M. Sc. CHEMISTRY and ENVIRONMENTAL SCIENCE

ENTRANCE EXAMINATION – 2025

Pt. RAVISHANKAR SHUKLA UNIVERSITY, RAIPUR

COURSE CONTENTS

(Based on B. Sc. I, II, III years Chemistry (Inorganic, Organic & Physical) Syllabi of Pt. R.S.U. Raipur)

(Only 50 Multiple Choice Questions will be asked from the following syllabus)

INORGANIC CHEMISTRY
(B.Sc. - I)

UNIT-1
A. ATOMIC STRUCTURE

Idea of de-Broglie matter-waves, Heisenberg Uncertainty principle, Schrodinger wave equation, significance of Ψ and Ψ_2, radial & angular wave functions and probability distribution curves, Atomic orbital and shapes of s, p, d orbital's, Aufbau and Pauliexclusion principles, Hund's Multiplicity rule, electronic configuration of the elements, effective nuclear charges.

B. PERIODIC PROPERTIES
Ionization energy, electron gain enthalpy and electro negativity, trend in periodic table and applications in predicting and explaining the chemical behavior.

UNIT-2 CHEMICAL BONDING

Covalent Bond: Valence bond theory and its limitations, directional characteristics of covalent bond, various types of hybridization & shapes of simple inorganic molecules and ions. Valence shell electron pair repulsion (VSEPR) theory to NH_3, H_3O^+,SF_4,CIF_3, CI_2 and H_2O I − . M.O. Theory, homonuclear & heteronuclear bond strength & bond energy, percentage ionic character

from dipole moment & electronegativity difference.

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UNIT-3 CHEMICAL BONDING

Ionic Solids- Ionic structures, radius ratio & co-ordination number, limitation of radius, ratio rule, lattice defects, semiconductors, lattice energy Born- Haber cycle, Solvation energy and solubility of ionic solids, polarising power & polarisability of ions, Fajans rule, Metallic bond-free electron, Valence bond & band theories.

UNIT-4 A. s-BLOCK ELEMENTS

Comparative study, salient features of hydrides, solvation & complexation tendencies including their function in biosystems and introduction to alkyl & aryls, Derivatives of alkali and alkaline earth metals.

B. CHEMISTRY OF NOBLE GASES

Chemical properties of the noble gases, chemistry of xenon, structure binding in xenon compounds.

UNIT-5 A. p-BLOCK ELEMENTS

Halides hydrides, oxides and oxyacids of Boron, Aluminum, Nitrogen and Phosphorus, boranes, borazines, fullerenes and silicates, interhalogens and pseudohalogens.

B. INORGANIC CHEMICAL ANALYSIS

Chemical principles involved in the detection of acids and basic radicals including interfering radicals

INORGANIC CHEMISTRY
(B.Sc. – II)

UNIT-I CHEMISTRY OF ELEMENTS OF FIRST TRANSITION SERIES

Characteristic properties of d-block elements. Properties of the elements of the first transition series, their binary compounds and complexes illustrating relative stability of their oxidation states, coordination number and geometry.

UNIT-II CHEMISTRY OF ELEMENTS OF SECOND & THIRD TRANSITION SERIES

General characteristics, comparative treatment with their 3d-analogues in respect of ionic radii, oxidation states, magnetic behaviour, spectral properties and stereochemistry.

UNIT-III A. OXIDATION AND REDUCTION

Use of redox potential data analysis of redox cycle, redox stability in water- Frost, Latimert & Pourbaix diagrams. Principles involved in the extraction of the elements.

B. COORDINATION COMPOUNDS

Werner's coordination theory and its experimental verification, effective atomic number concept, chelates, nomenclature of coordination compounds, isomerism in coordination compounds, valencey bond theory of transition metal complexes.

UNIT-IV A. CHEMISTRY OF LANTHANIDE ELEMENTS

Electronic structure, oxidation states and ionic radii and lanthanide contraction, complex formation, occurrence and isolation, lanthanide compounds.

B. CHEMISTRY OF ACTINIDES

General features and chemistry of actinides, chemistry of separation of Np, Pu and Am from uranium, similarities between the later actinides and the later lanthanides.

UNIT-V

A. ACID AND BASES

Arrhenius, Bronsted-Lowry, the Lux-flood, solvent system and Lewis concepts of acids and bases.

B. NON-AQUEOUS SOLVENTS

Physical properties of a solvent, types of solvents and their general characteristics, reaction in non-aqueous solvents with reference to liquid ammonia and liquid sulphur dioxide.

INORGANIC CHEMISTRY
(B.Sc. – III)

UNIT-I
METAL-LIGAND BONDING IN TRANSITION METAL COMPLEXES

Limitations of valence bond theory, an elementary idea of crystal field theory, crystal field splitting in octahedral, tetrahedral and square planar complexes, factors affecting the crystal field parameters. Thermodynamic and kirietic aspects of metal complexes. A brief outline of thermodynamic stability of metal complexes and factors affecting the stability, subsititution reactions of square planar complexes.

UNIT-II MAGNETIC PROPERTIES OF TRANSITION METAL COMPLEXES

Types of magnetic behaviour, methods of determining magnetic susceptibility, spin only formula, L-S coupling, correlation of μ s and μ eff. values, orbital contribution to magnetic moments, application of magnetic moment data for 3d metal complexes. Electronic spectra of Transition Metal Complexes. Types of electronic transitions, selection rules for d-d transitions, spectroscopic ground states, spectro-chemical series. Orgel-energy level diagram for d^1 and d^2 states, discussion of the electronic spectrum of $[Ti(H_2O)_6]^{3+}$ complex ion.

UNIT-III ORGANOMETALLIC CHEMISTRY

Definition, nomenclature and classification of organo metallic compounds. Preparation, properties, bonding and applications of alkyls and aryls of Li, Al, Hg, Sn, & Ti, A brief account of metal-ethylenic complexes and homogeneous hydrogenation, monouclear carbonyls and nature of bodning in metal carbonyls.

UNIT-IV BIOINORGANIC CHEMISTRY

Essential and trace elements in biological processes, metalloporphyrins with special reference to hemoglobin and myoglobin. Biological role of alkali and alkaline earth metals with special reference to Ca21, nitrogen fixation.

UNIT-V HARD AND SOFT ACIDS AND BASES (HSAB)

Classification of acids and bases as hard and soft. Perason's HSAB concept, acidbase strength and hardness and softness. Symbiosis Silicones and Phosphazenes Silicons and phosphazenes as examples of inorganic polymers, nature of bonding in triphosphazenes.

ORGANIC CHEMISTRY
(B.Sc. – I)

UNIT-I ELECTONIC STRUCTURE & BONDING

A. Resonance, Hyperconjugation, Inductive and other field effects, Aromaticity, hydrogen bonding.

B. MECHANISM OF ORGANIC REACTIONS

Homolytic & heterolytic bond breaking, types of reagents-electrhpiles & nucleophiles. Structure and reactivity of reaction intermediates-Carbocation, carbanions free radicals, carbenes and niterenes.

UNIT-2 STEREOCHEMISTRY OF ORGANIC COMPOUNDS

A. Optical Isomerism - enantiomers, diastereomers, threo and erythro meso compound, resolution of enantiomers, inversion, retention and recemization, Relative and absolute configuration, Sequence rules, D and L and R & S systems of nomenclature.

B. Geometrical isomerism - Syn and anti forms, E & Z system of nomenclature, properties of cis-trans isomers.

UNIT-3 ALIPHATIC AND AROMATIC RING COMPOUNDS

A. Cycloalkanes- Nomenclature, methods of formation, chemical reactions, Baeyer's strain theory and its limitations. Ring strain in small rings (cyclopropane and cyclobutane), theory of strainless rigns. The case of cyclopropane ring: banana bonds.

B. Mono-nuclear and polynuclear aromatic ring. Structure of benzene & naphthalene. Molecular formula and Kekule structure. Aromatic electrophilic substitution. General pattern of the mechanism, role of σ and π complexes. Electrophilic substitution in naphthalene.

UNIT-4 ALKENES, DIENES AND ALKYNES

A. Mechanism of dehydration of alcohols.

B. Chemical reactions of alkenes- Mechanisms involved in electrophilic and free radical additions, hydroboration-oxidation, oxymercuration- reduction. epoxidation. Substitution at the allylic and vinylic positions of alkenes. Structure of allenes and butadiene, chemical reaction- 1,2 and 1,4 addition, Diel-Alder reaction. Chemical reactions of alkynes and acidity of alkynes. Electrophilic and nucleophilic addition reactions, hydroboration and oxidation with ozone and $KMnO_4$.

UNIT-5 ARENES AND AROMATICITY

A. Alkyl halides and Aryl Halides

Mechanism and stereochemistry of nucleophilic substitution reactions and alkyl halides and aryl halides with energy profile diagrams. SN1, SN2, SNi mechanisms.

B. Mechanisms and stereochemistry of elimination reaction and alkyl halides.Elimination Vs Substitution.

ORGANIC CHEMISTRY
(B.Sc. – II)

UNIT-I ALCOHOLS

A. Dihydric alcohols - nomenclature, methods of formation, chemical reactions of vicinal glycols, oxidative cleavage [Pb(OAc)4 and HIO4] and pinacol – pinacolone rearrangement.
B. Trihydric alcohols - nomenclature and methods of formation, chemical reactions of glycerol.

PHENOLS
A. Structure and bonding, in phenols, physical properties and acidic character. Comparative acidic strength of alcohols and phenols, resonance stabilization of phenoxide lon. Reactions of phenols, acylation and carboxylation.

B. Mechanisms of Fries rearrangement, Claisen rearrangement, Gatterman synthesis, Hauben - Hoesch reaction, Lederer - Manasse reaction and Reimer- Tiemann reaction. EPOXIDES Synthesis of epoxides. Catalysed ring opening of epoxides, orientation of epoxide ring opening, reactions of Grignard and organolithium reagents with epoxides. Anti 1,2 dihydroxylation of alkenes via epoxides. Crown eithers.

UNIT-II ALDEHYDES AND KETONES

A. Nomenclature and Structure of the carbonyIs group. Synthesis of aldehydes and ketones using 1,3 - dithianes, synthesis of ketones from nitriles. Mechanism of nucleophilic additions to carbonyIs group Benzoin, Aldol, Perkin and Knoevenagel condensations. Condensations with ammonia and its derivateves, Wittig reaction, Mannich reaction.

B. Use of acetate as protecting group, Oxidation of aldehydes, Baeyer – Villiger oxidation of ketones, Cannizzaro reaction, MPV, Clemmensen Condensation, Wolff-Kishner reaction, LiAIH4 and NaBH4 reduction. Halogenation of enolizable ketones. An introduction to α,β unsaturated aldehydes and ketones.

UNIT-III A. CARBOXYLIC ACIDS

Structure and bonding, Physical properties, acidity of carboxylic acids, effects of substituents on acid strength. Hell-Volhard Zeilinsky reaction. Reduction of carboxylic acids. Mechanism of Decarboxylation. Methods of formation and chemical reactions of unsaturated mono carboxylic acids. Di carboxylic acids : methods of formation and effect of heat and dehydrating agents.

B. SUBSTITUTED CARBOXYLIC ACIDS

Hydroxy and Halo-substituted Acids.

C. CARBOXYLIC ACID DERIVATIVES

Structure of acid chloredes, esters, amides and acid anhydrides. Relative stability of acyl derivatives. Physical properties, interconversion of acid derivatives by nucleophilic acyl substitution. Mechanisms of acid and base catalyzed esterification and hydrolysis.

UNIT-IV ORGANIC COMPOUNDS OF NITROGEN

A. Preparation of nitroalkanes and nitroarenes. Chemical reactions of nitroalkanes. Mechanisms of nucleophilic substitution in nitroarenes and their reduction in acidic, neutral and alkaline medium.
B. Reactivity, Structure and nomenclature of amines, physical properties. Stereochemistry of amines. Separation of mixture of primary, secondary and tertiary amines. Structural features affecting basicity of amines. Prepatation of alkyl and aryl amines (reduction of nitro compounds, nitriles), reductive amination of aldehydic and ketonic compounds. Gabriel - phthalimide reaction, Hofmann bromamide reaction, Reactions of amines, electrophilic aromatic substitution in aryl amines, reactions of amines with nitrous acid. Synthetic transformations of aryl diazonium salts, azo coupling.

UNIT-V HETEROCYCLIC COMPOUNDS

A. Introduction
Molecular orbitl picture and aromatic character of pyrrole, furan, thiophene and pyridine, methods of synthesis and chemical reactions with emphasis on the mechanism of electrophilic substitution. Mechanism and nucleophilic substitution reaction in pyridine derivatives. Comparison of basicity of pyridine. Piperidine and pyrrole.

B. Preparation and reaction of Indole, quinoline and isoquinoline and with special reference to Fisher Indole synthesis and skraup synthesis and Bisher- Napieralski synthesis, Mechanism of electrophilic substitution reactions of indole, quinoline and isoquinoline. Amino acids and Peptides : A. Classification, Structure and stereochemistry of amino acids. Acid-base behaviour, isoelectric point and electrophoresis. Preparation and reaction of α- amino acids.

B. Structure and nomenclature of peptides. Peptide synthesis, solid - phase peptide synthesis.

ORGANIC CHEMISTRY
(B.Sc. – III)

UNIT-I A. ORGANICMETALLIC COMPOUNDS

Organomegenesium compounds : Grignard reagents-formation, structure and chemical reactions. Organozinc compounds : formation and chemical reactions. Organolithium compounds : formation and chemical reactions.

B. Organosulphur Compounds
Nomenclature, structural features, methods of formation and chemical reactions of thiols, thioethers, sulphonic acids, sulphonamides and sulphaguanidine. Organic Synthesis via Enolates Active methylene groupalkylation of diethylmalonate and ethyl acetoacetate. Synthesis of ethyl acetoacetate : the Claisen condensation. Keto-enol tautomerism of ethyl acetoacetate.

UNIT-II BIOMOLECULES

A. Carbohydrates :
Configration of monosaccharides, threo and erytho diastereomers. Formation of glycosides ethers and esters Determination of ring size of monosaccharides. Cyclic structure of D(+) glucose. Structure of ribose and deoxyribose. An introduction to disaccharides (maltose, sucrose and lactose) and polysaccharides (starch and cellulose) without involving structure determination.

B. Proteins and Nucleic acids
Classification and structure of protein levels of protein structure, protein denaturation / renaturation, Constituents of amino acids Ribonucleicsids and ribouncleotieds, double helical structure of DNA.

UNIT-III A. Synthetic Polymers

Addition or chain growth polymerization. Free radical vinyl polymerization, Ziegler- Natta polymerization, Condensation or Step growth polymerization, Polyesters, polyamides, phenols-formaldehyde resins, urea- formaldehyde resins, epoxy resins and polyurethanes, natural and synthetic rubbers.

B. Synthetic Dyes
Colour and constitution (Electronic Concept). Classification of Dyes. Chemistry of dyes. Chemistry and synthesis of Methyl Orange, Congo Red, Malachite Green, Crystal Violet, Phenolphthalein, fluorescein, Alizarine and Indigo.

UNIT-IV SPECTROSCOPY

A. Mass spectroscopy : mass spectrum fragmentation of functional groups

B. InfraRed Spectroscopy : IR absorption Band their position and intensity,
Identification of IR spectra.
C. UV-Visible Spectroscopy : Beer Lambert's law, effect of Conjugation λ max Visible spectrum and colour.
D. Anthocyanin as natural colouring matter (Introduction only)
E. Application of Mass, IR, UV-Visible Spectroscopy to organic molecules.

UNIT-V
A. NMR Spectroscopy : Introduction to NMR. Shielding and Number of signal in PMR, Chemical shift and characteristic values, spiltting of Signals and Coupling constant. Application to organic molcules.

B. 13CMR Spectroscopy : Principal & Application

C. Magnetic Resonance Imaging (MRI)- Introductory idea.

PHYSICAL CHEMISTRY
(B.Sc. – I)

UNIT-1 MATHEMATICAL CONCEPTS FOR CHEMIST AND COMPUTER

A. Logarithmic relations, curve sketching linear graphs, Properties of straight line, sloped and intercept, Differentiation of functions, Partial differentiation, Integration of some useful and relavant functions, Maxima and minima, Permutation and combination, Probability.

B. General introduction to computers, components of computer, hardware and software, input and output devices; binary numbers, Introduction to computer languages, Programming, Operation systems.

UNIT-2 A. MOLECULAR VELOCITIES :

Root mean square velocity average and most probable velocities, Maxwell's law of distribution of molecular velocites of gases, (Graphical interpretation), effect of temperature on distribution of molecular velocities, collision frequency, mean free path, Joule- Thompson effect, Liquification of gases.

B. Deviation from ideal behavior, Real gases, Vander Waal equation of state, Relationship, Vander waal constant and critical constants, Law of corresponding state.

UNIT-3 A. LIQUID STATE

Inter molecular forces, magnitude of intermolecular force, structure of liquids, Properties of liquids, viscosity and surface tension. B. Ideal and non ideal solutions, modes of representing concentration of solutions, activity and activity coefficient. Dilute solution : Colligative Properties, Lowering of vapor pressure of solvent, Roults law, Osmosis, Vant Hoff Theory of dilute solutions, measurements of Osmotic pressure, relationship between lowering of vapour pressure and osmotic pressure. Elevation of boiling point, Depression in freezing point, abnormal molar masses, Depress of dissociation and association of solutes, Vant Hoff factor.

UNIT-4 A. LIQUID CRYSTALS :

Defference between liquid Crystal, solids and liquids, Classification, Structure of nematic and cholestic phases, Thermography, Seven segment cell, applications of liquid Cristals.

B. COLLOIDAL STATE :

Classification, Optical, Kinetic, and Electrical Properties of colloid, Coagulation, Handy Schulze law, flocculation value, Protection, Gold number, Emulsion, micelle. Gel, Syneresis and thixotrophy, Application of colloid.

C. SOLID STATE

Space lattices, unit cells, Elements of Symmetry in crystallize solids, X-rays diffraction, Mills indices, identification of unit cell by Broggs Spectrometer, Powder method, Neutron and electron diffraction (Elementry idea only)

UNIT-5 A. CHEMICAL KINETICS

Rate of reaction, Factors influencing rate of reaction, rate constant, Order and molecularity of reactions, Zero, first and second order reaction, methods of determining order of reaction, Complex reactions : Consecutive, opposing and side reactions, Chain reactions. Temperature dependence of raction rate, Arrhenius theory, Physical significance of Activation energy, collision theory, demerits of collision theory, non mathematical concept of transition state theory.

B. CATALYSIS :

Homogeneous and Heterogeneous Catalysis, types of catalyst, characteristic of Catalyst, Enzyme Catalysed reactions, Micellor catalysed reactions, Industrial applications of Catalysis.

PHYSICAL CHEMISTRY
(B.Sc. – II)

UNIT-I A. Thermodynamics - I

Fundamental of thermodynamics system, surroundings etc. Types of systems, intensive and extensive properties, state and path functions themodynamic operations Internal energy, enthalpy, Heat capacity of gases at constant volume and at constant pressure and their relationship. First Law of Thermodynamics limitation of first law. Joule-Thompson expansion, inversion temperature of gases. Calculation of w,q, dU & dH for the liquification expansion of ideal gases under isothermal and adiabatic conditions.

B. Thermo chemistry

Standard state,- Hess's law of heat summation. Enthalpy of reaction at constant pressure and constant volume. Enthalpy of neutralizations. Enthalpy ofcombustion, Enthalpy of formation, Calculation of Bond enthalpy. Elirchhoff's equation.

UNIT-II A. Thermodynamics-II

Second Law of Thermodynamics : Spontaseous process need of second law, statements of Carnot cycle and effciency of heat engine, Carnot theorem. Thermodynamic state of temperature. Concept of entropy : entropy change in a reversible and irreversible process, Entropy change in insothermal reversible expansion of an ideal gas, Entropy change in isothermal mixing of ideal gases, physical signification of entropy.

B. Gibbs and Helmholtz free energy variation of G and A with pressure, volume temperature, Gibbs Helmholtz equation.

UNIT-III PHASE EQUILIBRIUM

A. Gibbs Phase rule, Phase components and degree of freedom, Limitation of phase rule. Applications of phase rule to one component system - water system, suplhur system. Application of phase rule to two component systems : pb-Ag system, Zn, Mg system, ferric chloride-water system, desilverization of congruent and incongruent, melting point, eutectic point. Three component systems : solid solution liquid pairs. Liquid liquid mixture : (Partially miscible liquids) : phenol-water, trimethylaminewater nicotine systems, constant temperature, azeotrops.

B. Nerst distribution law, Henry's law, application, solvent extraction.

UNIT-IV ELECTROCHEMISTRY-I

A. Electrolytic Conductance : Specific and equivalent conductance, measurement of equivalent conductance, effect of dilution on conductance, kohlrausch's law; application of kohlrausch's law in determination of dissociation constant of weak electrolyte, solubility of sparingly soluble electrolyte, absolute velocity of ions, ionic product of water, conductometric titration.

B. Theories of strong electrolytes : limitations of ostwald dilution law, weak and strong electrolyte, Debye-Huckel- Onsagar (DHO) equation for strong electrolyte, relaxation and electrophoretic effect.

C. Migration of ions : Transport number, definition and determination by Hittorf method and moving boundary method.

UNIT-V ELECTROCHEMISTRY-II

A. Electrochemical cell or Galvanic cell : reversible and irreversible cells conventional representation of electrochemical cells, EMF of the cell, the effect of temperature on EMF of the cell, Nernst equation, calculation of G, Δ H and Δ S for cell reaction.

B. Single electrode potential: standard hydrogen electrode, calomel electrode quinhydrone electrode, redox electrodes, electrochemical series.
C. Concentration cells with & without transport, liquid junction potential, application of concentration cell in determining valency of ions, solubility product, activity coefficient.

D. Determination of pH and pKa using hydrogen and quinhydrone electrode potentiometric titrations, buffer solutions; Henderson-Hazel Equation, Hydrolysis of salts, Corrosion: type theories and prevention.

PHYSICAL CHEMISTRY
(B.Sc. – III)

UNIT-I QUANTUM MECHANICS

Black body radiation, Plank's radiation law, photoelectric effect, Compton effect. DeBroglie's idea of matter waves, experimental verification Heisenberg's uncertainty principle, Sinosoidal wave equation, Operators : Hamiltonian operator, angular momentum operator, laplacian operators postulate of quantum mechanics Eigen values, Eigen function. Schrodinger time independed wave equation physical significance of Ψ and $\Psi 2$. Applications of schrodinger wave equation : particle in one dimensional box Hydrogenation (separation into three equation's) radial wave function and angular wave function.

UNIT-II QUANTUM MECHANICS-II

Quantum mechanical approach of molecular orbit theory; basic idea criteria for forming M.O and A.O, LCAO approximation, formation of H2+ ion, calculation of energy levels from wave functions bonding and antibonding wave functions concept of σ, σ^*, π and orbitals and their characteristics, Hybrid orbital : SP, SP2, SP3, Calculation of coefficients Ads used in these hybrid orbitals. Introduction to valence bond model of H2, Comparison of M.O. and V.B. model, Huckle theory, application of huckel theory to ethane propene etc.

UNIT-III SPECTROSCOPY-I

A. Introduction, characterization of electromagenetic radiation, regions of the spectrum, representation of spectra width and intensity of spectral transition, rotational spectra of calculated diatomic molecules, energy level of rigid rotator, selection rule, determination of bond length qualitative description of non – rigid rotator isotopic effect.

B. Vibrational spectra - Fundamental vibrational and their symmetry, vibrating diatomic molecules, enegy levels of simple harmonic oscillator. Selection Rule, Pure vibrational Spectrum, determination of force constant, diatomic vibrating operator. Anhormonic Oscillator.

C. Raman Spectra : Concept of polarizability, quantum theory of Raman spectra stokes and anti stokes lines pure rotational and vibrational Raman spectra, Application of Raman spectra stokes and anti stokes lines, pure rotational and vibrational Raman apectra, Applications of Raman spectra.

UNIT-IV SPECTROSCOPY-II

A. Electronic Spectra : Electronic Spectra of diatonic molecule, Frank London principle, types of electronic transitions. Applications of electronic spectra. B. Photo-chemistry : Interaction of radiation with matter, difference between thermal and photochemical processes. Laws of photochemistry. Grothus-Drapper law, Stark-Elinstein law, Jablonski diagram depicting various process occurring in the excited state, qualitative description of fluorescence, occurring in the excited state, qualitative descripiton of fluorescence, phosphorescence, non-radiative processes (internal conversion, intersystem crossing), quantum yield photosensitized reactions energy transfer processes (simple examples).

UNIT-V A. Thermodynamics

Energy refered to absolute zero, third law of therodynamics Test of III law of thermodynamics Nerst heat theorem application and limitation of Nerst heat theorem.

B. Physical properties and molecular structure : polarization of molecules, {Classius-Mosotti equation. orientation of dipoles in an electric field. Dipole moment, induced dipole moment, measurement of dipole moment. Temperature methods and refractivity methods. Dipole moment and molecular structure.

C. Magnetic Properties : Parmagenetism diamagnetism, ferromagnetism. Determination of magnetic susceptibility, elucidation of molecular structure.