B. Sc. Semester –III

Chemistry (Major-I) Organic Chemistry

BS23MJ3CH1

Learning Objectives: This core course aims to introduce the learner to the fascinating chemistry of some biomolecules,i.e., carbohydrates, amino acids, peptides, proteins. It aims to build the concept of amines, diazonium salts andheterocycles by the study of their physical properties, synthesis routes and chemical reactions. The course will delve into various aspects of alkenes and alkynes chemistry with specific emphasis on mechanistic studies.

Learning Outcomes: On completion of this course, the students will be able to: • demonstrate understanding regarding classification, occurrence and synthesis of biomolecules such as carbohydrates, proteins, peptides and amino acids. • Gain insight into chemistry of amines, diazo compounds regarding their synthesis and physic-chemical properties. • Demonstrate understanding of various aspects regarding chemical reactions such as mechanistic studies, synthesis and reactivity of heterocyclic, alkenes and alkynes.

UNIT-1 [A] Carbohydrates

Carbohydrates Occurrence, classification and their biological importance. Monosaccharides: Constitution and absolute configuration of glucose and fructose, epimers and anomers, mutarotation, determination of ring size of glucose and fructose, Haworth projection and conformational structures; Interconversion of aldoses and ketoses; Killiani-Fischer synthesis and Ruff degradation.

[B]Amino acids, Peptides and their classification.

α-Amino Acids – Synthesis(Strecker's and Gabriel's Pthalimide), ionic properties and reactions. Zwitterions, pKa values, isoelectric point and electrophoresis; Study of peptides: determination of their primary structure-end group analysis. Synthesis of peptides using N-protecting, C-protecting and C-activating groups, Solid-phase synthesis; primary, secondary and tertiary structures of proteins, Denaturation of proteins.

UNIT 2[A] Amines

Introduction, classification, chirality in amines (pyramidal inversion), importance and general methods of preparation. Properties: Physical properties, Basicity of amines: Effect of substituents, solvent and steric effects. Distinction between Primary, secondary and tertiary

amines using Hinsberg's method and nitrous acid. Discussion of the following reactions with emphasis on the mechanistic pathway: Gabriel Phthalimide synthesis, Hoffmann- Bromamide reaction, Carbylamine reaction, Mannich reaction, Hoffmann's exhaustive methylation, Hofmann-elimination reaction and Cope elimination.

[B] Diazonium Salts: Preparation and synthetic applications of diazonium salts including preparation of arenes, haloarenes, phenols, cyano and nitro compounds. Coupling reactions of diazonium salts (preparation of azo dyes)..

UNIT - 3 Heterocyclic Compounds

Introduction, importance, classification and nomenclature of heterocyclic compounds (containing only one hetero atom). General discussion on the following aspects of heterocyclic compounds: Structure, Aromaticity in 5-membered and 6-membered rings containing one heteroatom; Basicity and relative reactivity towards electrophilic substitution reactions(amongst five membered and six membered rings i.e. pyrrole, thiophene, furan, pyridine)

General methods of synthesis for: Furan, Pyrrole (Paal-Knorr synthesis, Knorr pyrrole synthesis, Hantzsch synthesis), Thiophene, Pyridine (Hantzsch synthesis),Properties: Physical properties, discussion on the following reaction (with mechanism) for Furan, Pyrrole, thiophene, Pyridine : Electrophilic substitution- Nitration, sulphonation, halogenation, Formylation, acylation, mercuration and carboxylation. Oxidation,Reduction, Addition, Reactions showing acidic /basic character,Nucleophilic substitution reaction.

Unit 4[A] Alkenes

Addition to C=C: Mechanism, reactivity, regioselectivity (Markownikoffs and Anti-Markownikoffs additions) and stereoselectivity. Reaction: Hydrogenations, Hydrohalogenation, Hydration, Oxymercuration-demercuration, Hydroboration-Oxidation , ozonolysis, electrophilic addition to diene (conjugated dienes and allene), reaction with NBS, Birch reduction of Benzenoid aromatics, inter-conversion of E- and Z- alkenes.

[B] Alkynes

Addition to C≡C (in comparison to C=C): Mechanism, reactivity ,regioselectivity (Markownikoffs and AntiMarkownikoffs additions) and stereo selectivity. Reaction: Hydrogenations, Hydro halogenations, Hydration, Oxymercuration-demercuration, Hydroboration-Oxidation, ozonolysis, Birch reduction of alkynes, reactions of terminal alkynes by exploring its acidity.

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B. Sc. Semester –III

Chemistry (Major-II) Physical Chemistry

BS23MJ3CH1

Learning Objectives: The aim of this course is to make students understand third law of thermodynamics and concept of absolute entropy, terms encountered in thermochemistry. The students will be exposed to important concepts such as solutions, colligative properties, adsorption and fundamentals of electrochemistry.

Learning Outcomes: By the end of the course, students will be able to Understand the third law of thermodynamics and its applications. Derive various expressions of thermochemistry.Explain the various conceptsregardingsolutions and colligative properties and adsorption.Explain the basic terms of electrochemistry.

UNIT-1 Third law of Thermodynamics and Thermochemistry

Statement of third law, unattainability of absolute zero, calculation of absolute entropy ofmolecules, concept of residual entropy, calculation of absolute entropy of solid, liquid and gases.

Enthalpy of reactions, standard states, enthalpy of neutralization, enthalpyof hydration, enthalpy of formation and enthalpy of combustion and its applications, bond dissociationenergy and bond enthalpy, Hess's law of constant heat summation and its application, bond energies, applications of bond energies.

UNIT-2 Solutions and Colligative properties

Dilute solutions; lowering of vapour pressure, Raoult'slaw, Henry's law. Thermodynamic basis of the colligative properties - lowering of vapour pressure, elevation ofBoiling Point, Depression of Freezing point and Osmotic pressure and derivation of expressions for theseusing chemical potential. Application of colligative properties in calculating molar masses of normal,dissociated and associated solutes in solutions. Concept of activity and activity coefficients.

UNIT-3 Adsorption

Definition of terms, Types of adsorption, Applications of adsorption, Factors affecting adsorption, Adsorption isobar and isostere, Desorption activation energy, Derivation of Freundlich adsorption isotherm, Derivation of Langmuir adsorption isotherm, Types of adsorption isotherms

UNIT– 4 Introduction of Electrochemistry

Electrodes, cell emf, emf and free energy, Standard electrode potentials, Nernst equation, emf and activities, activity coefficients from emf's, equilibrium constant from emf's, electrode concentration cells, electrolyte concentration cells, thermodynamic properties from cell emf's.

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BS23MJ3CH3
B. Sc. Semester –III
Chemistry (Major-III)
[Organic & Physical Practical]

Learning Objectives: To introduce fundamentals of organic spotting and estimation of organic compounds. To familiarize students with the concept of hydrolysis, conductometric titrations, adsorption, refraction and viscocity through practical methods.

Learning outcomes: After completion of course the students will be able to explain and perform organic spotting and estimation. The students will be able to perform experiment regarding measurements of temperature coefficient, strength of acids and conductometric titrations.

A. Organic Spotting and Estimation:

Organic spotting minimum eight compounds (5 solids and 3 liquids)
Acids: Salicylic acid, Cinnamic acid, Phthalic acid, Anthranilic acid
Phenols: p-Nitro phenol, α-Naphthol ,β-Naphthol
Bases: p-Toludine, Diphenyl amine , α-Nephthyl amine
Neutral: Solids:-Acetanilide ,m-Dinitrobenzene, Glucose, Bazamide
Liquids: Acetophenone, Carbon tetrachloride (CCl_4), Methyl acetate, Ethyl acetate

Estimations:(1)Glucose
(2) Ketone
(3) Phenol/Aniline

B. Physical Experiment

1. To determine the relative strength between HCl and H_2SO_4 by studying hydrolysis of methyl acetate.

2. To determine the temperature coefficient and energy of activation of hydrolysis of methyl acetate catalyzed by acid.

3. To study the adsorption of an organic acid by Animal Charcoal.(Acetic acid/Oxalic acid).

4. Conductometric titration.
(i) Strong acid vs Strong base (HCl vs NaOH)
(ii) Weak acid vs Strong base (CH_3COOH vs NaOH)
(iii) Mixture of acids vs Strong base (HCl+CH_3COOH vs NaOH)

5. To determine specific refraction and molar refraction of liquid A,B and their mixture(OnlyDemo)

6. To determine absolute viscosities of liquid A, B and their mixture (Only Demo)

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Shri Govind Guru University, Vinzol
B. Sc. Semester –III
BSC23VA301(IKS)

ANCIENT INDIAN SCIENCE, ENGINEERING AND TECHNOLOGY

Learning objectives: To review & strengthen the ancient discovery and research in physics, chemistry, maths, metallurgy, astronomy, architecture, textile, transport, agriculture and Ayurveda etc. To help students to trace, identify and develop the ancient knowledge systems to make meaningful contribution to development of science today.

Learning outcomes: After the completion of the course students will be able to trace historical development of science and technology in Indian subcontinent. This course will enhance students' understanding regarding the research of ancient Indian scientists and will help them to appreciate Indian culture of science and further build upon their research work.

UNIT - 1: Indian Traditional Science and Practices

Introduction to the Science and way of doing science and research in India, Ancient Science in Intra & Inter Culture Dialogue & coevolution. Traditional water-harvesting practices, Traditional Livestock and veterinary Sciences Traditional Houses & villages, Traditional Forecasting, Traditional Ayurveda & plant based medicine, Traditional writing Technology.

Physics in India:Vaisheshikadarshan, Atomic theory & law of motion, theory of panchmahabhoota, BrihathShathaka (divisions of the time, unit of distance), bhaskarachaya (theory of gravity, suryasiddhanta&sidhantashriomani), Lilavati (gurutvakashan Shakti).

Chemistry in India:Vatsyayana, Nagarjuna,Khanda, Al-Biruni, Vagbhaṭa –building of the ras-shala (laboratory), working arrangements of ras-shala, material and equipment, YaśodharaBhaṭṭa-process of distillation, apparatus, saranasamskara, saranataila.

Mathematics in India:Baudhayana'sSulbasutras, Aryabhaṭa, Bhaskaracharya-I, Severus Sebokht, Syria, Brahmagupta, Bhaskaracharya-II, Jyeṣṭhadeva.

UNIT - 2: Ancient Indian Science (Textile, Agriculture, Transport)

Textile Technology in India: Cotton (natural cellulose fiber), silk, wool (natural protein fibers), bast and leaf fibers, mridhudhautadhupitambaram (meaning a practice of fumigating the fabric with incence smoke before use as a part of the finishing process), sitadhautavasanayugala (bleached white–a finishing process); suchhastah, sutradharah (needle and thread – tools for stiching). Dyeing, washing spinning and weaving technology,

Agriculture in India:Traditional agricultural practices, krishisuktas, Krishiparashara, Brihatsamhita, Types of crops, Manures, Types of land- devamatruka, nadimatruka, use of animals in warfare, animal husbandry, Animals for medicines. Ancient transport in India.

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B. Sc. Semester –IV

Chemistry (Major-I) Inorganic Chemistry

BS23MJ4CH1

Learning Objectives : The course introduces the students to transition elements, their properties and applications. The course also delves on topics such as coordination compounds and their structural and spectral aspects. In addition to that the course introduces students to the concepts of chemical bonding and non-aqueous solvents.

Learning Outcomes: By the end of the course, the students will beable to:Understand the trends, properties and application of transition elements. Discuss the various theories for structure of coordination compounds, their properties and energies.Explain the theories of chemical bonding and structures of molecules on the basis of them. Understand the concept of non-aqueous solvents and their variety of applications in chemical reactions.

UNIT-1Transition Elements

General group trends with special reference to electronic configuration, colour,variable valency, magnetic properties (no temperature dependence), catalytic properties, and ability to form complexes. Latimer diagrams of Mn, Fe and Cu in acidic and basic media.

A brief discussion of differences between the first, second and third transition series. Some important compounds of Cr, Mn, Fe and Co and their roles as laboratory reagents; Potassium dichromate, potassium permanganate, potassium ferrocyanide, potassium ferricyanide, sodium nitroprusside and sodium cobaltinitrite.

UNIT-2 Co-ordination Compounds

Application of valence bond theory to some complexes; Shortcoming of valance bond theory; Crystal Field Theory; Orientation of d-orbitals and Crystal Field Splitting of Energy levels; Crystal Field Splitting in Octahedral complexes; Crystal Field Stabilization Energy (CFSE); Crystal Field Splitting in Tetrahedral Complexes; Crystal Field Splitting in Tetragonal and square Planar Complexes; Magnetic Properties of Metal Complexes and Crystal Field Theory; Factors influences the magnitude of Crystal Field Splitting; Color of Transition Metal Complexes; Crystal Field Effects on Ionic Radii; Crystal Field Effects on Lattice Energies; Jahn- Teller Effect.

UNIT- 3 Chemical Bonding

Molecular orbital Theory; Energy Level Diagram for Molecular Orbital's; Mixing of Orbital's; Filling up of Molecular Orbital's; Electronic Configuration of Hetero nuclear Diatomic molecules and ion (CN^-, HF, HCl, ClF), Molecular orbital's of Polyatomic Species (BeH_2, BH_3,NH_3)(Excluding Walsh diagram); M.O. Theory of $[Co\ (NH_3)_6]^{3+}$ and $[CoF_6]^{3-}$; Molecular orbital or Band Theory for metals.

UNIT- 4 Non Aqueous Solvents Marks

Introduction; Classification of Solvents; General Properties of Ionising Solvents

(a) Liquid Ammonia (NH3): Physical Properties, Auto-ionization , Acid-Base reactions, Reduction –Oxidation (Redox) reactions; Advantages and disadvantages of using liquid Ammonia as a solvent.

(b) Liquid SO_2 : Physical Properties, solubility of Inorganic materials and Organic Compounds, Electrolytic conductance behavior of solutions, Acid-Base reactions, Solvolysis, Reduction –Oxidation (Redox) reactions

(c) Liquid HF: Physical Properties, Solvent effect, Amphoteric behavior, Precipitation reactions, Reduction –Oxidation (Redox) reactions, Solutions of Compounds of Biological Interest.

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B.Sc.Semester IV

Chemistry (Major 2)AnalyticalChemistry

BS23MJ4CH2

Learning Objectives: To acquire basic knowledge of the analytical chemistry of important techniques that will provide the basis for their industrial production methods. To provide an adequate mastery of analytical methods used for the determination of commercial/domestic raw materials and finished product quality.

Learning outcomes: By the end of this course, students will be able to: • Become familiar with fundamental concepts of quantitative and qualitative analysis. • Develop the core skills to comprehend and perform acid-base, redox and Complexometric titrations and gravimetric and volumetric analysis.

UNIT-1 [A] Basic concept of Qualitative and Quantitative Analysis

Introduction, solubility product principle, common ion effect, separation of Cations ofeach groups and separation of anion (acid radicals), Introduction ofvolumetric titrationbased on normality of the solution, condition forVolumetricanalysis and types oftitrimetricanalysis.

[B] Estimation

Estimation of Acid(-COOH),1˚-Amine($-NH_2$), Aldehyde (-CHO) and Ketone (->C=O), Ether, –OH (alcohol and Phenol)

UNIT-2 [A] Acid Base Titration:

Theory of acid-base titration, Ways of locating the end point of acid-base, Titration of strong acid with strong base, Titration of week base with strong acid, Titration of weak acid with strong base, Factors determining the exaction of a pH curve.

[B] Redox titration

Theory of redox titration, theoretical basis of volumetric analysis involving (i) Potassium Permanganate (ii) Potassium dichromate and (iii) Iodine, study of redox titration by electrochemical Potential Method(only).

UNIT-3 Complexometric Titration

Theory of Complexometric titration: principle, effects of complexing agents and their advantages, stepwise and overall formation constants, Study of EDTA Complexformation taking disodium salt of EDTA and effect of pH, Way of locating the end pointbyvisualprocessandInstrumentProcess, indicators for EDTA titration-theory of metal ion indicators, titration methods employing EDTA – direct, back, displacement and indirect determinations, masking and demasking reagents, application of EDTA titration e.g. determination of hardness of water.

UNIT-4 [A] Precipitation Gravimetric and volumetric:

Introduction to gravimetric analysis, general principle, entire gravimetric procedure and gravimetric steps. Gravimetric Conversion Factor (GCF) - illustrations with reference to sulfate, chloride, ferric, calcium and phosphate as analyte ions. Precipitation: Saturation, super saturation, nucleation and crystal growth. Properties of precipitates-partical size, colloidal state; types of precipitates-crystalline, curdy and gelatinous precipitates.

[B] Inorganic precipitants & organic precipitants : Inorganic precipitants & organic precipitants advantages and disadvantages. Uses of inorganic precipitants: silver nitrate for chloride, dilute sulfuric acid for barium and lead, barium chloride for sulfate and ammonium hydroxide for iron. Uses of organic precipitants: dimethyl glyoxime for Nickel, 8-hydroxy quinoline for aluminum and α-benzoin oxime (Cupron) for copper.

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B.Sc. Semester IV
Chemistry(Major-3)
Inorganic&Analytical Practical
BS23MJ4CH3

Learning Objectives: To impart the students, skills regarding semi micro analysis method of qualitative inorganic analysis, volumetric and gravimetric analysis.

Learning out comes: After completion of course students will be able to comprehend and perform semi micro qualitative analysis of inorganic mixtures and volumetric and gravimetric analysis of ions and metals.

[A] Inorganic Mixture

Semi micro method of analysis of inorganic mixture containing four radicals (excluding phosphate, arsenite, arsenate and borate) Minimum eight mixtures should be performed. Onlywatersolublemixture.

[B] Volumetric and Gravimetric Analysis:

Volumetric Analysis:

(a) Hardness of Water, Ca & Mg (Total Hardness) by EDTA
(b) Estimation of Ni by using EDTA , $MgCl_2$ and Eriochrome Black – T (BackTitration)
(c) Determine the concentration of Cu^{2+}in the given solution by Colorimetry.

Gravimetric Analysis:

(a) Fe as Fe2O3
(b) Ba as BaSO4
(c) Al as Al2O3

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B.Sc. Semester – IV
Chemistry (Minor)
Optical and Electro analytical Methods in Chemistry
BS23MN4CH1

Learning Objectives: The objective of this course is to make student aware of the laws of spectroscopy and selection rules governing the possible transitions in the different regions of the electromagnetic spectra. The course exposes students to the electroanalytical methods of analysis.

Learning Outcomes: By the end of this course, students will be able to: Understand basic principle of instrument like UV-visible spectrophotometer, learn various electrochemical analysis methods and their applications.

UNIT - 1 Optical methods of analysis

Optical methods of analysis: Origin of spectra, interaction of radiation with matter, fundamental laws of spectroscopy and selection rules. UV-Visible Spectrometry: Basic principles of instrumentation (choice of source, monochromator and detector) for single and double beam instrument; Transmittance. Absorbance and Beer-Lambert law. Examples related to above said topics.

UNIT - 2Electroanalytical methods

Classification of electroanalytical methods, basic principle of pH metric, potentiometric and conductometric titrations.Techniques used for the determination of equivalence points. Techniques used for the determination of pKa values. Examples related to above said topics.

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B.Sc. Semester - IV
ChemistryPractical
Inorganic Practical

InorganicMixture

Semi micro method of analysis of inorganic mixture containing fourradicals (excluding phosphate, arsenite, arsenate and borate)Minimumeightmixtures shouldbeperformed. Onlywatersolublemixture.

REFERENCES

1. Vogel's "Textbook of Quantitative chemical Analysis", PearsonEducation Ltd.SixthEdition,2008.
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