TELANGANA UNIVERSITY

Telangana State Council of Higher Education
Govt.of Telangana

PROPOSED SYLLABUS

For

B.Sc. Chemistry (2016-17)

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. Structure of boron nitride. 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 reaction of anions- CO_3^{2-}, Cl^-, Br^-, CH_3COO^-, NO_3^-, SO_4^{2-}, PO_4^{3-}, BO_3^{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. 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 (mechanism not required)

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, 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 Diel's – Alder reaction.

Alkynes – Preparation by dehydrohalogenation of vicinal dihalides, dehalogenation of tetrahalides. Physical Properties: Acidity of terminal alkynes hydrogen (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 methods, heating dicarboxylic metal salts. Properties – reactivity of cyclo propane and cyclo butane by comparing with alkanes. Stability of cycloalkanes – Bayer's strain theory, sachse and Mohr predictions and Pitzer strain theory. Conformational structures of cyclobutane, cyclopentane, cyclohexane.

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

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

Failures of classical mechanics, black body radiation, heat capacities of solids, Rayleigh Jeans law, Planck's radiation law, photoelectric effect, 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, 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. SThe law of corresponding states, reduced equation of states. Joule Thomson effect and inversion temperature of a gas. Liquefaction 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, stereochemistry of inorganic molecules - 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. Electron distribution diagram for H_2, MOED of homonuclear diatomic molecules - H_2, N_2, O_2 , O_2^-, O_2^{2-}, F_2 (unhybridized diagrams only) and heternuclear diatomic molecules CO, CN^- NO, NO^+ and HF. Bond order 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, subtraction, 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.
5. General Organic chemistry by Sachin Kumar Ghosh.
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 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. Semimicro analysis of mixtures – Analysis of two cations in the given mixtures

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^+

B.Sc I yr CHEMISTRY
SEMESTER WISE SYLLABUS
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 N: 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 P: H_3PO_2 (reaction with $HgCl_2$), H_3PO_3 (reaction with $AgNO_3$, $CuSO_4$).
Redox properties of oxyacids of S: 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. Basic iodine- basic nature and evidence of +I and +III. 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 preapartion, 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, magnetic properties, catalytic properties and ability to form complexes. Stability of various oxidation states and e.m.f. 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 Benzenoid (Benzene, Napthalene, Anthracene and Phenanthrene) and Non – Benzenoid compounds (cyclopropenyl cation, cyclopentadienyl anion and tropylium cation).

Preapartions: From acetylene, phenols, benzene carboxylic acids – 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) activation groups: Amino, methoxy and methyl groups. (ii) Deactivating groups - carboxy, nitro, nitrile, carbonyl and sulphonic acid groups. Halogens (Explanation by taking minimum of one example from each type).

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 reaction – classification into SN^1 and SN^2. Mechanism and energy profile diagrams of SN^1 and SN^2 reactions. Stereochemistry of SN^2 (Walden Inversion), SN^1 (Racemisation) explanation of both by taking the example of optically active alkyl halide-2-bromo butane. Structure and reactivity – Base 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, Lever rule. 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-3: Solid state Chemistry 10 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). Band theory of Semi-conductors: Extrinsic and intrinsic semiconductors, n-type and p-type and their applications in photo-electro chemical cells.

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

S2-G-1: Theory of Quantitative Analysis 6 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+}

S2-G-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-G-3: ***Nanomaterials****:* 4h

Nano structured materials – Definition, description of graphite, fullerenes, carbon nano tubes. Synthetic techniques, bottom-up-sol-gel method, top-down, electro deposition method. Production of carbon nano tubes – arc discharge, pyrolysis, laser vaporization and electrolysis methods. Mechanical and electronic properties of carbon nano tubes (CNT). Properties and applications of nano-materials. Nano material advantage, importance in technological applications. Basics of advanced organic materials and their applications such as in LEDs, OLEDs, etc.

References

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6. Elements of Physical Chemistry by Lewis and Glasstone.
7. Material science by Kakani & Kakani

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^+

B.Sc II yr CHEMISTRY
SEMESTER WISE SYLLABUS
SEMESTER III
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**:** Electronic structure, position in periodic table, oxidation state, ionic and atomic radii- lanthanide contraction- cause and consequences, anomalous behavior of post lanthanides- basicity, 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: Theories of bonding in metals: 6 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 and insulators.

S3-I-3: Non – aqueous solvents 3 h
Classification and characteristics of a solvent. Reactions in liquid ammonia – physical properties, auto-ionisation, examples of ammono acids and ammono bases. Reactions taking place in liquid ammonia – precipitation, neutralization, solvolysis, solvation - solutions of metals in ammonia, complex formation, redox reactions. Reactions in HF – autoionisation, reactions taking place 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).

Introduction to α,β-unsaturated carbonyl compounds. Preparation: by dehydration of aldol. Reactivity: Michael addition.

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**

Colloids: Definition of colloids. Classification of colloids. Solids in liquids (sols): preparations and properties. 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, inbibition, 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: Symmetry of molecules 3 h

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

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, positional isomers and metamerism. Stereoisomers: enantiomers and diastereomers – definitions and examples.

Optical activity: Chiral centers: definition, wave nature of light, plane polarised light, optical rotation and specific rotation. 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 cyclohexane

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.
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5. Colloidal and surface chemistry , M. Satake, Y. Hayashi, Y.Mido, S.A.Iqbal and M.S.sethi
6. Material science by Kakani & Kakani

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Laboratory Course

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

Acid - Base titrations

1. Determination of Carbonate
2. Estimation of Carbonate in Washing Soda.
3. Estimation of Bicarbonate in Baking Soda.
4. Estimation of Carbonate and Bicarbonate in the Mixture.
5. 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

B.Sc II yr CHEMISTRY
SEMESTER WISE SYLLABUS
SEMESTER IV
Paper-IV
Chemistry - IV

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

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

Nomenclature – IUPAC rules, simple inorganic molecules and coordination complexes. 1. Brief review of Werner's theory, Sidgwick's electronic interpretation and EAN rule and defects of both. 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. Bonding in coordination compounds: 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 $[Cr(NH_3)_6]^{3+}$, $[Fe(CN)_6]^{4-}$, $[FeF_6]^{4-}$, $[Co(NH_3)_6]^{3+}$, $[CoF_6]^{3-}$. Limitations of VBT.

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 & Cd. Preparation and properties of ferrocene.

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

EAN rule, classification of metal carbonyls, structure and bonding in metal carbonyls of V, Cr, Mo,W, Mn, Fe, Co and Ni. Preparation and properties of $Ni(CO)_4$. Structure and bonding in Metal nitrosyls.

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 and aliphatic acids. 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 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 HONO (Nitrous acid), Nef reaction, Mannich reaction, Michael addition and reduction. Aromatic Nitro hydrocarbons: Nomenclature, Preparation of Nitrobenzene by Nitration, from diazonium salts. 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 – 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 quinhydrone electrode, Solubility product of AgCl. Potentiometric titrations.
Batteries: Primary and secondary batteries, battery components and their role, Characteristics of Battery. Working of following batteries: Pb acid, Li-Battery, Solid state electrolyte battery. Fuel Cells, Solar cell and polymer cell. Corrosion: cause, factors affecting corrosion and prevention of corrosion.

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 α-chiral carbonyl compound (Cram's Rule). 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

Unit IV

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))

Precipitation titration

1. Estimation of Zinc ion by Ferrocyanide.

Complexometry

1. Estimation of Copper by direct titration.
2. Estimation of Nickel by direct titration.
3. Estimation of Nickel by back titration (Standard $MgSO_4$ solution will be given)
4. Estimation of Calcium by substitution titration (Standard $MgSO_4$ solution will be given)
5. Estimation of Lead and Calcium in the mixture.(only estimation)
6. Estimation of Magnesium ion in Talcum powder.
7. Estimation of hardness of Water

Gravimetry:

1. Estimation of Barium as Barium Sulphate
2. Estimation of Nickel as Nickel dimethylglyoxinate

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

Unit –I (Inorganic Chemistry) **11 h**

S5-V-I-1: Coordination compounds - II

S5-V-I-2: Boranes and Carboranes

Unit – II (Organic Chemistry **11 h**

S5-V-O-1: Nitrogen compounds-Amines

S5-V-O-2: Cyanides and Isocyanides

Unit – III (Physical Chemistry) 11 h

S5-V-P-1: Chemical kinetics

Unit – IV (General Chemistry) 12 h

S5-V-G-1: Applications of Coordination compounds

S5-V-G-2: Molecular spectroscopy – IR and Raman

S5-V-G-3: Photo Chemistry

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

Unit –I (Inorganic Chemistry) **11 h**

S5-VI-I-1: Inorganic Reaction Mechanism

S5-VI-I-2: Bio-Inorganic Chemistry

Unit – II (Organic Chemistry) **11 h**

S5-VI-O-1: Heterocycles and Biomolecules (Carbohydrates, Amino acids and Protiens)

Unit – III (Physical Chemistry) 11 h

S5-VI-P-1: Thermodynamics - I

Unit – IV (General Chemistry) 12 h

S5-VI-G-1: Hard and Soft Acids and Bases

S5-VI-G-2: ^{1}H-NMR and Mass spectrometry

S5-V-G-3: Thermodynamics - II