity and speed, Acceleration, Kinematic equations for uniformly accelerated motion, Relative velocity.

Relative velocity in two dimensions, Projectile motion, Equation of path of a projectile, Time of Maximum height, Maximum height of a projectile, Horizontal range of projectile, Uniform circular motion.

3) **LAWS OF MOTION:** The law of inertia, Newton's laws of motion, Impulse, Conservation of momentum, Equilibrium of a particle, friction-its laws ,methods of reducing, motion of body on rough inclined plane, Circular motion, Motion of a car on a level road, Motion of a car on a Banked road.

4) **WORK, ENERGY AND POWER:** Introduction, The work-energy theorem, Work, Kinetic energy, Work done by a variable force, The work-energy theorem for a variable force, The concept of Potential Energy, The conservation of Mechanical Energy, The Potential Energy of a spring, Various forms of energy and its conservation..Power, Collisions, Elastic and Inelastic Collisions, Collisions in one dimension, Coefficient of Restitution and its determination, Collisions in Two Dimensions.

5) **SYSTEMS OF PARTICLES AND ROTATIONAL MOTION** Centre of mass, Centre of Gravity, Motion of centre of mass, Linear momentum of a system of particles, Angular velocity and its relation with linear velocity, Angular acceleration, Torque and angular momentum, Torque and angular momentum for a system of a particles, conservation of

angular momentum, Equilibrium of a rigid body, Moment of inertia and related theorems. Conservation of Angular Momentum.

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

7) GRAVITATION: Introduction, Kepler's laws, Universal law of gravitation, The gravitational constant, Acceleration due to gravity of the earth, Acceleration due to gravity below and above the surface of earth, Gravitational potential energy, Escape speed, Earth satellite, Energy of an orbiting satellite, Geostationary and polar satellites.

8) MECHANICAL PROPERTIES OF SOLIDS AND FLUIDS: Hooke's law of Elasticity, Stress-strain curve, Elastic moduli, Young's Modulus of the Material of a Wire, Shear Modulus, Bulk Modulus, and Poisson's Ratio. Surface tension-Surface Energy, Surface Energy and Surface Tension, Angle of Contact, Drops and Bubbles, Capillary Rise, Detergents and Surface Tension.

9) PROPERTIES OF MATTER: Thermal properties-Temperature and heat, Ideal-gas equation and absolute temperature, Thermal expansion, Specific heat capacity, Heat transfer, Conduction, thermal conductivity, Convection, Radiation, Black body Radiation, Newton's law of cooling. Thermodynamics- Zeroth law of thermodynamics, Internal Energy and work, First law of thermodynamics, Specific heat capacity, Thermodynamic state variables and equation of State, Thermodynamic process, Isothermal Process, Adiabatic Process, Isochoric Process, Cyclic process, Heat engines, Refrigerators and heat pumps, Second law of thermodynamics, Reversible and irreversible processes, Carnot engine, Carnot's theorem.

10) ACOUSTICS AND OPTICS: Transverse and longitudinal waves, Displacement relation in a progressive wave, The speed of a travelling wave, The principle of superposition of waves, Reflection of waves, Beats, Doppler effect.

Reflection of Light by Spherical Mirrors, Refraction, Total Internal Reflection, Refraction at Spherical Surfaces and by Lenses, eyepieces Refraction through a Prism, Optical Instruments and aberrations.

Huygens Principle, Refraction and reflection of plane waves using Huygens Principle, Coherent and Incoherent Addition of Waves, Interference of Light Waves and Young's Experiment, Diffraction, Polarization.

11) STATIC FIELDS: Electric fields-Charges, Conductors and Insulators, Properties of Electric Charges, Coulomb's Law, Electric Field, Flux Electric Dipole and Dipole in a Uniform External Field due to charge, Continuous Charge Distribution, Gauss's Law, Application of Gauss's Law.

Electrostatic Potential-Potential due to a Point Charge, Electric Dipole, Equipotential Surfaces, Dielectrics and Polarization, Capacitors and Capacitance, The Parallel Plate Capacitor, Effect of Dielectric on Capacitance, Combination of Capacitors, Energy Stored in a Capacitor.

Magnetic fields- Poles of magnet, magnetic flux, magnetic induction, field due to unit north pole, axial and equatorial line of magnet, earth's magnetic field and time period of vibration magnetometer.

12) CURRENT ELECTRICITY: Introduction, Electric Current, Electric Currents in Conductors, Ohm's law, Drift of Electrons and the Origin of Resistivity, Limitations of Ohm's Law, Resistivity of various Materials, Temperature Dependence of Resistivity, Electrical Energy, Power, Combination of Resistors — Series and Parallel, Cells, emf, Internal Resistance, Cells in Series and in Parallel, Kirchhoff's Laws, Wheatstone Bridge, Meter Bridge, Potentiometer.

13) ELECTROMAGNETISM-Moving magnetic fields -Magnetic Force, Motion in a Magnetic Field, Motion in Combined Electric and Magnetic Fields, Magnetic Field due to a Current Element, Biot-Savart Law, Magnetic Field on the Axis of a Circular Current Loop, Ampere's Circuital Law, The Solenoid and the Toroid, Force between Two Parallel Currents, the Ampere, Torque on Current Loop, Magnetic Dipole, The Moving Coil Galvanometer. Electromagnetic Induction-Faraday's Law of Induction, Lenz's Law and Conservation of Energy, Motional Electromotive Force, Energy Consideration. Alternating currents: Introduction, AC Voltage Applied to a Resistor, Representation of AC Current and Voltage by Rotating Vectors —Phasors, AC Voltage Applied to an Inductor, AC Voltage Applied to a Capacitor, Power in AC Transformers.

14) MODERN PHYSICS: Photoelectric Effect, Experimental Study of Photoelectric Effect, Photoelectric Effect and Wave Theory of Light, Einstein's Photoelectric Equation: Energy Quantum of Radiation, Particle Nature of Light: The Photon, Wave Nature of Matter, Davisson and Germer Experiment. Nuclear Physics-Alpha-particle Scattering and Rutherford's Nuclear Model of Atom, Atomic Spectra, Bohr Model of the Hydrogen Atom, The Line Spectra of the Hydrogen Atom, characteristic and continuous x ray spectrum, Atomic Masses and Composition of Nucleus, Size of the Nucleus, Mass-Energy and Nuclear Binding Energy, Nuclear Force, Radioactivity, Nuclear Energy.

15) SEMICONDUCTOR ELECTRONICS:: Introduction, Classification of Metals, Conductors and Semiconductors, Intrinsic Semiconductor, Extrinsic Semiconductor, p-n Junction, Semiconductor diode, Application of Junction Diode as a Rectifier, Special Purpose p-n Junction Diodes, Junction Transistor, Digital Electronics and Logic Gates, Integrated Circuits.

Section-C: Chemistry

1. **ATOMIC STRUCTURE:** Characteristics of Electron, Proton and Neutron, Rutherford's model of atom - Nature of electromagnetic theory - Planck's Quantum Theory, Explanation of photoelectric effect - Features of atomic Spectra - Characteristics of Hydrogen spectrum, Bohr's theory of structure of atom, Bohr's explanation of spectral lines, failure of Bohr's theory - Wave particle nature of electron - de Broglie's hypothesis, Heisenberg's uncertainty principle, Important features of the Quantum mechanical model of atom, Quantum numbers, concept of orbitals – Expressing atomic orbitals in terms of quantum numbers, shapes of s, p and d orbitals, Aufbau principle, Pauli exclusion principle, Hund's rule of maximum multiplicity. Electronic configuration of atoms, explanation of stability of half-filled and completely filled orbitals.

2. **CHEMICAL BONDING:** Orbital overlap and covalent bond, Ionic bond and Fajan's rules, Lattice energy, Hybridisation involving S, P and d orbitals, MOT, H-bond, Dipole moment, VSEPR theory and shapes of molecules.
3. **CLASSIFICATION OF ELEMENTS AND PERIODICITY OF PROPERTIES :** Concept of grouping of elements in accordance with their properties, The periodic law, The significance of atomic number and electronic configuration as the basis for periodic classification - Classification of elements into s,p,d, f blocks and their main characteristics - Classification of elements based on their properties.
4. **ALKALI AND ALKALINE EARTH METALS:** General introduction, electronic configuration, occurrence, anomalous properties of first element in each group, diagonal relationship, trends in properties like Ionisation enthalpy, atomic and ionic radii, reactivity with oxygen, hydrogen, halogens and water. Preparation and properties and uses of the compounds sodium hydroxide, salts of oxoacids, sodium carbonate, sodium hydrogen carbonate, sodium chloride, biological importance of sodium and potassium, preparation and uses of CaO, CaCO₃ and CaSO₄ , Industrial uses of lime and limestone - Biological importance of Mg and Ca.
5. **STATES OF MATTER: GASES AND LIQUIDS:** Grahams Law of diffusion, Dalton's law of partial pressures, Avogadro's law. Ideal behavior, Empirical derivation of Gas equation, Ideal gas equation. Kinetic molecular theory of gases, Kinetic gas equation (No derivation) and deduction of gas laws from kinetic gas equation, Distribution of molecular velocities - types of molecular velocities, behavior of real gases, Deviation from ideal behavior, compressibility factor Vs pressure diagrams of real Conditions for liquefaction of gases, critical temperature, Liquid state - properties of liquids in terms of Intermolecular attractions, Vapour pressure, viscosity and surface tension (Quantitative Idea only. No mathematical derivation).
6. **CHEMICAL THERMODYNAMICS : THERMODYNAMICS:** Concepts of system, types of systems, surroundings, work, heat, energy, extensive and intensive properties, state functions, First law of thermodynamics-internal energy and enthalpy, heat capacity and specific heat, Exothermic and endothermic reactions. Measurement of U and H, Enthalpies of bond dissociation, combustion, neutralization, formation, atomization, sublimation, phase transition, ionization and dilution, Thermo-chemical equations.

Hess's law of constant heat summation, Driving force for a spontaneous process, Thermodynamic representation of criteria of spontaneity in terms of entropy, entropy as a state function, Gibbs free energy, Gibbs free energy change for spontaneous, non spontaneous process and equilibrium process.
7. **SOLUTIONS:** Classification of solutions, Molarity Normality, Molality, Mole fraction, Dilute solutions, vapour pressure, Raoult's Law, Limitations of Raoult's Law Colligative properties, relative lowering of vapour pressure, elevation of boiling point, depression in freezing point, Osmosis and osmotic pressure, theory of dilute solutions, determination of molar masses using colligative properties, abnormal molecular mass.

8. **ACIDS AND BASES:** Lowry - Bronsted acids and bases theory, Lewis theory, limitations of Lewis theory, Ionic equilibrium, ionization of acids and bases, strong and weak electrolytes, degree of ionization, ionic product of water. Concept of p^H , Hydrolysis of salts (elementary idea), hydrolysis constant, buffer solutions, solubility product and common ion effect with illustrative examples.

9. **SOLID STATE:** Classification of solids based on different binding forces such as molecular, ionic, covalent solids and metallic solids, Treatment of metallic bond and metallic / solids, Amorphous and crystalline solids, Unit cell in two- dimensional and three- dimensional lattices, Seven crystal systems and Bravais lattices, Bragg's equation, X-ray study of crystal structure, Bragg's method. Calculation of density of unit cell, packing in solids, No. of atoms per cubic unit cell. Point defects - Schottky and Frenkel defects. Electrical and magnetic properties.

10. **SURFACE CHEMISTRY:** Adsorption, physical and chemical adsorption. Adsorption of gases on solids, factors affecting the adsorption - pressure (Langmuir and Freundlich Isotherms) and temperature, Catalysis-types of catalysis, autocatalysis. Colloidal state - colloidal solutions, classification of colloidal solutions, protective colloids and Gold number emulsions - classification of emulsions, micelles, cleansing action of soap, properties of colloids -Tyndall effect, Brownian movement, Coagulation.

11. **CHEMICAL KINETICS:** Concept of reaction rate, factors affecting reaction rates, Rate law, units of rate constant, Order and molecularity, methods of determination of order of reaction, Integrated rate equations and half lives for zero and first order reaction, Collision theory of reaction rates (elementary ideas), concepts of activation energy.

12. **EQUILIBRIUM:** Equilibrium in physical and chemical process, Dynamic nature of equilibrium, law of mass action, Equilibrium constant, Factors affecting equilibrium, Relation between K_p and K_c , Le- Chatlier's principle, applications to the industrial processes like (1) ammonia (2) sulphur trioxide.

13. **ELECTRO CHEMISTRY:** Conductance in electrolytic solutions, Specific and molar conductances- variation of conductance with concentration, Kohlrausch's law, application to calculation of equivalent conductance of weak electrolytes. Electrolytes and non-electrolytes, redox reactions, electrolysis - some typical examples of electrolysis viz; fused NaOH, brine solution, fused $MgCl_2$, Faraday's laws of electrolysis, Galvanic and voltaic cells representation and notation of electrochemical cells with and without salt bridge, Standard hydrogen electrode and electrode potentials, electro chemical series, EMF of cell, Nernst equation and its applications, calculation of EMF of electro chemical cells, Primary cell-dry cell/Leclanche cell, secondary cells - fuel cells - Hydrogen - Oxygen fuel cell and hydro carbon- oxygen fuel cell

14. **GROUP 13 ELEMENTS:** General introduction, electronic configuration, occurrence, variation of properties, oxidation states, trends in chemical reactivity, Anomalous properties of first element of the group, Boron: - Physical and chemical properties, uses, some important compounds: Borax and Boric acid. Boron hydrides, aluminium - uses, reactions with acids and alkalis, Potash alum.

15. **GROUP 14 ELEMENTS:** General introduction, electronic configuration, occurrence, Variation of properties, oxidation states, trends in chemical reactivity, Anomalous behavior of the first element of the group Carbon - catenation, allotropic forms, physical and chemical properties and uses. Similarities between carbon and silicon, uses of oxides of carbon, Important compounds of silicon - silicon dioxide and a few uses of silicon tetrachloride, silicones, silicates and zeolites (Elementary ideas) Fuel gases : Manufacture and uses of producer gas and water gas.
16. **ZERO GROUP ELEMENTS:** General introduction, electronic configuration, occurrence, Isolation trends in physical and chemical properties, uses, compounds of xenonoxides and xenon halides (structures only).
17. **GROUP 15 ELEMENTS (V A GROUP ELEMENTS):** Occurrence- physical states of Nitrogen and Phosphorous; allotropy, catenation. electronic configuration, oxidation states, General characteristics of hydrides, structure of hydrides, general characteristics of oxides, general characteristics of halides, Oxyacids of nitrogen, Oxyacids of phosphorous, preparation and uses of nitric acid and ammonia, superphosphate of lime.
18. **GROUP 16 ELEMENTS (VI GROUP ELEMENTS):** 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 oxyacids of chalcogens, Ozone, uses of ozone, Sodium thiosulphate, Sulphuric acid - industrial process of manufacture.
19. **TRANSITION ELEMENTS:** General introduction, electronic configuration, Occurrence and characteristics of transition metals, general trends in properties of first row transition elements- metallic character, ionization energy, Variable oxidation states, atomic and ionic radii, color, catalytic property, magnetic property, interstitial compounds. Alloy formation.
20. **LANTHANIDES:** Electronic configuration, variable oxidation states, chemical reactivity and lanthanide contraction.
21. **COORDINATION COMPOUNDS:** Introduction, ligands, coordination number, Werner's theory of coordination compounds, Shapes of coordination compounds, valence bond theory, IUPAC nomenclature of mono nuclear coordination compounds, Bonding, isomerism, EAN rule, Importance of coordination compounds in qualitative analysis, extraction of metals, Biological systems (chromo proteins, haemoglobin, chlorophyll structures only).
22. **GENERAL PRINCIPLES OF METALURGY:** Principles and methods of extraction-concentration, reduction by chemical and electrolytic methods and refining, Occurrence and principles of extraction of copper, zinc, iron and silver. Process of molten electrolysis to extract Al, Mg and Na.
23. **ORGANIC CHEMISTRY:** Some basic principles and techniques: General introduction, methods of purification, quantitative and qualitative analysis. Classification and IUPAC nomenclature of organic compounds. Electronic displacements in a

covalent bond, Inductive effect, electrometric effect, resonance and hyper conjugation, Fission of a covalent bond - homolytic and heterolytic fissions, Types of reagents : Electrophiles, nucleophiles and free radicals - examples and reactive intermediates, Common types of organic reactions - substitution, addition. Elimination and rearrangement reactions with examples.

24. **HYDROCARBONS** : Classification of hydrocarbons, Alkanes - Nomenclature, isomerism conformations (Ethane only), 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 (Markonikov's addition and peroxide effect), ozonolysis, oxidation, mechanism of electrophilic addition.
25. **AROMATIC HYDROCARBONS:** Introduction - IUPAC nomenclature, Benzene , resonance, aromaticity chemical properties: mechanism of electrophilic substitution - nitration, sulphonation, halogenation, Friedel crafts alkylation and acylation, directive influence of functional group in mono substituted Benzene carcinogenicity and toxicity, Stereochemistry : Introduction to Isomerism and recapitulation of geometrical isomerism and conformations, Optical activity - discovery, determination using a polarimeter, specific rotation, chirality - chiral objects, chiral molecules Configuration and Fischer projections of asymmetric carbon, elements of symmetry, Compounds containing one chiral centre, enantiomers, D-L and R-S nomenclature, racemic forms, racemisation. Compounds containing two chiral centres, diastereoisomers, mesoform, resolution, importance of stereo chemistry.
26. **ALCOHOLS, PHENOLS AND ETHERS: ALCOHOLS:** Nomenclature, methods of preparation of ethyl alcohol, physical and chemical properties (of primary alcohols only), Identification of primary, secondary, tertiary alcohols, Mechanism of dehydration. Uses of some important compounds - methanol and ethanol. **PHENOLS:** Nomenclature, methods of preparation of phenol, Physical and chemical properties, Acidic nature of phenol, Electrophilic substitution reactions, Uses of phenols. **ETHERS:** Nomenclature, Methods of preparation of diethyl ether, physical and chemical properties, uses.
27. **ALDEHYDES, KETONES AND CARBOXYLLIC ACIDS: ALDEHYDES AND KETONES** : Nomenclature, Nature of carbonyl group, Methods of preparation of acetaldehyde and acetone, physical and chemical properties, Mechanism of nucleophilic addition, Reactivity of alpha- hydrogen in aldehydes, uses. **CARBOXYLIC ACIDS:** Nomenclature, acidic nature, Methods of preparation of acetic acid, Physical and chemical properties, Uses.
28. **ORGANIC COMPOUNDS CONTAINING NITROGEN Nitrobenzene** - Preparation, properties uses. **AMINES:** Nomenclature, Classification, Structure, methods of preparation of aniline, physical and chemical properties, Uses, Identification of primary, secondary and tertiary amines. **DIAZONIUM SALTS:** Preparation, Chemical reactions and importance in synthetic organic chemistry, Uses of azodyes.

29. **POLYMERS:** 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.
30. **BIOMOLECULES: CARBOHYDRATES:** Classification (aldoses and ketoses), Monosaccharides. (glucose and fructose), Oligosaccharides (sucrose, lactose, maltose), Polysaccharides (starch, cellulose, glycogen) and Importance. **PROTEINS:** Elementary idea of amino acids, peptide, Polypeptides, proteins Primary structure, secondary structure, tertiary structure and quaternary structures (qualitative ideas only). Denaturation of proteins, enzymes. **VITAMINS:** Classification, Functions in bio systems. **NUCLEIC ACIDS:** Types of nucleic acids, primary building blocks of nucleic acids, Chemical composition of DNA & RNA, Primary structure of DNA, genetic code.

MODEL PAPER

SECTION-A1: Mathematics

1. If one of the roots of the equations $x^3 - 6x^2 + 11x - 6 = 0$ is 2, then the other two roots are _____
 a) 2 and 4 b) 1 and 3 c) 2 and 3 d) 1 and 4
2. The product of the eigen values of a matrix is equal to _____
 a) Determinant b) integral c) discriminant d) power of determinant
3. The equation of a straight line parallel to the x-axis is _____
 a) $(x-a) / 1$ b) $(y-b) / 1$ c) $(z-c) / 1$ d) $(x-a) / 1$
4. The probability of an impossible event is _____
 a) zero b) one c) two d) none of the above

SECTION- A2: BIOLOGY

1. Plasma membrane is composed of—
 a) Protein, b) Lipids,
 c) Cellulose d) Protein and Lipids
2. The dye involved in Feulgen reaction to stain DNA is--
 a) Janus green B b) Basic Fuchsin
 c) Neutral red d) Haemoxilin
3. Lamarck theory of Organic evolution is usually known as—
 a) Natural selection, b) Inheritance of acquired characters c)
 Descent with change d) continuity of form plasma

4. Which of the following causes plague---
 a) *Trichinella spiralis* b) *Yersinia pestis*
 c) *Salmonella typhimurium* d) *Leishmania donovani*
5. Diphtheria is caused by---
 a) Nematodes b) Virus
 c) Bacteria d) none of these

SECTION-B: PHYSICS

1. Angular displacement is measured in---
 a) metre b) time c) radian d) steradian
2. The operation of rocket is based on
 a) pushing against launching pad
 b) pushing against air
 c) conservation of linear momentum
 d) conservation of angular momentum
3. A thief stole a box with valuable articles of weight W and jumped down of height h .
 Before he reached the ground, he experienced a load of
 a) 0 b) $W/2$ c) W d) $2W$
4. The translational kinetic energy of gas molecules at temperature T gas is---
 a) $3/2 kT$ b) $9/2 kT$ c) $1/3 kT$ d) $5/2 kT$
5. The end product of $^{23}\text{Th}^{90}$ is $^{82}\text{X}^{208}$ the number of α and β particles emitted are---
 a) 3,3 b) 6,4 c) 6,0 d) 4,6

SECTION-C: CHEMISTRY

1. Structure of ammonia is
 a) Pyramidal b) Tetrahedral c) Trigonal d) Trigonal bipyramidal
2. Identify the compound which exhibit keto-enol tautomerism
 a) Acetaldehyde b) Propanol c) Propane d) Butane
3. Which of the following ions is expected to be colorless?
 a) Cu^{2+} b) Ti^{4+} c) V^{3+} d) Fe^{2+}
4. The most common way of expressing the concentration of a solution is---
 a) Normality b) Molarity c) Molality d) Mole fraction
5. Lewis bases are
 a) Electrophiles c) Both
 b) Nucleophiles d) None