RAJEEV GANDHI GOVT. (AUTONOMOUS) POST GRADUATE COLLEGE AMBIKAPUR

UNDER GRADUATE COURSE IN
CHEMISTRY(old course)

SYLLABUS
CHEMISTRY

2023- 2024

B.Sc.- SEMESTER -I /II/III/IV/V &VI

DEPARTMENT OF CHEMISTRY

B.Sc. Chemistry

Programme Outcomes :

After Sucessfully completion of Three Year degree program in chemistry a student will be ableto:-

PO1. Demonstrate, solve and an understanding of major concepts in all disciplines ofchemistry.

PO2. Create an awareness of the impact of chemistry on the environment societyand development outside the scientific community.

PO3. Solve the problem and also think methodically independently and draw alogical conclusion.

PO4. To inculcate the Scientific temperament in the student and outside the scientific community.

PO5. Use modern techniques, descent equipments and chemical Softwares.

Programme Specific Outcome

After Sucessfully completion of Three Year degree program in chemistry a student will be ableto:-

PSO1. Gain the knowledge of chemistry through theory and practicals.

PSO2. To explain nomenclature,stereochemistry structure, reactivity and mechanismof chemical reactions.

PSO3. Identify chemical formulae and solve numerical problems.

PSO4. Understand good laboratory practices and safety.

PSO5. Make aware and handle the sophisticated instruments/equipments.

Course Outcomes

B.Sc. I Semester (Chemistry)

After completion of course, the students will able to:-

CO 1. Understand concept of hybridization and shape of moleculesbased on hybridization.

CO 2. Explain the periodic properties.

CO 3. Recall the structure of atom.

CO 4. Explain the electron displacements and their effect on reactivity of organic molecules.

CO 5. Understand the concept of stereochemistry.

CO 6. Differentiate configuration and conformation.

CO 7. Acquire knowledge of application of Mathematics to calculate derivation offormula in thermodynamic, chemical kinetics quantumchemistryelectro chemistry etc.

	CO-1	CO-2	CO-3	CO-4	CO-5	CO-6	CO-7
PO- 1	✓		✓			✓	
PO-2		✓		✓			
PO-3					✓		
PO-4				✓			
PO-5			✓			✓	
PO-6		✓					
PO-7							✓
PO-8							✓

	B.Sc. CHEMISTRY SEMESTER-I
	COURSE CODE : UD2 PAPER CODE: CHE 101
	COURSE TITLE:
	CREDIT: HOURS **THEORY: THEORY: PRACTICAL** **PRACTICAL 90**
	MARKS: **THEORY: PRACTICAL** **50 + 25**
UNIT-I **15Hours**	**A. ATOMIC STRUCTURE** Bohr's theory, its limitation and atomic spectrum of hydrogen atom. General idea of de-Broglie matter-waves, Heisenberg uncertainty principle, Schrödinger wave equation, significance of Ψ and Ψ2, radial & angular wave functions and probability distribution curves, quantum numbers, Atomic orbital and shapes of s, p, d orbitals, Aufbau and Pauli exclusion principles, Hund's Multiplicity rule, electronic configuration of the elements. **B. PERIODIC PROPERTIES** Detailed discussion of the following periodic properties of the elements, with reference to s and p-block. Trends in periodic table and applications in predicting and explaining the chemical behavior. a) Atomic and ionic radii, b) Ionization enthalpy, c) Electron gain enthalpy, d) Electronegativity, Pauling's, Mulliken's, Allred Rochow's scales. e) Effective nuclear charge, shielding or screening effect, Slater rules, variation of effective nuclear charge in periodic table.
UNIT-II **20 Hours**	**A.CHEMICAL BONDING I** Ionic bond: 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 & polarisabilitry of ions, Fajans rule, Ionic character in covalent compounds: Bond moment and dipole moment, Percentage ionic character from dipole moment and electronegatiity difference, Metallic bond-free electron, Valence bond & band theories. **B. CHEMICAL BONDING II** Covalent bond: Lewis structure, Valence bond theory and its limitations, Concept of hybridization, Energetics of hybridization, equivalent and non-equivalent hybrid orbitals. Valence shell electron pair repulsion theory (VSEPR), shapes of the following simple molecules and ions containing lone pairs and bond pairs of electrons: H2O, NH3, PCl3, PCl5, SF6. H3O+, SF4, ClF3, and ICl2- Molecular orbital theory. Bond order and bond strength, Molecular orbital diagrams of diatomic and simple polyatomic molecules N2, O2, F2, CO, NO.
	BASICS OF ORGANIC CHEMISTRY Hybridization, Shapes of molecules, Influence of hybridization on bond properties.

UNIT-III **15** **Hours**	Electronic Displacements: Inductive, electromeric, resonance and mesomeric effects, hyperconjugation and their applications; Dipole moment. Electrophiles and Nucleophiles; Nucleophilicity and basicity; Homolytic and Heterolytic cleavage, Generation, shape and relative stability of Carbocations, Carbanions, Free radicals, Carbenes and Nitrenes. Introduction to types of organic reactions: Addition, Elimination and Substitution reactions.
UNIT-IV **18** **Hours**	**STEREOCHEMISTRY & CONFORMATIONAL ANALYSIS** Optical Isomerism: Optical Activity, Specific Rotation, Chirality/Asymmetry, Enantiomers, Molecules with two or more chiral-centres, Diastereoisomers, meso compounds, Relative and absolute configuration: Fischer, Newmann and Sawhorse Projection formulae and their interconversions; Erythrose and threose, D/L, d/l system of nomenclature, Cahn-Ingold-Prelog system of nomenclature (C.I.P rules), R/S nomenclature. Geometrical isomerism: cis–trans, syn-anti and E/Z notations. Conformational analysis of alkanes, ethane, butane, cyclohexane and sugars. Relative stability and Energy diagrams. Types of cycloalkanes and their relative stability, Baeyer strain theory: Theory of strainless rings, Chair, Boat and Twist boat conformation ofcyclohexane with energy diagrams; Relative stability of mono-substituted cycloalkanes and disubstituted cyclohexane.
UNIT-V **22Hours**	**A . MATHEMATICAL CONCEPTS FOR CHEMIST** Basic Mathematical Concepts: Logarithmic relations, curve sketching, linear graphs, Properties of straight line, slope and intercept, Functions, Differentiation of functions, maxima and minima; integrals; ordinary differential equations; vectors and matrices; determinants; Permutation and combination and probability theory, Significant figures and their applications. **B . GASEOUS STATE CHEMISTRY** Kinetic molecular model of a gas: postulates and derivation of the kinetic gas equation; collision frequency; collision diameter; mean free path; Maxwell distribution and its use in evaluating molecular velocities (average, root mean square and most probable) and average kinetic energy, law of equipartition of energy, degrees of freedom and molecular basis of heat capacities. Joule Thompson effect, Liquification of Gases. Behaviour of real gases: Deviations from ideal gas behaviour, compressibility factor (Z), and its variation with pressure and temperature for different gases. Causes of deviation from ideal behaviour. van der Waals equation of state, its derivation and application in explaining real gas behaviour, calculation of Boyle temperature. Isotherms of real gases and their comparison with van der Waals isotherms, continuity of states, critical state, relation between critical constants and van der Waals constants, law of corresponding states.

Course Outcomes

B.Sc. II Semester

After completion of course, the students will able to:-

CO1. Compare the properties of S and P block elements..

CO2. Analyse the inorganic mixture containing insolubles and interfering radicals.

CO3. Describe the mechanism of organic reaction.

CO4. Apply their knowledge to problem solve, deduce structure and synthesicesimple organic molecules using the studied reaction.

CO5. Solve the numerical problems based on chemical kinetics.

CO6. Explain properties of liquids viz viscosity surface tension etc.

CO7. Analyse properties of colloids and phenomena of various adsorption

CO8. Apply catalysis in industries to manufacture different kinds of products.

	CO-1	CO-2	CO-3	CO-4	CO-5	CO-6	CO-7	CO-8
PO- 1	✓		✓			✓		
PO-2		✓	✓	✓				
PO-3					✓			✓
PO-4				✓				
PO-5			✓			✓		✓
PO-6		✓			✓	✓		
PO-7	✓						✓	
PO-8				✓				✓

	B.Sc. CHEMISTRY SEMESTER-II
	COURSE CODE : UD2 PAPER CODE : CHE 201
	COURSE TITLE:
	CREDIT: HOURS **THEORY: THEORY: PRACTICAL** **PRACTICAL 90**
	MARKS: **THEORY: PRACTICAL** **50 + 25**
UNIT-I **18 Hours**	**A. s-BLOCK ELEMENTS** General concepts on group relationships and gradation properties, 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. p-BLOCK ELEMENTS** General concepts on group relationships and gradation properties. Halides, hydrides, oxides and oxyacids of Boron, Aluminum, Nitrogen and Phosphorus. Boranes, borazines, fullerenes, graphene and silicates, interhalogens and pseudohalogens. **C . CHEMISTRY OF NOBLE GASES** Chemical properties of the noble gases, chemistry of xenon, structure, bonding in xenon compounds **D . THEORETICAL PRINCIPLES IN QUALITATIVE ANALYSIS (H2S SCHEME)** Basic principles involved in the analysis of cations and anions and solubility products, common ion effect. Principles involved in separation of cations into groups and choice of group reagents. Interfering anions (fluoride, borate, oxalate and phosphate) and need to remove them after Group II.
UNIT-II **20 Hours**	**CHEMISTRY OF ALIPHATIC HYDROCARBONS** **A. Carbon-Carbon sigma (σ) bonds** Chemistry of alkanes: Formation of alkanes, Wurtz Reaction, Wurtz-Fittig Reaction, Free radical substitutions: Halogenation-relative reactivity and selectivity. **B. Carbon-Carbon Pi (л) bonds:** Formation of alkenes and alkynes by elimination reactions, Mechanism of E1, E2, E1cb reactions. Saytzeff and Hofmann eliminations. Reactions of alkenes: Electrophilic additions and mechanisms (Markownikoff/ Anti - Markownikoff addition), mechanism of oxymercuration-demercuration, hydroboration-oxidation, ozonolysis, reduction (catalytic and chemical), syn and anti-hydroxylation (oxidation). 1,2-and 1,4-addition reactions in conjugated dienes and, Diels-Alder reaction; Allylic and benzylic bromination and mechanism, e.g. propene, 1-butene, toluene, ethyl benzene. Reactions of alkynes: Acidity, Electrophilic and Nucleophilic additions. Hydration to form carbonyl compounds, Alkylation of terminal alkynes.

UNIT-III **15 Hours**	**AROMATIC HYDROCARBONS** Aromaticity: Hückel's rule, aromatic character of arenes, cyclic carbocations/ carbanions and heterocyclic compounds with suitable examples. Electrophilic aromatic substitution: halogenation, nitration, sulphonation and Friedel-Craft's alkylation/acylation with their mechanism. Directive effects of the groups.
UNIT-IV **22 Hours**	**A. LIQUID STATE CHEMISTRY** Intermolecular forces, magnitude of intermolecular force, structure of liquids, Properties of liquids, viscosity and surface tension. **B. COLLOIDS & SURFACE CHEMISTRY** Classification, Optical, Kinetic and Electrical Properties of colloids, Coagulation, Hardy Schulze law, flocculation value, Protection, Gold number, Emulsion, micelles and types, Gel, Syneresis and thixotrophy, Application of colloids. Physical adsorption, chemisorption, adsorption isotherms (Langmuir and Freundlich). Nature of adsorbed state. Qualitative discussion of BET. **C. SOLID STATE CHEMISTRY** Nature of the solid state, law of constancy of interfacial angles, law of rational indices, Miller indices, elementary ideas of symmetry, symmetry elements and symmetry operations, qualitative idea of point and space groups, seven crystal systems and fourteen Bravais lattices; X-ray diffraction, Bragg's law, a simple account of rotating crystal method and powder pattern method. Crystal defects.
UNIT-V **15 Hours**	**A. CHEMICAL KINETICS** Rate of reaction, Factors influencing rate of reaction, rate law, rate constant, Order and molecularity of reactions, rate determining step, Zero, First and Second order reactions, Rate and Rate Law, methods of determining order of reaction, Chain reactions. Temperature dependence of reaction 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 catatysed reactions, Micellar catatysed reactions, Industrial applications of Catalysis
	REFERENCE BOOKS: 1. Lee, J. D. Concise Inorganic Chemistry ELBS, 1991. 2. Douglas, B.E. and McDaniel, D.H. Concepts & Models of Inorganic Chemistry Oxford, 1970 3. Atkins, P.W. & Paula, J. Physical Chemistry, 10th Ed., Oxford University Press, 2014. 4. Day, M.C. and Selbin, J. Theoretical Inorganic Chemistry, ACS Publications, 1962. 5. Rodger, G.E. Inorganic and Solid State Chemistry, Cengage Learning India Edition, 2002. 6. Puri, B. R., Sharma, L. R. and Kalia, K. C., Principles of Inorganic Chemistry, Milestone Publishers/ Vishal Publishing Co.; 33rd Edition 2016 7. Madan, R. D. Modern Inorganic Chemistry, S Chand Publishing, 1987. 8. Morrison, R. N. & Boyd, R. N. Organic Chemistry, Dorling Kindersley (India) Pvt. Ltd.(Pearson Education). 9. Finar, I. L. Organic Chemistry (Volume 1), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education). 10. Finar, I. L. Organic Chemistry (Volume 2: Stereochemistry and the Chemistry of Natural Products), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education). 11. Eliel, E. L. &Wilen, S. H. Stereochemistry of Organic Compounds, Wiley: London, 1994.

	12. Kalsi, P. S. Stereochemistry Conformation and Mechanism, New Age International, 2005. 13. McMurry, J.E. Fundamentals of Organic Chemistry, 7th Ed. Cengage Learning India Edition, 2013. 14. Organic Chemistry, Paula Y. Bruice, 2nd Edition, Prentice-Hall, International Edition (1998). 15. A Guide Book of Reaction Mechanism by Peter Sykes. 16. Atkins, P. W. & Paula, J. de Atkin's Physical Chemistry 10th Ed., Oxford University Press (2014). 17. Ball, D. W. Physical Chemistry Thomson Press, India (2007). 18. Castellan, G. W. Physical Chemistry 4th Ed. Narosa (2004). 19. Mortimer, R. G. Physical Chemistry 3rd Ed. Elsevier: NOIDA, UP (2009). 20. Engel, T. & Reid, P. Physical Chemistry 3rd Ed. Pearson (2013). 21. Puri, B.R., Sharma, L. R. and Pathania, M.S., Principles of Physical Chemistry, Vishal Publishing Co., 47th Ed. (2016). 22. Bahl, A., Bahl, B.S. and Tuli, G.D. Essentials of Physical Chemistry, S Chand Publ. (2010). 23. Rakshit P.C., Physical Chemistry, Sarat Book House Ed. (2014). 24. Singh B., Mathematics for Chemist, Pragati Publications.

	LABOBATORY COURSE **INORGANIC CHEMISTRY** A. Semi-micro qualitative analysis (using H2S or other methods) of mixtures - not more than four ionic species (two anions and two cations, excluding interfering, insoluble salts) out of the following: Cations : NH4+, Pb2+, Bi3+, Cu2+, Cd2+, Fe3+, Al3+, Co2+, Ni2+, Mn2+, Zn2+, Ba2+, Sr2+, Ca2+, Na+ Anions : CO32- , S2-, SO32-, S2O32-, NO2-, CH3COO-, Cl-, Br-, I-, NO3-, SO42- (Spot tests may be carried out wherever feasible) B. Acid-Base Titrations • Standardization of sodium hydroxide by oxalic acid solution. • Determination of strength of HCl solution using sodium hydroxide as intermediate. • Estimation of carbonate and hydroxide present together in mixture. • Estimation of carbonate and bicarbonate present together in a mixture. • Estimation of free alkali present in different soaps/detergents C. Redox Titrations • Standardization of KMnO4 by oxalic acid solution. • Estimation of Fe(II) using standardized KMnO4 solution. • Estimation of oxalic acid and sodium oxalate in a given mixture. • Estimation of Fe(II) with K2Cr2O7 using internal (diphenylamine, anthranilic acid) and external indicator. D. Iodo / Iodimetric Titrations • Estimation of Cu(II) and K2Cr2O7 using sodium thiosulphate solution iodimetrically. • Estimation of (a) arsenite and (b) antimony iodimetrically. • Estimation of available chlorine in bleaching powder iodometrically. • Estimation of Copper and Iron in mixture by standard solution of K2Cr2O7 using sodium thiosulphate solution as titrants.

	ORGANIC CHEMISTRY 1. Demonstration of laboratory Glasswares and Equipments. 2. Calibration of the thermometer. 80o–82o (Naphthalene), 113.5o–114o (Acetanilide), 132.5o-133o (Urea), 100o (Distilled Water).) 3. Purification of organic compounds by crystallization using different solvents. • Phthalic acid from hot water (using fluted filter paper and stemless funnel). • Acetanilide from boiling water. • Naphthalene from ethanol. • Benzoic acid from water. 4. Determination of the melting points of organic compounds. Naphthalene 80o–82o, Benzoic acid 121.5o–122o, Urea 132.5o–133o Succinic acid 184.5o–185o, Cinnamic acid 132.5o–133o, Salicylic acid 157.5o–158o, Acetanilide 113.5o–114o, m-Dinitrobenzene 90o, p-Dichlorobenzene 52o, Aspirin 135o. 5. Effect of impurities on the melting point – mixed melting point of two unknown organic compounds. • Urea – Cinnamic acid mixture of various compositions (1:4, 1:1, 4:1). 6. Determination of boiling point of liquid compounds. (boiling point lower than and more than 100 °C by distillation and capillary method). • Ethanol 78o, Cyclohexane 81.4o, Toluene 110.6o, Benzene 80o. i. Distillation (Demonstration) • Simple distillation of ethanol-water mixture using water condenser. • Distillation of nitrobenzene and aniline using air condenser. ii. Sublimation • Camphor, Naphthalene, Phthalic acid and Succinic acid. iii. Decolorisation and crystallization using charcoal. • Decolorisation of brown sugar with animal charcoal using gravity filtrations crystallization and decolorisation of impure naphthalene (100 g of naphthalene mixed with 0.3 g of Congo red using 1 g of decolorizing carbon) from ethanol. 7. Qualitative Analysis Detection of elements (N, S and halogens) and functional groups (Phenolic, Carboxylic, CarbonyI, Esters, Carbohydrates, Amines, Amides, Nitro and Anilide) in simple organic
	PHYSICAL CHEMISTRY 1. Surface tension measurements. • Determine the surface tension by (i) drop number (ii) drop weight method. • Surface tension composition curve for a binary liquid mixture. 2. Viscosity measurement using Ostwald's viscometer. • Determination of viscosity of aqueous solutions of (i) sugar (ii) ethanol at room temperature. • Study of the variation of viscosity of sucrose solution with the concentration of solute. • Viscosity Composition curve for a binary liquid mixture. 3. Chemical Kinetics • To determine the specific rate of hydrolysis of methyl/ethyl acetate catalysed by hydrogen ions at room temperature. • To study the effect of acid strength on the hydrolysis of an ester. • To compare the strengths of HCl & H2SO4 by studying the kinetics of hydrolysis of ethyl acetate. 4. Colloids • To prepare colloidal solution of silver nanoparticles (reduction method) and other metal nanoparticles using capping agents. Note: Experiments may be added/ deleted subject to availability of time and facilitie

	PRACTICAL EXAMINATION **5HRS** **M.M. 50** Three experiments are to be performed 1. Inorganic Mixture Analysis, four radicals two basic & two acid (excluding insoluble, Interfering & combination of acid radicals) OR Two Titrations (Acid-Bases,Redox and Iodo/Iodimetry) 12 marks 2. Detection of functional group in the given organic compound and determine its MPt/BPt. 8 marks O R Crystallization of any one compound as given in the prospectus along with the determination of mixed MPt. O R Decolorisation of brown sugar along with sublimation of camphor/ Naphthlene. 3. Any one physical experiment that can be completed in two hours including calculations. 14 marks 4. Viva 10 marks 5. Sessionals 06 marks In case of Ex-Students two marks will be added to each of the experiments
	REFERENCE TEXT: 1. Mendham, J., A. I. Vogel's Quantitative Chemical Analysis 6th Ed., Pearson, 2009. 2. Ahluwalia, V. K., Dhingra, S. and Gulati, A. College practical Chemistry, University Press. 3. Mann, F.G. & Saunders, B.C. Practical Organic Chemistry, Pearson Education (2009) 4. Furniss, B.S.; Hannaford, A.J.; Smith, P.W.G.; Tatchell, A.R. Practical Organic Chemistry, 5th Ed., Pearson (2012) 5. Khosla, B. D.; Garg, V. C. & Gulati, A. Senior Practical Physical Chemistry, R. Chand & Co.: New Delhi (2011). 6. Garland, C. W.; Nibler, J. W. & Shoemaker, D. P. Experiments in Physical Chemistry 8th Ed.; McGraw-Hill: New York (2003). 7. Halpern, A. M. & McBane, G. C. Experimental Physical Chemistry 3rd Ed.; W.H. Freeman & Co.: New York (2003).

Course Outcomes

B.Sc. III Semester

After completion of course the students will able to:-

CO 1. Recall the fundamental concepts of thermodynamics such as system operationsand functions.

CO2. Explain the mechanism of different organic reaction such as nucleophilic addition, Substitution elimination rearrangement reactions.

CO 3. Compare Valence bond theory and crystal field theory of coordination compound.

CO4. Apply the laws of Thermodynamics to explain enthalpy relation between heat capacities entropy , change ,isothermal mixing of ideal gases.

CO5 . Design new organic reaction in order to achieve the required products.

	CO-1	CO-2	CO-3	CO-4	CO-5
PO- 1			✓		
PO-2	✓				✓
PO-3				✓	
PO-4		✓			
PO-5		✓			
PO-6					✓
PO-7	✓				
PO-8	✓	✓	✓	✓	✓

	B.Sc. CHEMISTRY SEMESTER –III
	COURSE CODE : UD2 PAPER CODE: CHE 301
	COURSE TITLE:
	CREDIT: HOURS THEORY: THEORY: PRACTICAL
	MARKS: THEORY: PRACTICAL 50 + 25
UNIT-I	**A. CHEMISTRY OF TRANSITION SERIES ELEMENTS** Transition Elements: Position in periodic table, electronic configuration, General Characteristics, viz., atomic and ionic radii, variable oxidation states, ability to form complexes, formation of coloured ions,magnetic moment μso (spin only) and μeff and catalytic behaviour. General comparative treatment of 4d and 5d elements with their 3d analogues with respect to ionic radii, oxidation states and magnetic properties. **B. Oxidation and Reduction:** Redox potential, electrochemical series and its applications, Principles involved in extraction of the elements.
UNIT-II	**A. COORDINATION COMPOUNDS**: Werner's theory and its experimental verification, IUPAC nomenclature of coordination compounds, isomerism in coordination compounds. Stereochemistry of complexes with 4 and 6 coordination numbers. Chelates, polynuclear complexes. **B.COORDINATION CHEMISTRY**: Valence bond theory (inner and outer orbital complexes), electroneutrality principle and back bonding. Crystal field theory, Crystal field splitting and stabilization energy, measurement of 10 Dq (Δo), CFSE in weak and strong fields, pairing energies, factors affecting the magnitude of 10 Dq (Δo, Δt). Octahedral vs. tetrahedral coordination
UNIT-III	**A. CHEMISTRY OF ORGANIC HALIDES** Alkyl halides: Methods of preparation, nucleophilic substitution reactions – SN1, SN2 and SN i mechanisms with stereochemical aspects and effect of solvent etc.; nucleophilic substitution, elimination reactions. Aryl halides: Preparation, including preparation from diazonium salts, Nucleophilic Aromatic Substitution; SNAr, Benzyne mechanism. Relative reactivity of alkyl, allyl/benzyl, vinyl and arylhalides towards nucleophilic substitution reactions. **B. ALCOHOLS & PHENOLS** (i) Trihydric alcohols - Nomenclature, methods of formation, chemical reactions of glycerol. (ii)Structure and bonding in phenols, physical properties and acidic character, Comparative acidicstrength of alcohols and phenols, acylation and carboxylation. (iii) Mechanism of Fries rearrangement, Claisen rearrangement, Gatterman synthesis, Hauben-Hoesh reaction, Lederer-Manasse reaction and Reimer-Tiemann reaction.
UNIT-IV	**ALDEHYDES AND KETONES** A. Nomenclature, structure and reactivity of carbonyl group. General methods of preparation of aldehydes and ketones. Mechanism of nucleophilic addition to carbonyl groups: Benzoin, Aldol, Perkin and Knoevenagel condensation. Condensation with ammonia and its derivatives, Wittig reaction, Mannich reaction, Beckmann and Benzil- Benzilic rearrangement. B. Use of acetate as protecting group, Oxidation of aldehydes, Baeyer-Villiger oxidation of ketones, Cannizzaro reaction, MPV, Clemmensen reduction, Wolf-Kishner reaction, LiAlH4 and NaBH4 reduction. Halogenation of enolizable ketones, An introduction to α,β-unsaturated aldehydes and ketones.

UNIT-V	**A. THERMODYNAMICS-I** Intensive and extensive variables; state and path functions; isolated, closed and open systems; Zeroth law of thermodynamics. First law: Concept of heat, work, internal energy and statement of first law; enthalpy, Relation between heat capacities, calculations of q, w, U and H for reversible, irreversible and free expansion of gases under isothermal and adiabatic conditions.Joule-Thompson expansion, inversion temperature of gases, expansion of ideal gases under isothermal and adiabatic condition **B. THERMO CHEMISTRY** Thermo chemistry, Laws of Thermochemistry, Heats of reactions, standard states; enthalpy of formation of molecules and ions and enthalpy of combustion and its applications; calculation of bond energy, bond dissociation energy and resonance energy from thermochemical data, effect of temperature (Kirchhoff's equations) and pressure on enthalpy of reactions, Adiabatic flame temperature, explosion temperature. **C. THERMODYNAMICS-II** Second Law of Thermodynamics: Spontaneous process, Second law, Statement of Carnot cycle and efficiency of heat engine, Carnot's theorem, thermodynamic state of temperature. Concept of entropy: Entropy change in a reversible and irreversible process, entropy change in isothermal reversible expansion of an ideal gas, entropy change in isothermal mixing of ideal gases, physical signification ofentropy, Molecular and statistical interpretation of entropy. **D. THERMODYNAMICS-III** Elementary idea of Third law of Thermodynamics, calculation of absolute entropy of molecule.

Course Outcomes

B.Sc. IV Semester

After completion of course the students will able to:-

CO1. Recall different concepts of Acids & Bases like Arrhenius, Bronsted Lawry,Lux flood, Lewis acid base concept.

CO2. Compare the properties of lanthanides and actinides.

CO3. Compare and contrast between ionic equilibrium and phase equilibrium.

CO4. Elucidate the structure of benzene diazonium chloride.

CO5. Explain structural features affecting basicity of amines.

CO6. Apply the concept of fluorescence Phosphorescence and chemiluminescenefor describing materials.

CO7. Analyse the characteristics of electromagnetic radiation and laws of photo chemistry.

	CO-1	CO-2	CO-3	CO-4	CO-5	CO-6	CO-7
PO- 1	✓			✓		✓	✓
PO-2	✓	✓	✓			✓	
PO-3				✓			
PO-4	✓						
PO-5				✓			
PO-6					✓		
PO-7				✓			
PO-8							✓

	B.Sc. CHEMISTRY SEMESTER –IV
	COURSE CODE : UD2 PAPER CODE: CHE 401
	COURSE TITLE:
	CREDIT: HOURS THEORY: THEORY: PRACTICAL
	MARKS: THEORY: PRACTICAL 50 + 25
UNIT-I	**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-II	**A. ACIDS BASES :** Arrhenius, Bronsted-Lowry, conjugate acids and bases, relative strengths of acids and bases, 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, HF, H2SO4 , Ionic liquids
UNIT-III	**A. CARBOXYLIC ACIDS & DERIVATIVES** Preparation, Structure and bonding, Physical and chemical properties including, acidity of carboxylic acids, effects of substituents on acid strength, Hell-Volhard Zeilinsky reaction. Reduction of carboxylic groups, Mechanism of decarboxylation. Di carboxylic acids: Methods of formation and effect of heat and dehydrating agents, Hydroxyacids. Structure of acid chlorides, esters, amides and acid anhydrides, Relative stability of acyl derivatives. Physical properties, inter-conversion of acid derivatives by nucleophilic acyl substitution. Mechanism of acid and base catalyzed esterification and hydrolysis. **B. ORGANIC COMPOUNDS OF NITROGEN:** (i) Preparation of nitroalkanes and nitroarenes. Chemical reactions of nitroalkanes. Mechanism of nucleophilic substitution in nitroarenes and their reduction in acidic, neutral and alkaline medium. (ii) 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. Preparation of alkyl and aryl amines (reduction of nitro compounds and nitriles), reductive amination of aldehydic and ketonic compounds. Gabriel-Phthalimide reaction, Hofmann Bromamide reaction, Reactions of amines, electrophilic aromatic substitution of aryl amines, Reaction of amines with nitrous acid. Synthetic transformations of aryl diazonium salts, Azo coupling.
UNIT IV	**A CHEMICAL EQUILIBRIUM** Criteria of thermodynamic equilibrium, Concept of Fugacity, Thermodynamic derivation of relation between Gibbs free energy of reaction and reaction quotient Coupling of exergonic and endergonic reactions. Equilibrium constants and their quantitative dependence on temperature, pressure and concentration. **B.PHASE EQUILIBRIUM** . Phase rule, Phase, component and degree of freedom, derivation of Gibbs phase rule, limitation of phase rule, applications of phase rule to one component system: Water system and sulphur system. Application of phase rule to two component system: Pb-Ag system, desilverization of lead, Zn-Mg system Ferric chloride-water system, congruent and incongruent, melting point and eutectic point. Three component system: Solid solution liquid pairs. Nernst distribution law, Henry's law, application, solvent extraction.

UNIT V	**A. IONIC EQUILIBRIA** Ionization of weak acids and bases, pH scale, common ion effect; dissociation constants of mono protic acids (exact treatment). Salt hydrolysis-calculation of hydrolysis constant, degree of hydrolysis and pH for different salts. Buffer solutions; derivation of Henderson equation and its applications. Solubility and solubility product of sparingly soluble salts – applications of solubility product principle. **B. PHOTOCHEMISTRY** Characteristics of electromagnetic radiation, Interaction of radiation with matter, difference between thermal and photochemical processes, Lambert-Beer's law and its limitations, physical significance of absorption coefficients. Laws of photochemistry: Grothus-Drapper law, StarkEinstein law, quantum yield, actinometry, examples of low and high quantum yields, Photochemical equilibrium and the differential rate of photochemical reactions, Quenching, Role of photochemical reaction in biochemical process. Jablonski diagram depicting various process occurring in the excited state, qualitative description of fluorescence, phosphorescence, non-radiative processes (internal conversion, intersystem crossing), photosensitized reactions, energy transfer processes {simple examples),Chemiluminescence
	REFERENCE BOOKS 1. Physical Chemistry, G. M. Barrow, International student edition, McGraw Hill. 2. University General Chemistry, C. N. R. Rao, Macmillan. 3. Physical Chemistry, R. A. Alberty, Wiley Eastern. 4. The elements of physical chemistry, Wiley Eastern. 5. Physical Chemistry through problems, S. K. Dogra & S. Dogra, Wiley Eastern. 6. Physical Chemistry, B. D. Khosla,. 7. Physical Chemistry, Puri & Sharma. 8. Bhautik Rasayan, Puri, Sharma and Pathania, Vishal Publishing Company. 9. Bhautik Rasayan, P. L. Soni. 10. Bhautik Rasayan, Bahl and Tuli. 11. Physical Chemistry, R. L. Kapoor, Vol I-IV . 12. Chemical kinetics, K. J. Laidler, Pearson Educations, New Delhi (2004).

LABORATORY COURSE

INORGANIC CHEMISTRY

Qualitative semimicro analysis of mixtures containing 5 radicals. Emphasis should be given to the understanding of the chemistry of different reactions. The following radicals are suggested: CO_3^{2-}, NO_2^-, S^{2-}, SO_3^{2-}, $S_2O_3^{2-}$, CH_3COO^-, F^-, Cl^-, Br^-, I^-, NO_3^-, BO_3^{3-}, $C_2O_4^{2-}$, PO_4^{3-}, NH_4^+, K^+, Pb^{2+}, Cu^{2+}, Cd^{2+}, Bi^{3+}, Sn^{2+}, Sb^{3+}, Fe^{3+}, Al^{3+}, Cr^{3+}, Zn^{2+}, Mn^{2+}, Co^{2+}, Ni^{2+}, Ba^{2+}, Sr^{2+}, Ca^{2+}, Mg^{2+}. Mixtures should preferably contain one interfering anion, or insoluble component ($BaSO_4$, $SrSO_4$, $PbSO_4$, CaF_2 or Al_2O_3) or combination of anions e.g. CO_3^{2-} and SO_3^{2-}, NO_2^- and NO_3^-, Cl^-, Br^-, I^-.

Volumetric analysis (a) Determination of acetic acid in commercial vinegar using NaOH. (b) Determination of alkali content-antacid tablet using HCl. (c) Estimation of calcium content in chalk as calcium oxalate by permanganometry. (d) Estimation of hardness of water by EDTA. (e) Estimation of ferrous & ferric by dichromate method. (f) Estimation of copper using thiosulphate.

• Principles involved in chromatographic separations. Paper chromatographic separation of following metal ions: i. Ni (II) and Co (II) ii. Fe (III) and Al (III)

ORGANIC CHEMISTRY

• Detection of elements (X, N, S).

• Qualitative analysis of unknown organic compounds containing simple functional groups (alcohols, carboxylic acids, phenols, nitro, amine, amide, and carbonyl compounds, carbohydrates)

• Preparation of Organic Compounds: (i) m-dinitrobenzene, (ii) Acetanilide, (iii) Bromo/Nitro-acetanilide, (iv) Oxidation of primary alcohols-Benzoic acid from benzylacohol, (v) azo dye.

PHYSICAL CHEMISTRY Transition Temperature

• Determination of the transition temperature of the given substance by thermometric/ dialometricmethod (e.g. $MnCl_2.4H_2O$/$SrBr_2.2H_2O$). Thermochemistry

• Determination of heat capacity of a calorimeter for different volumes using change of enthalpy data of a known system (method of back calculation of heat capacity of calorimeter from known enthalpy of solution or enthalpy of neutralization).

• Determination of heat capacity of the calorimeter and enthalpy of neutralization of hydrochloric acid with sodium hydroxide.

• To determine the solubility of benzoic acid at different temperature and to determine ΔH of thedissolution process.

• To determine the enthalpy of neutralization of a weak acid/ weak base versus strong base/ strong acidand determine the enthalpy of ionization of the weak acid/ weak base

. • To determine the enthalpy of solution of solid calcium chloride and calculate the lattice energy of calcium chloride from its enthalpy data using Born Haber cycle. Phase Equilibrium

• To study the effect of a solute (e.g. NaCl, Succinic acid) on the critical solution temperature of two partially miscible liquids (e.g. phenol-water system) and to determine the concentration of that solute in the given phenol-water system.

• To construct the phase diagram of two component system (e.g. diphenylamine– benzophenone) by cooling curve method.

• Distribution of acetic/ benzoic acid between water and cyclohexane.

• Study the equilibrium of at least one of the following reactions by the distribution method: (i) $I_2(aq) + I^- \rightarrow I_3(aq)^{2+}$ (ii) $Cu^{2+}(aq) + nNH_3 \rightarrow Cu(NH_3)_n$ Molecular Weight Determination Determination of molecular weight by Rast Camphor and Landsburger method. Note: Experiments may be added/ deleted subject to availability of time andfacilities**.**

	PRACTICAL EXAMINATION **5HRS** **M.M. 50** Three experiments are to be performed 1. Inorganic Mixture Analysis, four radicals two basic & two acid (excluding insoluble, Interfering & combination of acid radicals) OR Two Titrations (Acid-Bases,Redox and Iodo/Iodimetry) 12 marks 2. Detection of functional group in the given organic compound and determine its MPt/BPt.8 marks O R Crystallization of any one compound as given in the prospectus along with the determination of mixed MPt. O R Decolorisation of brown sugar along with sublimation of camphor/ Naphthlene. 3. Any one physical experiment that can be completed in two hours including calculations.14 marks 4. Viva 10 marks 5. Sessionals 06 marks In case of Ex-Students two marks will be added to each of the experiments
	REFERENCE TEXT: 1. Mendham, J., A. I. Vogel's Quantitative Chemical Analysis 6th Ed., Pearson, 2009. 2. Ahluwalia, V. K., Dhingra, S. and Gulati, A. College practical Chemistry, University Press. 3. Mann, F.G. & Saunders, B.C. Practical Organic Chemistry, Pearson Education (2009) 4. Furniss, B.S.; Hannaford, A.J.; Smith, P.W.G.; Tatchell, A.R. Practical Organic Chemistry, 5th Ed., Pearson (2012) 5. Khosla, B. D.; Garg, V. C. & Gulati, A. Senior Practical Physical Chemistry, R. Chand & Co.: New Delhi (2011). 6. Garland, C. W.; Nibler, J. W. & Shoemaker, D. P. Experiments in Physical Chemistry 8th Ed.; McGraw-Hill: New York (2003). 7. Halpern, A. M. & McBane, G. C. Experimental Physical Chemistry 3rd Ed.; W.H. Freeman & Co.: New York (2003).

Course Outcomes

B.Sc. V Semester

After completion of course the students will able to:-

CO1. Recall valence bond theory and crystal field theory.

CO2. Explain concept of color and chemical constitution and aromaticityin 5 & 6 membered heterocyclic chemistry.

CO3. Explain the basies of quantum mechanics via various effects, operations and Equations.

CO4. Compare and contrast between molecular orbital and valence bond models.

CO5. Analyse Characteristics of electromagnetic radiation regionsintensity and representation of spectra.

	CO-1	CO-2	CO-3	CO-4	CO-5
PO- 1	✓				
PO-2		✓			
PO-3					✓
PO-4				✓	
PO-5					✓
PO-6					✓
PO-7			✓		
PO-8		✓	✓	✓	✓

	B.Sc. CHEMISTRY SEMESTER –V
	COURSE CODE : UD2 PAPER CODE: CHE 501
	COURSE TITLE:
	CREDIT: HOURS: **THEORY: THEORY:** **PRACTICAL**
	MARKS: **THEORY: PRACTICAL** **50 + 25**
UNIT I	**METAL-LIGAND BONDING IN TRANSITION METAL COMPLEXES** (A) Limitations of valence bond theory, Limitation of Crystal Field Theory, Application of CFSE, tetragonal distortions from octahedral geometry, Jahn–Teller distortion, square planar geometry. Qualitative aspect of Ligand field and MO Theory. (B) Thermodynamic and kinetic aspects of metal complexes. A brief outline of thermodynamic stability of metal complexes and factors affecting the stability, substitution reactions of square planar complexes, Trans- effect, theories of trans effect. Mechanism of substitution reactions of square planar complexes.
UNIT II	**MAGNETIC PROPERTIES OF TRANSITION METAL COMPLEXES** Types of magnetic behavior, methods of determining magnetic susceptibility, spin only formula, L-S coupling, correlation of $\mu_{so(spin\ only)}$ and $\mu_{eff.}$ 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	**A.HETEROCYCLIC COMPOUNDS** Classification and nomenclature, Structure, aromaticity in 5-membered and 6-membered rings containing one heteroatom; Synthesis, reactions and mechanism of substitution reactions of: Furan,Pyrrole (Paal-Knorr synthesis, Knorr pyrrole synthesis, Hantzsch synthesis), Thiophene, Pyridine(Hantzsch synthesis), Indole (Fischer indole synthesis and Madelung synthesis), Quinoline and isoquinoline, (Skraup synthesis, Friedlander's synthesis, Knorr quinoline synthesis, Doebner-Miller synthesis, Bischler-Napieralski reaction, Pictet- Spengler reaction, Pomeranz-Fritsch reaction). **B. ORGANOMETALLIC REAGENT** Organomagnesium compounds: Grignard reagents formation, structure and chemical reactions. Organozinc compounds: formation and chemical reactions.Organolithium compounds: formation and chemical reactions. **C. ORGANIC SYNTHESIS VIA ENOLATES** Active methylene group, alkylation of diethylmalonate and ethyl acetoacetate, Synthesis of ethyl acetoacetate: The Claisen condensation. Keto-enol tautomerism of ethyl acetoacetate. Robbinson annulations reaction.

UNIT-IV	**BIOMOLECULES** **A. CARBOHYDRATES** Occurrence, classification and their biological importance. Monosaccharides: relative and absolute configuration of glucose and fructose, epimers and anomers, mutarotation, determination of ring size of glucose and fructose, Haworth projections and conformational structures; Interconversions of aldoses and ketoses; Killiani Fischer synthesis and Ruff degradation; Disaccharides – Structural comparison of maltose, lactose and sucrose. Polysaccharides – Elementary treatment of starch and cellulose. **B. AMINO ACIDS, PROTEINS AND NUCLEIC ACIDS** Classification and Nomenclature of amino acids, Configuration and acid base properties of amino acids, Isoelectric Point, Peptide bonds, Protein structure, denaturation/ renaturation, Constituents of nucleic acid, DNA, RNA nucleoside, nucleotides, double helical structure of DNA. **SYNTHETIC POLYMERS** **C.** 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. **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-V	**QUANTUM MECHANICS–I** Black-body radiation, Planck's radiation law, photoelectric effect, Compton effect. Operator: Hamiltonian operator, angular momentum operator, Laplacian operator, postulate of quantum mechanics, eigen values, eigen function, Schrodinger time independent wave equation, physical significance of ψ & ψ^2, application of Schrodinger wave equation to particle in a one dimensional box, hydrogen atom (separation into three equations) radial and angular wave functions. **A. QUANTUM MECHANICS–II** Quantum Mechanical approach of Molecular orbital theory, basic ideas-criteria for forming M.O. and A.O., LCAO approximation, formation of H_2^+ ion, calculation of energy levels from wave functions, bonding and antibonding wave functions, Concept of σ, σ^*, π, π^* orbitals and their characteristics, Hybrid orbitals-sp,sp^2,sp^3 Calculation of coefficients of A.O.'s used in these hybrid orbitals. Introduction to valence bond model of H_2, comparison of M.O. and V.B. models. Huckeltheory, application of Huckel theory to ethene, propene, etc.
	REFERENCE BOOKS 1. Basic Inorganic Chemistry, F. A. Cotton, G. Wilkinson and P. L. Gaus, Wiley. 2. Concise Inorganic Chemistry, J. D. Lee, ELBS. 3. Concepts of Models of Inorganic Chemistry, B. Douglas, D. Mc Daniel and J. Alexander, John Wiley. 4. Inorganic Chemistry, D. E. Shriver, P. W. Atkins and C. H. Langford, Oxford. 5. Inorganic Chemistry, W. W. Porterfield, Addison – Wiley. 6. Inorganic Chemistry, A. G. Sharp, ELBS.

	7. Inorganic Chemistry, G. L. Miessler and D. A. Tarr, Prentice Hall. 8. Advanced Inorganic Chemistry, Satya Prakash. 9. Advanced Inorganic Chemistry, Agarwal and Agarwal. 10. Advanced Inorganic Chemistry, Puri, Sharma, S. Naginchand. 11. Inorganic Chemistry, Madan, S. Chand. 12. Aadhunik Akarbanic Rasayan, A. K. Shrivastav & P. C. Jain, Goel Pub. 13. Uchchattar Akarbanic Rasayan, satya Prakash 14. Organic Chemistry, Morrison and Boyd, Prentice-Hall. 15. Organic Chemistry, L. G. Wade Jr. Prentice Hall. 16. Fundamentals of Organic Chemistry, Solomons, John Wiley. 17. Organic Chemistry, Vol I, II, III S. M. Mukherjee, S. P. Singh and R. P. Kapoor, Wiley Easters (New Age). 18. Organic Chemistry, F. A. Carey, McGraw Hill. 19. Introduction to Organic Chemistry, Struiweisser, Heathcock and Kosover, Macmillan. 20. Acheson, R.M. Introduction to the Chemistry of Heterocyclic compounds, John Wiley & Sons (1976). 21. Graham Solomons, T.W. Organic Chemistry, John Wiley & Sons, Inc. 22. McMurry, J.E. Fundamentals of Organic Chemistry, 7th Ed. Cengage Learning IndiaEdition, 2013. 23. Kalsi, P. S. Textbook of Organic Chemistry 1st Ed., New Age International (P) Ltd. Pub. 24. Clayden, J.; Greeves, N.; Warren, S.; Wothers, P.; Organic Chemistry, Oxford University

Course Outcomes

B.Sc. VI Semester

After completion of course the students will able to:-

CO1. Understand bonding and preparation of metal carbonyl and inorganic polymers.

CO2. Explain the role of metal in biological system.

CO3. Describe the basic principles and application of IR,U.V. and NMR spectroscopy.

CO4. Evaluate vibrational, Raman,Electronic Spectroscopic techniques and there fundamental conceptional principles

CO5. Apply electro chemical, Galvanic and Concentration cell in determiningvalency of ions, solubility and activity cofficient.

	CO-1	CO-2	CO-3	CO-4	CO-5
PO- 1	✓				
PO-2	✓	✓			
PO-3				✓	✓
PO-4			✓		
PO-5					
PO-6		✓			
PO-7			✓		
PO-8	✓			✓	✓

	B.Sc. CHEMISTRY SEMESTER –VI
	COURSE CODE : UD2 PAPER CODE: CHE 601
	COURSE TITLE:
	CREDIT: HOURS: **THEORY: THEORY:** **PRACTICAL**
	MARKS: **THEORY: PRACTICAL** **50 + 25**
UNIT I	**ORGANOMETALLIC CHEMISTRY** Definition and classification of organometallic compounds on the basis of bond type. Concept of hapticity of organic ligands. Metal carbonyls: 18-electron rule, electron count of mononuclear,polynuclear and substituted metal carbonyls of 3d series. General methods of preparation (direct combination, reductive carbonylation, thermal and photochemical decomposition) of mono and binuclear carbonyls of 3d series. Structures of mononuclear and binuclear carbonyls of Cr, Mn, Fe, Co and Ni using VBT. π-acceptor behavior of CO (MO diagram of CO to be discussed), Zeise's salt: Preparation and structure. **Catalysis by Organometallic Compounds –** Study of the following industrial processes and their mechanism : 1. Alkene hydrogenation (Wilkinsons Catalyst) 2. Polymeration of ethane using Ziegler – Natta Catalyst
UNIT- II	**BIOINORGANIC CHEMISTRY** to Ca2+ and Mg2+, nitrogen fixation Essential and trace elements in biological processes, Excess and deficiency of some trace metals,Toxicity of some metal ions (Hg, Pb, Cd and As), metalloporphyrins with special reference to hemoglobin and myoglobin. Biological role of alkali and alkaline earth metalswith special reference. **HARD AND SOFT ACIDS AND BASES (HSAB)** Classification of acids and bases as hard and soft. Pearson's HSAB concept, acid-base strength and hardness and softness. Symbiosis, Applications of HSAB principle. **INORGANIC POLYMERS** Types of inorganic polymers, comparison with organic polymers, synthesis, structural aspects and applications of silicones. Silicates, phosphazenes and polyphosphate.
UNIT-III	**A. INFRA-RED SPECTROSCOPY** Basic principle, IR absorption Band their position and intensity, IR spectra of organic compounds. **B. UV-VISIBLE SPECTROSCOPY** Beer Lambert's law, effect of Conjugation, Types of electronic transitions λmax, hromophores and Auxochromes, Bathochromic and Hypsochromic shifts, Intensity of absorption Visible spectrum and colour. **C. NMR SPECTROSCOPY** Basic principles of Proton Magnetic Resonance, Tetramethyl silane (TMS) as internal standard, chemical shift and factors influencing it; Spin – Spin coupling and coupling constant(J); Anisotropic effects in alkene, alkyne, aldehydes and aromatics, Interpretation of NMR spectra of simple organic compounds. 13CMR spectroscopy: Principle and applications

UNIT-IV	**SPECTROSCOPY** **Introduction**: Characterization of Electromagnetic radiation, regions of the spectrum, representation of spectra, width and intensity of spectral transition, Rotational Spectrum of Diatomic molecules. Energy levels of a rigid rotor, selection rules, determination of bond length, qualitative description of non-rigid rotator, isotopic effect. **Vibrational Spectroscopy:** Fundamental vibration and their symmetry vibrating diatomic molecules, Energy levels of simple harmonic oscillator, selection rules, pure vibrational spectrum, determination of force constant, anharmonic oscillator **Raman spectrum:** Concept of polarizability, quantum theory of Raman spectra, stokes and antistokes lines, pure rotational and pure vibrational Raman spectra. Applications of Raman Spectra. **Electronic Spectroscopy:** Basic principles, Electronic Spectra of diatomic molecule, Franck-Condon principle, types of electronic transition, application of electronic spectra
UNIT-V	**A. ELECTROCHEMISTRY-I** Electrolytic conductance: Specific and equivalent conductance, measurement of equivalent conductance, effect of dilution on conductance, Kohlrausch law, application of Kohlrausch law in determination of dissociation constant of weak electrolyte, solubility of sparingly soluble electrolyte, absolute velocity of ions, ionic product of water, conductometric titrations. Theories of strong electrolyte: limitations of Ostwald's dilution law, weak and strong electrolytes, Elementary ideas of Debye-Huckel-Onsager's equation for strong electrolytes , relaxation and electrophoretic effects. Migration of ions: Transport number, Determination by Hittorf method and moving boundary method, ionic strength. **B.ELECTROCHEMISTRY-II** Electrochemical cell and Galvanic cells – reversible and irreversible cells, conventional representation of electrochemical cells, EMF of the cell and effect of temperature on EMF of the cell, Nernst equation Calculation of ΔG, ΔH and ΔS for cell reactions. Single electrode potential : standard hydrogen electrode, calomel electrode, quinhydrone electrode, redox electrodes, electrochemical series Concentration cell with and without transport, liquid - junction potential, application of concentration cells in determining of valency of ions , solubility product and activity coefficient Corrosion-types , theories and prevention
	REFERENCE BOOKS 1. Basic Inorganic Chemistry, F. A. Cotton, G. Wilkinson and P. L. Gaus, Wiley. 2. Concise Inorganic Chemistry, J. D. Lee, ELBS. 3. Concepts of Models of Inorganic Chemistry, B. Douglas, D. Mc Daniel and J. Alexander, John Wiley. 4. Inorganic Chemistry, D. E. Shriver, P. W. Atkins and C. H. Langford, Oxford. 5. Inorganic Chemistry, W. W. Porterfield, Addison – Wiley. 6. Inorganic Chemistry, A. G. Sharp, ELBS. 7. Inorganic Chemistry, G. L. Miessler and D. A. Tarr, Prentice Hall. 8. Advanced Inorganic Chemistry, Satya Prakash. 9. Advanced Inorganic Chemistry, Agarwal and Agarwal. 10. Advanced Inorganic Chemistry, Puri, Sharma, S. Naginchand. 11. Inorganic Chemistry, Madan, S. Chand. 12. Aadhunik Akarbanic Rasayan, A. K. Shrivastav & P. C. Jain, Goel Pub. 13. Uchchattar Akarbanic Rasayan, satya Prakash

	14. Organic Chemistry, Morrison and Boyd, Prentice-Hall. 15. Organic Chemistry, L. G. Wade Jr. Prentice Hall. 16. Fundamentals of Organic Chemistry, Solomons, John Wiley. 17. Organic Chemistry, Vol I, II, III S. M. Mukherjee, S. P. Singh and R. P. Kapoor, Wiley Easters (New Age). 18. Organic Chemistry, F. A. Carey, McGraw Hill. 19. Introduction to Organic Chemistry, Struiweisser, Heathcock and Kosover, Macmillan. 20. Acheson, R.M. Introduction to the Chemistry of Heterocyclic compounds, John Wiley & Sons (1976). 21. Graham Solomons, T.W. Organic Chemistry, John Wiley & Sons, Inc. 22. McMurry, J.E. Fundamentals of Organic Chemistry, 7th Ed. Cengage Learning IndiaEdition, 2013. 23. Kalsi, P. S. Textbook of Organic Chemistry 1st Ed., New Age International (P) Ltd. Pub. 24. Clayden, J.; Greeves, N.; Warren, S.; Wothers, P.; Organic Chemistry, Oxford University

	PRACTICAL
	INORGANIC CHEMISTRY Gravimetric analysis: • Estimation of nickel (II) using Dimethylglyoxime (DMG). • Estimation of copper as CuSCN • Estimation of iron as Fe_2O_3 by precipitating iron as $Fe(OH)_3$. • Estimation of Al (III) by precipitating with oxine and weighing as $Al(oxine)_3$ (aluminium oxinate). • Estimation of Barium as $BaSO_4$ Inorganic Preparations: • Tetraamminecopper (II) sulphate, $[Cu(NH_3)_4]SO_4.H_2O$ • Cis and trans $K[Cr(C_2O_4)_2.(H_2O)_2]$ Potassium dioxalatodiaquachromate(III) • Tetraamminecarbonatocobalt (III) ion • Potassium tris(oxalate)ferrate(III)/ Sodium tris(oxalate)ferrate(III) • Cu(I) thiourea complex, Bis (2,4-pentanedionate) zinc hydrate; Double salts (Chrome alum/ Mohr's salt)
	ORGANIC CHEMISTRY 1. Preparation of organic Compounds • Acetylation of one of the following compounds: amines (aniline, o-, m-, p-toluidines and o-,m-, p-anisidine) and phenols (β-naphthol, vanillin, salicylic acid) • Benzolyation of one of the following amines (aniline, o-, m-, p- toluidines and o-, m-, panisidine) and one of the following phenols (β-naphthol, resorcinol, p cresol) by Schotten-Baumann reaction. • Bromination of any one of the following: a. Acetanilide by conventional methods b.Acetanilide using green approach (Bromate-bromide method) • Nitration of any one of the following: a. Acetanilide/nitrobenzene by conventional method b. Salicylic acid by green approach (using ceric ammonium nitrate). • Reduction of p-nitrobenzaldehyde by sodium borohydride. • Hydrolysis of amides and esters. • Semicarbazone of any one of the following compounds: acetone, ethyl methyl ketone, cyclohexanone, benzaldehyde. • Benzylisothiouronium salt of one each of water soluble and water insoluble acids (benzoic acid, oxalic acid, phenyl acetic acid and phthalic acid). • Aldol condensation using either conventional or green method. • Benzil-Benzilic acid rearrangement. • Preparation of sodium polyacrylate. • Preparation of urea formaldehyde. • Preparation of methyl orange. The above derivatives should be prepared using 0.5-1g of the organic compound. The solid samples must be collected and may be used for recrystallization, melting point and TLC.

	2. Qualitative Analysis Analysis of an organic mixture containing two solid components using water, $NaHCO_3$, NaOH for separation and preparation of suitable derivatives. 3. Extraction of caffeine from tea leaves. 4. Analysis of Carbohydrate: aldoses and ketoses, reducing and non-reducing sugars. 5. Identification of simple organic compounds by IR spectroscopy and NMR spectroscopy. (Spectra to be provided). 6. Estimation of glycine by Sorenson's formalin method. 7. Study of the titration curve of glycine. 8. Estimation of proteins by Lowry's method. 9. Study of the action of salivary amylase on starch at optimum conditions. 10. Effect of temperature on the action of salivary amylase.
	PHYSICAL CHEMISTRY Conductometry • Determination of cell constant • Determination of equivalent conductance, degree of dissociation and dissociation constant of a weak acid. • Perform the following conductometric titrations: i. Strong acid vs. strong base ii. Weak acid vs. strong base iii. Mixture of strong acid and weak acid vs. strong base iv. Strong acid vs. weak base • To determine the strength of the given acid conductometrically using standard alkali solution. • To determine the solubility and solubility product of a sparingly soluble electrolyte conductometrically • To study the saponification of ethyl acetate conductometrically. Potentiometry/pH metry Perform the following potentio/pH metric titrations: i. Strong acid vs. strong base ii. Weak acid vs. strong base iii. Dibasic acid vs. strong base iv. Potassium dichromate vs. Mohr's salt v. Determination of pKa of monobasic acid UV/ Visible spectroscopy • Verify Lambert-Beer's law and determine the concentration of $CuSO_4$/$KMnO_4$/$K_2Cr_2O_7$ in a solution of unknown concentration • Determine the concentrations of $KMnO_4$ and $K_2Cr_2O_7$ in a mixture. • Study the kinetics of iodination of propanone in acidic medium. • Determine the amount of iron present in a sample using 1,10-phenathroline. • Determine the dissociation constant of an indicator (phenolphthalein). • Study the kinetics of interaction of crystal violet/ phenolphthalein with sodium hydroxide. • Study of pH-dependence of the UV-Vis spectrum (200-500 nm) of potassium dichromate.

	• Spectral characteristics study (UV) of given compounds (acetone, acelaldehyde, acetic acid, etc.) in water. • Absorption spectra of $KMnO_4$ and $K_2Cr_2O_7$ (in 0.1 M H_2SO_4) and determine λ_{max} values. ***Note:*** **Experiments may be added/deleted subject to availability of time and facilities**
	REFERENCE BOOKS: 1. Vogel, A.I. Quantitative Organic Analysis, Part 3, Pearson (2012).31 2. Mann, F.G. & Saunders, B.C. Practical Organic Chemistry, Pearson Education (2009) 3. Furniss, B.S.; Hannaford, A.J.; Smith, P.W.G.; Tatchell, A.R. Practical Organic Chemistry, 5th Ed., Pearson (2012) 4. Ahluwalia, V.K. & Aggarwal, R. Comprehensive Practical Organic Chemistry: Preparation and Quantitative Analysis, University Press (2000). 5. Ahluwalia, V.K. & Dhingra, S. Comprehensive Practical Organic Chemistry: Qualitative Analysis, University Press (2000) 6. Manual of Biochemistry Workshop, 2012, Department of Chemistry, University of Delhi.
	PRACTICAL EXAMINATION M.M.50 Five experiments are to be performed. 1. **Inorganic** - Two experiments to be performed. Gravimetric estimation compulsory **08 marks**. (Manipulation 3 marks) Anyone experiment from synthesis and analysis **04 marks**. 2. **Organic -** Two experiments to be performed. Qualitative analysis of organic mixture containing two solid components. compulsory carrying **08 marks** (03 marks for each compound and two marks for separation). One experiment from synthesis of organic compound (Single step) **04 marks**. 3. Physical-One physical experiment **12 marks**. 4. Sessional **04 marks**. 5. Viva Voce **10 marks**. In case of Ex-Students one mark each will be added to Gravimetric analysis and Qualitative analysis of organic mixture and two marks in Physical experiment.