(Bachelor of Science)(Undergraduate)
B. Sc. (UG) Semester -III

Course Code	**US03CCHE51**	Title of the Course	**Inorganic Chemistry**
Total Credits of the Course	4	Hours per Week	4

Course Objectives:	To make students familiar with: 1. Inorganic chemistry as an individual subject. 2. Application of inorganic chemistry in various fields. 3. Basic concepts related to acid base concepts, valence bond theory, lanthanides & actinides and chemistry of carbonyl compounds.

Course Content		
Unit	Description	Weightage* (%)
1.	**ACID-BASE AND NON-AQUEOUS SOLVENT** **ACIDS AND BASES** Arrhenius concept-the water ion system, Lowry-Bronsted theory-the proton donor-acceptor system, Conjugate acid-base pairs, Relative strength of acids and bases, Periodic variations of acidic and basic properties, The levelling effect, levelling and differentiating solvents, Utility and limitation of Bronsted concept, Utility and limitation of Bronsted concept, The Lewis concept-the electron donor concept system, Classification of Lewis acids, Classification of Lewis acids, Classification of Lewis acids and bases in to Hard and Soft Acids and Bases, HSAB principle and stability of the complex A:B, The Usanovich concept-the positive-negative system. **NON-AQUEOUS SOLVENT** Classification of solvents, General properties of ionizing solvents (physical and chemical), Chemical reactions, Liquid ammonia as non-aqueous solvent, Solubility of substance in liq. NH_3, Advantage and disadvantage of using liq. NH_3 as a solvent, Auto-ionization of liq. NH_3, Chemical reactions occurring in liq. NH_3, Liquid Sulphur dioxide as solvent, Chemical reactions occurring in liq. SO_2	**25%**
2.	**VALANCE BOND THEORYAND ISOMERISM IN COORDINATION COMPOUNDS** Main assumption of VBT, Octahedral complexes- d^2sp^3 or sp^3d^2: $[Fe(CN)_6]^{4-}$, $[Fe(F)_6]^{3-}$, Tetrahedral complexes- sp^3: $[Ni(CO)_4]$, $[Ni(Cl)_4]^2$, Square planar complexes- dsp^2: $[Ni(CN)_4]^{2-}$, Limitation	

	VBTStructural Isomerism: Conformation isomerism, Ionization isomerism, Hydrate isomerism, Coordination isomerism, Linkage isomerism, Coordination position isomerism, Ligand isomerism, Polymerization isomerism Stereo isomerism: Geometrical isomerism, Geometrical isomerism in 4-coordinated complex compounds, Geometrical isomerism in 6-coordinated complex compounds, distinguish between cis and trans isomers, Optical isomerism in 4-coordinated complex compounds, Optical isomerism in 6-coordinated complex compounds	**25%**
3.	**LANTHANIDES AND ACTINIDES** **LANTHANIDES:** Definitions, Position of Lanthanides in periodic table, General properties, Electronic configuration, Oxidation state and oxidation potential Chemistry of +2, +3, and +4 state, Atomic and ionic radii: Lanthanide contraction, Cause of Lanthanide contraction, Consequences of Lanthanide contraction, Color and absorption spectra in Ln+3 ion, Magnetic properties Complex formation, Extraction of Lanthanide from monazite, Separation of individual rare earth elements by modern methods, Solvent extraction method Uses of Lanthanide compounds **ACTINIDES:** Definition, Position of Actinides in periodic table, General properties of Actinides and their comparison with Lanthanides, Electronic configuration and nature of bonding in Actinide compounds, Oxidation state and oxidation potential, Chemistry of +2, +3, +4, +5, +6, and +7 oxidation state, Atomic and ionic radii: Actinide contraction, Color and absorption spectra of Actinide ions, Magnetic properties, Complex formation, Separation of actinide elements, Solvent extraction method, Ion exchange method.	**25%**
4.	**CHEMISTRY OF METAL CARBONYL AND NITROSYLS** **METALLIC CARBONYLS**: Classification of carbonyls, General methods of preparations, General properties (physical & chemical), Structure and nature of M-CO bonding in carbonyls, Effective atomic number (EAN) rule as applied to metallic carbonyls, 18-electron rule as applied to metallic carbonyls, Some carbonyls (preparation, properties and structure), Nickel tetracarbonyl, $Ni(CO)_4$, Iron pentacarbonyl, $Fe(CO)_5$, Chromium hexacarbonyl, $Cr(CO)_6$, Dimanganesedecacarbonyl, $Mn_2(CO)_{10}$, Dicobaltoctacarbonyl, $Co_2(CO)_8$, Di-iron enneacarbonyl, $Fe_2(CO)_9$, Tri-iron dodecacarbonyl, $Fe_3(CO)_{12}$, **METALLIC NITROSYLS**: Some metallic nitrosyls, Sodium nitroprusside, $Na_2[Fe_2+(CN)_5(NO+)]$, Nitroso ferrous sulphate, $FeSO_4.NO$, Effective atomic number (EAN) rule as applied to metallic	**25%**

	nitrosyls,	

Teaching-Learning Methodology	Conventional method (classroom blackboard teaching), ICT. Courses for B. Sc. Chemistry programme are delivered through classroom, laboratory work in a challenging, engaging, and inclusive manner that accommodates a variety of learning styles and tools (PowerPoint presentations, audio visual resources, e-resources, seminars, workshops, models).

Evaluation Pattern		
Sr. No.	Details of the Evaluation	Weightage
1.	Internal Written / Practical Examination (As per CBCS R.6.8.3)	15%
2.	Internal Continuous Assessment in the form of Practical, Viva-voce, Quizzes, Seminars, Assignments, Attendance (As per CBCS R.6.8.3)	15%
3.	University Examination	70%

Course Outcomes: Having completed this course, the learner will be able to	
1.	Learn about basic concepts of acids and bases, non-aqueous solvent, valence bond theory, various types of hybridization, lanthanides and actinides, metal carbonyls and metal nitrosyls.
2.	Apply knowledge in further studies of third year B.Sc. chemistry course.

Suggested References:	
Sr. No.	References
1.	Selected Topic in Inorganic Chemistry, 8th-edition, By Wahid U. Malik, G. D. Tuli And R. D. Madan
2.	Advance Inorganic Chemistry (Volume –II) By: Satya Prakash, G. D. Tuli, S.K. Basu, R. D. Madan

On-line resources to be used if available as reference material

On-line Resources: Google books, INFLIBNET, Google Web

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(Bachelor of Science)(Undergraduate)
B. Sc. (UG) Semester - III

Course Code	**US03CCHE52**	Title of the Course	**Physical Chemistry**
Total Credits of the Course	4	Hours per Week	4

Course Objectives:	To make students familiar with: 1. Physical Chemistry as a subject. 2. Historic development and scope of physical chemistry. 3. Basic concepts related to states of matter, chemical thermodynamics, colligative properties, electrolytes in solutions.

Course Content		
Unit	Description	Weightage* (%)
1.	**STATES OF MATTER** **Gaseous state** The Gas Laws, Kinetic Molecular Theory of Gases, Deviation of Real Gases from Ideal Behaviour, Effect of Temperature and Explanation for the deviation, Vander Waals Equation of State, Discussion of Vander Waal's Equation, Critical Constants of Gas, Determination of Critical Pressure, Temperature and Volume, Relation Between Vander Waal's Constant and Critical Constants, Numerical **Liquid state** Vapour Pressure and Its Experimental Determination, Surface Tension and Its Experimental Determination, Viscosity And Its Experimental Determination, Numerical.	**25%**
2.	**CHEMICAL THERMODYNAMICS** Introduction, Terminology of Thermodynamics, state function, thermal equilibrium, Thermodynamic process, First law of thermodynamics, Enthalpy, work, Thermochemistry, Molar heat at constant volume and constant pressure, Kirchhoff's equation, Criteria for spontaneous process, Reversible and Irreversible process, Relation between q_{rev} and q_{irr}, Numerical	**25%**
3.	**COLLIGATIVE PROPERTIES OF DILUTE SOLUTIONS** Colligative Properties, Vapour Pressure Lowering, Determination of Molar Mass of Solute, Measurement of Vapour Pressure Lowering , The Boiling Point Elevation, Derivation of Equation and Measurement	

	of Boiling Point Elevation The Freezing Point Depression, Derivation of Equation For Molar Mass, Measurement Of Freezing Point Depression, Numerical	**25%**
4.	**ELECTROLYTES IN SOLUTION** Specific Conductance, Molar Conductance, Conductance and Electrolytic Dissociation, Colligative Properties And Electrolytic Dissociation, Electrolysis Transference Numbers, Ionic Mobilities, Applications, Ionic Strength, Dissociation Of Weak Electrolytes.	**25%**

Teaching-Learning Methodology	Conventional method (classroom blackboard teaching), ICT. Courses for B. Sc. Chemistry programme are delivered through classroom, laboratory work in a challenging, engaging, and inclusive manner that accommodates a variety of learning styles and tools (PowerPoint presentations, audio visual resources, e-resources, seminars, workshops, models).

Evaluation Pattern		
Sr. No.	Details of the Evaluation	Weightage
1.	Internal Written / Practical Examination (As per CBCS R.6.8.3)	15%
2.	Internal Continuous Assessment in the form of Practical, Viva-voce, Quizzes, Seminars, Assignments, Attendance (As per CBCS R.6.8.3)	15%
3.	University Examination	70%

Course Outcomes: Having completed this course, the learner will be able to	
1.	Learn about basic concept of acids and bases, non-aqueous solvent, valence bond theory, various types of hybridization, lanthanides and actinides, metal carbonyls and metal nitrosyls.
2.	Apply this knowledge in further studies of third year B.Sc. chemistry course.

Suggested References:	
Sr. No.	References

1.	Principles of Physical Chemistry by Puri, Sharma and Pathania. 38th Edition
2.	Essential of physical chemistry by Bahl, Bahl and Tuli. 25th Edition.
3.	Physical Chemistry by G. M. Barrow, 5th Edition
4.	Textbook of physical chemistry by P.L. Soni, O.P. Dharmarha, U. N. Dash
5.	University chemistry by Bruce H Mahan
6.	Principles of Physical chemistry, S H Marron, Karl F Prutton
7.	Physical Chemistry, Ira Levine

On-line resources to be used if available as reference material
On-line Resources: Google books, INFLIBNET, Google Web

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(Bachelor of Science)(Undergraduate)
B. Sc. (UG) Semester - III

Course Code	**US03CCHE53**	Title of the Course	**Chemistry Practical**
Total Credits of the Course	4	Hours per Week	8

Course Objectives:	To make students familiar with: 1. Practical aspects of inorganic chemistry. 2. Hands on experience of binary mixture of inorganic compounds and volumetric titration. 3. Basic concepts related to practical inorganic chemistry.

Course Content	
Unit	Description
1.	**Practical - I: Inorganic Mixture:** Four radicals. It may include two positive Radicals and two negative radicals.(At least Ten) Cd^{+2}, Cu^{+2}, Bi^{+3}, Fe^{+2}, Zn^{+2}, Al^{+3}, Ni^{+2}, Mn^{+2}, Ba^{+2}, Sr^{+2}, Ca^{+2}, Mg^{+2}, NH_4^+, K^+, Cl^-, Br^-, I^-, NO_3^-, CO_3^{-2} , S^{-2}, PO_4^{-3}, BO_3^{-3}, SO_4^{-2}, CrO_4^{-2}, $Cr_2O_7^{-2}$etc.
2.	**Practical - II : Volumetric Titration** (By self-preparation of solution of titrant): (i) Estimation of copper by iodometric method. (ii) Determination of total hardness of water sample. (iii) Determination of nickel by back titration. (iv) Determination of nitrite by back titration. (v) Estimation of Aniline (vi) Determine the Unsaturation
3.	**Preparation of standard solutions.**
4.	**Paper chromatography.**
5.	**Viva**

Teaching-Learning Methodology	Hands on training, Practical Courses for B. Sc. Chemistry programme are delivered through classroom, laboratory work in a challenging, engaging, and inclusive manner that accommodates a variety of learning styles and tools (PowerPoint presentations, audio visual resources, e-resources, seminars, workshops,

	models).

Evaluation Pattern		
Sr.No.	Details of the Evaluation	Weightage
1.	Internal Written / Practical Examination (As per CBCS R.6.8.3)	---
2.	Internal Continuous Assessment in the form of Practical, Viva-voce, Quizzes, Seminars, Assignments, Attendance (As per CBCS R.6.8.3)	--
3.	University Examination	100%

Course Outcomes: Having completed this course, the learner will be able to	
1.	Learn about separation and identification of inorganic mixture.
2.	Know about preparation of standard solutions, paper chromatography and Volumetric Titration. This will improve practical skills of students.

Suggested References:	
Sr. No.	References
1.	Vogel's Textbook of Quantitative Chemical Analysis, 5th Edition By G. H. Jeffery, J. Basset, J. Mendham, R. C. Denney.
2.	Practical Chemistry By O. P. Pandey, D. N. Bajpai & S. Giri
3.	An Advanced Course In Practical Chemistry By Ghoshal, Mahapatra & Nad
4.	Vogel's Textbook Of Qualitative Inorganic Analysis By G. Svehla

On-line resources to be used if available as reference material
On-line Resources: Google books, INFLIBNET, Google Web

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(Bachelor of Science)(Undergraduate)
B. Sc. (UG) Semester -IV

Course Code	**US04CCHE51**	Title of the Course	**Organic Chemistry**
Total Credits of the Course	4	Hours per Week	4

Course Objectives:	To make students familiar with: 1. Organic chemistry as a subject 2. Application of organic chemistry in development of chemical science as subject. 3. Basic concepts related to stereochemistry, carbohydrates, ultraviolet spectroscopy and acid- base properties.

Course Content		
Unit	Description	Weightage* (%)
1.	**STEREOCHEMISTRY** Stereochemistry and stereoisomerism, Optical activity, Specific rotation, Production of Enantiomerism, Chirality, the chiral centre, enantiomers, Configuration, Specification of configuration: R and S, Sequence rules, Diastereomers, Meso structures, Specification of configuration : More than one chiral center, Generation of a chiral center, Synthesis and optical activity, Reaction of chiral molecules: Bond-breaking, Reaction of chiral molecules: Generation of second chiral center, Reaction of chiral molecules. Free rotation about C-C single bond. Conformation. Torsional strain Conformation of n-butane Vander Waals repulsion, Factors affecting stability of conformation, Conformation of cycloalkanes, Equatorial and axial bond in cyclohexane.	**25%**
2.	**ULTRAVIOLET SPECTROSCOPY** Origin of UV Spectra, Principle, Electronic transition (σ-σ*, n-σ*, π-π* and n-π*), relative positions of λ_{max} considering conjugative effect, steric effect, solvent effect, red shift (bathochromic shift), blue shift (hypsochromic shift), hyperchromic effect, hypochromic effect (typical examples). Aromatic and Polynuclear aromatic hydrocarbons. Problems of Dienes and enones using Woodward-Fieser rules. Problems of aromatic ketones, aldehydes and esters using empirical rules.	**25%**
3.	**CARBOHYDRATES**	

	Introduction, classification of carbohydrates, osazone formation, epimerization, step up (Killani Fisher Synthesis) and step down (Ruff Degradation) reactions of monosaccharides, simple structures of glucose and fructose, Fischer's proof of configuration of D-glucose, Cyclic structure of D (+) Glucose. Disaccharides: structure of (+) cellobiose.	**25%**
4.	**CHEMICAL REACTIVITY AND MOLECULAR STRUCTURE: (ACID- BASE PROPERTIES)** Acid-Bases, scale of acidity-basicity, Resonance effect, drawing of structures and the condition for resonance, Effect of change of hybridization on acidity and basicity, Inductive and electronic effects, steric effect and hydrogen bonding, Lewis acid and bases, Keto – enol tautomerism. Difference between resonance and tautomerism.	**25%**

Teaching-Learning Methodology	Conventional method (classroom blackboard teaching), ICT. Courses for B. Sc. Chemistry programme are delivered through classroom, laboratory work in a challenging, engaging, and inclusive manner that accommodates a variety of learning styles and tools (PowerPoint presentations, audio visual resources, e-resources, seminars, workshops, models).

Evaluation Pattern		
Sr. No.	Details of the Evaluation	Weightage
1.	Internal Written / Practical Examination (As per CBCS R.6.8.3)	15%
2.	Internal Continuous Assessment in the form of Practical, Viva-voce, Quizzes, Seminars, Assignments, Attendance (As per CBCS R.6.8.3)	15%
3.	University Examination	70%

Course Outcomes: Having completed this course, the learner will be able to	
1.	Learn about basic concepts of stereochemistry, ultraviolet spectroscopy, carbohydrates, chemical reactivity and molecular structure.
2.	Apply this knowledge in further studies of third year B.Sc. chemistry course.

Suggested References:	
Sr. No.	References
1.	A text book of organic chemistry by Arun Bahl and B. S. Bahl, 16th Ed.
2.	Organic chemistry by Morrison and Boyd, 6th Ed.
3.	Organic reaction mechanism by R. K. Bansal, 3rd Ed.
4.	Organic chemistry by S. M. Mukherji, S. P. Singh and R. P. Kapoor. Vol. II.

On-line resources to be used if available as reference material
On-line Resources: Google books, INFLIBNET, Google Web

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(Bachelor of Science)(Undergraduate)
B. Sc. (UG) Semester -IV

Course Code	**US04CCHE52**	Title of the Course	**ANALYTICAL CHEMISTRY**
Total Credits of the Course	4	Hours per Week	4

Course Objectives:	To make students familiar with: 1. Analytical chemistry as a subject. 2. Applications of analytical chemistry. 3. Basic concepts related to different kinds of analysis.

Course Content		
Unit	Description	Weightage* (%)
1.	**TITRIMETRIC METHODS IN ANALYSIS** Introduction, Definitions: Standard solutions, Equivalence Point, Indicators, End point, Titration General Aspects of: Primary standards, Desirable properties of standard solution. Volumetric calculations: Molarity, Normality, percentage concentration, parts per million. **Neutralization Titration** Standard solution and acid- base indicators. Titration curve for strong acid-strong base, Systematic equilibrium concentrations for SA-SB titration. Acid-Base indicators, color change range of an indicator, Indicator error. Determination of Acetic acid in vinegar. Determination of Alkalinity of soda ash.	**25%**
2.	**COMPLEXOMETRIC TITRATION** Introduction, terms involved in titration: complex, ligand, buffer solution, chelating agents, chelates, Some Chelating agents, Stability of complexes: stepwise formation constants. Complexometric titration curve. Equilibria involved in EDTA titration, Indicators for EDTA titrations. Hardness of water. Ca in Calcium Gluconate Sample. Numerical based on this titration.	**25%**
3.	**REDOX TITRATION** Introduction, Terms involved: oxidation, reduction. Single electrode potential, formal potential, Nernst Equation, Titration curve for Iron (II) and cerium (IV). Types of redox indicators and their selection. Structural chemistry of redox indicators. Numericals: Calculation based on emf of electrode/cell, end point calculations, equation constants.	**25%**

4.	**WATER POLLUTANTS ANALYSIS** Water pollution: Introduction. Classification of water pollutants, Sources of water pollution. Origin of waste water, Effect of water pollutants, Water analysis: colour, turbidity, total dissolved solids, conductivity, acidity,alkalinity, hardness, chlorides, sulphates, fluorides. Drinking water standards.	**25%**

Teaching-Learning Methodology	Conventional method (classroom blackboard teaching), ICT. Courses for B. Sc. Chemistry programme are delivered through classroom, laboratory work in a challenging, engaging, and inclusive manner that accommodates a variety of learning styles and tools (PowerPoint presentations, audio visual resources, e-resources, seminars, workshops, models).

Evaluation Pattern		
Sr. No.	Details of the Evaluation	Weightage
1.	Internal Written / Practical Examination (As per CBCS R.6.8.3)	15%
2.	Internal Continuous Assessment in the form of Practical, Viva-voce, Quizzes, Seminars, Assignments, Attendance (As per CBCS R.6.8.3)	15%
3.	University Examination	70%

Course Outcomes: Having completed this course, the learner will be able to	
1.	Learn about basic Titrimetric Methods in Analysis, Neutralization Titration, Complexometric and Redox Titration, Water Pollutants Analysis.
2.	Use this information in further studies of third year B.Sc. chemistry course.

Suggested References:	
Sr. No.	References
1.	Fundamentals of Analytical Chemistry, 7th Edition by skoog, west, Holler.

2.	Quantitative Analysis 6th Edition, R.A. Day, Jr., A.L. Underwood.
3.	Analytical Chemistry –Dr. Alka Gupta, Pragati Prakashan.

On-line resources to be used if available as reference material
On-line Resources: Google books, INFLIBNET, Google Web

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(Bachelor of Science)(Undergraduate)
B. Sc. (UG) Semester -IV

Course Code	**US04CCHE53**	Title of the Course	**Chemistry Practical**
Total Credits of the Course	4	Hours per Week	8

Course Objectives:	To make students familiar with: 1. Practical organic chemistry as a subject. 2. Practical aspects of gravimetric analysis. 3. Practical aspects of qualitative analysis of binary organic mixture.

Course Content	
Unit	Description
1.	**Practical-I: BINARY ORGANIC MIXTURE** [Solid + Solid] Only water insoluble (At least Ten) Separation and identification of binary organic mixture : Solid + Solid [A/B/P/N] Solid Acid : Benzoic Acid, Salicylic Acid And Cinnamic Acid Solid Phenol : (α-napthol, β-napthol) Solid Base : (o, m, and p-nitroaniline) Solid Neutral : p-dichlorbenzene, naphthalene, anthracene, benzamide, acetanilide, m-dinitrobenzene.
2.	**Practical-II : GRAVIMETRIC ANALYSIS (SINGLE)** (i) Ba as $BaSO_4$ (ii) Fe as Fe_2O_3 (iii) Al as Al_2O_3 (iv) Ni as $Ni(DMG)_2$ (v) $ZnCO_3$ as ZnO (vi) $BaCl_2.2H_2O$ as $BaCl_2$
	Viva

Teaching-Learning Methodology	Hands on training, Practical Courses for B. Sc. Chemistry programme are delivered through classroom, laboratory work in a challenging, engaging, and inclusive manner that accommodates a variety of learning styles and tools (PowerPoint presentations, audio visual resources, e-resources, seminars, workshops, models).

Evaluation Pattern

Sr. No.	Details of the Evaluation	Weightage
1.	Internal Written / Practical Examination (As per CBCS R.6.8.3)	--
2.	Internal Continuous Assessment in the form of Practical, Viva-voce, Quizzes, Seminars, Assignments, Attendance (As per CBCS R.6.8.3)	---
3.	University Examination	100%

Course Outcomes: Having completed this course, the learner will be able to	
1.	Learn about separation and identification of binary organic mixture. As well as Gravimetric analysis. Which will be beneficial them for higher study.
2.	Improve practical skills of students.

Suggested References:	
Sr. No.	References
1.	Vogel's Textbook of Quantitative Chemical Analysis, 5th Edition By G. H. Jeffery, J.Basset, J.Mendham, R.C.Denney.
2.	Practical Chemistry By O. P. Pandey, D. N. Bajpai & S.Giri
3.	An Advanced Course In Practical Chemistry By Ghoshal, Mahapatra & Nad
4.	Vogel's Textbook Of Qualitative organic Analysis By G. Svehla

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On-line Resources: Google books, INFLIBNET, Google Web

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