St. Xavier's College (Autonomous), Ahmedabad-09

Syllabus of Semester – IV of the following departments under Faculty of Science based on Under Graduate Curriculum Framework - 2023 to be implemented from the Academic Year 2025-26.

FACULTY OF SCIENCE

DEPARTMENT OF CHEMISTRY

BSc. (Hons.) Chemistry
Category – IV

Major Course – 1: Inorganic Chemistry

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course Title & Code	Credit Distribution of The Course			Eligibility Criteria	Pre-requisite(s) of the Course (if any)
	Lecture	Tutorial	Practical / Practice		
CHMC441C Inorganic Chemistry	4	0	0	10 + 2 from a recognized board in any stream	

LEARNING OBJECTIVES (LO): The main objective of the course will be to build the basic foundation for studying chemistry. By the end of the paper, a student should be able to:	
LO-1	To learn wave –mechanics and terms related to wave –mechanics the knowledge from this part can help to build a career in Quantum chemistry or specialization at higher study.
LO-2	To learn various aspect of coordination chemistry in detail to calculate CFSE and stability of complex compounds can help for the research specialization at higher study.

LO-3	To Understand the concept of molecular orbitals, Construct and interpret molecular orbital diagrams and Use of MO theory to explain chemical bonding in inorganic chemistry.
LO-4	To learn organometallic chemistry and applications of catalysis is important for higher study in the subject and helpful for Industrial chemistry purpose.
Course OUTCOMES (CO)	
On Completion of this course, the student will be able to	
CO-1	Apply the postulates of quantum mechanics to solve the Schrodinger wave equation for simple chemical systems
CO-2	Use the bonding theories like CFT and MOT to understand the chemical properties and structure of simple molecules, co-ordination compounds and organometallic compounds
CO-3	The objective of this course segment is to equip students with a comprehensive understanding of Molecular Orbital Theory as a quantum mechanical model of chemical bonding.
CO-4	Use basic knowledge of the catalysis help for the basic research activity in future.

Unit:1 Wave Mechanics (15L)	
	Difference between Classical mechanics and modern mechanics in wave mechanics, Basic postulates of quantum mechanics (Postulates 1,2,3 and 4); Types of Operators, Setting up of operators: Quantum mechanical operator for momentum, Quantum mechanical operator for total Energy (Hamiltonian Operator); Energy equation derivation for Particle in a box (One dimensional); Zero potential energy; Characteristics of the wave functions; Energy equation derivation for Electron confined in a ring.
Unit 2 Coordination Compounds (15L)	
A	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.

B	Coordination Chemistry: Lability, inertness, Stability, Instability, reaction, kinetics and mechanism, Trans effect and Influence
Unit 3 Advanced Chemical Bonding -Molecular Orbital Theory: (15L)	
.	Introduction of AO's, MO's, Molecular orbital Theory; LCAO; Energy Level Diagram for Molecular Orbitals; Mixing of Orbitals; Filling up of Molecular Orbitals; MO diagram of Heteronuclear Diatomic molecules (HF, HCl); Molecular orbitals of Polyatomic Species (BeH_2, CO_2,NH_3)(Excluding Walsh diagram); Molecular orbital Theory of Octahedral Sigma donation$[Co(NH_3)_6]^{3+}$ and; Sigma & Pi-donation $[CoF_6]^{3-}$, Pi- acceptance $[Fe(CN)_6]^{4-}$, Tetrahedral: Sigma & Pi-donation $[NiCl_4]^{2-}$, Square planar: Sigma & Pi-donation, Pi- acceptance $[PtCl_4]^{2-}$
Unit 4 Organometallic Chemistry and Catalysis (15L)	
A	**Organometallic Chemistry:** Introduction of organometallic, classification, types of bond, methods for electron counting, electron count preference. Ligands: Carbon monoxide, Phosphines, hydrides and dihydride complexes, n'-Alkyl, alkenyl, alkynyl, and Aryl ligands.
B	**Catalysis:** General principle, The language of catalysis, hydrogenation of alkene. Heterogeneous catalysis: surfaces four interactions with adsorbates.

Suggestive Reading:

1. "Advanced Inorganic Chemistry", by Gurdeep Raj, Goel Publishing House, Meerut, Volume –I, 24th Revised Edition,1998
2. "Modern Inorganic Chemistry', by R.D. Madan, S. Chand & Co. Ltd., New Delhi, 2nd Edition, 2006.
3. "Concise Inorganic Chemistry", by J.D. Lee, Wiley India Publication, 5th Edition, 1996, Reprint 2011.
4. "Selected Topics in Inorganic Chemistry", by W.V. Malik, G.D. Tuli, R.D. Madan, S.Chand & Co. Ltd., New Delhi, 7th Edition, 2007
5. "Introductory Quantum Chemistry", by A.K. Chandra, Tata- McGraw Hill Pub. Co. Ltd., New Delhi, 4th Edition.
6. "Principles of Inorganic Chemistry", by Puri, Sharma, Kalia, Milestone Publishers & Distributors, New Delhi, 3rd Edition, 2006.
7. "Quantum chemistry", by R.K.Prasad, New Age International (P) Ltd., Publishers, 4th Edition, 2010.
8. "Shriver & Atkins' Inorganic Chemistry",Peter Atkins, Tina Overton, Jonathan Rourke, Mark Weller, Fraser Armstrong, Oxford University Press, 2011.
9. "Inorganic Chemistry", by Catherine E Housecroft and Alan G Sharpoe, 2nd edn.
10. Symmetry and Spectroscopy of Molecules by K. Veera Reddy 2 nd a edition New Age International publisher.

St. Xavier's College (Autonomous), Ahmedabad-09

Syllabus of Semester – IV of the following departments under Faculty of Science based on Under Graduate Curriculum Framework - 2023 to be implemented from the Academic Year 2025-26.

FACULTY OF SCIENCE

DEPARTMENT OF CHEMISTRY

BSc. (Hons.) Chemistry
Category – IV

Major Course – 2: Analytical Chemistry (Theory)

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course Title & Code	Credit Distribution of The Course			Eligibility Criteria	Pre-requisite(s) of the Course (if any)
	Lecture	Tutorial	Practical / Practice		
CHMC442C Analytical Chemistry (Theory)	4	0	0	10 + 2 from a recognized board in any stream	

LEARNING OBJECTIVES (LO): The main objective of the course will be to build the basic foundation for studying chemistry. By the end of the paper, a student should be able to:	
LO-1	To learn basic concepts of acid-base titration and Precipitation Titration which develop theoretical skill to the students for further lab practices.
LO-2	To explain the importance of EDTA in complexometric titrations and effect of pH on it. To enable the students to understand the mechanism of indicator and to determine hardness of water.

LO-3	To learn basic concepts of gravimetric analysis which enhance theoretical knowledge for the practical and in the field of research area.
LO-4	To explain the characteristics and applications of various organic indicators.
Course OUTCOMES (CO)	
On Completion of this course, the student will be able to	
CO-1	Employ the fundamentals of quantitative analysis to interpret the theory and locate the end point for various acid-base systems, determine the theoretical construction of the graph and understand its actual nature.
CO-2	Apply the basics of classical analysis methods to comprehend the various aspects of gravimetric analysis.
CO-3	To employ the method of solvent extraction and remember its use in single and batch process, extraction of metals and also determine the separation efficiency.
CO-4	Remember the theory and uses of 8-Hydroxy Quinoline, Cupferron, DMG and N-benzoyl-N-phenylhydroxylamine as precipitants.

Unit:1 ACID BASE AND PRECIPITATION TITRATIONS (15L)	
A	Theory of acid-base titration: Theory of acid-base titration, Ways of locating the end point of an acid-base titration, Titration of strong acid with strong base, Titration of weak acid with strong base, Titration of weak base with strong acid, Titration of weak base with weak acid, Factors determining the exact form of a pH curve.
B	Precipitation Titration: Titration curves, Feasibility, Indicators, Mohr, Volhard and Fajans' Methods, Factors affecting solubility
Unit 2 REDOX TITRATIONS (15L)	
A	Theory of redox titration, study of redox titration by electrochemical potential method and its derivation, Ways of locating the end point for redox titration by (i) visual (self-indication, starch and redox indicator) (ii) electro potential method.
B	Titration involving Iodine: iodimetry and iodometry, Standardization of sodium thiosulphate by $K_2Cr_2O_7$, Titration with other oxidizing agents: Potassium permanganate, potassium dichromate, cerium Titration with reducing agents: Sodium thiosulfate, Fe(II).
Unit 3 GRAVIMETRIC ANALYSIS AND ORGANIC REAGENTS(15L)	

A	**Gravimetric Analysis:** (8L) Introduction, Precipitation, Digestion, Filtration, washing of the precipitate, Drying and/or incineration of the precipitate, Weighing, Gravimetric factors, Specific and selective precipitation,Masking or sequestering agent, Problems involved in precipitation gravimetry.
B	**Organic reagents used in quantitative Analysis:** (7L) Organic precipitants, Separation methods with 8-Hydroxy Quinoline, Cupferron, DMG and N-benzoyl-N- phenylhydroxylamine.
Unit 4 SOLVENT EXTRACTION AND COMPLEXOMETRIC TITRATION (15L)	
A	**Solvent Extraction Separation**: Principles of solvent extraction, choice of solvent, distribution coefficient, distribution ratio, percentage, (%) extraction. The extraction process, solvent extraction of metals, selective extraction and separation efficiency.
B	**Complexometric Titration:** Theory of complexometric titration involving EDTA, Study of EDTA complex formation taking disodium salt of EDTA and effect of pH, Ways of locating the end point, Estimation of calcium and magnesium by complexometric titration by EDTA.

Suggestive reading: CH 4502: Analytical Chemistry (Theory)

1. "Analytical Chemistry", by Dhruba Charan Dash, PHI Learning Pvt. Ltd., New Delhi, 2011.
2. "Quantitative Analysis", by R.A.Day, A.L.Underwood, Prentice-Hall of India Pvt.Ltd., New Delhi, 2004. (Sixth edition)
3. Analytical Chemistry", by Gary D. Christian, John Wiely & Sons, INC, New York, 1994. (Fifth edition)
4. "Analytical Chemistry An Introduction", by Douglas A. Skoog, Donald M. West, F.James Holler, Saunders College Publishing, Harcourt Brace College Publishers, Philadelphia, 1994. 6th edition.
5 "A Textbook of Analytical Chemistry",by Y.Anjaneyulu, K.Chandrasekhar, Valli Manickam, Pharma Book Syndicate, Hyderabad, India, 2006.
6. "Instrumental Methods of analysis" by H.H . Willard, L.L. Mirrit, J.A. Dean, CBS Publications.
7. "Solvent extraction in Analytical Chemistry"by G.H. Morrison, F. Frieiser, John Wiley & Sons, NY
8. "Quantitative Chemical Analysis" by Daniel C. Harris, W H Freeman, New York.
9. "Ion exchange and solvent extraction of metal compounds' by Y. Macros, A.S.Kertes, Wiley,Interscience