B.Sc I yr CHEMISTRY
SEMESTER WISE SYLLABUS
SEMESTER I
Paper – I
Chemistry - I

Unit-I (Inorganic Chemistry) 15h (1 hr/week)

S1-I-1. s-block elements:

General Characteristics of groups I and II elements, Diagonal relationship between Li and Mg, Be and Al **2 h**

S1-I-2. p-block elements 1: 7 h

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), Lewis acid nature of BX_3

Group – 14: Carbides-Classification – ionic, covalent, interstitial – synthesis. Structures and reactivity. Industrial application. Silicones – Preapartion – a) direct silicon process b) use of Grignard reagent c) aromatic silylation. Classification – straight chain, cyclic and cross-linked.

Group – 15: Nitrides – Classification – ionic, covalent and interstitial. Reactivity – hydrolysis. Preparation and reactions of hydrazine, hydroxyl amine, phosphazenes.

S1-I-3. General Principles of Inorganic qualitative analysis 6 h

Anion analysis: Theory of sodium carbonate extract, classification and reactions of anions-CO_3^{2-}, Cl^-, Br^-, SO_4^{2-}, PO_4^{3-}, BO_3^{3-}, CH_3COO^-, NO_3^-.

Cation Analysis: Principles involved - Solubility product, common ion effect, general discussion for the separation and identification of group I individual cations (Hg_2^{2+}, Ag+, Pb+) with flow chart and chemical equations. Principle involved in separation of group II & IV cations.

General discussion for the separation and identification of group II (Hg^{2+}, Pb^{2+}, Bi^{3+}, Cd^{2+}, Sb^{2+}), III (Al^{3+}, Fe^{3+}), IV ((Mn^{2+}, Zn^{2+}) individual cations with flow chart and chemical equations. Application of concept of hydrolysis in group V cation analysis. General discussion for the separation and identification of group V individual cations (Ba^{2+}, Sr^{2+}, Ca^{2+}) with flow chart and chemical equations. Theory of flame test. Identification of Group VI cations (Mg^{2+}, NH_4^+).

Unit - II (Organic Chemistry) 15h (1 hr/week)

S1-O-1: Structural Theory in Organic Chemistry 6 h

***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 - Mesomeric effect, application to (a) acidity of phenol. (b) acidity of carboxylic acids and basicity of anilines. Stability of carbo cations, carbanions and free radicals. Hyper conjugation and its application to stability of carbonium ions, Free radicals and alkenes.

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

S1-O-2: Acyclic Hydrocarbons 6 h

***Alkane*s** – Methods of preparation: Corey-House reaction, Wurtz reaction, from Grignard reagent, Kolbe synthesis. Chemical reactivity - inert nature, free radical substitution, Halogenation example- reactivity, selectivity and orientation.

Alkenes - Preparation of alkenes (with mechanism) (a) by dehydration of alcohols (b) dehydrohalogenation of alkyl halides (c) by dehalogenation of 1,2 dihalides, Zaitsev's rule. Properties: Addition of Hydrogen – heat of hydrogenation and stability of alkenes. trans-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). Oxidation (cis – additions) – hydroxylation by $KMnO_4$, OsO_4, trans addition- peracids (via epoxidation), hydroboration, ozonolysis – location of double bond. Dienes – Types of dienes, reactions of conjugated dienes – 1,2 and 1,4 addition of HBr to 1,3 – butadiene and Diels – Alder reaction.

Alkynes – Preparation by dehydrohalogenation of vicinal dihalides, dehalogenation of tetrahalides. Physical Properties: Acidity of terminal alkynes (formation of metal acetylides) preparation of higher alkynes, Chemical reactivity – electrophilic addition of X_2, HX, H_2O (tautomerism), Oxidation (formation of enediol, 1,2 diones and carboxylic acids) and reduction (Metal-ammonia reduction, catalytic hydrogenation)

S1-O-3: Alicyclic Hydrocarbons 3 h

Nomenclature, preapartion by Freunds method, Dickmann, heating dicarboxylic metal salts. Properties – reactivity of cyclo propane and cyclo butane by comparing with alkanes. Stability of cycloalkanes – Baeyer strain theory, Sachse and Mohr predictions and Pitzer strain theory. Conformational structures of cyclopentane, cyclohexane.

Unit-III (Physical Chemistry) 15 h (1 hr/week)

S1-P-1: Atomic structure and elementary quantum mechanics 6 h

Black body radiation, heat capacities of solids, Rayleigh Jeans law, Planck's radiation law, photoelectric effect, Limitations of classical mechanics, Compton effect, De Broglie's hypothesis. Heisenberg's uncertainty principle, Schrodinger's wave equation and its importance. Physical interpretation of the wave function, significance of ψ and ψ^2, a particle in a box, energy levels, wave functions and probability densities. Schrodinger wave equation for H-atom. Separation of variables, radial and angular functions (only equation), hydrogen like wave functions, quantum numbers and their importance.

S1-P-2: Gaseous State 5 h

Deviation of real gases from ideal behavior. van der Waals equation of state. Critical phenomenon. PV isotherms of real gases, continuity of state. Andrew's isotherms of CO_2. The van der Waal's equation and critical state. Derivation of relationship between critical constants and van der Waal's constants. The law of corresponding states, reduced equation of states. Joule Thomson effect and inversion temperature of a gas. Liquifaction of gases: i) Linde's method based on Joule Thomson effect ii) Claude's method based on adiabatic expansion of a gas.

S1-P-3: Liquid State 4 h

Intermolecular forces, structure of liquids (qualitative description). Structural differences between solids, liquids and gases. Surface tension and its determination using stalagmometer. Viscosity of a liquid and determination of coefficient of viscosity using Ostwald viscometer. Effect of temperature on surface tension and coefficient of viscosity of a liquid (qualitative treatment only). Liquid crystals, the mesomorphic state: Classification of liquid crystals in to Smectic and Nematic, differences between liquid crystal and solid / liquid. Application of liquid crystals as LCD devices.

Unit – IV (General Chemistry) 15 h (1 hr/week)

S1-G-1 Chemical Bonding 11 h

Ionic solids- lattice and solvation energy, solubility of ionic solids, Fajan's rule, polarity and polarizability of ions, covalent nature of ionic bond, covalent bond - Common hybridization and shapes of molecules.

Molecular orbital theory: Shapes and sign convention of atomic orbitals. Modes of overlapping. Concept of σ and π bonds. Criteria for orbital overlap. LCAO concept. Types of molecular orbitals- bonding, antibonding and non bonding. MOED of homonuclear diatomics - H_2, N_2, O_2 , O_2^-, O_2^{2-}, F_2 (unhybridized diagrams only) and heteronuclear diatomics CO, CN^- NO, NO^+ and HF. Bond order, stability and magnetic properties.

S1-G-2 Evaluation of analytical data 4 h

Significant figures, accuracy and precision. Errors-classification of errors- determinate and indeterminate errors, absolute and relative errors, propagation of errors in mathematical operations – addition, substraction, division and multiplication (with respect to determinate errors).

References:

Unit- I

1. Principles of Inorganic Chemistry by Puri, Sharma and Kalia Vishal Publications 1996.
2. Concise Inorganic Chemistry by J.D. Lee 3rd edn.
3. Basic Inorganic Chemistry by F.A.Cotton, G.Wilkinson and Paul.L. Gaus 3rd edn Wiley Publishers 2001. Chem.
4. Vogel's Qualitative Inorganic Analysis by Svehla
5. Inorganic Chemistry Principles of structure and reactivity by James E.Huhey, E.A. Keiter and R.L. Keiter 4th edn.
6. Chemistry of the elements by N.N.Greenwood and A. Earnshaw Pergamon Press 1989.
7. Inorganic Chemistry by Shriver and Atkins 3rd edn Oxford Press 1999.
8. Qualitative analysis by Welcher and Hahn.
9. Textbook of Inorganic Chemistry by R Gopalan
10. College Practical chemistry by V K Ahluwalia, Sunitha Dhingra and Adarsh Gulati

Unit- II

1. Text book of organic chemistry by Morrison and Boyd.
2. Text book of organic chemistry by Graham Solomons.
3. Text book of organic chemistry by Bruice Yuranis Powla.
4. Text book of organic chemistry by Soni.
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6. Text book of organic chemistry by C N pillai

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5. Physical Chemistry through problems by S.K. Dogra.
6. Text Book of Physical Chemistry by R.P. Verma.
7. Elements of Physical Chemistry by Lewis Glasstone.

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2. Concise Inorganic Chemistry by J.D. Lee 3rd edn.
3. Basic Inorganic Chemistry by F.A.Cotton, G.Wilkinson and Paul.L. Gaus 3rd edn Wiley Publishers 2001. Chem
4. Analytical chemistry by G. L. David Krupadanam, D. Vijaya Prasad, K. Varaprasada Rao, K.L.N. Reddy and C. Sudhakar

Laboratory Course **45h (3 h / week)**

Paper I Qualitative Analysis - I

I. Preparations:

1. Tetrammine copper (II) sulphate,
2. Potash alum $KAl(SO_4)_2.\ 12H_2O$,
3. Bis (dimethylglyoximato) nickel(II)

II. Analysis of two anions (one simple and one interfering)

Prof. Gade Dayakar
Chairman
Board of Studies in
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(09849777797)

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SEMESTER II
Paper II
Chemistry - II

Unit-I (Inorganic Chemistry) 15 h (1 hr/week)

S2-I-1 p-block Elements -II 7 h

Oxides: Types of oxides (a) Normal- acidic, basic amphoteric and neutral (b) Mixed (c) sub oxide d) peroxide e) superoxide. Structure of oxides of C, N, P, S and Cl - reactivity, thermal stability, hydrolysis.

Oxy acids: Structure and acidic nature of oxyacids of B, C, N, P, S and Cl. Redox properties of oxyacids of Nitrogen: HNO_2 (reaction with $FeSO_4$, $KMnO_4$, $K_2Cr_2O_7$), HNO_3 (reaction with H_2S, Cu), HNO_4 (reaction with KBr, Aniline), $H_2N_2O_2$ (reaction with $KMnO_4$). Redox properties of oxyacids of Potasium: H_3PO_2 (reaction with $HgCl_2$), H_3PO_3 (reaction with $AgNO_3$, $CuSO_4$).
Redox properties of oxyacids of Sulphur: H_2SO_3 (reaction with $KMnO_4$, $K_2Cr_2O_7$), H_2SO_4 (reaction with Zn, Fe, Cu), $H_2S_2O_3$ (reaction with Cu, Au), H_2SO_5 (reaction with KI, $FeSO_4$), $H_2S_2O_8$ (reaction with $FeSO_4$, KI)

Interhalogens - classification- general preparation- structures of AB,AB_3, AB_5 and AB_7 type and reactivity. Poly halides - definition and structure of ICl_2^-, ICl_4^- and I_3^-. Comparison of Pseudohalogens with halogens.

S2-I-2 Chemistry of Zero group elements 2 h

General preparation, structure, bonding and reactivity of Xenon compounds – Oxides, Halides and Oxy-halides. Clatherate compounds and Anomalous behavior of He (II)

S2-I-3 Chemistry of d-block elements 6 h

Characteristics of d-block elements with special reference to electronic configuration variable valence, ability to form complexes, magnetic properties & catalytic properties. Stability of various oxidation states and SRP Comparative treatment of second and third transition series with their 3d analogues. Study of Ti, Cr and Cu traids. Titanium triad – electronic configuration and reactivity of +3 and +4 states – oxides and halides. Chromium triad – reactivity of +3 and +6 states. Copper triad – reactivity of +1, +2 and +3 states.

Unit - II (Organic chemistry) 15 h (1 hr/week)

S2-O-1: Aromatic Hydrocarbons 7 h

Concept of aromaticity – definition, Huckel's rule – application to Benzenoids and Non – Benzenoids (cyclopropenyl cation, cyclopentadienyl anion and tropylium cation).

Preapartions: From acetylene, phenols, benzene carboxylic acids and sulphonic acids

Reactions - General mechanism of electrophilic substitution, mechanism of nitration, sulphonation, and halogenation, Friedel Craft's alkylation (polyalkylation) and acylation. Orientation of aromatic substitution - Definition of ortho, para, and meta directing groups. Ring activating and deactivating groups with examples. Orientation – (i)

activating groups: Amino, methoxy and alkyl groups. (ii) Deactivating groups - carboxy, nitro, nitrile, carbonyl and sulphonic acid & halo groups.

S2-O-2: Arenes and Polynuclear Aromatic Hydrocarbons 3 h

Preparation of alkyl benzenes by Friedel Craft's alkylation, Friedel Craft's acylation followed by reduction, Wurtz-Fittig reaction. Chemical reactivity: Ring substitution reactions,side chain substitution reactions and oxidation.

Polynuclear hydrocarbons – Structure of naphthalene and anthracene (Molecular Orbital diagram and resonance energy) Reactivity towards electrophilic substitution. Nitration and sulphonation as examples.

S2-O-3: Halogen compounds 5 hrs

Nomenclature and classification: alkyl (primary, secondary, tertiary), aryl, aralkyl, allyl, vinyl, benzyl. Chemical reactivity - reduction, formation of RMgX, Nucleophilic substitution reactions – classification into S_N^1 and S_N^2. Mechanism and energy profile diagrams of S_N^1 and S_N^2 reactions. Stereochemistry of S_N^2 (Walden Inversion) 2-bromobutane, S_N^1 (Racemisation) 1-bromo-1-phenylpropane explanation of both by taking the example of optically active alkyl halide. Structure and reactivity – Ease hydrolysis - comparison of alkyl, vinyl, allyl, aryl, and benzyl halides.

Unit – III (Physical Chemistry) 15 h (1 hr/week)

S2-P-1: Solutions 5 h

Liquid - liquid mixtures, ideal liquid mixtures**,** Raoult's and Henry's laws. Non ideal systems. Azeotropes HCl-H_2O and C_2H_5OH - H_2O systems. Fractional distillation,. Partially miscible liquids- Phenol – Water, Trimethyl amine – Water and Nicotine – Water systems. Lower upper consolute temperatures. Effect of impurity on consolute temperature. Immiscible liquids and steam distillation. Nernst distribution law. Calculation of the partition coefficient. Applications of distribution law with solvent extraction.

S2-P-2: Dilute Solutions & Colligative Properties 5 h

Dilute Solutions, Colligative Properties, Raoult's law, relative lowering of vapour pressure, molecular weight determination. Osmosis - laws of osmotic pressure, its measurement, determination of molecular weight from osmotic pressure. 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 for determining various colligative properties. Abnormal molar mass, Van't hoff factor, degree of dissociation and assocoation of solutes.

S2-P-3: Solid state Chemistry 5 h

Laws of Crystallography – (i) Law of Constancy of interfacial angles (ii) Law of Symmetry, Symmetry elements in crystals (iii) Law of rationality of indices. Definition of space lattice, unit cell. Bravais Lattices and Seven Crystal systems (a brief review). X-ray diffraction by crystals; Derivation of Bragg's equation, Determination of structure of NaCl, KCl & CsCl (Bragg's method and Powder method).

Unit – IV (General Chemistry) 15 h (1 hr/week)

S2-G-1: Theory of Quantitative Analysis 5 hours

Volumetric Analysis: Introduction, standard solutions, indicators, end point, titration curves, Types of titrations: i)neutralization titration- principle, theory of acid base indicators, titration curves and selection of indicators- strong acid - strong base, strong acid –weak base, weak acid- strong base and weak acid –weak base.

Gravimetric analysis- Introduction, nucleation, precipitation, growth of precipitate, filtration and washing, drying and incineration of precipitate, coprecipitation and post precipitation. Determination of Ni^{2+}

S3-G-2: Theories of bonding in metals: 5 h

Valence bond theory, Explanation of metallic properties and its limitations, Free electron theory, thermal and electrical conductivity of metals, limitations, Band theory, formation of bands, explanation of conductors, semiconductors n-type and p-type, extrinsic & intrinsic semiconductors, and insulators.

S2-G-3: Material Science 5 h

Classification of materials- classification as metals, ceramics, organic polymers, composites, biological materials etc. The property of super conductivity of materials.

Super conducting materials- elements, alloys and compounds. Properties of super conductors- zero resistivity, Meisener effect and thermal properties. Composites- meaning of composites, advanced composites, classification –particle rein forced fiber reinforced and structural composites general characters of composite materials-Particle-reinforced composites – large particle and dispersion- strengthened composite. Fiber reinforced composites (continuous and discontinuous fiber composites).

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Unit IV

1. Vogel's Text Book of Quantitative Analysis by G.H.Jeffery, J.Bassett, J.Mendham and R.C. Denney 5th edn Addison Wesley Longman Inc. 1999.
2. Quantitative Analysis by Day and Underwood Prentice Hall (India) VI Edn..
3. Nano: The Essentials by T. Pradeep, McGraw-Hill Education.
4. Chemistry of nanomaterials: Synthesis, Properties and applications by CNR Rao et.al.
5. Nanostructured Materials and Nanotechnology, edited by Hari Singh Nalwa, Academic Press
6. College Practical chemistry by V K Ahluwalia, Sunitha Dhingra and Adarsh Gulati

Laboratory Course **45hrs (3 h / week)**

Paper II - Qualitative Analysis - II

I Semi micro analysis of mixtures

Analysis of two anions and two cations in the given mixture.

Anions: CO_3^{2-}, SO_3^{2-}, $.S^{2-}$ Cl^-, Br^-, I^- CH_3COO^-, NO_3^- PO_4^{3-}, BO_3^{3-}, SO_4^{2-}

Cations: Ag^+, Pb^{2+}, Hg^+, Hg^{2+}
Pb^{2+}, Bi^{3+}, Cd^{2+}, Cu^{2+}, $As^{3+/5+}$, $Sb^{3+/5+}$, $Sn^{2+/4+}$
Al^{3+}, Cr^{3+}, Fe^{3+}
Zn^{2+}, Ni^{2+}, Co^{2+}, Mn^{2+}
Ca^{2+}, Sr^{2+}, Ba^{2+}
Mg^{2+}, NH_4^+

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Paper-III
Chemistry - III

Unit-I (Inorganic Chemistry) 15 h (1 hr/week)

S3-I-1: Chemistry of f-block elements: 6 h

Chemistry of Lanthanides**:** Position in periodic table, Electronic structure, oxidation state, ionic and atomic radii- lanthanide contraction- cause and consequences, anomalous behavior of post lanthanides-complexation- type of donor ligands preferred. Magnetic properties- paramagnetism. Colour and spectra, f-f transitions –occurrence and separation – ion exchange method, solvent extraction.

Chemistry of actinides- general features – electronic configuration, oxidation state, actinide contraction, colour and complex formation. Comparison with lanthanides.

S3-I-2: Symmetry of molecules 5 h

Symmetry operations and symmetry elements in molecules. Definition of Axis of symmetry types of C_n, Plane of symmetry (σh, σv, σd) Center of symmetry and improper rotational axis of symmetry (S_n). Explanation with examples.

S3-I-3: Non – aqueous solvents 4 h

Classification and characteristics of a solvent. Reactions in liquid ammonia – physical properties, auto-ionisation, examples of ammono acids and ammono bases. Reactions in liquid ammonia – precipitation, neutralization, solvolysis, solvation - solutions of metals in ammonia, complex formation, redox reactions. Reactions in HF – autoionisation, reactions in HF – precipitation, acid – base reactions, protonation.

Unit - II (Organic chemistry) 15 h (1 hr/week)

S3-O-1: Alcohols 6 hrs

Preaparation: 1°, 2° and 3° alchols using Griganard reagent, Ester hydrolysis, Reduction of Carbonyl compounds, carboxylic acids and esters. Physical properties: H-bonding, Boiling point and Solubility. Reactions with Sodium, $HX/ZnCl_2$ (Lucas reagent), esterification, oxidation with PCC, alk. $KMnO_4$, acidic dichromates, conc. HNO_3 and Oppenauer oxidation.

Diols: Pinacol - pinacolone rearrangement

Phenols: Preapartion: (i) from diazonium salts of anilines, (ii) from benzene sulphonic acids and (iii) Cumene hydroperoxide method.

Properties: Acidic nature, formation of phenoxide and reaction with R-X, electrophilic substitution nitration, halogenation and sulphonation. Riemer Tiemann reaction, Gattermann-Koch reaction, Azo-coupling reaction, Schotton-Boumann raction, Houben-Hoesch condensation, $FeCl_3$ reaction.

S3-O-2: Ethers and epoxides **2 hrs**

Nomenclature, preparation by (a) Williamson's synthesis (b) from alkenes by the action of conc. H_2SO_4. Physical properties – Absence of Hydrogen bonding, insoluble in water, low boiling point. Chemical properties – inert nature, action of conc. H_2SO_4 and HI.

S3-O-3 Carbonyl compounds **7 h**

Nomenclature of aliphatic and aromatic carbonyl compounds and isomerism.

Praparation of aldehydes & ketones from acid chloride, 1,3-dithianes, nitriles and from carboxylic acids. Special methods of preparing aromatic aldehydes and ketones by (a) Oxidation of arenes (b) Hydrolysis of benzal halides Physical properties – absence of Hydrogen bonding. Keto-enol tautomerism, polarisability of carbonyl groups, reactivity of the carbonyl groups in aldehydes and ketones. Chemical reactivity: Addition of [a] $NaHSO_3$ (b) HCN (c) RMgX (d) NH_3 (e) RNH_2 (f) NH_2OH(g) $PhNHNH_2$ (h) 2,4DNP (Schiff bases). Addition of H_2O to form hydrate (unstable), comparison with chloral hydrate (stable), addition of alcohols - hemi acetal and acetal formation. Base catalysed reactions with mechanism- Aldol, Cannizaro reaction, Perkin reaction, Benzoin condensation, haloform reaction, Knoevengeal condensation. Oxidation reactions – $KMnO_4$ oxidation and auto oxidation, reduction – catalytic hydrogenation, Clemmenson's reduction, Wolf- kishner reduction, Meerwein Pondoff Verly reduction, reduction with LAH, $NaBH_4$. Analysis – 2,4 –DNP test, Tollen's test, Fehlings test, Scihff's test, haloform test (with equations).

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UNIT – III (Physical Chemistry) **15 hr (1h / week)**

S3-P-1: Phase Rule **6 h**

Statement and meaning of the terms – Phase, Component and degrees of freedom, Gibb's Phase rule, phase equilibria of one component system – water system. Phase equilibria of two-component system – Solid-Liquid equilibria, simple eutectic – Pb-Ag system, desilverisation of lead. Solid solutions – compound with congruent melting point – Mg-Zn system and incongruent melting point – NaCl-H_2O system.

S3-P-2: Colloids & surface chemistry **9 h**

Definition of colloids. Classification of colloids. Solids in liquids (sols): preparations and properties – (including Kinetic, Optical and Electrical stability of colloids) Protective action. Hardy–Schultz law, Gold number. Liquids in liquids (emulsions): Types of emulsions, preparation and emusifier. Liquids in solids (gels); Classification, preparations and properties, General applications of colloids.

Micelles: Classification of surface active agents. Surfactant action, micellization and micellar interactions, Structure of micelles – spherical and laminar. Critical micellar concentration (CMC). Factors affecting the CMC of surfactants. Counter ion binding to micelles.

Adsorption: Types of adsorption, Factors influencing adsorption. Freundlich adsorption isotherm. Langmuir theory of unilayer adsorption isotherm. Applications**.**

Unit –IV (General Chemistry) 15 h (1h/week)

S3-G-1: ***Nanomaterials:*** 3h

Nano structured materials – Definition, size, description of graphene, fullerenes, carbon nano tubes. Synthetic techniques, bottom-up-sol-gel method, top-down, electro deposition method. Production of carbon nano tubes – arc discharge, laser vaporization methods. General applications of nano materials.

S3-G-2: Stereochemistry of carbon compounds 10 h

Isomerism: Definition of isomers. Classification of isomers: Constitutional and Stereoisomers - definition and examples. Constitutional isomers: chain, functional and positional isomers. Stereoisomers: enantiomers and diastereomers – definitions and examples.

Optical activity: Definition, wave nature of light, plane polarised light, optical rotation and specific rotation, chiral centers. Chiral molecules: definition and criteria - absence of plane, center and S_n axis of symmetry – asymmetric and dissymmetric molecules. Examples of asymmetric molecules (Glyceraldehyde, Lactic acid, Alanine) and disymmetric molecules (trans-1,2-dichlorocyclopropane). Molecules with constitutionally symmetrical chiral carbons (Tartaric acid) Molecules with constitutionally unsymmetrical chiral carbons (2,3-dibromopentane) Number of enantiomers and mesomers - calculation. D, L &, R, S configuration for asymmetric and disymmetric molecules (Allenes, spiro compounds and biphenyls), Cahn-Ingold-Prelog rules. Racemic mixture, Racemisation and Resolution techniques. Geometrical isomerism with reference to alkenes and cyclo alkanes– cis, trans and E, Z configuration.

S3-G-3: Conformational analysis 2 h

Classification of stereoisomers based on energy. Definition and examples of conformational and configurational isomers. Conformational analysis of ethane, n-butane, 1,2-dichloroethane,2-chloroethanol and methylcyclohexane

Referances:

Unit- I

1. Principles of Inorganic Chemistry by Puri, Sharma and Kalia Vishal Publications 1996.
2. Concise Inorganic Chemistry by J.D. Lee 3rd edn.
3. Basic Inorganic Chemistry by F.A.Cotton, G.Wilkinson and Paul.L. Gaus 3rd edn Wiley Publishers 2001.
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Laboratory Course

Paper III - Quantitative Analysis - I **45hrs (3 h / week)**

Acid - Base titrations

1. Estimation of Carbonate in Washing Soda.
2. Estimation of Bicarbonate in Baking Soda.
3. Estimation of Carbonate and Bicarbonate in the Mixture.
4. Estimation of Alkali content in Antacid using HCl.

Redox Titrations

1. Determination of Fe(II) using $K_2Cr_2O_7$
2. Determination of Fe(II) using $KMnO_4$ with sodium oxalate as primary standard.
3. Determination of Cu(II) using $Na_2S_2O_3$ with $K_2Cr_2O_7$ as primary standard

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Paper-IV
Chemistry - IV

Unit-I (Inorganic Chemistry) 15h (1 h/week)

S4-I-1: Coordination Compounds-I 7 h

Simple inorganic molecules and coordination complexes. Nomenclature – IUPAC rules, 1. Brief review of Werner's theory, Sidgwick's electronic interpretation and EAN rule and their limitations. (Valence bond theory (VBT) – postulates and application to (a) tetrahedral complexes $[Ni(NH_3)_4]^{2+}$, $[NiCl_4]^{2-}$ and $[Ni(CO)_4]$ **(**b) square planar complexes $[Ni(CN)_4]^{2-}$, $[Cu(NH_3)_4]^{2+}$, $[PtCl_4]^{2-}$ (c) octahedral complexes $[Fe(CN)_6]^{4-}$, $[Fe(CN)_6]^{-3}$, $[FeF_6]^{4-}$, $[Co(NH_3)_6]^{3+}$, $[CoF_6]^{3-}$. Limitations of VBT). 2. Coordination number, coordination geometries of metal ions, types of ligands. 3. Isomerism in coordination compounds, stereo isomerism – (a) geometrical isomerism in (i) square planar metal complexes of the type $[MA_2B_2]$, $[MA_2BC]$, $[M(AB)_2]$, [MABCD]. (ii) Octahedral metal complexes of the type $[MA_4B_2]$, $[M(AA)_2B_2]$, $[MA_3B_3]$ using suitable examples, (b) Optical isomerism in (i). tetrahedral complexes [MABCD], (ii). Octahedral complexes $[M(AA)_2B_2]$, $[M(AA)_3]$ using suitable examples. Structural isomerism: ionization, linkage, coordination ligand isomerism using suitable examples.

S4-I-2:Organometallic Chemistry 4 h

Definition, nomenclature and classification of organometallic compounds. Methods of preparation, properties and applications of alkyl and aryl compounds of Li, Mg & Al. Preparation and properties of ferrocene.

S4-I-3: Metal carbonyls and related compounds 4 h

18 valence electron rule, classification of metal carbonyls: $Ni(CO)_4$, $Fe(CO)_5$, $Fe_2(CO)_9$, $Fe_3(CO)_{12}$ and $Cr(CO)_6$, Preparation and properties of Ni(CO)4.

UNIT - II (Organic chemistry) 15 h (1 hr/week)

S4-O-1: Carboxylic acids and derivatives 6 h

Nomenclature, classification and methods of preparation a) Hydrolysis of Nitriles, amides and esters. b) Carbonation of Grignard reagents. Special methods of preparation of Aromatic Acids. Oxidation of the side chain of Arenes. Hydrolysis of benzotrichlorides. Kolbe reaction. Physical properties- hydrogen bonding, dimeric association, acidity – strength of acids with the examples of trimethyl acetic acid and trichloro acetic acid, Relative differences in the acidity of Aromatic, aliphatic acids & phenols. Chemical properties – Reactions involving H, OH and COOH groups -salt formation, anhydride formation, Acid halide formation, Esterification (mechanism) & Amide formation. Reduction of acid to the corresponding primary alcohol - via ester or acid chloride. Degradation of carboxylic acids by Huns Diecker reaction, Schmidt reaction (Decarboxylation). Arndt – Eistert synthesis, Halogenation by Hell – Volhard - Zelensky reaction. Carboxylic acid Derivatives – Reactions of acid halides, Acid anhydrides, acid amides and esters (mechanism of ester hydrolysis by base and acid).

S4-O-2: Synthesis based on Carbanions **3 h**

Acidity of α-Hydrogens of withdrawing groups, structure of carbanion. Preparation of Aceto acetic ester (ethylacetoester) by Claisen condensation and synthetic application of Aceto acetic ester. (a) Acid hydrolysis and ketonic hydrolysis: Butanone, 3-Methyl 2-butanone. Preparation of (i) monocarboxylic acids ii) dicarboxylic acids (b) malonic ester – synthetic applications. Preparation of (i) substituted mono carboxylic acids and (ii) substituted dicarboxylic acids.

S4-O-3 Nitro hydrocarbons: **6 h**

Nomenclature and classification of nitro hydrocarbons. Structure. Tautomerism of nitroalkanes leading to aci and keto form. Preparation of Nitroalkanes. Reactivity - halogenation, reaction with HNO_2 (Nitrous acid), Nef reaction, Mannich reaction, Michael addition and reduction. Aromatic Nitro hydrocarbons: Nomenclature, Preparation of Nitrobenzene by Nitration. Physical properties, chemical reactivity – orientation of electrophilic substitution on nitrobenzene. Reduction reaction of Nitrobenzenes in different media.

Unit – III (Physical Chemistry) **15 hr (1h / week)**

S4-P-1: Electrochemistry & EMF **15 h**

Electrical transport – conduction in metals and in electrolyte solutions, specific conductance and equivalent conductance, measurement of equivalent conductance, variation of specific and equivalent conductance with dilution. Migration of ions and Kholrausch's law, Arrhenius theory of electrolyte dissociation and its limitations, weak and strong electrolytes, Ostwald's dilution law, its uses and limitations. Debye-Huckel-Onsagar's equation for strong electrolytes (elementary treatment only). Transport number, definition and determination by Hittorf's method for attackable electrodes. Applications of conductivity measurements: Determination of degree of dissociation, determination of K_a of acids, determination of solubility product of a sparingly soluble salt, conductometric titrations.

Electrolyte and Galvanic cells – reversible and irreversible cells, conventional representation of electrochemical cells. EMF of a cell and its measurement. Computation of EMF. Types of reversible electrodes- the gas electrode, metal-metal ion, metal-insoluble salt and redox electrodes. Electrode reactions, Nernst equation, cell EMF and single electrode potential, standard Hydrogen electrode – reference electrodes (calamel electrode) – standard electrode potential, sign conventions, electrochemical series and its significance.

Applications of EMF measurements, Calculation of thermodynamic quantities of cell reactions (ΔG, ΔH and K). Determination of pH using hydrogen electrode, glass electrode and quinhydrone electrode, Solubility product of AgCl. Potentiometric titrations.

Unit –IV (General Chemistry) 15 h (1h/week)

S4-G-1: Pericyclic Reactions 5 h

Concerted reactions, Molecular orbitals of ethene, 1,3-butadiene and allyl radical. Symmetry properties, HOMO, LUMO, Thermal and photochemical pericyclic reactions. Types of pericyclic reactions – electrocyclic, cycloaddition and sigmatropic reactions – one example each and their explanation by FMO theory.

S4-G-2: Synthetic Strategies 5 h

Terminology – Target molecule (TM), Disconnection approach – Retrosynthesis, Synthon, Synthetic equivalent (SE), Functional group interconversion (FGI), Linear, Convergent synthesis. Retrosynthetic analysis of the following molecules: 1) acetophenone 2) cyclohexene and 3) phenylethylbromide.

S4-G-3: **Asymmetric synthesis 5 h**

Definition and classification of stereoslective reactions: substrate, product stereoselective reactions, enantio and diastereo selective reactions. Stereospecific reaction – definition – example – dehalogenation of 1,2-dibromides induced by iodide ion. Enantoselective reactions – definition – example –Reduction of Ethylacetoacetate by Yeast. Diastereoselective reaction-definition-example: Acid catalysed dehydration of 1-phenylproponal and Grignard addition to 2-phenyl propanal. Definition and explanation of enantiomeric excess and diastereomeric excess.

References:

Unit- I

1. Principles of Inorganic Chemistry by Puri, Sharma and Kalia Vishal Publications
2. 1996.
3. Concise Inorganic Chemistry by J.D. Lee 3rd edn.
4. Basic Inorganic Chemistry by F.A.Cotton, G.Wilkinson and Paul.L. Gaus 3rd edn Wiley Publishers 2001.
5. Inorganic Chemistry Principles of structure and reactivity by James E.Huhey, E.A. Keiter and R.L. Keiter 4th edn.
6. Chemistry of the elements by N.N.Greenwood and A. Earnshaw Pergamon Press 1989.
7. Inorganic Chemistry by Shriver and Atkins 3rd edn Oxford Press 1999.
8. Textbook of Inorganic Chemistry by R Gopalan

Unit- II

1. Text book of organic chemistry by Soni.
2. General Organic chemistry by Sachin Kumar Ghosh.
3. Text book of organic chemistry by Morrison and Boyd.
4. Text book of organic chemistry by Graham Solomons.
5. Text book of organic chemistry by Bruice Yuranis Powla.
6. Text book of organic chemistry by C N pillai

Unit III

1. Principles of physical chemistry by Prutton and Marron.
2. Text Book of Physical Chemistry by Soni and Dharmahara..
3. Text Book of Physical Chemistry by Puri and Sharma.
4. Text Book of Physical Chemistry by K. L. Kapoor.
5. Physical Chemistry through problems by S.K. Dogra.
6. Text Book of Physical Chemistry by R.P. Verma.
7. Elements of Physical Chemistry byLewis Glasstone.
8. Industrial Electrochemistry, D. Pletcher, Chapman & Hall

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1. Text book of organic chemistry by Morrison and Boyd
2. Text book of organic chemistry by Graham solomons
3. Fundamentals of organic synthesis and retrosynthetic analysis
4. by Ratna Kumar Kar
5. Organic synthesis by Dr. Jagadamba Singh and Dr. L.D.S. Yadav
6. Stereochemistry of organic compounds by D. Nasipuri
7. Organic chemistry by Clayden, Greeves, Warren and Wothers
8. Fundamentals of Asymmetric Synthesis by G. L. David Krupadanam

Laboratory Course

Paper IV - Quantitative Analysis - II **45hrs (3h/ week))**

1. Conductometry titrations:
   i) Strong acid Vs Strong base;
   ii) Weak acid Vs Strong base.
2. Potentiometry titration:
   i) Strong acid Vs Strong base;
   ii) Weak acid Vs Strong base.
3. Estimation of Nickel by back titration (Standard $MgSO_4$ solution will be given)
4. Estimation of Barium as Barium Sulphate

Prof. Gade Dayakar
Chairman
Board of Studies in
Chemistry (UG & PG)
(09849777797)

B.Sc III yr CHEMISTRY
SEMESTER WISE SYLLABUS
SEMESTER V
Paper-V
Chemistry - V

Unit-I (Inorganic Chemistry) 11 h

S5-I-1: Coordination compounds –II 9 h

Crystal field theory (CFT)- Postulates of CFT, splitting patterns of d-orbitals in octahedral, tetrahedral, square planer with suitable examples. Crystalfield stabilization energies and its calculations for various d^n configurations in octahedral complexes. High Spin Low Spin complexes.

Magnetic properties of transition metal complexes- para, dia, ferro , anti ferromagnetic properties, determination of magnetic susceptibility (Guoy method), spin only formula, calculations of magnetic moments.

Electronic spectra of metal complexes – colour of transtion metal aqua complexes– d-d transitions.Detection of complex formation - basic principles of various methods- change in chemical properties, solubility, colour, pH, conductivity, magnetic susceptibility.

Thermodynamic and kinetic stability of transition of metal complexes . Stability of metal complexes –stepwise and overall stability constant andf their relationship.Factors effecting the stability constants. Chelate effect, determination of composition of complex by Job's method and mole ratio method.

Applications of coordination compounds

Applications of coordination compounds a) in quantitative and qualitative analysis with suitable examples b) in medicine for removal of toxic metal ions and cancer therapy c) in industry as catalysts polymerization – Ziegler Natta catalyst d) water softening .

S5-I-2: Boranes and Carboranes: 2 h

Definition of clusters. Structures of boranes and carboranes- Wade's rules, closo, nido arachno Boranes and carboranes.

Unit-II (Organic Chemistry) 11 h

S5-O-1: Amines, Cyanides and Isocyanides 7 h

Amines:

Nomenclature, classification into 1^0, 2^0, 3^0 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. Use of amine salts as phase transfer catalysts. 4. Chemical Properties: a) Alkylation b) Acylation c) Carbylamine reaction d) Hinsberg separation. 5. Reaction with Nitrous acid of 1^0, 2^0, 3^0 (Aliphatic and aromatic amines). Electophilic substitutions of Aromatic amines – Bromination and Nitration, oxidation of aryl and 3^0 Amines, diazotisation. 6. Diazonium salts: Preparation with mechanism. Synthetic importance – a) Replacement of diazonium group by – OH, X (Cl)- Sandmeyer and Gatterman reaction, by fluorine (Schiemann's reaction), by iodine, CN, NO_2, H and aryl groups. Coupling Reaction of diazonium salts. i) with phenols ii) with anilines. Reduction to phenyl hydrazines.

Cyanides and isocyanides:

Nomenclature (aliphatic and aromatic) structure. Preparation of cyanides from a) Alkyl halides b) from amides c) from aldoximes. Preparation of isocyanides from Alkyl halides and Amines. 2. Properties of cyanides and isocyanides, a)hydrolysis b) addition of Grignard reagent iii) reduction iv) oxidation.

S5-O-2: Heterocyclic Compounds 4 h

Introduction and definition: Simple 5 membered ring compounds with one hetero atom Ex. Furan. Thiophene and pyrrole. Importance of ring systems – presence in important natural products like hemoglobin and chlorophyll. Numbering the ring systems as per Greek letter and Numbers. Aromatic character – 6- electron system (four-electrons from two double bonds and a pair of non-bonded electrons from the hetero atom). Tendency to undergo substitution reactions.

Resonance structures: Indicating electron surplus carbons and electron deficient hetero atom. Explanation of feebly acidic character of pyrrol, electrophillic substitution at 2 or 5 position, Halogenation, Nitration and Sulphonation under mild conditions. Reactivity of furan as 1,3-diene, Diels Alder reactions (one example). Sulphonation of thiophene purification of Benzene obtained from coal tar). Preparation of furan, Pyrrole and thiophene from 1,4,- dicarbonyl compounds only, Paul-Knorr synthesis, structure of pyridine, Basicity – Aromaticity – Comparison with pyrrole – one method of preparation and properties – Reactivity towards Nucleophilic substitution reaction – chichibabin reaction.

Unit-III(Physical Chemistry)

S5-P-1: Chemical Kinetics 11 h

Introduction to chemical kinetics, rate of reaction, variation of concentration with time, rate laws and rate constant. Specific reaction rate. Factors influencing reaction rates: effect of concentration of reactants, effect of temperature, effect of pressure, effect of reaction medium, effect of radiation, effect of catalyst with simple examples, order of reaction.

First order reaction, derivation of equation for rate constant. Characteristics of first order reaction. Units for rate constant. Half- life period, graph of 1^{st} order reaction, examples. Decomposition of H_2O_2 and decomposition of oxalic acid.

Pseudo first order reaction, Hydrolysis of methyl acetate, inversion of cane sugar, problems.

Second order reaction, derivation of expression for 2^{nd} order rate constant, examples- Saponification of ester, $2O_3$ ---→ $3O_2$, $C_2H_4 + H_2$ ------.> C_2H_6. characteristics of second order reaction, units for rate constants, half- life period and second order plots.

Zero order reaction: derivation of rate expression, examples i)combination of H_2 and Cl_2 to form HCl, ii) thermal decomposition of HI on gold surface characteristics of Zero order reaction units of k, half-life period and graph, problems.

Determination of order of reaction: i) method of integration, ii) half life method, iii) vant-Hoff differential method iv) Ostwald's isolation method. Problems

Kinetics of complex reactions (first order only): opposing reactions, parallel reactions, consecutive reactions and chain reactions. Problems.

Effect of temperature on reaction rate, Arrhenius equation. Temperature coefficient. Concept of energy of activation, determination of energy of activation from Arrhenius equation and by graphical method, problems. Simple collision theory based on hard sphere model explanation of frequency factor, orientation or steric factor. The transition state theory (elementary treatment).

Unit-IV (General Chemistry) 12 h

S5-G-2: Molecular spectroscopy 8 h

Introduction to electromagnetic radiation, interaction of electromagnetic rations with molecules, various types of molecular spectra.

Rotational spectroscopy (Microwave spectroscopy)

Rotational axis, moment of inertia, classification of molecules (based on moment of inertia), rotational energies, selection rules, determination of bond length of rigid diatomic molecules eg. HCl.

Infra red spectroscopy

Energy levels of simple harmonic oscillator, molecular vibration spectrum, selection rules. Determination of force constant. Qualitative relation of force constant to bond energies. Anharmonic motion of real molecules and energy levels. Modes of vibrations in polyatomic molecules. Characteristic absorption bands of various functional groups. Finger print nature of infrared spectrum.

Electronic spectroscopy:

Bonding and antibonding molecular orbitals, electronic energy levels of molecules (σ, π, n), types of electronic transitions: σ-σ^*, n-σ^*, n-π^*, π-π^* with suitable examples. Selection rules, Terminology of chromophore, auxochrome, bathochromic and hypsochromic shifts. Absorption of characteristics of chromophones: diene, enone and aromatic chromophores. Representation of UV-visible spectra.

S5-G-3: Photochemistry 4 h

Introduction to photochemical reactions, Difference between thermal and photochemical reactions, Laws of photo chemistry- Grotthus - Drapper law, Stark – Einsteins Law of photo chemical equivalence.Quantum yield. Examples of photo chemical reactions with different quantum yields. Photo chemical combinations of H_2 – Cl_2 and H_2 – Br_2

reactions, reasons for the high and low quantum yield. Problems based on quantum efficiency, Consequences of light absorptions. Singlet and triplet states. Jablonski diagram Explanation of internal conversion, inter- system crossing, Phosphorescence, fluorescence.

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1. Principles of Inorganic Chemistry by Puri, Sharma and Kalia Vishal Publications 1996.
2. Concise Inorganic Chemistry by J.D. Lee 3rd edn.
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7. Text Book of Physical Chemistry by R.P. Verma.
8. Elements of Physical Chemistry byLewis Glasstone.
9. Basics of Chemical Kinetics by G.L. Agarwal
10. Kinetics and mechanism of chemical transformations by Rajaram & Kuriacose

Unit IV

1. Bioinorganic Chemistry, M.N.Huges
2. Organic spectroscopy, William Kemp
3. Text Book of Physical Chemistry by Puri, Sharma and Pattania.
4. Photochemistry by Gurdeep Raj, Goel publishing house, 5th edition

Laboratory Course:

Paper V(Organic Chemistry) (CHE 551) 45 h (3h/w)

1. **Synthesis of Organic compounds:**

   Acetylation: Acetylation of salicylic acid, Benzoylation of Aniline.

   Aromatic electrophilic substitution: Nitration: Preparation of nitro benzene and m-dinitro benzene.

   Halogenation: Preparation of p-bromo acetanilide, Preparation of 2,4,6-tribromo phenol

   Oxidation: Preparation of benzoic acid from benzyl chloride.

   Esterification: Preparation of n-butyl acetate from acetic acid.

   Methylation: Preparation of β- naphthyl methyl ether.

   Condensation: Preparation of benzilidine aniline and Benzaldehyde and aniline.

   Diazotisation: Azocoupling of β-Naphthol.

2. **Thin layer Chromatography**
   Determination of Rf values and identification of organic compounds: preparation and separation of 2,4-dinitrophenyl hydrazones of acetione and 2-butanone using toluene and light petroleum(40:60)
   Separation of ortho & para nitro aniline mixtures

3. **Microwave assisted synthesis of organic compounds – DEMO (demonstration only)**

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SEMESTER V
Paper-VI
Chemistry - VI

Unit-I (Inorganic Chemistry) 11 h

S5-I-1:Inorganic reaction mechanisms 4h

Labile and inert complexes, Thermodynamic and kinetic stability based on VBT & CFT: ligand substitution reactions – S_N1 and S_N2 in Octahedral complexes; substitution reactions of square planar complexes – Trans effect and applications of trans effect.
Reactions of tetrahedral complexes - Hydrolysis of silicon halides and phosphorous oxides.

S5-I-2:Bioinorganic chemistry 5h

Essential elements, biological significance of Na, K, Mg, Ca, Fe, Co, Ni, Cu, Zn and chloride (Cl^-). Toxic metal ions As, Hg & Pb
Oxygen transport and storage – structure of hemoglobin, binding and transport of oxygen. Fixation of CO_2 in photosynthesis- overview of light and dark reactions in photosynthesis. Structure of chlorophyll and coordination of magnesium. Electron transport in light reactions from water to $NADP^+$ (Z – scheme).

S5-I-3:Hard and soft acids bases (HSAB) 2h

Classification, Pearson's concept of hardness and softness, application of HSAB principles – Stability of compounds / complexes, predicting the feasibility of reaction

UNIT - II (Organic Chemistry) 11 h

S5-O-1: Carbohydrates 6 h

Introduction: Classification and nomenclature – classification into mono, oligo and polysacchrides, into pentoses, hexoses *etc*., into aldoses and ketoses.
Monosaccharides: All discussion to be confined to (+) glucose as an example of aldo hexoses and (-) fructose as example of ketohexoses. Chemical properties and structural elucidation: Evidences for straight chain pentahydroxy aldehyde structure (Acetylation,

reduction to n- hexane, cyanohydrin formation, reduction of Tollen's and Fehling's reagents and oxidation to gluconic and saccharic acids). Number of optically active, isomers possible for the structure, configuration of glucose based on D-glyceraldehyde as primary standard (No proof for configuration is required). Evidence for cyclic structure of glucose (some negative aldehyde tests and mutarotation). Cyclic structure of glucose: Proposition of cyclic structure (Pyranose structure, anomeric Carbon and anomers). Proof for the ring size (methylation, hydrolysis and oxidation reactions). Different ways of writing pyranose structure (Haworth formula and chair conformational formula). Structure of fructose: Evidence of 2 – ketohexose structure (formation of penta acetate, formation of cyanohydrin its hydrolysis and reduction by HI to give 2-Carboxy-n-hexane) Same osazone formation from glucose and fructose, Hydrogen bonding in osazones, cyclic structure for fructose (Furanose structure, Haworth formula).
Inter Conversion of Monosaccharides: Aldopentose to aldo hexose – eg: Arabinose to D-glucose, D- mannose (kiliani – Fischer method). Epimers, Epimerisation- Lobry de bruyn van Ekenstein rearrangement. Aldohexose – Aldopentose eg: D-glucose to D-arabinose by Ruff's degradation. Aldohexose(+) (glucose) to ketohexose
(–)(fructose) and Ketohexose(Fructose) to aldohexose (Glucose).

S5-O-2 Amino acids and proteins 5 h

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 Leucene) by following methods: a) From halogenated Carboxylic acid b)Malonic ester synthesis c) strecker's synthesis.Physical properties: Optical activity of naturally occurring amino acids: L – configuration, irrespective of sign of rotation. 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, peptide synthesis

Unit-III (Physical Chemistry) 11 h

S5-P-1:Thermodynamics -I 11h

A brief review of - Energy, work and heat units, mechanical equivalent of heat, definition of system, surroundings. I law of thermodynamics statement- various forms mathematical expression. Thermodynamic quantities- extensive properties and intensive properties, state function, path functions energy as a state function, and exact differential. Work of expansion and heat absorbed as path function.
Expression for work of expansion, sign convention problems on I law. Heat changes at constant pressure and heat changes at constant volume. Enthalpy. Heat capacities at constant pressure and constant volume. Derivation Cp-Cv = R.
Isothermal adiabatic processes. Reversible and irreversible processes. Reversible change and maximum work. Derivation of expression for maximum work for isothermal reversible process. Problems. Internal energy of an ideal gas. Joules experiment and

Joule-Thompson coefficient. Adiabatic changes in ideal gas derivation of equation, PV^{γ} = constant. P-V curves for isothermal and adiabatic processes.
Heat of a reaction at constant volume and at constant pressure, relation between ΔH and ΔV. Variation of heat of reaction with temperature. Kirchoff's equation and problems. Limitations of I law and need for II law. Statement of II law of thermodynamics. Cyclic process. Heat engine, Carnot's theorem, Carnot's cycle. Derivation of efficiency of heat engine problems. Thermodynamic scale of temperature.

Unit-IV **12 h**

S5-G-1: Proton Magnetic Resonance Spectroscopy **4h**

Principles of nuclear magnetic resonance, equivalent and non-equivalent protons, position of signals. Chemical shift, NMR splitting of signals – spin-spin coupling, representation of proton NMR spectrum – Integrations. ^{1}H NMR spectrum of – ethyl bromide, acetaldehyde, 1,1,2-tribromo ethane, ethyl acetate and acetophenone.

S5-G-2: Mass Spectrometry **4 h**

Electron Impact Mass: Basic principles, Nitrogen rule, types of ions: Molecular ion, fragment ion and isotopic ions, representation of mass spectrum, types of peaks (molecular ion, fragment and isotopic ion peaks). Determination of molecular weight Mass spectrum of ethyl chloride, ethyl bromide and acetophenone.

S5-G-3: Thermodynamics- II **4 hrs**

Entropy: Definition from Carnot's cycle. Entropy as a state function. Entropy as a measure of disorder. Sign of entropy change for spontaneous and non- spontaneous processes& equilibrium processes. Entropy changes in i). Reversible isothermal process, ii). reversible adiabatic process, iii). phase change, iv). reversible change of state of an ideal gas. Problems. Entropy of mixing inert perfect gases. Free energy Gibb's function (G) and Helmholtz's function (A) as thermodynamic quantities. Concept of maximum work and net work ΔG as criteria for spontaneity. Derivation of equation $\Delta G = \Delta H - T\Delta S$. significance of the equation. Gibbs equations and the Maxwell relations. Variation of G with P, V and T.

References :

Unit- I

1. Basic Inorganic Chemistry by F.A.Cotton, G.Wilkinson and Paul.L. Gaus 3rd edn Wiley Publishers 2001.
2. Inorganic Chemistry Principles of structure and reactivity by James E.Huhey, E.A. Keiter and R.L. Keiter 4th edn.
3. Reaction mechanisms, K.Veera Reddy.

Unit- II

1. Text book of organic chemistry by Soni.
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8. Elements of Physical Chemistry byLewis Glasstone.
9. Thermodynamics by Rajaram

Unit IV

1. Basic Inorganic Chemistry by F.A.Cotton, G.Wilkinson and Paul.L. Gaus 3rd edn Wiley Publishers 2001.
2. Organic Spectroscopy, William Kemp
3. Principles of physical chemistry by Prutton and Marron.
4. Text Book of Physical Chemistry by Soni and Dharmahara..
5. Text Book of Physical Chemistry by Puri, Sharma and Pattania.
6. Thermodynamics by Rajaram

Paper VI (Physical Chemistry) (CHE 552) **45hrs (3 h / w)**

1. **Distribution law**
   i. Determination of distribution coefficient of iodine between water and carbon Tetrachloride/determination of molecular status and partition coefficient of benzoic acid in Toluene and water.
   ii. Determination of distribution coefficient of acetic acid between n-butanol and water.

2. Electrochemistry

i. Determination of cell constant of conductivity cell.
ii. Determination of dissociation constant (K_a) of acetic acid by conductivity measurements.
iii. Determination of solubility and solubility product of $BaSO_4$

2. Colorimetry

i. Verification of Beer's - Lamberts law for KMnO4 and determine the concentration of given solution.

4. Adsorption

i. Adsorption of acetic acid on animal charcoal, verification of Freundlich isotherm.

5. Physical constants

i. Surface tension and viscosity of liquids

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