252	HINDI	25201	M.A. Hindi	Any bachelor degree in Arts, Science or Commerce with Hindi as one of the subjects or any bachelor degree in Arts, Science or Commerce without Hindi as one of the subjects, but with a diploma such as Sahitya Ratna, Bhasha Praveena or Vidwan or Equivalent to that.
253	B.F.A.	25301	B.F.A. (4 years duration)	A pass in higher secondary course (H.S.C.) 10+2 pattern or Intermediate examination or its equivalent / 10+3 years Diploma.

**Seats will be filled on all India basis.**

APPENDIX-II

SYLLABI FOR ENTRANCE TESTS IN SCIENCE, ARTS, COMMERCE & ENGINEERING

101 – LIFE SCIENCES

Total Marks : 100

1. **Cell Biology :** Ultrastructure of prokaryotic and eukaryotic cell, Structure and function of cell organelles. Cell division – Mitosis and Meiosis. Chromosomes structure, Karyotype.
2. **Genetics :** Mendelian principles, Gene Interaction, Linkage and Crossing over, Sex determination, Sex linkage, Mutations – Genic and chromosomal (Structural and numerical); Chromosomal aberrations in humans. Recombination in prokaryotes transformation, conjugation, transduction, sexduction. Extra genomic inheritance.
3. **Molecular Biology and Genetic Engineering :** Structure of eukaryotic gene, DNA and RNA structure, DNA replication in pro and eukaryotes, Transcription and translation in pro and eukaryotes, genetic code. Regulation of gene expression in prokaryotes, Principles of recombinant DNA technology. DNA vectors, Transgenesis. Applications of genetic engineering.
4. **Biotechnology :** Plant and animal cell culture, cloning, Fermentors types and process, Biopesticides, biofertilizers, Bioremediation, Renewable and non – renewable energy resources, Non-conventional fuels.
5. **Biomolecules :** Carbohydrates, proteins, amino acids, lipids, vitamins and porphyrins. Enzymes – classification and mode of action, enzyme assay, enzyme units, enzyme inhibition, enzyme kinetics, Factors regulating enzyme action.
6. **Immunology :** Types of immunity, cells and organelles of immune system, Antigen – antibody reaction. Immunotechniques, Hypersensitivity, Vaccines.
7. **Techniques :** Microscopy – Light and Electron, Centrifugation, Chromatography, Eletrophoresis, Calorimetric and Spectrophotometric techniques, Blotting techniques, PCR, DNA finger printing.
8. **Ecology, Environment and Evolution :** Theories and evidences of organic evolution, Hardy – Weinberg law. Components of an ecosystem, Ecological pyramids, Biogeochemical cycles, Ecological adaptations. Climatic and edaphic and biotic factors. Ecological sucession – Hydrosere and xerosere, Natural resources, Biodiversity, current environmental issues, Environmental pollution, Globla warming and climate change.
9. **Physiology :** Structure and function of liver, kidney and heart, composition of blood, blood types, blood coagulation, Digestion and absorption, Endocrinology, Muscle and Nervous system.
10. **Metabolism :** Metabolism of carbohydrates, lipids, proteins, aminoacids and nucleic acids. Biological oxidation and bioenergetics.

11. **Animal Science :** Biology of invertebrates and chordates, Embryology of chordates, Classification of marine environment – Physical and chemical parameters, Marine, estuarine, reservoir and riverine fisheries, Cultivation of fin and shell fish. Culture practices.
12. **Plant Science :** Classification of cryptogams and phanerogams. General characteristics of taxonomic groups at class and family level Water relations and mineral nutrition of plants, Plant growth regulators, Ethnobotany and medicinal plants, Biology of plant seed, Photosynthesis.
13. **Microbiology :** Microbes – Types, distribution and biology. Isolation and cultivation of bacteria and virus. Staining techniques. Bacterial growth curve, Microbial diseases – food and water borne, insect borne, contact diseases in humans. Microbial diseases in plants – by bacteria, fungi and virus, Plant microbe – interactions.
14. **Nutrition :** Biological value of proteins, protein malnutrition, disorders, Chemistry and physiological role of vitamins and minerals in living systems.

102 – PHYSICAL SCIENCES

Total Marks : 100

Mechanics& Properties of Matter

1. Vector Analysis

Scalar and vector fields, gradient of a scalar field and its physical significance. Divergence and curl of a vector field with derivations and physical interpretation. Vector integration (line, surface and volume), Statement and proof of Gauss and Stokes theorems.

2. Mechanics of particles

Laws of motion, motion of variable mass system, Equation of motion of a rocket. Conservation of energy and momentum, Collisions in two and three dimensions, Concept of impact parameter, scattering cross-section, Rutherford scattering-derivation.

3. Mechanics of Rigid bodies

Definition of rigid body, rotational kinematic relations, equation of motion for a rotating body, angular momentum, Euler equations and its applications, precession of a top, Gyroscope, precession of the equinoxes.

4. Mechanics of continuous media

Elastic constants of isotropic solids and their relations, Poisson's ratio and expression for Poisson's ratio in terms of y, n, k. Classification of beams, types of bending, point load, distributed load, shearing force and bending moment, sign conventions.

5. Central forces

Central forces, definition and examples, characteristics of central forces, conservative nature of central forces, conservative force as a negative gradient of potential energy, equatglobal ion of motion under a central force. Derivation of Kepler's laws. Motion of satellites, idea of Global Positioning System (GPS).

6. Special theory of relativity

Galilean relativity, absolute frames. Michelson-Morley experiment, negative result. Postulates of special theory of relativity. Lorentz transformation, time dilation, length contraction, addition of velocities, mass-energy relation. Concept of four-vector formalism.

Waves & Oscillations

1. Simple Harmonic oscillations

Simple harmonic oscillator and solution of the differential equation-Physical characteristics of SHM, torsion pendulum-measurements of rigidity modulus, compound pendulum- measurement of 'g', Principle of superposition, beats, combination of two mutually perpendicular simple harmonic vibrations of same frequency and different frequencies. Lissajous figures.

2. Damped and forced oscillations

Damped harmonic oscillator, solution of the differential equation of damped oscillator. Energy considerations, comparison with un-damped harmonic oscillator, logarithmic decrement, relaxation time, quality factor, differential equation of forced oscillator and its solution, amplitude resonance and velocity resonance.

3. Complex vibrations

Fourier theorem and evaluation of the Fourier coefficients, analysis of periodic wave functions-square wave, triangular wave, saw tooth wave, simple problems on evolution of Fourier coefficients.

4. **Vibrating strings:**
Transverse wave propagation along a stretched string, general solution of wave equation and its significance, modes of vibration of stretched string clamped at ends, overtones and harmonics. Energy transport and transverse impedance.

5. **Vibrations of bars:**
Longitudinal vibrations in bars-wave equation and its general solution. Special cases (i) bar fixed at both ends (ii) bar fixed at the midpoint (iii) bar fixed at one end. Tuning fork.

6. **Ultrasonics:**
Ultrasonics, properties of ultrasonic waves, production of ultrasonics by piezoelectric and magnetostriction methods, detection of ultrasonics, determination of wavelength of ultrasonic waves.Applications of ultrasonic waves.

Wave Optics

1. **Aberrations:**
Introduction – monochromatic aberrations, spherical aberration, methods of minimizing spherical aberration, coma, astigmatism and curvature of field, distortion. Chromatic aberration-the achromatic doublet.Achromatism for two lenses (i)in contact and (ii) separated by a distance.

2. **Interference**
Principle of superposition – coherence-temporal coherence and spatial coherence-conditions for interference of light.Fresnel's biprism-determination of wavelength of light –change of phase on reflection.Oblique incidence of a plane wave on a thin film due to reflected and transmitted light (cosine law) –colors of thin films-Interference by a film with two non-parallel reflecting surfaces (Wedge shaped film). Determination of diameter of wire, Newton's rings in reflected light. Michelson interferometer, Determination of wavelength of monochromatic light using Newton's rings and Michelson Interferometer.

3. **Diffraction**
Introduction,distinction between Fresnel and Fraunhoffer diffraction, Fraunhoffer diffraction –Diffraction due to single slit-Fraunhoffer diffraction due to double slit-Fraunhoffer diffraction pattern with N slits (diffraction grating).Resolving power of grating, Determination of wavelength of light in normal incidence and minimum deviation methods using diffraction grating,
Fresnel's half period zones-area of the half period zones-zone plate-comparison of zone plate with convex lens-difference between interference and diffraction.

4.**Polarisation:**
Polarized light: methods of polarization polarization by reflection, refraction, double refraction, scattering of light-Brewster's law-Mauls law-Nicol prism polarizer and analyzer-Quarter wave plate, Half wave plate-optical activity, determination of specific rotation by Laurent's half shade polarimeter-Babinet's compensator – idea of elliptical and circular polarization

5. **Lasers and Holography**
Lasers: introduction,spontaneous emission, stimulated emission. Population Inversion, Laser principle-Einstein coefficients-Types of lasers-He-Ne laser, Ruby laser- Applications of lasers.Holography: Basic principle of holography-Gabor hologram and its limitations, Applications of holography.

6. **Fiber Optics**
Introduction- different types of fibers, rays and modes in an optical fiber, fiber material,principles of fiber communication (qualitative treatment only), advantages of fiber optic communication.

Thermodynamics &Radiation Physics

1. **Kinetic theory of gases**
Introduction –Deduction of Maxwell's law of distribution of molecular speeds, experimental verification. Transport phenomena – Mean free path – Viscosity of gases-thermal conductivity-diffusion of gases.

2. **Thermodynamics**
Introduction- Isothermal and adiabatic process- Reversible and irreversible processes-Carnnot's engine and its efficiency-Carnot's theorem-Second law of thermodynamics. Kelvin's and Claussius statements-Entropy, physical significance –Change in entropy in reversible and irreversible processes-Entropy and disorder-Entropy of Universe–Temperature-Entropy (T-S) diagram and its uses – Change of entropy of a perfect gas- change of entropy when ice changes into steam.

3. **Thermodynamic potentials and Maxwell's equations**
Thermodynamic potentials-Derivation of Maxwell's thermodynamic relations-Clausius-Clayperon's equation-Derivation for ratio of specific heats-Derivation for difference of two specific heats for perfect gas.Joule Kelvin effect-expression for Joule Kelvin coefficient for perfect and vander Waal's gas.

4. Low temperature Physics

Introduction-Joule Kelvin effect-Porous plug experiment – Joule expansion-Distinction between adiabatic and Joule Thomson expansion-Expression for Joule Thomson cooling-Liquefaction of helium, Kapitza's method-Adiabatic demagnetization, Production of low temperatures –applications of substances at lowtemperature-effects of chloro and fluoro carbons on ozone layer.

5. Quantum theory of radiation

Blackbody-Ferry's black body-distribution of energy in the spectrum of black body-Wein's displacement law,Wein's law, Rayleigh-Jean's law-Quantum theory of radiation-Planck's law-Measurement of radiation-Types of pyrometers-Disappearing filament optical pyrometer-experimental determination – Angstrompyrheliometer-determination of solar constant, Temperature of Sun.

Electricity, Magnetism& Electronics

1. Electric field intensity and potential:

Gauss's law statement and its proof- Electric field intensity due to (1) Uniformly charged sphere and (2) an infinite conducting sheet of charge. Electrical potential – equipotential surfaces- potential due to i) a point charge, ii)charged spherical shell and uniformly charged sphere.

4. Dielectrics:

Electric dipolemoment and molecular polarizability- Electric displacement D, electric polarization P – relation between D, E and P- Dielectric constant and susceptibility. Boundary conditions at the dielectric surface.

5. Electric and magnetic fields

Biot-Savart's law, explanation and calculation of B due to long straight wire, a circular current loop and solenoid – Lorentz force – Hall effect – determination of Hall coefficient and applications.

4. Electromagnetic induction

Faraday's law-Lenz's law- Self and mutual inductance, coefficient of coupling, calculation of self inductance of a long solenoid, energy stored in magnetic field.Transformer – energy losses – efficiency.

5. Alternating currents and electromagnetic waves

Alternating current – Relation between current and voltage in LR and CR circuits,vector diagrams, LCR series and parallel resonant circuit, Q –factor, power in ac circuits.

6. Maxwell's equations

Idea of displacement current – Maxwell's equations (integral and differential forms) (no derivation), Maxwell's wave equation (with derivation), Transverse nature of electromagnetic waves.Poynting theorem (statement and proof), production of electromagnetic waves (Hertz experiment).

7. Basic electronics:

PN 20ehavior diode, Zener diode, Tunnel diode, I-V characteristics, PNP and NPN transistors, CB, CE and CC configurations – Relation between α, β and γ - transistor (CE) characteristics –Determination of hybrid parameters, Transistor as an amplifier.

8. Digital electronics

Number systems – Conversion of binary to decimal system and vice versa.Binary addition and subtraction (1's and 2's complement methods).Laws of Boolean algebra – De Morgan's laws-statement and proof, Basic logic gates, NAND and NOR as universal gates, exclusive-OR gate, Half adder and Full adder, Parallel adder circuits.

Modern Physics

6. Atomic and molecular physics

Introduction –Drawbacks of Bohr's atomic model- Sommerfeld's elliptical orbits-relativistic correction (no derivation).Vector atom model and Stern-Gerlach experiment – quantum numbers associated with it. L-S and j-j coupling schemes.Zeeman effect and its experimental arrangement.

Raman effect, hypothesis, Stokes and Anti Stokes lines. Quantum theory of Raman effect. Experimental arrangement – Applications of Raman effect.

2. Matter waves &   Uncertainty Principle

Matter waves, de Broglie's hypothesis – wavelength of matter waves, Properties of matter waves – Davisson and Germer experiment – Phase and group velocities.

Heisenberg's uncertainty principle for position and momentum (x and p), & energy and time (E and t). Experimental verification - Complementarity principle of Bohr.

7. Quantum (wave) mechanics

Basic postulates of quantum mechanics-Schrodinger time independent and time dependent wave equations-derivations. Physical interpretation of wave function. Eigen functions, Eigen values. Application of Schrodinger wave equation to particle in one dimensional infinite box.

4. **General Properties of Nuclei**
   Basic ideas of nucleus –size, mass, charge density (matter energy), binding energy, angular momentum, parity, magnetic moment, electric moments. Liquid drop model and Shell model (qualitative aspects only) – Magic numbers.
5. **Radioactivity decay:**
   Alpha decay: basics of α-decay processes. Theory of α-decay, Gamow's theory, Geiger Nuttal law.β-decay, Energy kinematics for β-decay, positron emission, electron capture, neutrino hypothesis.
6. **Crystal Structure**
   Amorphous and crystalline materials, unit cell, Miller indices, reciprocal lattice, types of lattices, diffraction of X-rays by crystals, Bragg's law, experimental techniques, Laue's method and powder diffraction method.
7. **Superconductivity:**
   Introduction – experimental facts, critical temperature – critical field – Meissner effect – Isotope effect – Type I and type II superconductors – BCS theory (elementary ideas only) – applications of superconductors.

103 – MATHEMATICAL SCIENCES

Total Marks : 100

DIFFERENTIAL EQUATIONS:

Differential Equations of first order and first degree: Linear differential equations; Differential equations reducible to linear Form; Exact differential equations; Integrating factors; Change of variables. Orthogonal trajectories.

Differential Equations of first order but not of the first degree : Equations solvable for p; Equations solvable for y; Equations solvable for x; Equations that do not contain x (or y); Equations of the first degree in x and y – Clairaut's Equation**.**

Higher order linear differential equations-I : Solution of homogeneous linear differential equations of order n with constant coefficients; Solution of the non-homogeneous linear differential equations with constant coefficients by means of polynomial operators.

General Solution of f(D)y=0

General Solution of f(D)y=Q when Q is a function of x.

$\dfrac{1}{f(D)}$ is Expressed as partial fractions.

P.I. of f(D)y = Q when Q= be^{ax}

P.I. of f(D)y = Q when Q is b sin ax or b cos ax**.**

Higher order linear differential equations-II :

Solution of the non-homogeneous linear differential equations with constant coefficients.

P.I. of f(D)y = Q when Q= bx^{k}

P.I. of f(D)y = Q when Q= $e^{ax}V$

P.I. of f(D)y = Q when Q= xV

P.I. of f(D)y = Q when Q= $x^{m}V$

Higher order linear differential equations-III : Method of variation of parameters; Linear differential Equations with non-constant coefficients; The Cauchy-Euler Equation.

SOLID GEOMETRY:

The Plane: Equation of plane in terms of its intercepts on the axis, Equations of the plane through the given points, Length of the perpendicular from a given point to a given plane, Bisectors of angles between two planes, Combined equation of two planes, Orthogonal projection on a plane.

The Line: Equation of a line; Angle between a line and a plane; The condition that a given line may lie in a given plane; The condition that two given lines are coplanar; Number of arbitrary constants in the equations of straight line; Sets of conditions which determine a line; The shortest distance between two lines; The length and equations of the line of shortest distance between two straight lines; Length of the perpendicular from a given point to a given line;

Sphere: Definition and equation of the sphere; Equation of the sphere through four given points; Plane sections of a sphere; Intersection of two spheres; Equation of a circle; Sphere through a given circle; Intersection of a sphere and a line; Power of a point; Tangent plane; Plane of contact; Polar plane; Pole of a Plane; Conjugate points; Conjugate planes;

Sphere &Cones: Angle of intersection of two spheres; Conditions for two spheres to be orthogonal; Radical plane; Coaxial system of spheres; Simplified from of the equation of two spheres. Definitions of a cone; vertex; guiding curve; generators; Equation of the cone with a given vertex and guiding curve; Enveloping cone of a sphere; Equations of cones with vertex at origin are homogenous; Condition that the general equation of the second degree should represent a cone; Condition that a cone may have three mutually perpendicular generators;

Cones & Cylinders: Intersection of a line and a quadric cone; Tangent lines and tangent plane at a point; Condition that a plane may touch a cone; Reciprocal cones; Intersection of two cones with a common vertex; Right circular cone; Equation of the right circular cone with a given vertex; axis and semi-vertical angle. Definition of a cylinder; Equation to the cylinder whose generators intersect a given conic and are parallel to a given line; Enveloping cylinder of a sphere; The right circular cylinder; Equation of the right circular cylinder with a given axis and radius.

Abstract Algebra :

Groups: Binary Operation – Algebraic structure – semi group-monoid – Group definition and elementary properties – Finite and Infinite groups – examples – order of a group. Composition tables with examples.

Subgroups: Complex Definition – Multiplication of two complexes Inverse of a complex-Subgroup definition – examples-criterion for a complex to be a subgroup. Criterion for the product of two subgroups to be a subgroup-union and intersection of subgroups. Cosets and Lagrange's Theorem**:** Cosets Definition – properties of Cosets – index of a subgroups of a finite groups–Lagrange's Theorem.

Normal subgroups: Definition of normal subgroup – proper and improper normal subgroup–Hamilton group – criterion for a subgroup to be a normal subgroup – intersection of two normal subgroups – Sub group of index 2 is a normal sub group – simple group – quotient group – criteria for the existence of a quotient group.

Homomorphism: Definition of homomorphism – Image of homomorphism elementary properties of homomorphism – Isomorphism – automorphism definitions and elementary properties–kernel of a homomorphism – fundamental theorem on Homomorphism and applications.

Permutations and cyclic groups: Definition of permutation – permutation multiplication – Inverse of a permutation – cyclic permutations – transposition – even and odd permutations – Cayley's theorem. Cyclic Groups : Definition of cyclic group – elementary properties – classification of cyclic groups.

REAL ANALYSIS:

Real numbers: [The algebraic and order properties of R, Absolute value and Real line, Completeness property of R, Applications of supreme property; intervals. No. Question is to be set from this portion.]

Real Sequences: Sequences and their limits, Range and Boundedness of Sequences, Limit of a sequence and Convergent sequence. The Cauchy's criterion, properly divergent sequences, Monotone sequences, Necessary and Sufficient condition for Convergence of Monotone Sequence, Limit Point of Sequence, Subsequences and the Bolzano-weierstrass theorem – Cauchy Sequences – Cauchy's general principle of convergence theorem.

Infinite series : series : Introduction to series, convergence of series. Cauchy's general principle of convergence for series tests for convergence of series, Series of Non-Negative Terms.

1. P-test

2. Cauchy's n^{th} root test or Root Test.

3. D-Alemberts' Test or Ratio Test.

4. Alternating Series – Leibnitz Test.

Absolute convergence and conditional convergence, semi convergence.

Continuity : limits : [Real valued Functions, Boundedness of a function, Limits of functions. Some extensions of the limit concept, Infinite Limits. Limits at infinity. No. Question is to be set from this portion.]

Continuous functions : Continuous functions, Combinations of continuous functions, Continuous Functions on intervals, uniform continuity.

Differentiation and mean value theorems: The derivability of a function, on an interval, at a point, Derivability and continuity of a function, Graphical meaning of the Derivative, Mean value Theorems; Role's Theorem, Lagrange's Theorem, Cauchy's Mean value Theorem. **Riemann integration:** Riemann Integral, Riemann integral functions, Darboux theorem. Necessary and sufficient condition for R – integrability, Properties of integrable functions, Fundamental theorem of integral calculus, integral as the limit of a sum, Mean value Theorems.

Ring Theory & Vector Calculus:

Rings-I: Definition of Ring and basic properties, Boolean Rings, divisors of zero and cancellation laws in Rings, Integral Domains, Division Ring and Fields, The characteristic of a ring – The characteristic of an Integral Domain, The characteristic of a Field. Sub Rings, Ideals **Rings-II :** Definition of Homomorphism – Homomorphic Image – Elementary Properties of Homomorphism –Kernel of a Homomorphism – Fundamental theorem of Homomorhphism – Maximal Ideals – Prime Ideals.

Vector differentiation: Vector Differentiation, Ordinary derivatives of vectors, Differentiability, Gradient, Divergence, Curl operators, Formulae Involving these operators. **Vector integration:** Line Integral, Surface integral, Volume integral with examples.

Vector integration applications: Theorems of Gauss and Stokes, Green's theorem in plane and applications of these theorems.

LINEAR ALGEBRA

Vector Spaces-I : Vector Spaces, General properties of vector spaces, n-dimensional Vectors, addition and scalar multiplication of Vectors, internal and external composition, Null space, Vector subspaces, Algebra of subspaces, Linear Sum of two subspaces, linear combination of Vectors, Linear span Linear independence and Linear dependence of Vectors.

Vector Spaces-II : Basis of Vector space, Finite dimensional Vector spaces, basis extension, co-ordinates, Dimension of a Vector space, Dimension of a subspace, Quotient space and Dimension of Quotient space.

Linear Transformations: Linear transformations, linear operators, Properties of L.T, sum and product of LTs, Algebra of Linear Operators, Range and null space of linear transformation, Rank and Nullity of linear transformations – Rank – Nullity Theorem.

Matrix : Matrices, Elementary Properties of Matrices, Inverse Matrices, Rank of Matrix, Linear Equations, Characteristic Roots, Characteristic Values & Vectors of square Matrix, Cayley – Hamilton Theorem.

Inner product space: Inner product spaces, Euclidean and unitary spaces, Norm or length of a Vector, Schwartz inequality, Triangle in Inequality, Parallelogram law, Orthogonality, Orthonormal set, complete orthonormal set, Gram – Schmidt orthogonalisation process. Bessel's inequality and Parseval's Identity.

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104 – CHEMICAL SCIENCES

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Total Marks : 100

INORGANIC CHEMISTRY

p-block elements –I

Group-13: Synthesis and structure of diborane and higher boranes (B_4H_{10} and B_5H_9)**,** boron-nitrogen compounds ($B_3N_3H_6$ and BN)

Group – 14: Preparation and applications of silanes and silicones.

Group – 15: Preparation and reactions of hydrazine, hydroxylamine.

p-block elements –II

Group – 16: Classifications of oxides based on (i) Chemical behavior and (ii) Oxygen content.

Group-17: Inter halogen compounds and pseudo halogens.

Organometallic Chemistry

Definition – classification of Organometallic compounds – nomenclature, preparation, properties and applications of alkyls of Li and Mg.

Chemistry of d-block elements:

Characteristics of d-block elements with special reference to electronic configuration, variable valence, magnetic properties, catalytic properties and ability to form complexes. Stability of various oxidation states

Theories of bonding in metals:

Metallic properties and its limitations, Valence bond theory, Free electron theory, Explanation of thermal and electrical conductivity of metals, limitations, Band theory, formation of bands, explanation of conductors, semiconductors and insulators.

Metal carbonyls :

EAN rule, classification of metal carbonyls, structures and shapes of metal carbonyls of V, Cr, Mn, Fe, Co and Ni.

Chemistry of f-block elements:

Chemistry of lanthanides – electronic structure, oxidation states, lanthanide contraction, consequences of lanthanide contraction, magnetic properties. Chemistry of actinides – electronic configuration, oxidation states, actinide contraction, comparison of lanthanides and actinides.

Coordination Chemistry:

IUPAC nomenclature – bonding theories – Review of Werner's theory and Sidgwick's concept of coordination – Valence bond theory - geometries of coordination numbers 4-tetrahedral and square planar and 6-octahedral and its limitations, crystal filed theory - splitting of d-orbitals in octahedral, tetrahedral and square-planar complexes – low spin and high spin complexes – factors affecting crystal-field splitting energy, merits and demerits of crystal-field theory. Isomerism in coordination compounds – structural isomerism and stereo isomerism, stereochemistry of complexes with 4 and 6 coordination numbers.

Spectral and magnetic properties of metal complexes:

Types of magnetic behavior, spin-only formula, calculation of magnetic moments, experimental determination of magnetic susceptibility- Gouy method.

Stability of metal complexes:

Thermodynamic stability and kinetic stability, factors affecting the stability of metal complexes, chelate effect, determination of composition of complex by Job's method and mole ratio method.

Reactivity of metal complexes:

Labile and inert complexes, ligand substitution reactions – SN^1 and SN^2, substitution reactions of square planar complexes – Trans effect and applications of trans effect.

Bioinorganic chemistry:

Essential elements, biological significance of Na, K, Mg, Ca, Fe, Co, Ni, Cu, Zn and Cl^-. Metalloporphyrins – Structure and functions of hemoglobin, Myoglobin and Chlorophyll.

Quantitative analysis:

Importance in various fields of science, steps involved in chemical analysis. Principles of volumetric analysis: Theories of acid-base, redox, complexometric, iodometric and precipitation titrations – choice of indicators for these titrations.

Principles of gravimetric analysis: precipitation, coagulation, peptization, coprecipitation, post precipitation, digestion, filtration and washing of precipitate, drying and ignition.

Treatment of analytical data:

Types of errors, significant figures and its importance, accuracy – methods of expressing accuracy, error analysis and minimization of errors, precision – methods of expressing precision, standard deviation and

SEPARATION TECHNIQUES IN CHEMICAL ANALYSIS:

SOLVENT EXTRACTION: Introduction,principle,techniques,factors affecting solvent extraction, Batch extraction, continuous extraction and counter current extraction. Synergism., Application – Determination of Iron (III)

ION EXCHANGE :Introduction,action of ion exchange resins,separation of inorganic mixtuers,applications, Solvent extraction: Principle and process,

Chromatography: Classification of chromatography methods, principles of differential migration adsorption phenomenon, Nature of adsorbents, solvent systems, R_f values, factors effecting R_f values.

Paper Chromatography: Principles, R_f values, experimental procedures, choice of paper and solvent systems, developments of chromatogram – ascending, descending and radial. Two dimensional chromatography, applications.

Thin layer Chromatography (TLC): Advantages. Principles, factors effecting R_f values. Experimental procedures. Adsorbents and solvents. Preparation of plates. Development of the chromatogram. Detection of the spots. Applications.

Column Chromatography: Principles, experimental procedures, Stationary and mobile Phases, Separation technique. Applications

HPLC: Basic principles and applications.

ORGANIC CHEMISTRY

Structural theory in Organic Chemistry

Types of bond fission and organic reagents (Electrophilic, Nucleophilic, and free radical reagents including neutral molecules like H_2O, NH_3 & $AlCl_3$).

Bond polarization : Factors influencing the polarization of covalent bonds, electro negativity – inductive effect. Application of inductive effect (a) Basicity of amines (b) Acidity of carboxylic acids (c) Stability of carbonium ions. Resonance or Mesomeric effect, application to (a) acidity of phenol, and (b) acidity of carboxylic acids. Hyper conjugation and its application to stability of carbonium ions, Free radicals and alkenes, carbanions, carbenes and nitrenes.

Types of Organic reactions : Addition – electrophilic, nucleophilic and free radical. Substitution – electrophilic, nucleophilic and free radical. Elimination- Examples.

Acyclic Hydrocarbons

Alkenes – Preparation of alkenes. Properties: Addition of hydrogen – heat of hydrogenation and stability of alkenes. Addition of halogen and its mechanism. Addition of HX, Markonikov's rule, addition of H_2O, HOX, H_2SO_4 with mechanism and addition of HBr in the presence of peroxide (anti – Markonikov's addition). Dienes – Types of dienes, reactions of conjugated dienes – 1,2 and 1,4 addition of HBr to 1,3 – butadiene and Diel's – Alder reaction.

Alkynes – Preparation by dehydrohalogenation of dihalides, dehalogenation of tetrahalides, Properties; Acidity of acetylenic hydrogen (formation of Metal acetylides). Preparation of higher acetylenes, Metal ammonia reductions, Physical properties. Chemical reactivity – electrophilic addition of X_2, HX, H_2O (Tautomerism), Oxidation with $KmnO_4$, OsO_4, reduction and Polymerisation reaction of acetylene.

Alicyclic hydrocarbons (Cycloalkanes)

Nomenclature, Preparation by Freunds method, Wislicenus method. Properties – reactivity of cyclopropane and cyclobutane by comparing with alkanes, Stability of cycloalkanes – Baeyer's strain theory, Sachse and Mohr predictions and Pitzer's strain theory. Conformational structures of cyclobutane, cyclopentane, cyclohexane.

Benzene and its reactivity

Concept of resonance, resonance energy. Heat of hydrogenation, heat of combustion of Benzene, mention of C-C bond lengths and orbital picture of Benzene. Concept of aromaticity – aromaticity (definition), Huckel's rule – application to Benzenoid (Benzene, Naphthalene) and Non – Benzenoid compounds (cyclopropenyl cation, cyclopentadienyl anion and tropylium cation)

Reactions – General mechanism of electrophilic substitution, mechanism of nitration, Friedel Craft's alkylation and acylation. Orientation of aromatic substitution – Definition of ortho, para and meta directing groups. Ring activating and deactivating groups with examples (Electronic interpretation of various groups like NO_2 and Phenolic). Orientation of (i) Amino, methoxy and methyl groups (ii) Carboxy, nitro, nitrile, carbonyl and sulphonic acid groups (iii) Halogens

(Explanation by taking minimum of one example from each type)

Halogen compounds

Nomenclature and classification of alkyl (into primary, secondary, tertiary), aryl, aryl alkyl, allyl, vinyl, benzyl halides. Nucleophilic aliphatic substitution reaction- classification into SN^1 and SN^2 – reaction mechanism with examples – Ethyl chloride, t-butyl chloride and optically active alkyl halide 2-bromobutane.

Hydroxy compounds

Nomenclature and classification of 26ehavior compounds.

Alcohols: Preparation with hydroboration reaction, Grignard synthesis of alcohols. Phenols: Preparation i) from diazonium salt, ii) from aryl sulphonates, iii) from cumene. Physical properties- Hydrogen bonding (intermolecular and intramolecular). Effect of hydrogen bonding on boiling point and solubility in water.

Identification of alcohols by oxidation with $KmnO_4$, Ceric ammonium nitrate, Luca's reagent and phenols by reaction with $FeCl_3$.

Chemical properties:

  a) Dehydration of alcohols.

  b) Oxidation of alcohols by CrO_3, $KmnO_4$.

  c) Special reaction of phenols: Bromination, Kolbe-Schmidt reaction, Riemer-Tiemann reaction, Fries rearrangement, azocoupling, Pinacol-Pinacolone rearrangement.

Carbonyl compounds

Nomenclature of aliphatic and aromatic carbonyl compounds, structure of the carbonyl group. Synthesis of aldehydes from acid chlorides, synthesis of aldehydes and ketones using 1,3-dithianes, synthesis of ketones from nitriles and from carboxylic acids. Physical properties: Reactivity of carbonyl group in aldehydes and ketones.

Nucleophilic addition reaction with a) $NaHSO_3$, b) HCN, c) RMgX, d) NH_2OH, e)$PhNHNH_2$, f) 2,4 DNPH, g) Alcohols-formation of hemiacetal and acetal. Base catalysed reactions: a) Aldol, b) Cannizzaro's reaction, c) Perkin reaction, d) Benzoin condensation, e) Haloform reaction, f) Knoevenagel reaction. Oxidation of aldehydes- Baeyer-Villiger oxidation of ketones.Reduction: Clemmensen reduction, Wolf-Kishner reduction, MPV reduction, reduction with $LiAlH_4$ and $NaBH_4$. Analysis of aldehydes and ketones with a) 2,4-DNPH test, b) Tollen's test, c) Fehling test, d) Schiff's test   e) Haloform test (with equation)

Carboxylic acids and derivatives

Nomenclature, classification and structure of carboxylic acids. Methods of preparation by a) Hydrolysis of nitriles, amides b) Hydrolysis of esters by acids and bases with mechanism c) Carbonation of Grignard reagents. Special methods of preparation of aromatic acids by a) Oxidation of side chain. B) Hydrolysis by benzotrichlorides.   C) Kolbe reaction. **Physical properties**: Hydrogen bonding, dimeric association, acidity- strength of acids with examples of trimethyl acetic acid and trichloroacetic acid. Relative differences in the acidities of aromatic and aliphatic acids.

Chemical properties: Reactions involving H, OH and COOH groups- salt formation, anhydride formation, acid chloride formation, amide formation and esterification (mechanism). Degradation of carboxylic acids by Huns-Diecker reaction, decarboxylation by Schimdt reaction, Arndt-Eistert synthesis, 26ehavior26ions by Hell- Volhard-Zelinsky reaction.

Active methylene compounds

Acetoacetic ester: keto-enol tautomerism, preparation by Claisen condensation, Acid hydrolysis and ketonic hydrolysis. Preparation of a) monocarboxylic acids.   B) Dicarboxylic acids. C) Reaction with urea

Malonic ester: preparation from acetic acid. **Synthetic applications**: Preparation of   a) monocarboxylic acids (propionic acid and n-butyric acid). B) Dicarboxylic acids (succinic acid and adipic acid) c) α,β-unsaturated carboxylic acids (crotonic acid). D) Reaction with urea.

Nitro hydrocarbons:

Nomenclature and classification-nitro hydrocarbons, structure –Tautomerism of nitroalkanes leading to aci and keto form, Preparation of Nitroalkanes, reactivity –halogenation, reaction with HONO (Nitrous acid),Nef reaction and Mannich reaction leading to Micheal addition and reduction.

Nitrogen compounds   :

Amines (Aliphatic and Aromatic): Nomenclature, Classification into 1°, 2°, 3° Amines and Quarternary ammonium compounds. Preparative methods – 1. Ammonolysis of alkyl halides 2. Gabriel synthesis 3. Hoffman's bromamide reaction (mechanism). Reduction of Amides and Schmidt reaction. Physical properties and basic character – Comparative basic strength of Ammonia, methyl amine, dimethyl amine, trimethyl amine and aniline – comparative basic strength of aniline, N-methylaniline and N,N-dimethyl aniline (in aqueous and non-aqueous medium), steric

effects and substituent effects. Chemical properties: a) Alkylation b) Acylation c) Carbylamine reaction d) Hinsberg separation e) Reaction with Nitrous acid of 1°, 2°, 3° (Aliphatic and aromatic amines). Electrophillic substitution of Aromatic amines – Bromination and Nitration. Oxidation of aryl and Tertiary amines, Diazotization.

Heterocyclic Compounds

Introduction and definition: Simple five membered ring compounds with one hetero atom Ex. Furan. Thiophene and pyrrole – Aromatic character – Preparation from 1,4,- dicarbonyl compounds, Paul-Knorr synthesis.

Properties : Acidic character of pyrrole – electrophillic substitution at 2 or 5 position, Halogenation, Nitration and Sulphonation under mild conditions - Diels Alder reaction in furan.

Pyridine – Structure – Basicity – Aromaticity – Comparison with pyrrole – one method of preparation and properties – Reactivity towards Nucleophilic substitution reaction.

Carbohydrates

Monosaccharides: (+) Glucose (aldo hexose) – Evidence for cyclic structure of glucose (some negative aldehydes tests and mutarotation) - Proof for the ring size (methylation, hydrolysis and oxidation reactions) – Pyranose structure (Haworth formula and chair conformational formula).

(-) Fructose (ketohexose) – Evidence of 2 – ketohexose structure (formation of pentaacetate, formation of 27ehavior27ion its hydrolysis and reduction by HI). Cyclic structure for fructose (Furanose structure and Haworth formula) – osazone formation from glucose and fructose – Definition of anomers with examples.

Interconversion of Monosaccharides: Aldopentose to Aldohexose (Arabinose to

D- Glucose, D-Mannose) (Kiliani – Fischer method). Epimers, Epimerisation – Lobry de bruyn van Ekenstein rearrangement. Aldohexose to Aldopentose (D-Glucose to

D- Arabinose) by Ruff degradation. Aldohexose to Ketohexose

[(+) Glucose to (-) Fructose] and Ketohexose to Aldohexose (Fructose to Glucose)

Amino acids and proteins

Introduction: Definition of Amino acids, classification of Amino acids into alpha, beta, and gamma amino acids. Natural and essential amino acids – definition and examples, classification of alpha amino acids into acidic, basic and neutral amino acids with examples. Methods of synthesis: General methods of synthesis of alpha amino acids (specific examples – Glycine, Alanine, valine and leucine) by following methods: a) from halogenated carboxylic acid b) Malonic ester synthesis c) strecker's synthesis.

Physical properties: Zwitter ion structure – salt like character – solubility, melting points, amphoteric character, definition of isoelectric point.

Chemical properties: General reactions due to amino and carboxyl groups – lactams from gamma and delta amino acids by heating peptide bond (amide linkage). Structure and nomenclature of peptides and proteins.

Analysis of the following drugs and pharmaceuticals preparations:

(Knowledge of molecular formula, structure and analysis)

Analysis of anlgesics and antipyretics like aspirin and paracetamol

Analysis of antimalerials like choloroquine .

Analysis of drugs in the treatment of infections and infestations :Amoxycillin., chloramphenicol, metronidazole, penicillin, tetracycline, cephalexin(cefalexin).

Anti tuberculous drug- isoniazid.

Analysis of the following drugs and pharmaceuticals preparations:

(Knowledge of molecular formula, structure and analysis)

Analysis of antihistamine drugs and sedatives like: allegra, zyrtec(citirizine), alprazolam, trazodone, lorazepem, ambien(zolpidem), diazepam,

Analysis of anti epileptic and anti convulsant drugs like phenobarbital and phenacemide.

Analysis of drugs used in case of cardiovascular drugs:atenolol, norvasc(amlodipine),

Analysis of lipitor(atorvastatin) a drug for the preventin of productin of cholesterol.

Analysis of diuretics like: furosemide (Lasix), triamterene

Analysis of prevacid(lansoprazole) a drug used for the prevention of production of acids in stomach.

Analysis of Milk and milk products: Acidity, total solids, fat, total nitrogen, protenines,lactose, phosphate activity, casein, choride. Analysis of food materials- Preservatives: Sodium carbonate, sodium benzoate sorbic acid Coloring matters, - Briliant blue FCF, fast green FCF, tertrazine, erytrhosine , sunset yellow FCF.

Flavoring agents – Vanilla , diacetyl, isoamyl acetate, limonene, ethylpropionate , allyl hexanoate and Adulterants in rice and wheat, wheat floo0r, sago,coconut oil, coffee powder, tea powder, milk..

Clinical analysis of blood:Composition of blood,clinical analysis,trace   elements in the body.Estimation of blood chlolesterol,glucose,enzymes,RBC & WBC , Blood gas analyser.

PHYSICAL CHEMISTRY

Solidstate

Symmetry in crystals. Law of constancy of interfacial angles. The law of rationality of indices. The law of symmetry. Definition of lattice point, space lattice, unit cell. Bravis lattices and crystal systems. X-ray diffraction and crystal structure. Bragg's law. Defects in crystals. Stoichiometric and non-stoichiometric defects.

Gaseous state

Compression factors, deviation of real gases from ideal behavior. Vander Waal's equation of state. P-V Isotherms of real gases, Andrew's isotherms of carbon dioxide, continuity of state. Critical phenomena. The vander Waal's equation and the critical state. Law of corresponding states.Relationship between critical constants and vander Waal's constants. Joule Thomson effect.

Liquid state

Structural differences between solids, liquids and gases. Liquid crystals, the mesomorphic state. Classification of liquid crystals into Smectic and Nematic. Differences between liquid crystal and solid/liquid. Application of liquid crystals as LCD devices.

Solutions

Liquid-liquid – ideal solutions, Raoult's law. Ideally dilute solutions, Henry's law. Non-ideal solutions. Vapour pressure – composition and vapour pressure- temperature curves. Azeotropes-HCl-H_2O, ethanol-water systems and fractional distillation. Partially miscible liquids-phenol-water, trimethylamine-water, nicotine-water systems. Effect of impurity on consulate temperature. Immiscible liquids and steam distillation.

Nernst distribution law. Calculation of the partition coefficient. Applications of distribution law.

SPECTROSCOPY

General features of absorption – Beer-Lambert's law and its limitations, transmittance, Absorbance, and molar absorptivity. Single and double beam spectrophotometers. Application of Beer-Lambert law for quantitative analysis of 1. Chromium in $K_2Cr_2O_7$

8.   Manganese in Manganous sulphate

Electronic spectroscopy:

Interaction of electromagnetic radiation with molecules and types of molecular spectra. Energy levels of molecular orbitals (σ, π, n). Selection rules for electronic spectra. Types of electronic transitions in molecules effect of conjugation. Concept of chromophore and auxochrome.

Infra red spectroscopy

Different Regions in Infrared radiations. Modes of vibrations in diatomic and polyatomic molecules. Characteristic absorption bands of various functional groups. Interpretation of spectra-Alkanes, Aromatic, Alcohols carbonyls, and amines with one example to each.

Proton magnetic resonance spectroscopy (^{1}H-NMR)

Principles of nuclear magnetic resonance, equivalent and non-equivalent protons, position of signals. Chemical shift, NMR splitting of signals – spin-spin coupling, coupling constants. Applications of NMR with suitable examples – ethyl bromide, ethanol, acetaldehyde, 1,1,2-tribromo ethane, ethyl acetate, toluene and acetophenone.

Dilute solutions

Colligative properties. Raoult's law, relative lowering of vapour pressure, its relation to molecular weight of non-volatile solute. Elevation of boiling point and depression of freezing point. Derivation of relation between molecular weight and elevation in boiling point and depression in freezing point. Experimental methods of determination. Osmosis, osmotic pressure, experimental determination. Theory of dilute solutions. Determination of molecular weight of non-volatile solute from osmotic pressure. Abnormal Colligative properties- Van't Hoff factor.

Electrochemistry-I

Specific conductance, equivalent conductance. Variation of equivalent conductance with dilution. Migration of ions, Kohlrausch's law. Arrhenius theory of electrolyte dissociation and its limitations. Ostwald's dilution law. Debye-Huckel-Onsagar's equation for strong electrolytes (elementary treatment only). Definition of transport number, determination by Hittorfs method. Application of conductivity measurements- conductometric titrations.

Electrochemistry-II

Single electrode potential, sign convention, Reversible and irreversible cells Nernst Equation- Reference electrode, Standard Hydrogen electrode, calomel electrode, Indicator electrode, metal – metal ion electrode, Inert electrode, Determination of EMF of cell, Applications of EMF measurements – Potentiometric titrations.

Phase rule

Concept of phase, components, degrees of freedom. Thermodynamic Derivation of Gibbs phase rule. Phase equilibrium of one component system – water system. Phase equilibrium of two- component system, solid-liquid equilibrium. Simple eutectic diagram of Pb-Ag system, simple eutectic diagram, desilverisation of lead., NaCl-Water system, Freezing mixtures.

Thermodynamics

The first law of thermodynamics-statement, definition of internal energy and enthalpy. Heat capacities and their relationship. Joule-Thomson effect- coefficient. Calculation of w, for the expansion of perfect gas under isothermal and adiabatic conditions for reversible processes. State function. Temperature dependence of enthalpy of formation-Kirchoff s equation. Second law of thermodynamics. Different Statements of the law. Carnot cycle and its efficiency. Carnot theorem. Concept of entropy, entropy as a state function, entropy changes in reversible and irreversible processes. Entropy changes in spontaneous and equilibrium processes.

Chemical kinetics

Rate of reaction – Definition of order and molecularity. Derivation of rate constants for first, second, third and zero order reactions and examples. Derivation for time half change. Methods to determine the order of reactions. Effect of temperature on rate of reaction, Arrhenius equation, concept of activation energy.

Photochemistry

Difference between thermal and photochemical processes. Laws of photochemistry- Grothus-Draper's law and Stark-Einstein's law of photochemical equivalence. Quantum yield-Photochemical reaction mechanism- hydrogen-chlorine, hydrogen- bromine reaction. Qualitative description of fluorescence, phosphorescence, Photosensitized reactions- energy transfer processes (simple example)

105 – GEOLOGY

Total Marks : 100

Palaeontology, Indian Geology and Economic Geology

Palaeontology : Definition of palaeontology, conditions of fossilization, modes of preservation and uses of fossils. Phylum Echinodermata and Phylum Brachiopod, Phylum Mollusca and Phylum Arthropoda, Phylum Hemichordata, Phylum Coelenterata. Study of the following fossils with respect to their classification, morphology and geological distribution. Cidaris, Micraster, Holaster, Hemiaster, Terebratula, Spinifer, Rhynchonella, Productus, Turritella, Murex, Cypraea, Natica, Voluta, Pecten, Gryphaea, Arca, Cardita, Exogyra, Nautilus, Ammonoids, Belemnites, Calymene, Paradoxide, Corals and Graptolites. Plant fossils : Glossopteris, Gangam Operas, Ptylophyllum.

Indian Geology : **Definition** of stratigraphy, principles of stratigraphy, lithostratigraphy, standard geological timescale. Physiographic divisions of India with their stratigraphic and structural characteristics. Dharwar System, Cuddapah System, Vindhyan System, Kurnool System and Gondwana System. Triassic of Spiti, Jurssic of Kutch, Cretaceous of Tiruchirapalli, Deccan Traps and their Age, Siwaliks with vertebrate fossils. Geology of Andhra Pradesh. Stratigraphic contacts – boundaries between Archaean and Proterozoic; and Cretaceous and Tertiary.

Economic Geology : **Definition** of Economic Geology, Global tectonics and metallogeny – mineral resources and mineral deposits, Importance of economic minerals and rocks, ore minerals, gangue minerals (gangue). Ore, industrial minerals, tenor and grade; Syngenetic deposits, epigenetic deposits. Classification of mineral deposits – Bateman's classification modified by Jenson. Processes of formation of mineral deposits; endogenetic and exogenetic processes. Study of ore deposits of gold, copper, lead, zinc, aluminium, iron, manganese, chromium, uranium and thorium with respect to their mineralogy, uses, mode of occurrence, origin and distribution in India. Distribution of industrial minerals in India for the following industries : abrasives, cement, ceramics, glass, fertilizers and chemicals, and insulators. Fossils fuels : Coal, it's origin and types of coal – Coal deposits of India. Oil and Natural Gas : Origin, migration and entrapment and distribution in India, Use of micropaleontology in oil exploration,

Gemstones and Dimensional Stones. Atomic minerals : Uraninite, pitchblende, coffenite; Beach sands : monazite, ilmenite, rutile, zircon and their uses. Mineral resources of Andhra Pradesh.

Petrology and Structural Geology

Nature and scope of Petrology – Definition of rock, classification of rocks into igneous, sedimentary and metamorphic. Distinguishing features of the three types of rocks. **Igneous rocks** : Classification into plutonic, hypabyssal and volcanic rocks; Forms – Lava flows, intrusions, sills, laccolith, lopolith, dykes, ring dykes, cone sheets, volcanic necks, phacoliths and batholiths. Structures : vescicular, amygdaloidal, block lava, ropy lava, pillow lava, flow, jointing and sheet structures. Platy, columnar and prismatic structures. Textures – Definition of texture, micro-structure, devitrification. Allotriomorphic, hypidiomorphic, panidiomorphic, porphyritic, poikilitic, ophitic, intergranular, intersertal, trachytic, graphic and micro-graphic. Reaction structures – Corona, myrmekitic, orbicular, spherulitic, perlitic. Classification of igneous rocks – CIPW and Tyrrell tabular classification. Descriptive study of the following rocks types : granite, granodiorite, syenite, nepheline syenite, diorite, pegmatite, aplite, gabbro, anorthosite, peridotite, pyroxenite, dunite, dolerite, rhyolite, obsidian, trachyte, andesite and basalt. Composition and constitution of magma – Crystallization of magma, unicomponent and binary systems, eutectic and solid solutions. Origin of igneous rocks – Bowen's reaction principle, differentiation and assimilation.

Sedimentary rocks: Sources of sediments – mechanical and chemical weathering, modes of transportation, stratification. Sedimentary structures : types of bedding, surface marks, deformed bedding and solution structures. Classification of sedimentary rocks : Clastic – rudaceous, arenaceous, and argillaceous; Non-Clastic – calcareous, carbonaceous, ferruginous, phosphatic, and evaporates. Descriptive study of the following sedimentary rocks – conglomerate, 30ehavior, sandstone, grit, arkose, greywacke, shale, limestone, and shelly limestone. **Metamorphic rocks**: Definition of metamorphism, agencies of metamorphism, types of metamorphism, grades and zones of metamorphism. Metamorphic minerals – stress and antistress minerals – Structures of metamorohic rocks – Cataclastic, maculose, schistose, granulose and gneissose. Textures of metamorphic rocks – crystalloblastic, 30ehavior30i, xenoblastic and idioblastic. Classification of metamorphic rocks – concept of metamorphic facies. Cataclastic metamorphism of argillaceous and arenaceous rocks. Thermal metamorphism of argillaceous, arenaceous and calcareous rocks. Dynamothermal metamorphism of argillaceous, arenaceous and basic igneous rocks. Plutonic metamorphism, metasomatism and additive processes. Definition of anatexis and palingenesis. Descriptive study of the following metamorphic rocks : gneiss, schist, slate, phyllite, quartzite, marble, granulite, eclogite, 30ehavior30ion, migmatite, charnockite and khondalite.

Structural Geology: Definition of structural geology, aim and objectives of structural geology; Importance of study of structures, primary and secondary structures; Outcrops, attitude of beds; Strike, dip and apparent dip, and Use of 30ehavior30io. Primary structures. Folds – description, nomenclature and recognition in the field. Joints – geometrical and genetic classification. Faults – geometrical and genetic classification and recognition in the field. Effects of faults on the outcrops. Unconformities – definition, types, and recognition in the field. Distinguishing the faults from unconformities. Definitions of overlap, offlap, outlier, cleavage, schistosity, foliation and lineation.

Physical Geology, Crystallography and Mineralogy

Physical Geology : General aspects, definition of geology – Basic assumptions of Geology – Its relationship with other sciences – Branches of geology – Aim and applications of Geology. **Earth as a planet** – It's shape, size, density – movements and their effects. Origin and age of the earth. Geological processes – exogenic and endogenic. Definition of weathering – types of weathering of rocks – physical and chemical. Definition of erosion and denudation, cycle of erosion, transportation and deposition, agents of erosion. **Rivers** : erosion, transportation and deposition of river (fluvial) cycle in different stages – Development of typical landforms by river erosion and deposition. V-shaped valley, waterfall, alluvial fan, meander, ox-bow lake, flood plane, natural plane, peneplain and delta. Types of rivers. **Glaciers** : Definition of a glacier – types – development of typical landforms by glacial erosion and deposition – cirque, U-shaped valley – changing valley; Rocks – monadrocks, morains, drum-line, kama, eskors and varves, characteristic features of glaciated regions. Groundwater : starage of ground water – porosity, permeability, acquifer, water table – zone of saturation, artesian well, spring, geysers – development of typical landforms by erosion and deposition by groundwater (Karst topography), sinkhole, cavern, stalactites and stalagmites. **Seas** : Offshore profile – landforms of sea – marine deposits and coral reefs. Lacustrine deposits, atmospheric circulation, weather and climatic changes, land-air-sea interaction. Earth's heat budget and global climatic changes. **Wind** : Development of characteristic features by winds (arid cycle), erosion and deposition –

pedestal rock – mushroom topography – Incelberg – Ventifacts – locus and sand dunes. **Earth movements** : definition of diastrophism, epirogenic and orogenic movements – mountains, 31ehavior31ion. Basic concepts of isostasy, continental drift and plate tectonics. **Earthquakes** : causes, kinds of earthquake waves, mode of propagation, intensity of earthquakes, Richter's scale, seismograph and seismogram. Effects of earthquakes, earthquake zones, interior of the earth. **Volcanoes** : origin and products.

Crystallography : **Definition of crystal** – amorphous and crystalline states – morphology of crystals – face, edge, solid angle and interfacial angle. **Forms** : simple, combination, closed and open forms. **Symmetry** : Plane, axis, centre, crystallographic axes, parameters, indices, crystallographic notation – Parameter system of Weiss, Index system of Miller. **Classification** of Crystals into '7' systems. Morphological study of the following classes of symmetry : a) Cubic system – Normal (Galena) type, b) Tetragonal system – Zircon type, c) Hexagonal system – Beryl type, d) Trigonal system – Calcite type, e) Orthorhombic system – Barytes type, f) Monoclinic system – Gypsum type, and g) Triclinic system – Axinite type. **Twinning** in crystals – definition of twin, twin plane, twin axis and composition plane.

Mineralogy : Definition of a mineral – Classification of minerals into rock forming and ore forming minerals. Physical properties of minerals – colour, streak, play of colours, opalescence, asterism, transparency, luster, luminescence, fluorescence, form, hardness, tenacity, cleavage, parting, fracture, specific gravity, magnetic properties, electrical properties, pyro- and piezo-electricity. **Modes of mineral formation** : Occurrence and association of minerals. Chemical properties of minerals – isomorphism – solid solution – polymorphism – allotropy, pseudomorphism, radioactivity, silicate structure. **Descriptive Mineralogy** : Study of physical and chemical properties and mode of occurrence of the following mineral groups : Nesosilicate – Olivine, garnet and aluminium silicates; Sorosilicate – epidote; Cyclosilicate – beryl; Inosilicate – pyroxene and amphibole; Phyllosilicate – mica, hydrous magnesium silicate; Tektosilicate – feldspars, feldspathoids and quartz; Miscellaneous – staurolite, tourmaline, zircon, calcite, corundum and apatite. **Optical Mineralogy** : Optical properties of minerals – Isotropic and Anisotropic – Polarized light, refractive index – Double refraction, Uniaxial and Biaxial minerals – Nicol Prism and it's construction, Concept of crossed nicols. Petrological (Polarizing) Microscope – Its mechanical and optical p[arts – 31ehavior of isotropic ancd anisotropic mineral between crossed nicols – extinction, pleochroism, interference colour. Optical properties of important minerals.

106 – STATISTICS

Total Marks : 100

Concepts of Primary and Secondary Data. Methods of collection and editing of primary data, secondary data. Designing a questionnaire and a schedule. Measures of central tendency – Mean, Median, Mode, Geometric Mean and Harmonic Mean. Measures of Dispersion: Range, Quartile Deviation, Mean Deviation and Standard Deviation. Descriptive Statistics - Central and Non-central moments and their Interrelationship. Sheppard's correction for moments. Skewness and kurtosis. Introduction to Probability: Basic Concepts of Probability, random experiments, trial, outcome, sample space, event, mutually exclusive and exhaustive events, equally likely and favourable outcomes. Mathematical, Statistical, axiomatic definitions of probability. Conditional Probability and independence of events. Probability Theorems: Addition and multiplication theorems of probability for 2 and for n events. Boole's inequality and Baye's Theorem and problems based on Baye's theorem. Random variable: Definition of random variable, discrete and continuous random variables, functions of random variable. Probability mass function, Probability density function, Distribution function and its properties. Bivariate random variable – meaning, joint, marginal and conditional Distributions, independence of random variables.

Mathematical expectation (ME) of a random variable and function of a random variable, Moments and covariance using mathematical expectation with examples. Addition and Multiplication theorems on expectation. Definitions of M.G.F, C.G.F, P.G.F, C.F. its properties Chebyshev and Cauchy – Sehwartz inequalities. Binomial and Poisson distributions, their definitions, 1st to 4th central moments, M.G.F, C.F, C.G.F, P.G.F, mean, variance, additive property if exists, Poisson approximation to Binomial distribution. Negative Binomial, geometric, hyper geometric distributions – Definitions, means, variances, M.G.F, C.F, C.G.F, P.G.F, reproductive property if exists. Binomial approximation to Hyper Geometric Distribution, Poisson approximation to Negative binomial distribution. Continuous Distributions: Rectangular, Exponential, Gamma, Beta Distributions of two kinds. Other properties such as mean, variance, M.G.F, C.G.F, C.F, reproductive property. Normal Distribution: Definition, Importance,

Properties, M.G.F., additive properties, Interrelation between Normal and Binomial, Normal and Poisson distribution. Cauchy Distribution.

Definition of correlation coefficient and its properties, scatter diagram, computation of correlation coefficient for ungrouped data, Spearman's rank correlation coefficient, properties of Spearman's correlation coefficients. Simple linear regression, properties of regression coefficients, Regression lines. Concept of Correlation ratio, partial and multiple correlation coefficients, correlation versus regression. Method of least squares, Fitting of linear, quadratic, Exponential and power curves using least squares method. Introduction to Attributes, Nature and consistency. Independence and association of attributes, coefficient of association, coefficients of contingency. Concept of population, Parameter, random sample, statistic, sampling distribution, standard error. Definition and Properties of χ^2, t, F distributions and their inter relationships.

Estimation of parameter, criteria of a good estimator. Neyman's factorization theorem. Estimation of parameters by method of moments and maximum likelihood, properties of MLEs. Estimation of parameters of Binomial and Poisson and Normal Populations by ML method. Confidence intervals of the parameters of normal population. Concepts of Statistical hypothesis: Null and alternative hypothesis, critical region, two types of errors, level of significance, power of a test. One-tailed, two-tailed tests, Neyman – Pearson's lemma. Examples of Binomial Poisson, Normal distributions. Large sample tests for single mean, equality of two means, Single proportion, equality of proportions, Standard Deviation of single and double samples and Fisher's Z transformation. χ^2 – Test for independence of attributes, t-test for single mean, two means and paired t-test, Variance Ration Test (F-test). Non-parameter tests – Advantages and Disadvantages. Two sample run test, Two sample Median test and Two sample sign test.

Principal steps in a sample survey, Censes versus sample survey, sampling and Non-sampling errors. Types of sampling – subjective, probability and mixed sampling methods. Simple Random Sampling: Methods of random sample selection, estimation of population mean, variances in SRSWR and SRSWOR. Stratified random sampling: Proportional and optimum allocation of Sample sizes in stratification. Variance of estimators. Systematic sampling, Systematic sampling when N=nk, relative efficiencies of systematic sample estimates with simple and stratified random samples. Advantages and disadvantages of above methods of sampling. One way analysis of variance with equal and unequal classifications and ANOVA for two way classifications. Principles of experimentation in designs, analysis of completely randomized design, Randomized block design and Latin square design, including one missing observation. Efficiency of these designs. Concept of factorial experiments.

107 – 5-Year Integrated course in Geology & Applied Chemistry

Total Marks : 100

Physics

Marks 50

PHYSICAL WORLD

Scope and excitement of Physics, Physics, technology and society, Fundamental forces in nature, Gravitational Force, Electromagnetic Force, Strong Nuclear Force, Weak Nuclear Force, Towards Unification of Forces, Nature of physical laws.

UNITS AND MEASUREMENTS

The international system of units, Measurement of Length, Measurement of Large Distances, Estimation of Very Small Distances, Size of a Molecule, Range of Lengths, Measurement of Mass, Range of Masses, Measurement of time, Accuracy, precision of instruments and errors in measurement, Systematic errors, random errors, least count error, Absolute Error, Relative Error and Percentage Error, Combination of Errors, Significant figures, Rules for Arithmetic Operations with Significant Figures, Rounding off the Uncertain Digits, Rules for Determining the Uncertainty in the Results of Arithmetic Calculations, Dimensions of Physical Quantities, Dimensional Formulae and dimensional equations, Dimensional Analysis and its Applications, Checking the Dimensional Consistency of Equations, Deducing Relation among the Physical Quantities.

MOTION IN A STRAIGHT LINE

Position, path length and displacement, average velocity and average speed, instantaneous velocity and speed, acceleration, kinematic equations for uniformly accelerated motion, relative velocity.

MOTION IN A PLANE

Scalars and vectors, position and displacement vectors, equality of vectors, multiplication of vectors by real numbers, addition and subtraction of vectors – graphical method, resolution of vectors, vector addition – analytical method, motion in a plane, position vector and displacement, velocity, acceleration, motion in a plane

with constant acceleration, 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.

LAWS OF MOTION

Aristotle's fallacy, The law of inertia, Newton's first law of motion, Newton's second law of motion, momentum, Impulse, Newton's third law of motion, Conservation of momentum, Equilibrium of a particle, Common forces in mechanics, friction, types of friction, static, kinetic and rolling frictions, Circular motion, Motion of a car on a level road, Motion of a car on a banked road, solving problems in mechanics.

WORK, ENERGY AND POWER

The Scalar Product, Notions of work and kinetic energy, 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, Heat, Chemical Energy, Electrical Energy, The Equivalence of Mass and Energy, Nuclear Energy, The Principle of Conservation of Energy, Power, Collisions, Elastic and Inelastic Collisions, Collisions in one dimension, Coefficient of Restitution and its determination, Collisions in Two Dimensions.

SYSTEMS OF PARTICLES AND ROTATIONAL MOTION

Rigid body motion, Centre of mass, Centre of Gravity, Motion of centre of mass, Linear momentum of a system of particles, Vector product of two vectors, Angular velocity and its relation with linear velocity, Angular acceleration, Kinematics of rotational motion about a fixed axis, Moment of force (Torque), Angular momentum of particle, Torque and angular momentum for a system of a particles, conservation of angular momentum, Equilibrium of a rigid body, Principle of moments, Moment of inertia, Theorems of perpendicular and parallel axes, Dynamics of rotational motion about a fixed axis, Angular momentum in case of rotation about a fixed axis, Rolling motion, Kinetic Energy of Rolling Motion.

OSCILLATIONS

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, The Simple Pendulum, Damped simple harmonic motion, Forced oscillations and resonance.

GRAVITATION

Kepler's laws, Universal law of gravitation, central forces, 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, Orbital Speed, Earth satellites, Energy of an orbiting satellite, Geostationary and polar satellites, Weightlessness.

MECHANICAL PROPERTIES OF SOLIDS

Elastic 33ehavior of solids, Stress and strain, Hooke's law, Stress-strain curve, Elastic moduli, Young's Modulus, Determination of Young's Modulus of the Material of a Wire, Shear Modulus, Bulk Modulus, Poisson's Ratio, Elastic Potential Energy in a Stretched wire, Applications of elastic 33ehavior of materials.

MECHANICAL PROPERTIES OF FLUIDS

Pressure, Pascal's Law, Variation of Pressure with Depth, Atmospheric Pressure and Gauge Pressure, Hydraulic Machines, Archimedes' Principle, Streamline flow, Bernoulli's principle, Speed of Efflux, Torricelli's Law, Venturi-meter, Blood Flow and Heart Attack, Dynamic Lift, Viscosity, Variation of Viscosity of fluids with temperature, Stokes' Law, Reynolds number, Critical Velocity, Surface tension and Surface Energy, Angle of Contact, Drops and Bubbles, Capillary Rise, Detergents and Surface Tension.

THERMAL PROPERTIES OF MATTER

Temperature and heat, Measurement of temperature, Ideal-gas equation and absolute temperature, Thermal expansion, Specific heat capacity, Calorimetry, Change of state, Triple Point, Regelation, Latent Heat, Heat transfer, Conduction, Convection, Radiation, Black body Radiation, Greenhouse Effect, Newton's law of cooling and its experimental verification.

THERMODYNAMICS

Thermal equilibrium, Zeroth law of thermodynamics, Heat, Internal Energy and work, First law of thermodynamics, Specific heat capacity, Specific heat capacity of water, Thermodynamic state variables and equation of State, Thermodynamic processes, Quasi-static process, Isothermal Process, Adiabatic Process, Isochoric Process, Isobaric process, Cyclic process, Heat engines, Refrigerators and heat pumps, Second law of thermodynamics, Reversible and irreversible processes, Carnot engine, Carnot's theorem

KINETIC THEORY

Molecular nature of matter, Behaviour of gases, Boyle's Law, Charles' Law, Kinetic theory of an ideal gas, Pressure of an Ideal Gas, Kinetic interpretation of temperature, Law of equipartition of energy, Specific heat capacity, Monatomic Gases, Diatomic Gases, Polyatomic Gases, Specific Heat Capacity of Solids, Specific Heat Capacity of Water, Mean free path.

WAVES

Transverse and longitudinal waves, displacement relation in a progressive wave, amplitude and phase, wavelength and angular wave number, period, angular frequency and frequency, the speed of a travelling wave, speed of a transverse wave on stretched string, speed of a longitudinal wave (speed of sound), the principle of superposition of waves, reflection of waves, standing waves and normal modes, beats, Doppler effect: source moving and observer stationary, observer moving and source stationary, both source and observer moving.

RAY OPTICS AND OPTICAL INSTRUMENTS:

Reflection of light by spherical mirrors, sign convention, focal length of spherical mirrors, the mirror equation, refraction, total internal reflection, total internal reflection in nature and its technological applications, refraction at spherical surfaces and by lenses, power of a lens, combination of thin lenses in contact, refraction through a prism, dispersion by a prism, some natural phenomena due to sunlight, the rainbow, scattering of light, optical instruments, the eye, the simple and compound microscopes, refracting telescope and Cassegrain reflecting telescope.

WAVE OPTICS

Huygens principle, refraction and reflection of plane waves using Huygens principle, refraction in a rarer medium (at the denser medium boundary), reflection of a plane wave by a plane surface, the Doppler effect, coherent and incoherent addition of waves, interference of light waves and Young's experiment, diffraction, the single slit diffraction, resolving power of optical instruments, the validity of ray optics, 34ehavior34ion, 34ehavior34ion by scattering, 34ehavior34ion by reflection.

ELECTRIC CHARGES AND FIELDS

Electric charge, conductors and insulators, charging by induction, basic properties of electric charges, additivity of charges, conservation of charge, quantization of charge, Coulomb's law, forces between multiple charges, electric field, electric field due to a system of charges, physical significance of electric field, electric field lines, electric flux, electric dipole, the field of an electric dipole for points on the axial line and on the equatorial plane, physical significance of dipoles, dipole in a uniform external field, continuous charge distribution, Gauss's law, applications of Gauss's law, field due to an infinitely long straight uniformly charged wire, field due to a uniformly charged infinite plane sheet, field due to a uniformly charged thin spherical shell.

ELECTROSTATIC POTENTIAL AND CAPACITANCE

Electrostatic potential, potential due to a point charge, potential due to an electric dipole, potential due to a system of charges, equipotential surfaces, relation between field and potential, potential energy of a system of charges, potential energy in an external field, potential energy of a single charge, potential energy of a system of two charges in an external field, potential energy of a dipole in an external field, electrostatics of conductors, electrostatic shielding, dielectrics and 34ehavior34ion, electric displacement, capacitors and capacitance, the parallel plate capacitor, effect of dielectric on capacitance, combination of capacitors, capacitors in series, capacitors in parallel, energy stored in a capacitor, Van de Graaff generator.

CURRENT ELECTRICITY

Electric current, electric current in conductors, Ohm's law, drift of electrons and the origin of resistivity, mobility, limitations of Ohm's law, resistivity of various materials, colour code of resistors, 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 rules, Wheatstone Bridge, Meter Bridge, Potentiometer.

MOVING CHARGES AND MAGNETISM

Magnetic force, sources and fields, magnetic field, Lorentz force, magnetic force on a current carrying conductor, motion in a magnetic field, helical motion of charged particles, motion in combined electric and magnetic fields, velocity selector, Cyclotron, magnetic field due to a current element, Biot – Savart's law, Magnetic field on the axis of a circular current loop, Ampere's circuital law, the solenoid and the toroid, force between two parallel current carrying conductors, the ampere (UNIT), torque on current loop, magnetic dipole, torque on a rectangular current loop in a uniform magnetic field, circular current loop as a magnetic dipole, the magnetic dipole moment of a revolving electron, the Moving Coil Galvanometer; conversion into ammeter and voltmeter.

MAGNETISM AND MATTER

The bar magnet, the magnetic field lines, bar magnet as an equivalent solenoid, The dipole in a uniform magnetic

field, the electrostatic analog, Magnetism and Gauss's Law, The Earth's magnetism, magnetic declination and dip, 35ehavior35ions and magnetic intensity, susceptibility, magnetic properties of materials; Diamagnetism, Paramagnetism, Ferromagnetism, Hysteresis loop, permanent magnets and electromagnets.

ELECTROMAGNETIC INDUCTION

The experiments of Faraday and Henry, magnetic flux, Faraday's Law of induction, Lenz's law and conservation of energy, motional electromotive force, energy consideration – a quantitative study, Eddy currents, inductance, mutual inductance, self inductance, AC generator.

ALTERNATING CURRENT

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, AC voltage applied to a series LCR circuit, Phasor – diagram solution, analytical solution, resonance, sharpness of resonance, power in AC circuit, the power factor, LC oscillations, transformers.

ELECTROMAGNETIC WAVES

Displacement current, Maxwell's equations, electromagnetic waves, sources of electromagnetic waves, nature of electromagnetic waves, electromagnetic spectrum: radio waves, microwaves, infrared waves, visible rays, ultraviolet rays, X-rays, gamma rays.

DUAL NATURE OF RADIATION AND MATTER

Electron emission, Photoelectric Effect, Hertz's observations, Hallwachs and Lenard's observations, experimental study of photoelectric effect, effect of intensity of light on photocurrent, effect of potential on photoelectric current, effect of frequency of incident radiation on stopping potential, 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, photocell, Davisson and Germer experiment.

ATOMS

Alpha particle scattering and Rutherford's nuclear model of atom, alpha particle trajectory, electron orbits, atomic spectra, spectral series, Bohr model of the hydrogen atom, energy levels, Franck – Hertz experiment, the line spectra of the hydrogen atom, de Broglie's explanation of Bohr's second postulate of quantization, LASER light.

NUCLEI

Atomic masses and composition of nucleus, discovery of neutron, size of the nucleus, Mass – Energy and Nuclear Binding Energy, Nuclear Force, Radioactivity, Law of radioactive decay, Alpha decay, Beta decay, Gamma decay, Nuclear Energy, Fission, Nuclear reactor, nuclear fusion, energy generation in stars, controlled thermonuclear fusion.

SEMICONDUCTOR ELECTRONICS: MATERIALS, DEVICES AND SIMPLE CIRCUITS Classification of metals,

conductors, and semiconductors on the basis of conductivity and energy bands, Band theory of solids, Intrinsic semiconductor, Extrinsic semiconductor, p-type semiconductor, n-type semiconductor, p-n junction formation, semiconductor diode, p-n junction diode under forward bias, p-n junction diode under reverse bias, Application of junction diode as a rectifier, special purpose p-n junction diodes, Zener diode, Zener diode as voltage regulator, Optoelectronic junction devices, Photodiode, light emitting diode, solar cell. Junction transistor, structure and action, Basic transistor circuit configurations and transistor characteristics, transistor as a switch and as an amplifier (CE – Configuration), Feedback amplifier and transistor oscillator, Digital Electronics and Logic gates, NOT, OR, AND, NAND and NOR Gates, Integrated circuits.

COMMUNICATION SYSTEMS

Elements of a Communication system, basic terminology used in electronic communication systems, bandwidth of signals, bandwidth of transmission medium, propagation of electromagnetic waves, ground waves, sky waves, space wave, modulation and its necessity, size of the antenna or aerial, effective power radiated by an antenna, mixing up of signals from different transmitters, amplitude modulation, production of amplitude modulated wave, detection of amplitude modulated wave.

CHEMISTRY

Marks 50

ATOMIC STRUCTURE

Sub- atomic particles; Atomic models –Rutherford's Nuclear model of atom; Developments to the Bohr's model of atom; Nature of electromagnetic radiation; Particle nature of electromagnetic radiation- Planck's quantum theory; Bohr's model for Hydrogen atom; Explanation of line spectrum of hydrogen; Limitations of Bohr's model; Quantum mechanical considerations of sub atomic   particles; Dual 35ehavior of matter; Heisenberg's uncertainty principle; Quantum mechanical model of an atom. Important features of Quantum

mechanical model of atom; Orbitals and quantum numbers; Shapes of atomic orbitals; Energies of orbitals; Filling of orbitals in atoms. Aufbau Principle, Pauli's exclusion Principle and Hund's rule of maximum multiplicity; Electronic configurations of atoms; Stability of half filled and completely filled orbitals.

CLASSIFICATION OF ELEMENTS AND PERIODICITY IN PROPERTIES

Need to classify elements; Genesis of periodic classification; Modern periodic law and present form of the periodic table; Nomenclature of elements with atomic number greater than 100; Electronic configuration of elements and the periodic table; Electronic configuration and types of elements s,p,d.and f blocks; Trends in physical properties: (a) Atomic radius, (b) Ionic radius (c)Variation of size in inner transition elements, (d) Ionization enthalpy, (e) Electron gain enthalpy, (f) Electro negativity; Periodic trends in chemical properties: (a) Valence or Oxidation states, (b) Anomalous properties of second period elements – diagonal relationship; Periodic trends and chemical reactivity.

CHEMICAL BONDING AND MOLECULAR STRUCTURE

Kossel – Lewis approach to chemical bonding, Octet rule, Representation of simple molecules, formal charges, limitations of octet rule; Ionic or electrovalent bond – Factors favourable for the formation of ionic compounds-Crystal structure of sodium chloride, General properties of ionic compounds; Bond Parameters – bond length, bond angle, and bond enthalpy, bond order, resonance-Polarity of bonds dipole moment-Fajan rules; Valence Shell Electron Pair Repulsion (VSEPR) theory; Predicting the geometry of simple molecules; Valence bond theory-Orbital overlap concept-Directional properties of bonds-overlapping of atomic orbitals-types of overlapping and nature of covalent bonds-strength of sigma and pi bonds-Factors favouring the formation of covalent bonds; Hybridisation- different types of hybridization involving s, p and d orbitals- shapes of simple covalent molecules; Coordinate bond – definition with examples; Molecular orbital theory - Formation of molecular orbitals, Linear combination of atomic orbitals (LCAO)-conditions for combination of atomic orbitals - Energy level diagrams for molecular orbitals –Bonding in some homo nuclear diatomic molecules- H_2, He_2, Li_2, B_2, C_2, N_2 and O_2; Hydrogen bonding-cause of formation of hydrogen bond – Types of hydrogen bonds- inter and intra molecular-General properties of hydrogen bonds.

STATES OF MATTER: GASES AND LIQUIDS

Intermolecular forces; Thermal Energy; Intermolecular forces Vs Thermal interactions; The Gaseous State; The Gas Laws; Ideal gas equation; Graham's law of diffusion – Dalton's Law of partial pressures; Kinetic molecular theory of gases; Kinetic gas equation of an ideal gas (No derivation) deduction of gas laws from Kinetic gas equation; Distribution of molecular speeds – rms, average and most probable speeds-Kinetic energy of gas molecules; Behaviour of real gases – Deviation from Ideal gas 36ehavior – Compressibility factor Vs Pressure diagrams of real gases; Liquefaction of gases; Liquid State – Properties of Liquids in terms of Inter molecular interactions – Vapour pressure, Viscosity and Surface tension (Qualitative idea only. No mathematical derivation).

STOICHIOMETRY

Some Basic Concepts – Properties of matter – uncertainty in Measurement-significant figures, dimensional analysis; Laws of Chemical Combinations – Law of Conservation of Mass, Law of Definite Proportions, Law of Multiple Proportions, Gay Lussac's Law of Gaseous Volumes, Dalton's Atomic Theory, Avogadro Law, Examples; Atomic and molecular masses- mole concept and molar mass. Concept of equivalent weight; Percentage composition of compounds and calculations of empirical and molecular formulae of compounds; Stoichiometry and stoichiometric calculations-limiting reagent; Methods of Expressing concentrations of solutions-mass percent, mole fraction, molarity, molality and normality; Redox reactions-classical idea of redox reactions, oxidation and reduction reactions-redox reactions in terms of electron transfer; Oxidation number concept; Types of Redox reactions- combination, decomposition, displacement and disproportionation reactions; Balancing of redox reactions – oxidation number method Half reaction (ion-electron) method; Redox reactions in Titrimetry.

THERMODYNAMICS

Thermodynamic Terms; The system and the surroundings; Types of systems and surroundings; The state of the system; The Internal Energy as a State Function. (a) Work (b) Heat (c) The general case, the first law of Thermodynamics; Applications; Work; Enthalpy, H- a useful new state function; Extensive and intensive properties; Heat capacity; The relationship between C_p and C_v; Measurement of U and H: Calorimetry; Enthalpy change, Δ_rH of reactions - reaction Enthalpy (a) Standard enthalpy of reactions, (b) Enthalpy changes during transformations, (c) Standard enthalpy of formation, (d) Thermo chemical equations (e) Hess's law of constant Heat summation; Enthalpies for different types of reactions. (a) Standard enthalpy of combustion (Δ_cH), (b) Enthalpy of atomization (Δ_aH), phase transition, sublimation and ionization, (c) Bond Enthalpy ($\Delta_{bond}H$), (d) Enthalpy of solution ($\Delta_{sol}H$) and dilution-lattice enthalpy; Spontaneity. (a) Is decrease

in enthalpy a criterion for spontaneity? (b) Entropy and spontaneity, the second law of thermodynamics, (c) Gibbs Energy and spontaneity; Gibbs Energy change and equilibrium; Absolute entropy and the third law of thermodynamics.

CHEMICAL EQUILIBRIUM AND ACIDS-BASES

Equilibrium in Physical process; Equilibrium in chemical process - Dynamic Equilibrium; Law of chemical Equilibrium – Law of mass action and Equilibrium constant; Homogeneous Equilibria, Equilibrium constant in gaseous systems. Relationship between K_P and K_C; Heterogeneous Equilibria; Applications of Equilibrium constant; Relationship between Equilibrium constant K, reaction quotient Q and Gibbs energy G; Factors affecting Equilibria.-Le-chatlier principle application to industrial synthesis of Ammonia and Sulphur trioxide; Ionic Equilibrium in solutions; Acids, bases and salts- Arrhenius, Bronsted-Lowry and Lewis concepts of acids and bases; Ionisation of Acids and Bases – Ionisation constant of water and its ionic product- pH scale-ionisation constants of weak acids-ionisation of weak bases-relation between K_a and K_b-Di and poly basic acids and di and poly acidic Bases-Factors affecting acid strength-Common ion effect in the ionization of acids and bases-Hydrolysis of salts and pH of their solutions; Buffer solutions-designing of buffer solution-Preparation of Acidic buffer; Solubility Equilibria of sparingly soluble salts. Solubility product constant Common ion effect on solubility of Ionic salts.

HYDROGEN AND ITS COMPOUNDS

Position of hydrogen in the periodic table; Dihydrogen-Occurence and Isotopes; Preparation of Dihydrogen; Properties of Dihydrogen; Hydrides: Ionic, covalent, and non-stiochiometric hydrides; Water: Physical properties; structure of water, ice. Chemical properties of water; hard and soft water, Temporary and permanent hardness of water; Hydrogen peroxide: Preparation; Physical properties; structure and chemical properties; storage and uses; Heavy Water; Hydrogen as a fuel.

THE s – BLOCK ELEMENTS (ALKALI AND ALKALINE EARTH METALS)

Group 1 Elements : Alkali metals; Electronic configurations; Atomic and Ionic radii; Ionization enthalpy; Hydration enthalpy; Physical properties; Chemical properties; Uses; General characteristics of the compounds of the alkali metals: Oxides; Halides; Salts of oxo Acids; Anomalous properties of Lithium: Differences and similarities with other alkali metals, Diagonal relationship; similarities between Lithium and Magnesium; Some important compounds of Sodium: Sodium Carbonate; Sodium Chloride; Sodium Hydroxide; Sodium hydrogen carbonate; Biological importance of Sodium and Potassium.

Group 2 Elements: Alkaline earth elements; Electronic configuration; Ionization enthalpy; Hydration enthalpy; Physical properties, Chemical properties; Uses; General characteristics of compounds of the Alkaline Earth Metals: Oxides, hydroxides, halides, salts of oxoacids (Carbonates; Sulphates and Nitrates); Anomalous behavior of Beryllium; its diagonal relationship with Aluminium; Some important compounds of calcium: Preparation and uses of Calcium Oxide; Calcium Hydroxide; Calcium Carbonate; Plaster of Paris; Cement; Biological importance of Calcium and Magnesium.

p- BLOCK ELEMENTS GROUP 13 (BORON FAMILY)

General introduction – Electronic configuration, Atomic radii, Ionization enthalpy, Electro negativity; Physical & Chemical properties; Important trends and anomalous properties of boron; Some important compounds of boron - Borax, Ortho boric acid,diborane; Uses of boron, aluminium and their compounds.

p-BLOCK ELEMENTS – GROUP 14 (CARBON FAMILY)

General introduction – Electronic configuration, Atomic radii, Ionization enthalpy, Electro negativity; Physical & Chemical properties; Important trends and anomalous properties of carbon; Allotropes of carbon; Uses of carbon; Some important compounds of carbon and silicon – carbonmonoxide, carbon dioxide,Silica, silicones, silicates and zeolites.

ENVIRONMENTAL CHEMISTRY

Definition of terms: Air, Water and Soil Pollutions; Environmental Pollution; Atmospheric pollution; Tropospheric Pollution; Gaseous Air Pollutants (Oxides of Sulphur; Oxides of Nitrogen; Hydrocarbons; Oxides of Carbon (CO, CO_2). Global warming and Green house effect; Acid Rain- Particulate Pollutants- Smog; Stratospheric Pollution: Formation and breakdown of Ozone- Ozone hole- effects of depletion of the Ozone Layer; Water Pollution: Causes of Water Pollution; International standards for drinking water; Soil Pollution: Pesticides, Industrial Wastes; Strategies to control environmental pollution- waste Management- collection and disposal; Green Chemistry: Green chemistry in day-to-day life; Dry cleaning of clothes; Bleaching of paper; Synthesis of chemicals.

ORGANIC CHEMISTRY-SOME BASIC PRINCIPLES AND TECHNIQUES AND HYDROCARBONS

General introduction; Tetravalency of Carbon: shapes of organic compounds; Structural representations of organic compounds; Classification of organic compounds; Nomenclature of organic compounds; Isomerism; Fundamental concepts in organic reaction mechanisms; Fission of covalent bond; Nucleophiles and electrophiles; Electron movements in organic reactions; Electron displacement effects in covalent bonds: inductive effect, resonance, resonance effect, electromeric effect, hyperconjugation; Types of Organic reactions; Methods of purification of organic compounds; Qualitative elemental analysis of organic compounds; Quantitative elemental analysis of organic compounds.

HYDROCARBONS

Classification of Hydrocarbons; **Alkanes** – Nomenclature, isomerism (structural and conformations of ethane only); Preparation of alkanes; Properties – Physical properties and chemical Reactivity, Substitution reactions - Halogenation(free radical mechanism), Combustion, Controlled Oxidation, Isomerisation, Aromatization, reaction with steam and Pyrolysis; **Alkenes-** Nomenclature, structure of 38ehavi, Isomerism (structural and geometrical); Methods of preparation; Properties- Physical and chemical reactions: Addition of Hydrogen, halogen, water, sulphuric acid, Hydrogen halides (Mechanism- ionic and peroxide effect, Markovnikov's, antiMarkovnikov's or Kharasch effect). Oxidation, Ozonolysis and Polymerization; **Alkynes –** Nomenclature and isomerism, structure of acetylene. Methods of preparation of acetylene; Physical properties, Chemical reactions- acidic character of acetylene, addition reactions- of hydrogen, Halogen, Hydrogen halides and water. Polymerization; **Aromatic Hydrocarbons:** Nomenclature and isomerism, Structure of benzene, Resonance and aromaticity; Preparation of benzene. Physical properties. Chemical properties: Mechanism of electrophilic substitution. Electrophilic substitution reactions- Nitration, Sulphonation, Halogenation, Friedel-Craft' alkylation and acylation; Directive influence of functional groups in mono substituted benzene, Carcinogenicity and toxicity.

SOLID STATE

General characteristics of solid state; Amorphous and crystalline solids; Classification of crystalline solids based on different binding forces (molecular, ionic, metallic and covalent solids); Probing the structure of solids: X-ray crystallography; Crystal lattices and unit cells. Bravais lattices primitive and centred unit cells; Number of atoms in a unit cell (primitive, body centred and face centred cubic unit cell); Close packed structures: Close packing in one dimension, in two dimensions and in three dimensions- tetrahedral and octahedral voids- formula of a compound and number of voids filled- locating tetrahedral and octahedral voids; Packing efficiency in simple cubic, bcc and in hcp, ccp lattice; Calculations involving unit cell dimensions- density of the unit cell; Imperfections in solids-types of point defects-stoichiometric and non-stoichiometric defects; Electricalproperties- conduction of electricity in metals, semiconductors and insulators- band theory of metals; Magnetic properties.

SOLUTIONS

Types of solutions; Expressing concentration of solutions – mass percentage, volume percentage, mass by volume percentage, parts per million, mole fraction, molarity and molality; Solubility: Solubility of a solid in a liquid, solubility of a gas in a liquid, Henry's law; Vapour pressure of liquid solutions: vapour pressure of liquid- liquid solutions. Raoult's law as a special case of Henry's law –vapour pressure of solutions of solids in liquids; Ideal and non-ideal solutions; Colligative properties and determination of molar mass-relative lowering of vapour pressure-elevation of boiling point-depression of freezing point-osmosis and osmotic pressure-reverse osmosis and water purification; Abnormal molar masses-van't Hoff factor.

ELECTROCHEMISTRY AND CHEMICAL KINETICS:

ELECTROCHEMISTRY: Electrochemical cells; Galvanic cells: measurement of electrode potentials; Nernst equation-equilibrium constant from Nernst equation- electrochemical cell and Gibbs energy of the cell reaction; Conductance of electrolytic solutions- measurement of the conductivity of ionic solutions-variation of conductivity and molar conductivity with concentration-strong electrolytes and weak electrolytes- applications of Kohlrausch's law; Electrolytic cells and electrolysis: Faraday's laws of electrolysis-products of electrolysis; Batteries: primary batteries and secondary batteries; Fuel cells; Corrosion of metals-Hydrogen economy.

CHEMICAL KINETICS: Rate of a chemical reaction; Factors influencing rate of a reaction: 38ehavior38i of rate on concentration- rate expression and rate constant- order of a reaction, molecularity of a reaction; Integrated rate equations-zero order reactions-first order reactions- half life of a reaction; Pseudo first order reaction; Temperature dependence of the rate of a reaction –effect of catalyst; Collision theory of chemical reaction rates.

SURFACE CHEMISTRY

Adsorption : Distinction between adsorption and absorption-mechanism of adsorption-types of adsorption- characteristics of physisorption-characteristics of chemisorptions-adsorption isotherms- adsorption from solution phase-applications of adsorption; **Catalysis**: Catalysts, promoters and poisons- auto catalysis- homogeneous and heterogeneous catalysis-adsorption theory of heterogeneous catalysis- important features of solid catalysts: (a)activity (b)selectivity-shape-selective catalysis by zeolites- enzyme catalysis-characteristics and mechanism- catalysts in industry; **Colloids**; Classification of colloids: Classification based on physical state of dispersed phase and dispersion medium- classification based on nature of interaction between dispersed phase and dispersion medium- classification based on type of particles of the dispersed phase- multi molecular, macromolecular and associated colloids- cleansing action of soaps-preparation of colloids-purification of colloidal solutions- properties of colloidal solutions: Colligative properties, Tyndal effect, colour, Brownian movement-charge on colloidal particles, electrophoresis; coagulation-precipitation methods-coagulation of lyophilic sols and protection of colloids-Emulsions; Colloids around us- application of colloids.

GENERAL PRINCIPLES OF METALLURGY

Occurrence of metals; Concentration of ores-levigation, magnetic separation, froth floatation, leaching; Extraction of crude metal from concentrated ore-conversion to oxide, reduction of oxide to the metal; Thermodynamic principles of metallurgy – Ellingham diagram-limitations-applications-extraction of iron, copper and zinc from their oxides; Electrochemical principles of metallurgy; Oxidation and reduction; Refining of crude metal-distillation, liquation poling, electrolytic refining, zone refining and vapour phase refining; Uses of aluminium, copper, zinc and iron.

p-BLOCK ELEMENTS:

GROUP-15 ELEMENTS : Occurrence- electronic configuration, atomic and ionic radii, 39ehavior39i enthalpy, electronegativity, physical and chemical properties; Dinitrogen-preparation, properties and uses; Compounds of nitrogen-preparation, properties and uses of ammonia; Oxides of nitrogen; Preparation and properties of nitric acid; Phosphorous-allotropic forms; Phosphine-preparation, properties and uses; Phosphorous halides; Oxoacids of phosphorous

GROUP-16 ELEMENTS: Occurrence- electronic configuration, atomic and ionic radii, 39ehavior39i enthalpy, electron gain enthalpy, electronegativity, physical and chemical properties; Dioxygen- preparation, properties and uses; Simple oxides; Ozone-preparation, properties, structure and uses; Sulphur-allotropic forms; Sulphur dioxide-preparation, properties and uses; Oxoacids of sulphur; Sulphuric acid- manufacture, properties and uses.

GROUP-17 ELEMENTS: Occurrence, electronic configuration, atomic and ionic radii, 39ehavior39i enthalpy, electron gain enthalpy, electronegativity, physical and chemical properties; Chlorine- preparation, properties and uses; Hydrogen chloride- preparation, properties and uses; Oxoacids of halogens; Interhalogen compounds- preparation, properties and uses.

GROUP-18 ELEMENTS : Occurrence, electronic configuration, ionization enthalpy, atomic radii, electron gain enthalpy, physical and chemical properties(a) Xenon-fluorine compounds- XeF_2, XeF_4 and XeF_6 -preparation, hydrolysis and formation of fluoro anions-structures of XeF_2, XeF_4 and XeF_6 (b) Xenon-oxygen compounds XeO_3 and $XeOF_4$ - their formation and structures-uses of noble gases.

D AND f BLOCK ELEMENTS & COORDINATION COMPOUNDS

d AND f BLOCK ELEMENTS : Position in the periodic table; Electronic configuration of the d-block elements; General properties of the transition elements (d-block) -physical properties, variation in atomic and ionic sizes of transition series, 39ehavior39i enthalpies, oxidation states, trends in the M^{2+}/M and M^{3+}/M^{2+} standard electrode potentials, trends in stability of higher oxidation states, chemical reactivity and E^{θ} values, magnetic properties, formation of coloured ions, formation

of complex compounds, catalytic properties, formation of interstitial compounds, alloy formation; Some important compounds of transition elements-oxides and oxoanions of metals-preparation, properties and uses of potassium dichromate and potassium permanganate-structures of chromate, dichromate, manganate and permanganate ions; Inner transition elements(f-block)-lanthanoids- electronic configuration-atomic and ionic sizes-oxidation states- general characteristics; Actinoids- electronic configuration atomic and ionic sizes, oxidation states, general characteristics and comparison with lanthanoids; Some applications of d and f block elements.

COORDINATION COMPOUNDS: Werner's theory of coordination compounds; Definitions of some terms used in coordination compounds; Nomenclature of coordination compounds-IUPAC nomenclature; Isomerism in

coordination compounds- (a)Stereo isomerism-Geometrical and optical isomerism (b)Structural isomerism-linkage, coordination, 40ehavior40i and hydrate isomerism; Bonding in coordination compounds. (a)Valence bond theory – magnetic properties of coordination compounds-limitations of valence bond theory (b) Crystal field theory (i) Crystal field splitting in octahedral and tetrahedral coordination entities (ii) Colour in coordination compounds-limitations of crystal field theory; Bonding in metal carbonyls; Stability of coordination compounds; Importance and applications of coordination compounds.

POLYMERS

Classification of Polymers –Classification based on source, structure, mode of polymerization, molecular forces and growth polymerization; Types of polymerization reactions-addition polymerization or chain growth polymerization-ionic polymerization, free radical mechanism- preparation of addition polymers-polythene, 40ehavi and polyacrylonitrile-condensation polymerization or step growth polymerization-polyamides-preparation of Nylon 6,6 and nylon 6- poly esters-terylene-bakelite, melamine-formaldehyde polymers; copolymerization-Rubber-natural rubber-vulcanisation of rubber-Synthetic rubbers-preparation of neoprene and buna-N; Molecular mass of polymers-number average and weight average molecular masses- poly dispersity index(PDI); Biodegradable polymers-PHBV, Nylon 2-nylon 6; Polymers of commercial importance- polypropene, polystyrene, polyvinylchloride (PVC), urea-formaldehyde resin, glyptal and 40ehavior – their monomers, structures and uses.

BIOMOLECULES

Carbohydrates - Classification of carbohydrates- Monosaccharides: preparation of glucose from sucrose and starch- Properties and structure of glucose- D,L configurations and (+), (-) notations of glucose-Structure of fructose; Disaccharides: Sucrose- preparation, structure; Invert sugar- Structures of maltose and lactose-Polysaccharides: Structures of starch, cellulose and glycogen- Importance of carbohydrates; **Proteins**-Aminoacids: Natural aminoacids-classification of aminoacids – structures and D and L forms-Zwitter ions; **Proteins:** Structures, classification, fibrous and globular- primary, secondary, tertiary and quarternary structures of proteins- Denaturation of proteins; **Enzymes:** Enzymes, mechanism of enzyme action; **Vitamins:** Explanation-names- classification of vitamins – sources of vitamins-deficiency diseases of different types of vitamins; **Nucleic acids:** chemical composition of nucleic acids, structures of nucleic acids, DNA finger printing biological functions of nucleic acids; **Hormones:** Definition, different types of hormones, their production, biological activity, diseases due to their abnormal activities.

CHEMISTRY IN EVERYDAY LIFE

Drugs and their classification: (a) Classification of drugs on the basis of 40ehavior40ions40l effect (b) Classification of drugs on the basis of drug action (c) Classification of drugs on the basis of chemical structure (d) Classification of drugs on the basis of molecular targets; Drug-Target interaction- Enzymes as drug targets (a) Catalytic action of enzymes (b) Drug-enzyme interaction, receptors as drug targets; Therapeutic action of different classes of drugs: antacids, antihistamines, neurologically active drugs: tranquilizers, analgesics-non-narcotic, narcotic analgesics, antimicrobials-antibiotics, antiseptics and disinfectants- antifertility drugs; Chemicals in food-artificial sweetening agents, food preservatives, antioxidants in food; Cleansing agents-soaps and synthetic detergents – types and examples.

HALOALKANES AND HALOARENES

Classification and nomenclature; Nature of C-X bond; Methods of preparation: Alkyl halides and aryl halides-from alcohols, from hydrocarbons (a) by free radical 40ehavior40ions (b) by electrophilic substitution (c) by replacement of diazonium group(Sandmeyer reaction) (d) by the addition of hydrogen halides and halogens to alkenes-by halogen exchange reactions; Physical properties- melting and boiling points, density and solubility; Chemical reactions: Reactions of haloalkanes (i)Nucleophilic substitution reactions (a) SN^2 mechanism (b) SN^1 mechanism (c) stereochemical aspects of nucleophilic substitution reactions-optical activity (ii) Elimination reactions (iii) Reaction with metals-Reactions of haloarenes: (i) Nucleophilic substitution (ii)Electrophilic substitution and (iii) Reaction with metals; Polyhalogen compounds: Uses and environmental effects of dichloro methane, trichloromethane triiodomethane, tetrachloro methane, freons and DDT

ORGANIC COMPOUNDS CONTAINING C, H AND O (Alcohols, Phenols, Ethers, Aldehydes, Ketones and Carboxylic acids)

ALCOHOLS, PHENOLS AND ETHERS

Alcohols,phenols and ethers -classification; Nomenclature: (a)Alcohols, (b)phenols and (c) ethers; Structures of 40ehavior and ether functional groups; Methods of preparation: **Alcohols** from alkenes and carbonyl compounds, from Grignard reagents; **Phenols** from haloarenes, benzene sulphonic acid, diazonium

salts, cumene; Physical propertics of alcohols and phenols; Chemical reactions of alcohols and phenols (i) Reactions involving cleavage of O-H bond in alcohols-Acidity of alcohols and phenols, esterification (ii) Reactions involving cleavage of C-O bond- reactions with HX, PX₃, dehydration and oxidation (iii) Reactions of phenols- electrophilic aromatic substitution, Kolbe's reaction, Reimer - Tiemann reaction, reaction with zinc dust, oxidation; Commercially important alcohols (methanol,ethanol); **Ethers**-Methods of preparation: By dehydration of alcohols, Williamson synthesis- Physical properties-Chemical reactions: Cleavage of C-O bond and electrophilic substitution of aromatic ethers (anisole).

ALDEHYDES AND KETONES

Nomenclature and structure of carbonyl group; Preparation of aldehydes and ketones-(1) by oxidation of alcohols (2) by dehydrogenation of alcohols (3) from hydrocarbons –Preparation of aldehydes (1) from acyl chlorides (2) from nitriles and esters(3) from hydrocarbons-Preparation of ketones(1) from acyl chlorides (2)from nitriles (3)from benzene or substituted benzenes; Physical properties of aldehydes and ketones; Chemical reactions of aldehydes and ketones-nucleophilic addition, reduction, oxidation, reactions due to α – Hydrogen and other reactions (Cannizzaro reaction,electrophilic substitution reaction); Uses of aldehydes and ketones.

CARBOXYLIC ACIDS

Nomenclature and structure of carboxylgroup; Methods of preparation of carboxylic acids (1)from primary alcohols and aldehydes (2) from alkylbenzenes(3)from nitriles and amides (4)from Grignard reagents (5) from acyl halides and anhydrides (6) from esters; Physical properties; Chemical reactions: (i) Reactions involving cleavage of O-H bond-acidity, reactions with metals and alkalies (ii) Reactions involving cleavage of C-OH bond-formation of anhydride, reactions with PCl₅, PCl₃, SOCl₂, esterification and reaction with ammonia (iii) Reactions involving-COOH group-reduction, decarboxylation (iv) Substitution reactions in the hydrocarbon part - 41ehavior41ions and ring substitution; Uses of carboxylic acids.

ORGANIC COMPOUNDS CONTAINING NITROGEN:

AMINES

Structure of amines; Classification; Nomenclature; Preparation of amines: reduction of nitro compounds, ammonolysis of alkyl halides, reduction of nitriles, reduction of amides, Gabriel phthalimide synthesis and Hoffmann bromamide degradation reaction; Physical properties; Chemical reactions: basic character of amines, alkylation, acylation, carbyl amine reaction, reaction with nitrous acid, reaction with aryl sulphonyl chloride, electrophilic substitution of aromatic amines (aniline)- bromination, nitration and sulphonation.

DIAZONIUM SALTS

Methods of preparation of diazonium salts (by diazotization) Physical properties; Chemical reactions: Reactions involving displacement of Nitrogen; Sandmeyer reaction, Gatterman reaction, replacement by i) iodiode and fluoride ions ii) hydrogen, hydroxyl and Nitro groups; reactions involving retention of diazo group; coupling reactions; Importance of diazonium salts in synthesis of aromatic compounds. CYANIDES AND ISOCYANIDES Structure and nomenclature of cyanides and isocyanides; Preparation, physical properties and chemical reactions of cyanides and isocyanides.

201 – HUMANITIES & SOCIAL SCIENCES

Total Marks : 100

REASONING (25 Marks)

Analogy Test – Alphabet Series – Test of Direction Sense – Coding – Decoding test – Number series – Puzzle – Problem on Age Calculation – Blood Relations – Calendar – Decision Making – Number Series – Matrix – Mathematical Reasoning – Statement and Assumption – Statement and Arguments – Dice – Clock – Inserting the Mission Character – Clerical Aptitude – Word formation – Venn Diagram.

INDIAN CONSTITUION (25 Marks)

Preamble, Fundamental Rights, Directive Principles of State, Local Self Governance.

Structure of Society : Social Groups, Indian Culture, Social Institutions, Individual and Society, Culture and Personality

Methods of Social Work, Group works, Principles, Community Development, Basics of Internet, World Wide Web, Digitalization

Unity and Diversity of Indian Society; Philosophical Foundations of Indian Culture; History and Culture of Andhra Pradesh.

GENERAL ENGLISH **(25 Marks)**

Active/Passive Voice; Parts of Speech; Time, Tense and Aspect; Phrasal Verbs; Auxiliary verbs; Use of Shall, will, For, Since; Idioms and Phrases; Common Errors; Preposition; Synonyms and Antonyms; Precis Writing   and Comprehension

CURRENT AFFAIRS **(25 Marks)**

Current events of national and international importance. – History of India and Indian National Movement. – Indian and World Geography – Physical, Social, Economic Geography of India and the World. – Indian Policy and Governance – Constitution, Political System, Panchayati Raj, Public Policy. - Economic and Social Development Sustainable Development, Poverty, Inclusion, Demographics, Social Sector initiatives, etc. General issues on Environmental Ecology, Bio-diversity and Climate Change – that do not require subject specialization, General Science, Demonetization and Goods and Services Tax (GST).

202 – ENGLISH

Total Marks : 100

1.   Literary terms, Genres, Literary Movements and Trends, Critical concepts.
2.   Verb, verb patterns and structures, phrasal verbs concord, Active and Passive Voice, Prepositions, Question tags, Articles, synonyms and antonyms, one word substitutes, Note taking, confusables.
3.   Comprehension – unknown poem and passage, Letter writing, Idioms, and phrases.

203 – TELUGU

Total Marks : 100

తెలుగు భాషా చరిత్ర - వ్యాకరణం :

1.   ద్రావిడ భాషలు - వ్యవహర్తలు - ప్రాంతాలు.
2.   ఆంధ్రము - తెలుగు - తెనుగు - పుట్టు పూర్వోత్తరాలు - వాని వ్యాప్తి.
3.   ప్రాఙ్నన్నయ యుగ భాషా స్వరూపం.
4.   ధ్వనుల మార్పులు : వర్ణ సమీకరణం, వర్ణ విభేదం, వర్ణ వ్యత్యయం, వర్ణ సామ్యం. తాలవ్యీకరణం, శ్వాసత - నాదత.
5.   అర్థవిపరిణామం : అర్థ సంకోచం, అర్థవ్యాకోచం, సభ్యోక్తి, మృదూక్తి, అర్థగ్రామ్యత, లక్ష్ణార్థాలు.
6.   అన్యదేశ్యాలు
7.   ఆదాన ప్రదానాలు
8.   మాండలిక భేదాలు - పరిచయం. వ్యాకరణం, తెలుగు సాహిత్య చరిత్ర,
       సాహిత్య విమర్శ : 1 . కావ్య ప్రకరణం, 2. రస ప్రకరణం, 3. రూపక ప్రకరణం, 4. ఆధునిక ప్రక్రియలు, 5. సాహిత్య విమర్శ - ప్రయో జనం.

గద్య భాగం :

1. గాలివాన - పాలగుమ్మి పద్మరాజు, 2. ఆకలి - ఆచార్య కొలకలూరి ఇనాక్, 3. నమ్ముకున్న నేల - ఆచార్య కేతు   విశ్వనాధరెడ్డి. 4. జైలు - పొట్లపల్లి రామారావు, 5. తెలుగు భాషా - ఆచార్య గుజ్జర్లమూడి కృపాచారి,   6. వ్యక్తిత్వ వికాసం -   ఆచా ర్య రాచపాళెం చంద్రశేఖర రెడ్డి, 7. మాధ్యమాలకు రాయడం -   ఆచార్య ఎస్.ఐ.డి. చంద్రశేఖర్, 8. అభివ్యక్తి నైపు ణ్యాలు - డా॥ పి.వి. సుబ్బారావు, వ్యాకరణం : సంధులు, సమాసాలు,   అలంకారాలు, ఛందస్సు.

ప్రాచీన పద్య భాగం :

1. గంగా శంతముల కథ - నన్నయ, 2. మూషిక మార్జాల వృత్తాంతం - తిక్కన, 3. హంసీ చక్రవాక సంవాదం -   అల్లసాని పెద్ద న, 4. ఎఱుకత - తరిగొండ వెంగమాంబ, 5. వామనావతారము - పోతన, 6. శాలివాహన విజయము   - కొఱవి గోపరాజు, 7. గ్రీష్మర్తు వు - రాఘునాథనాయకుడు, ఆధునిక కవిత్వం : 1. మా కొద్దీ తెల్ల దొరతనము -   గరిమెళ్ళ   సత్యనారాయణ, 2. మహాప్రస్థాన ం - శ్రీ శ్రీ.3. మునాఫరులు - గుర్రం జాషువ, 4. మేఘదూతము -   పుట్టపర్తి నారాయణాచార్యులు, 8. మనిషి - అందెశ్రీ 9. రాయల సీమ - గంజికేంద్రము - బెళ్ళూరి శ్రీనివాసమూర్తి,   10. వంటిల్లు - విమల

Total Marks : 100

Fundamentals of Accounting

Need for Accounting – Definition – Objectives, Advantages – Book keeping and Accounting–Accounting concepts and conventions – Accounting Cycle - Classification of Accounts and its rules – Double Entry Book-keeping – Journalization – Posting to Ledgers, Balancing of ledger Accounts. Types of Subsidiary Books – Cash Book, Three-column Cash Book- Petty cash Book. Preparation of Trail balance – Errors – Meaning – Types of Errors – Rectification of Errors. Need for bank reconciliation – Reasons for difference between Cash Book and Pass Book Balances-Preparation of Bank Reconciliation Statement. Preparation of Final Accounts: Trading account – Profit and Loss account – Balance Sheet – Final Accounts with adjustments. Meaning of Depreciation – Methods of Depreciation: Straight line – Written down Value – Sum of the Years' Digits – Annuity and Depletion. Meaning – Provision vs. Reserve – Preparation of Bad debts Account – Provision for Bad and doubtful debts – Provision for Discount on Debtors – Provision for discount on creditors – Repairs and Renewals Reserve A/c. Meaning of Bill –Features of bill – Parties in the Bill – Discounting of Bill – Renewal of Bill – Entries in the books of Drawer and Drawee. Consignment – Features – Proforma invoice – Account sales – Del-credre Commission – Accounting treatment in the books of consigner and consignee – Valuation of closing stock – Normal and Abnormal losses - Joint venture – Features – Differences between Joint-venture and consignment – Accounting procedure – Methods of keeping records – Disclosure of Accounting policies – Valuation of inventories – Cash flow statement – Contingencies in balance sheet – Net profit or loss, prior period items and changes – Depreciation Accounting – Construction Contracts – Revenue Recognition - Accounting for Fixed assets. Effects of changes in foreign exchange rates – Accounting for government grants – Accounting for Amalgamation. Employee benefits – Borrowing costs – Indian Accounting Standards.

Cost Accounting

Distinguish between Financial Accounting, Cost Accounting and management accounting – Cost Concepts and Classification – Cost Centre and Cost Unit – Preparation of Cost Sheet. Materials: Material control – Selective control, ABC technique – Methods of pricing issues – FIFO, LIFO, Weighted average, Base stock methods, choice of method. Labour: Control of labor costs – time keeping and time booking – Idle time –Methods of remuneration – labour incentives schemes – Overheads: Allocation and apportionment of overheads – Machine hour rate. Job costing – Process costing – treatment of normal and abnormal process losses – preparation of process cost accounts – treatment of waste and scrap, joint products and by products. Marginal Costing – Standard costing – Variance Analysis.

Management Accounting

Interface with Financial Accounting and Cost Accounting – Financial Statement analysis and interpretation: Comparative analysis – Common size analysis and trend analysi. Classification, Importance and limitations – Analysis and interpretation of Accounting ratios – Liquidity, profitability, activity and solvency ratios. Concept of fund: Preparation of funds flow statement. Uses and limitations of funds flow analysis. Concept of cash flow – Preparation of cash flow statement – Uses and limitations of cash flow analysis. Calculation of Break-even point – Uses and limitations – Margin of safety – Make/Buy Decision – Lease/own Decision.

Business Economics

Meaning and Definitions of Business Economics – Nature and scope of Business Economics- Micro and Macro Economics and their differences. Meaning and Definition of Demand – Determinants of Demand – Demand function – Law of demand- Demand Curve – Exceptions to Law of Demand. Meaning and Definition of Elasticity of Demand – Types of Elasticity of Demand – Measurements of Price elasticity of demand – Total outlay Method – Point Method – Arc Method. Classification of Costs – Total - Average – Marginal and Cost function – Long-run – Short-run – Total Revenue – Average revenue – Marginal Revenue. Type of Costs – Fixed Cost – Semi-variable Cost – Variable Cost– Cost 43ehavior – Breakeven Analysis – Its Uses and limitations. Techniques of Maximization of output, Minimization of costs and Maximization of profit – Scale of production – Economies and Dis-economies of Scale – Costs of Production – Cobb-Douglas Production Function. Concepts of Economic liberalization, Privatization, Globalization – WTO Objectives Agreements – Functions – Trade cycles – Meaning – Phases – Benefits of International Trade – Balance of Trade and Balance of payments.

Business Organization

Concepts of Business, Trade , Industry and Commerce – Features of Business –Trade Classification – Aids to Trade – Industry – Classification – Relationship of Trade, Industry and Commerce. Functions of Business and their relationship – Factors influencing the choice of suitable form of organization – Meaning of Entrepreneurship – Characteristics of a good entrepreneur – Types – Functions of Entrepreneurship. Sole Proprietorship – Meaning – Characteristics – Advantages and Disadvantages – Partnership – Meaning – Characteristics- Kinds of partners –

Advantages and Disadvantages – Partnership Deed – Hindu-undivided Family – Cooperative Societies. Joint Stock Company – Meaning – Characteristics –Advantages – Kinds of Companies - Differences between Private Ltd and Public Ltd Companies. Preparation of important Documents for incorporation of Company – Memorandum of Association – Articles of Association – Differences Between Memorandum of Association and Articles of Association - Prospectus and its contents.

Business Laws

Meaning and Definition of Contract-Essential elements of valid Contract –Valid, Void and Voidable Contracts – Indian Contract Act, 1872. Definition of Valid Offer, Acceptance and Consideration –Essential elements of a Valid Offer, Acceptance and Consideration. Rules regarding to Minors contracts – Rules relating to contingent contracts – Different modes of discharge of contracts-Rules relating to remedies to breach of contract.   Contract of sale – Sale and agreement to sell – Implied conditions and warranties –   Rights of unpaid vendor.   Cyber Law and Contract Procedures – Digital Signature – Safety Mechanisms.

Banking Theory & Practice

Meaning & Definition of Bank – Functions of Commercial Banks – Kinds of Banks – Central Banking Vs. Commercial Banking. Unit Banking , Branch Banking, Investment Banking- Innovations in banking – E banking – Online and Offshore Banking , Internet Banking – Anywhere Banking – ATMs – RTGS. Indigenous Banking – Cooperative Banks, Regional Rural banks, SIDBI, NABARD – EXIM Bank. Meaning and Definition of Banker and customer – Types of Customers – General Relationship and Special Relationship between Banker and Customer – KYC Norms. Concepts – Duties & Responsibilities of Collecting Banker – Holder for Value – Holder in Due Course – Statutory Protection to Collecting Banker – Responsibilities of Paying Banker – Payment Gateways.

E-Commerce

Features of Electronic Commerce – Distinction between e-Commerce and e-Business – Types of Business Models: B2B, B2C, C2C – Benefits and Limitations of e-Commerce – Apps.   Integration and e-Business suits – ERP, e-SCM, e-CRM – Methods and benefits of e-Payment Systems –e-Marketing – Applications and issues. E-Tourism – e-Recruitment – e- Real Estate – e-Stock Market – e-Music/Movies – e-Publishing and e-Books. Process – Methods – e-Content development and Deliveries – Major technologies used in e-Education – Online Testing – Methods – Future Trends. Ticketing – Me-Seva; Government and Consumer Services – e-Retailing – e-Groceries – Security challenges – Case Studies.

Auditing & Corporate Taxation

Meaning – Objectives – Importance of Auditing – Auditing as a Vigil Mechanism – Role of Auditor in checking corporate frauds. Based on Ownership and time – Independent, Financial, Internal, Cost, Tax, Government, Secretarial audits. Steps to be taken at the commencement of a new audit – Audit programme – Audit note book – Internal check, internal audit and internal control. Vouching of cash and trading transactions – Investigation, Auditing vs. Investigation. Auditor's Qualifications – Appointment and Reappointment – Rights, duties, liabilities and disqualifications – Audit report: Contents – Preparation – Relevant Provisions of Companies Act, 2013. Income from Business or Profession, Tax Provisions for certain types of businesses. Capital Gains, Income from Other Sources – Tax Provisions for Off shore and Special Tax Zones. Computation of Gross Total Income – Deductions – Carry-forward and set-off of losses – Minimum Alternative Tax (MAT). Procedure for Filing Returns, e-Filing, Assessment, Reassessment and Settlement of Cases, Special Procedure for Assessment of Search Cases. Powers and Duties – Appeals and Revisions – Tax Administration – Collection of Tax at Source – Advance payment of Tax – Recovery and Refund of Tax – Penalties, Offences and Prosecution.

Business Environment

Business Environment – Meaning – Macro and Micro Dimensions of Business Environment – Economic – Political – Social – Technological – Legal – Ecological – Cultural – Demographic – Changing Scenario and implications – Indian Perspective – Global perspective. Meaning of Economic growth – Factors Influencing Development – Balanced Regional Development. Rostow's stages of economic development – Meaning – Types of plans – Main objects of planning in India – NITI Ayog and National Development Council – Five year plans. Economic Reforms and New Economic Policy – New Industrial Policy – Competition Law – Fiscal Policy – Objectives and Limitations – Union budget – Structure and importance of Union budget – Monetary policy and RBI. Concept of Social Justice – Schemes – Political Stability – Leal Changes.

1. Verbal Ability, Reading Comprehension and Writing Ability (10+10+10=30 Marks)

Verbal Ability

- Antonyms
- Analogies
- Odd word out
- Word substitute in a sentence
- Right usage of words in fill in the blank
- Right usage of word in match the following
- Fill in the Blanks – Homophones
- Idioms – Fill in the blank
- Idioms – Match the following
- Sentence Correction

Reading Comprehension

- Purpose of the passage
- Strengthen and Weaken
- Assumption and Supporting Statement
- Flaw and Discrepancy
- Inference and Conclusion Drawn
- Passage based questions
- Author's Point of View
- Main idea of the Passage

Writing Ability

The applicant is to express their ideas on a given topic in 250 words.

2. Logical and Analytical Reasoning, Mental Ability (10+10=20 Marks)

Logical and Analytical Reasoning

- Number and letter Series
- Statement Conclusion / Assumption / Arguments
- Logical Connectivity
- Linear / Circular / Family Arrangement
- Venn Diagram
- Blood relations
- Coding and decoding
- Cause and effect

Mental Ability

- Averages
- Ratio & Proportion
- Partnership
- Problem on Ages Trains
- Time and Distance, Time and Work
- Boats and Streams
- Profit and Loss
- HCM and LCM

3. HRM Aptitude and General Awareness (30+10=40 Marks)

HRM Aptitude

- Business environment

- Contemporary issues in HRM
- Indian constitution and labour laws
- Contribution of national and international bodies to Labour
- Training and Development
- Human Behaviour in Organisations
- Compensation and Fringe benefits

HRM Aptitude

- Environment & ecology
- Politics / History / Economy
- Governance / Law
- International politics / Current events
- Gender / Health / Education
- Media / ICTs / Literature / Art / Culture
- Sports

206 – ECONOMICS - SYLLABUS

Total Marks : 100

A) Micro Economics – Consumer Behavior (16 Marks)

Nature, definition and scope of Economics - Wealth, Welfare, Scarcity and modern definitions. Methodology in Economics - Micro & Macro; Static and Dynamic analysis; Normative and positive science, Inductive & Deductive methods; Partial and general Equilibrium. Utility analysis: - cardinal approach-The Law of diminishing Marginal utility- The Law of Equi-Marginal Utility- concept of consumer's surplus. Demand analysis - Law of Demand - Elasticity of Demand - Measurement of Elasticity of Demand - Price, Income & Cross Elasticities of Demand. Ordinal Approach: Indifference Curve analysis - Properties of Indifference curves - Price or budget line - Equilibrium of the Consumer with the help of Indifference curves – Samuelson's Revealed preference theory.

B) Micro Economics - Production and Price Theory (16 Marks)

Production function-Concept of homogeneous production function-Cobb- Douglas Production function- Law of variable proportions-Law of Returns to Scale - Different Concepts of Costs – Explicit & Implicit, Opportunity, Total – fixed and Variable Costs, Marginal & Average Costs & its Relationship. Concept of Revenue – Total, Marginal & Average Revenue and Break – Even Point. Analyse different types of Market structures - Perfect Competition - Price determination and equilibrium of firm and industry under perfect competition - Monopoly - Price determination - Price discrimination. Monopolistic competition - price determination - Oligopoly - Kinked demand curve approach.Marginal Productivity theory of distribution - Theories of wage determination Subsistence theory of wages, Standard of living theory of wages, Modern theory of wages Wages and collective bargaining - concept of minimum wage. Theory of Rent: Ricardian theory of rent - Quasi rent concept of Alfred Marshall. Theories of Interest - Classical, Neo-classical and Keynes Liquidity Preference theory - Profit - dynamic, innovations, Risk and Uncertainty theories.

C) Macro Economics - National Income, Employment and Money (16 Marks)

Meaning, definition of Macro Economics - Importance of Macro Economics- Difference between Micro and Macro Economics - Paradox of Macro Economics –Limitations National Income - Definitions, Concepts of National Income - Measurement of National Income- Circular flow of Income in Two, Three and Four Sector Economy. Classical theory of Employment - Say's Law of Markets. Keynesian Theory of Employment - Consumption function – Investment Function - Marginal Efficiency of Capital (MEC)- Concepts of multiplier and accelerator. Meaning and Functions of Money - Classification of money - Gresham's Law - RBI classification of Money. Theories of Money - Fisher's Quantity theory of Money Cambridge approach (Marshall, Pigou, Robertson & Keynes).

D) Banking and International Trade (16 Marks)

Trade Cycles - meaning and definition - Phases of a Trade Cycle -Inflation - definition - types of inflation - causes and effects of inflation measures to control inflation. Banking: Meaning and definition -Functions of Commercial

Banks - Concept of Credit creation-Functions of RBI - Recent developments in banking sectors. Non-Bank Financial Institutions – Types of NBFIs - Factors contributing to the Growth of NBFIs –-Money market – Defects of Indian money market. Concepts of Shares-Debentures - Stock Market - Functions - Primary and Secondary Markets - SEBI - - Insurance - Life Insurance and General Insurance. Macro Economic Policy - Fiscal, Monetary and Exchange rate policies Objectives and Significance - Importance of International Trade - Regional and International Trade – Defining Balance of Trade and Balance of Payment.

E)   Economic Development and Indian Economy   (16 Marks)

Concept of Economic Growth - Distinction between economic growth and development - Measurement of economic development - Theories of Economic Growth: Adam Smith, Rostow, Karl Marx and Harrod & Domar Models. Sustainable development - Balanced and unbalanced growth-choice of techniques Labour intensive and capital intensive methods. Basic features of the Indian Economy - Natural Resources - Important Demographic features-Concept of Population Dividend - Population Policy. National Income in India - trends and composition-poverty, inequalities and Unemployment - Measures taken by the Government. – MGNREGS Economic reforms - liberalization, privatization and globalisation - concept of inclusive growth.

F)   Indian and Andhra Pradesh Economy   (20 Marks)

Indian Agriculture - Importance of Agriculture in India - Agrarian structure and relations- Factors determining Productivity- Agricultural Infrastructure - Rural credit - Micro Finance - Self Help Groups (SHGs) - Agricultural Price policy- concept of Crop Insurance - Food Security. Structure and growth of Indian Industry - Industrial policies of 1956 & 1991 Meaning of Micro small and Medium Enterprises (MSMEs)- Problems and Prospects of small scale Industries in India. Disinvestment in India - FEMA - Foreign direct investment - Services Sector in India – Reforms in Banking and Insurance -, IT, Education and Health. Planning in India Economy - Objectives of Five year plans - Review of Five year Plans - Current Five year plan- NITI Aayog. Andhra Pradesh Economy - Population - GSDP - Sector Contribution and trends - IT – Small Scale Industry - SEZs.

MODEL QUESTION PAPER

GENERAL INFORMATION:

1. For all Tests, the candidate has to answer 100 multiple choice questions in 90 minutes. Each question contains four alternative answers (a, b, c, d). The candidate must mark the answer on OMR Sheet and should not answer any where on the Test booklet.

GENERAL MODEL PAPER

Time: 90 Min   **Max. marks: 100**

1. The Scattering cross section has dimension of
   (a) Volume   (b) Area   (c) Density   (d) Length
2. In an irreversible process, the entropy of a system
   (a) Remains constant   (b) Decreases   (c) Increases   (d) Becomes infinite
3. Table 'A' of Companies Act gives
   (a) A model minute book   (b) A model form of balance sheet
   I A model memorandum of association   (d)   A model articles of association

Note : *For M.P.Ed. Students in addition to entrance examination another a minimum of 100 marks will be awarded for meritorious sports certificates at the time of counseling and merit order will be prepared.*