VANITA VISHRAM WOMEN'S UNIVERSITY

(Managed By: Vanita Vishram, Surat)

1st Women's University of Gujarat

SCHOOL OF SCIENCE AND TECHNOLOGY

DEPARTMENT OF CHEMISTRY

M.Sc. Chemistry

SYLLABUS

As per NEP-2020

w.e.f 2023-24

INDEX

1 PREAMBLE – VVWU

Vanita Vishram Women's University (VVWU) is the First-ever Women's University of Gujarat approved by the Government of Gujarat under the provisions of the Gujarat Private Universities Act, 2009. It is a University committed to achieve Women's Empowerment through Quality Education, Skill Development, and by providing employment opportunities to its girl students through its model curriculum, integration of technology in pedagogy and best-in-class infrastructure. The focus is on prioritizing practical component and experiential learning supported through academia-industry linkages, functional MoUs, skill development training, internships etc. It aims at providing opportunities to the girl students for holistic development and self-reliance.

VISION

Empowerment of women through quality education and skill development, so as to make them strong pillars of stability in the society.

MISSION

To provide Education & Professional Training to all women for their all-round development, so as to enable them to become economically independent and socially empowered citizens.

2 SALIENT FEATURES

- Based on NEP-2020 & CBCS
- Interdisciplinary as well as multidisciplinary.
- Practical-oriented, skill-based & vocation-based.
- Based on experiential learning.
- Greater exposure to internship, hands-on training, project work, field work, presentation etc.
- Mode of teaching shall be Offline.
- Qualified & Competent Faculty Members for effective teaching-learning
- Employment-Generating

3 INTRODUCTION OF THE PROGRAM

The M.Sc. Chemistry course is an advanced postgraduate program designed to provide students with a comprehensive and in-depth understanding of complex chemical principles and their practical applications. Delving into various specialized areas, such as organic, physical and analytical, the program equips students with specialized knowledge and expertise.

A significant emphasis is placed on hands-on research, experimentation, and laboratory work, enabling students to develop advanced skills in chemical analysis, compound synthesis, and data interpretation. Through rigorous academic training, the program fosters critical thinking, problem-solving aubilities, and a spirit of scientific inquiry, preparing students to tackle challenging scientific questions.

Upon successful completion of the M.Sc. Chemistry students are well-prepared to embark on rewarding careers in diverse fields. They can pursue opportunities in research and development, where they contribute to the advancement of scientific knowledge and the discovery of new materials and processes. Additionally, graduates can find fulfilling roles in quality control, ensuring the safety and effectiveness of various products and processes.

Moreover, the course lays the groundwork for potential teaching careers, empowering graduates to impart their knowledge and passion for chemistry to the next generation of students. Furthermore, the program provides a solid foundation for those considering further studies at the doctoral level, where they can explore cutting-edge research and make significant contributions to the field. Students will develop a deep understanding of chemical concepts and their practical applications in areas such as pharmaceuticals, materials science, polymer science, dyes industries, environmental science, fermentation, food & dairy and forensics etc.

Overall, chemists play a crucial role in addressing real-world challenges, such as sustainable energy, environmental conservation, and advancements in healthcare and technology. By applying their knowledge and skills, M.Sc. Chemistry graduates become catalysts for progress and innovation, driving society towards a brighter future.

4 PROGRAMME OBJECTIVES (POS)

PO 1. To impart knowledge of Chemical sciences and application of chemistry in day-to-day life.

PO 2. To strengthen the in-field practical knowledge of the students by providing them hands-on experimentation, project work and field work.

PO 3. To develop capability of thinking, understanding/analyzing and interpreting and solving problems to meet the need of industries such as pharmaceuticals, materials science, polymer science, dyes industries, environmental science, food & dairy, forensics, Academia, etc. and research.

PO 4. To make learners understand about ethical aspects, safety aspects and their responsibilities towards mankind and the environment.

PO 5. To make students capable of finding entrepreneurship opportunities for betterment of society, environment.

PO 6. To make the students avail of all the basic knowledge required for various competitive examinations related to the Sciences.

5 PROGRAM SPECIFIC OUTCOMES (PSOS)

Upon completion of the M.Sc. Chemistry program, the students would:

PSO 1. Have the knowledge of advanced principles of Chemistry and its understanding.

PSO 2. Be able to apply their practical skills and knowledge to identify and resolve the problems related to and serve various Chemical Industries such as pharmaceuticals, materials science, polymer science, dyes industries, environmental science, food & dairy etc.

PSO 3. This program fosters interdisciplinary learning habits, enabling students to utilize modern analytical tools and software for industry and research analysis.

PSO 4. Be able to cultivate professional ethics and equip students to pursue careers in various sectors as chemists, researchers, educators, managers, regulators and professionals in chemistry-related industries.

PSO 5. Develop high-quality research encouraging scientific thinking and approach for research.

PSO 6. Develop skills for further higher studies, competitive examinations and employment.

6 PROGRAM HIGHLIGHTS:

Course Level	PG						
Program	Postgraduate in Science						
Duration	2 years (4 semesters)						
Examination Type	Semester system (1-4 semesters)						
Intake	40						
Eligibility	Bachelor degree in Chemistry						
Mapping between POs and PSOs		PSO 1.	PSO 2.	PSO 3.	PSO 4.	PSO 5.	PSO 6.
	PO 1.						
	PO 2.						
	PO 3.						
	PO 4.						
	PO 5.						
	PO 6.						
Job Positions	Scientist, Teacher, RnD Officials, QA/QC Executives in various sectors of Chemistry domain such as pharmaceuticals, materials science, polymer science, dyes industries, environmental science, forensics, Academia etc.						

7 Scheme of Assessment

Following is the scheme of assessment followed by the university –

Weightage (%)	Continuous Assessment (CA) (40%)	End Semester Examination (ESE) (60%)
100%	[Internal written Theory Exam] (20%) + [Assignments/Presentations/Viva/group discussion/Journal/ MCQ/QUIZ + Attendance] (20% - Any Two)	End Semester Examination (ESE) Theory/Practical Exams Whole Syllabus

8 Credit Structure

Proposed PG Credit structure for PG -2023					
Semester	**Major (4)**	**DSE(4)**	**ProjectP/Internship**	**Dissertation**	**Total**
1	4*4=16 (Th) 2*4= 08 (Pr)	-	-	-	24
2	4*4=16 (Th) 2*4= 08 (Pr)	-	-	-	24
3	3*4=12 (Th) 1*4=04 (Pr)	**(1*4) Any One** Group A Group B	1*4=4	-	24
4	1*4=04	**(1*4) Any One** Group A Group B	1*4 = 4(add to Dissertation)	1*12=12	24
Total	**12*4=48** (Th) **5*4 =20** (Pr) **68**	**2*4=08**	**1*4=4** **1*4=4** **08**	**1*12=12**	**96**

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SCHOOL OF SCIENCE AND TECHNOLOGY

DEPARTMENT OF CHEMISTRY

M.Sc. CHEMISTRY

SEMESTER 1

SYLLABUS

AS PER NEP-2020

W.E.F 2023-24

9 Course Structure – Paper Titles SEMESTER 1

Semester	Major (4)	DSE(4)	Project/Internship	Dissertation	Total
1	Inorganic Chemistry-I (Th)	-	-	-	06
	Organic Chemistry-I (Th)				
	Physical Chemistry-I (Th)				
	Analytical Chemistry-I (Th)				
	Inorganic & Organic Chemistry Practical-I (Pr)				
	Physical & Analytical Chemistry Practical-I (Pr)				

10 Teaching and Evaluation Scheme for bsc Chemistry academic year 2023-24

VANITA VISHRAM WOMEN'S UNIVERSITY, SURAT

SCHOOL OF SCIENCE AND TECHNOLOGY

TEACHING & EXAMINATION SCHEME FOR M.Sc. Chemistry Programme, AY 2024-25

Semester	Course Code	Course Category	Course Title	Teaching Scheme				Examination Scheme													
								Theory						Practical							
				Contact Hours			Total Credit	Credit	CCE		SEE			Credit	CCE		SEE			Total	Total Credit
				Theory	Practical	Total			Max.	Passing	Max.	Passing	CCE+SEE Passing		Max.	Passing	Max.	Passing	CCE+SEE Passing		
I (Chemistry)	CH21260	CC	Inorganic Chemistry-I (Theory)	4	0	4	4	4	40	16	60	24	40	0	0	0	0	0	0	100	4
	CH21270	CC	Organic Chemistry-I (Theory)	4	0	4	4	4	40	16	60	24	40	0	0	0	0	0	0	100	4
	CH21280	CC	Physical Chemistry-I (Theory)	4	0	4	4	4	40	16	60	24	40	0	0	0	0	0	0	100	4
	CH21290	CC	Analytical Chemistry-I (Theory)	4	0	4	4	4	40	16	60	24	40	0	0	0	0	0	0	100	4
	CH21300	CC	Inorganic Chemistry & Organic Chemistry Practicals-I (Practical)	0	8	8	4	0	0	0	0	0	0	4	40	16	60	24	40	100	4
	CH21310	CC	Physical Chemistry & Analytical Chemistry Practicals-I (Practical)	0	8	8	4	0	0	0	0	0	0	4	40	16	60	24	40	100	4
TOTAL MARKS																				**600**	**24**

VANITA VISHRAM WOMEN'S UNIVERSITY, SURAT
SCHOOL OF SCIENCE AND TECHNOLOGY
Department of Chemistry
M.Sc. Chemistry Program
Semester I

CH21260: INORGANIC CHEMISTRY-I

Credit 4 **Contact Hour per week: 4**

Outline of the Course:

Course type	Theory
Purpose of Course	Higher study in chemistry is a current need of the competitive environment. The M.Sc. Chemistry and chemistry programmes provides knowledge and skill-based training to the students to flourish in research and in the professional career. The course offers a deep understanding of concept, theory and experiments that make students reach knowledge of chemistry. The dissertation in the end semester provides a research environment for the student to build a career in the research field.
Course Objective	CO 1. Detail study based on Symmetry and symmetry elements, operation, types. CO 2. Identify and name the three different kinds of symmetry: rotational, reflectional, and point symmetry. find the symmetry line of a form. determine the rotational order of a shape. CO 3. Define importance of inorganic elements in vital systems CO 4. Explain Metal ion binding to biomolecules and their functions CO 5. Study of metal ions, their roles, toxicity. CO 6. Inorganic polymer, their characterization, methods, synthesis CO 7. General discussion on the properties of the non-transition elements and types
Minimum weeks per Semester	15 (Including Class work, examination, preparation, holidays etc.)
Last Review / Revision	August 2023
Pre-requisite	● Detail study of symmetry of molecule and its character table ● Metal ions application in biological units and its overdose. ● Study of inorganic polymer, and different method to study weight of inorganic polymer ● Non transition elements detail study, silanes etc.
Teaching Methodology	Class Room Teaching, Use of ICT, Class exercise, Discussion and Assignment
Evaluation Method	40% Continuous Assessment (CA) 60% End Semester Examination (ESE)

Course Content:

Units	Particulars	% Weightage of Unit	Minimum Nos. of Hours
1	**Symmetry and Group Theory in Chemistry** Concept of symmetry in chemistry, Symmetry operations & Symmetry elements: Rotation axis of symmetry and types of rotational axis, Plane of symmetry and types of planes, Improper rotational axis of symmetry, Inversion center and Identity element, More about symmetry elements-Molecular point groups: Definition and notation of point groups, Classification of molecules into C1, CS, Ci, Cn, C_nh, $C_\infty V$, D_n, D_nd, $D_\infty h$, S_n (n=Even), Td, Oh, Ih groups, Symmetry and Dipole moment, Symmetry criteria for optical activity, Representation of groups: Reducible and Irreducible representations and their relation, The great orthogonality theorem, Preparation of character table for C2v and C3v point groups.	25 %	15
2	**Bioinorganic Chemistry** Introduction, Classification and role of metal ions according to their action in biological system, Effect of metal ion concentration and its physiological effect, Basic principles in the biological selection of elements, Oxygen transfer and storage: Heme and non-heme proteins, Haemoglobin and myoglobin as oxygen carriers, Structure and functions of Cytochromes, Cytochrome C and Hemerythrins. Biochemistry of Iron storage and Transport: Ferritin, Transferrin; Metal ion transport and storage: Siderophores and metallothionein; Electron Transfer: Cytochromes, Iron-Sulfur Proteins and Copper Proteins. Introduction to Ferredoxins, Blue copper proteins: Hemocyanin, Zinc protein (carbonic anhydrase), and Iron Sulfur proteins, Bioinorganic chemistry of cobalt: Vitamin B12, Bioinorganic chemistry of Magnesium, Chlorophyll, Mechanism of Photosynthesis I and II; Metal deficiency and disease, Toxic effects of metals.	25 %	15
3	**Inorganic Polymers** Definition of polymers and their depiction, Characteristics of inorganic polymer, Characterization of inorganic polymer by molecular weight, Number average and Weight average, Determination of molecular weight by Viscometry and Osmometry, Structural features of polymer: Backbone bonding, Branching and Cross-linking, Chemical and stereo chemical variability, Classification of inorganic polymer, Synthesis, properties, Structure and uses of polyphosphazene and polysiloxanes.	25 %	15

4	**Chemistry of Non-Transition Elements** Introduction, General discussion on the properties of the non-transition elements, Special feature of individual elements like Li and Be, Synthesis, properties and structure of their halides and oxides, Polymorphism of carbon, phosphorus and sulphur, Polyhedral borans, carboranes, Wade's rule, Borax and borazine molecule, Isolobal analogy, STYX number. Metalloboranes and metallacarboranes compounds with M-M multiple bonds, Synthesis, properties and structure of silicates, silicones, phosphazenes.	25 %	15

REFERENCE:

1. Chemical Applications of group theory by F. A. Cotton, Wiley Eastern Limited, 1976, New Delhi.
2. Group theory and its Applications by P. K. Bhattacharya, Himalaya Publishing House, Mumbai, 1986.
3. Group theory and symmetry by L. R. Hall, McGraw Hill, New York, 1989.
4. Chemical Application of Symmetry and Group theory by Rakshit Ameta & R. C. Ameta, CRC Press, 2017.
5. Symmetry & Spectroscopy of molecules by K. V. Reddy, New age International Publishers, New Delhi, 2009.
6. Bioinorganic Chemistry by R. W. Hay, Ellis Harwood, England, 1984.
7. Elements of Bioinorganic Chemistry, G. N. Mukherjee and A. Das, Dhuri& Sons, Calcutta, 1988.
8. A Guidebook to Biochemistry, J. M. D. Yudkin and R. E. Offord, Cambridge University Press, 1980.
9. A text book of Inorganic Polymers by G. R. Chatwal, Himalaya Publishing House, 2001.
10. Introductory polymer chemistry by G. S. Mishra, Wiley Estern limited, 1993. 3. Inorganic Polymers by J. E. Mark, H. R. Allcock& Robert West, Oxford University Press, 2005.
11. Inorganic Chemistry, J. E. Huheey, K. A. Keiter and R. L. Keiter, Harper Cottens College Publications, 1993.
12. Concise Inorganic Chemistry by J.D. Lee, Chapman & Hall, 1996

COURSE OUTCOMES:

Upon successful completion of the course,

•	Students will identify the molecule symmetry on basis of their geometry, also will attain knowledge of inorganic polymers, the metal ion their importance and toxicity, also study of phosphorus, boranes, like non transition elements

COURSE OUTCOMES MAPPING

Unit No.	Title of the Unit	Course Outcomes				
		CO 1	CO 2	CO 3	CO 4	CO 5
1	**Symmetry and Group Theory in Chemistry**					
2	**Bioinorganic Chemistry**					

3	**Inorganic Polymers**					
4	**Chemistry of Non-Transition Elements**					

COURSE ARTICULATION MATRIX

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1						
CO2						
CO3						
CO4						

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SCHOOL OF SCIENCE AND TECHNOLOGY
Department of Chemistry
M.Sc. Chemistry Program
Semester I

CH21270 : ORGANIC CHEMISTRY-I

Credit 4 **Contact Hour per week: 4**

Outline of the Course:

Course type	Theory
Purpose of Course	Higher study in chemistry is a current need of the competitive environment. The M.Sc. Chemistry and chemistry programmes provides knowledge and skill-based training to the students to flourish in research and in the professional career. The course offers a deep understanding of concept, theory and experiments that make students reach knowledge of chemistry. The dissertation in the end semester provides a research environment for the student to build a career in the research field.
Course Objective	CO 1. To be able to understand preparation and reactions of selected intermediates in organic chemistry CO 2. To understand concepts and applications of substitution and elimination reactions and its stereochemistry aspects. CO 3. To understand aromaticity and application in chemistry. CO 4. To study different Conformations and conformational analysis of acyclic and cyclic molecules. CO 5. To learn the importance and basics of dynamic stereochemistry and asymmetric synthesis.
Minimum weeks per Semester	15 (Including Class work, examination, preparation, holidays etc.)
Last Review / Revision	August 2023
Pre-requisite	Elementary knowledge of Chemistry
Teaching Methodology	Class Room Teaching, Use of ICT, Class exercise, Discussion and Assignment
Evaluation Method	40% Continuous Assessment (CA) 60% End Semester Examination (ESE)

Course Content:

Units	Particulars	% Weightage of Unit	Minimum Nos. of Hours
1	**Reaction Mechanism & Reactive Intermediates** Detailed study of organic reaction intermediates. Generation, structure, stability and reactions of – Carbocations (Classical and non-classical): Phenonium ion, norbornyl system, common carbocation rearrangements- Demjanov, Pinacole-Pinacolone, Rupe. Carbanions: Mechanism of condensation involving enolates - Aldol, Claisen, Mannich, Dieckmann, and Shapiro reactions. Carbenes: Mechanism of Arndt-Eistert reaction, Reimer-Tiemann reaction and Bamford Steven's rearrangement reaction. Free Radicals: Allylic halogenation (NBS), coupling of alkenes and arylation of aromatic compounds by diazonium salts. Sandmeyer reactions. Free radical rearrangements, Hunsdiecker reaction.	25 %	15
2	**Substitution and Elimination Reactions** Mechanisms for nucleophilic substitution at saturated carbon atoms, SN^1, SN^2, SN^i reaction, Contrasts between SN^1 and SN^2, The leaving group, Solvent and Nucleophiles in SN^1 and SN^2 reactions, Reactions of Allylic halides, neighbouring group participation by -OH, $-NH_2$, -COO-, -RS, - halogen, aromatic ring. Aromatic Nucleophilic Substitution: The SN_2, SN_1 and benzyne mechanisms, Reactivity - effect of substrate structure, leaving group and attaching nucleophile, The Von Richter rearrangement. Elimination reaction: Hoffmann and Zaitsev's rule of elimination, E_1, E_2 and E_1CB Reaction mechanism and orientation.	25 %	15
3	**Aromaticity** Benzene and aromaticity: Sources and Names of Aromatic Compounds, Structure and Stability of Benzene, Aromaticity, Frost circle diagram, heat of hydrogenation; Huckel's rule; HMO method, Aromatic ions, Aromatic Heterocycles: Pyridine and Pyrrole, Polycyclic Aromatic, Compounds, Spectroscopy of Aromatic Compounds, Antiaromaticity, homoaromaticity, non aromaticity; aromaticity in benzenoid compounds, Aromaticity non-benzenoid compounds	25 %	15
4	**Stereochemistry** Enantiomers and Distereomeric the Tetrahedral Carbon, Sequence Rules for Specifying Configuration (R-S and E-Z nomenclature), Chirality, Optical Activity, Meso Compounds, Racemic Mixtures and the Resolution of Enantiomers, Optical activity in the absence of chiral carbons biphenyl, allenes, spiranes, Chirality at Nitrogen, Phosphorus, and Sulfur, Prochirality, Stereo selective and Stereo specific reactions. Interconversion of Fischer, Newman and Sawhorse projections. Newer method of asymmetric synthesis (including enzymatic and catalytic nexus), enantio and diastereo selective synthesis. Conformational Analysis: Bond rotation allows chains of atoms to	25 %	15

	adopt, a number of conformations Conformation and configuration Barriers to rotation Conformations of ethane, propane, butane Ring strain A closer look at cyclohexane, Substituted cyclohexanes, Decalins. Effects of conformation on reactivity in acyclic compounds and substituted cyclohexanes.		

REFERENCE:

1. Reaction Mechanism in Organic Chemistry by S. M. Mukherji and S. P. Singh (McMillan India Ltd., 1976).
2. Organic chemistry 2nd ed. Jonathan Clayden, Nick Greeves, Stuart Warren.
3. March's Advanced Organic Chemistry Reactions, Mechanisms, And Structure 7th ed. 2013 Michael B. Smith. Wiley.
4. Advanced Organic Chemistry Part A: Structure and Mechanisms by Carey & Sundberg (5th edition),2000, Springer.
5. A GuideBook to Mechanism in Organic Chemistry, Peter Sykes, Longman.
6. Reaction mechanism by Jagdambasingh.
7. Organic chemistry - Reaction mechanism, by P.S. Kalsi, New age international publishers.
8. Basic organic stereochemistry; By Ernest Ludwig Eliel, Samuel H. Wilen, Michael P. Doyle, Published by Wiley-Inter Science.
9. Stereochemistry of Organic Compounds: Principles and Applications; By D. Nasipuri, New Age International (P) Ltd. Publisher.

COURSE OUTCOMES:

Upon successful completion of the course,

●	Students will gain the understanding of major concepts, theoretical principles and chemistry of selected intermediates
●	Students will be able to understand many name reactions and their mechanism incorporated selected intermediates
●	Students are able to know about detailed concepts of substitution and elimination reaction and their mechanisms.
●	Students can gain knowledge about aromaticity and its theories.
●	Students are capable of understanding the concepts of advanced stereochemistry.

COURSE OUTCOMES MAPPING

Unit No.	Title of the Unit	Course Outcomes				
		CO 1	CO 2	CO 3	CO 4	CO 5
1	**Reaction Mechanism & Reactive Intermediates**					
2	**Substitution and Elimination Reactions**					
3	**Aromaticity**					
4	**Stereochemistry**					

COURSE ARTICULATION MATRIX

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1						
CO2						
CO3						
CO4						

VANITA VISHRAM WOMEN'S UNIVERSITY, SURAT
SCHOOL OF SCIENCE AND TECHNOLOGY
Department of Chemistry
M.Sc. Chemistry Program
Semester I

CH21280 : PHYSICAL CHEMISTRY-I

Credit 4 **Contact Hour per week: 4**

Outline of the Course:

Course type	Theory
Purpose of Course	Higher study in chemistry is a current need of the competitive environment. The M.Sc. Chemistry and chemistry programmes provides knowledge and skill-based training to the students to flourish in research and in the professional career. The course offers a deep understanding of concept, theory and experiments that make students reach knowledge of chemistry. The dissertation in the end semester provides a research environment for the student to build a career in the research field.
Course Objective	CO1. Familiar with a basic knowledge of the thermal properties of polymers, aspects of crystallization kinetics, glass transition; to teach how these properties depend on structure. ▪ CO2. To understand the different theories of chemical kinetics. CO3. To study thermodynamic properties of partial molar properties. CO4. Provide students with fundamentals of colloidal chemistry.
Minimum weeks per Semester	15 (Including Class work, examination, preparation, holidays etc.)
Last Review / Revision	August 2023
Pre-requisite	Elementary knowledge of Chemistry
Teaching Methodology	Class Room Teaching, Use of ICT, Class exercise, Discussion and Assignment
Evaluation Method	40% Continuous Assessment (CA) 60% End Semester Examination (ESE)

Course Content:

Units	Particulars	% Weightage of Unit	Minimum Nos. of Hours
1	**Polymer Chemistry** Types of polymers, Stereochemistry of polymers, Mechanism of polymerization (free radical, anionic and cationic), Kinetics of free radical polymerization, Thermodynamics of polymerization, Phase techniques of polymerization (Bulk, solution, suspension and emulsion), Number & mass average molecular mass, Molecular mass determination (Osmometry and Viscometry), Thermal transitions in polymer: glass transition temperature and its significance, Numericals	25 %	15
2	**Chemical Kinetics** Collision theory of reaction rates, steric factor, activated complex theory, ionic reactions, Factors affecting reaction rates in solution. Effect of ionic strength on the rate constant. Kinetics and mechanism of following complex reactions in details: i) Reversible, ii) Parallel, iii) Consecutive, iv) Chain and v) Enzyme catalysed reactions, Photochemical reactions (Hydrogen-bromine and hydrogen-chlorine reactions), Numericals.	25 %	15
3	**Thermodynamics** Partial molar properties: Partial molar free energy, Partial molar volume, Partial molar heat content, Chemical Potential, and their significances, determination of these quantities. Non-ideal systems: Basic idea on Excess functions of non-ideal solutions Thermodynamic probability and most probable distribution, Boltzmann Distribution law, Partition function and its significance, Rotational, Vibrational & translational: Relation between Partition function and entropy. Partition function and equilibrium constant, Partition function and heat content, Numericals.	25 %	15
4	**Colloids** Introduction, lyophilic and lyophobic, sols or colloids, characteristics of lyophilic and lyophobic sols, preparation of sols dispersion methods, aggregation methods, purification of sols, dialysis, electrodialysis, ultrafiltration, optical properties of sols, tyndall effect, kinetic properties of sols, Brownian movement, electrical properties of sols, electrical double layer, electrophoresis, electro-osmosis, coagulation, gold number, stability of sols	25 %	15

REFERENCE:

1. Physical Chemistry, P. W. Atkins, 6th Edition, ELBS.
2. Physical Chemistry by Protuon and Marron
3. A Textbook of Physical Chemistry, Vol. 4, K. L. Kapoor, McMillan, 1985
4. Essentials of Physical Chemistry by Arun Bahl and B.S. Bahl
5. Textbook of Polymer Science by Billmeyer Wiley.
6. Introduction to Polymer Chemistry by A.M. Lesk, Prentice – Hall Inc., 1982.
7. Introduction to Polymer Science, V. R. Gowarikar, N. V. Vishwanathan & J. Sridhar, Wiley
8. Principles of Polymer Science P. Bahadur and N. V. Sastry, Narosa 2006.
9. Chemical Kinetics, K. J. Laidler, 3rd Edition, Harper and Row, 1987.
10. Basic Chemical Kinetics by G. L. Agrawal
11. Chemical Kinetics, Ira N. Levine, Prentice Hall.
12. Thermodynamics of Chemist, Glasstone, Van Nostrand Co.
13. Statistical Thermodynamics by Gupta M.C.
14. Thermodynamic Properties of Non-electrolyte Solutions by W.E. Acree, Academic Press,
15. Introduction to Colloid and Surface Chemistry by Shaw.

COURSE OUTCOMES:

Upon successful completion of the course, the learner shall be able to:

CO 1	Explain thermal properties of polymers, crystallization kinetic and understand how these properties depend on the structure of polymers.
CO 2	Solve questions basis on rates of different reactions
CO 3	Able to understand detailed concepts of thermodynamics.
CO 4	Explain the main concepts of colloidal solution

COURSE OUTCOMES MAPPING

Unit No.	Title of the Unit	Course Outcomes			
		CO 1	CO 2	CO 3	CO 4
1	**Polymer Chemistry**				
2	**Chemical Kinetics**				
3	**Thermodynamics**				
4	**Colloids**				

COURSE ARTICULATION MATRIX

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1						
CO2						
CO3						
CO4						

VANITA VISHRAM WOMEN'S UNIVERSITY, SURAT
SCHOOL OF SCIENCE AND TECHNOLOGY
Department of Chemistry
M.Sc. Chemistry Program
Semester I

CH21290 : ANALYTICAL CHEMISTRY - I

Credit 4 **Contact Hour per week: 4**

Outline of the Course:

Course type	Theory
Purpose of Course	The course aims to equip students with essential skills in chemical analysis and data interpretation. Through practical applications and theoretical learning, students will grasp the principles of analytical techniques, including UV-Visible Spectrophotometry, Thermo-gravimetric Analysis (TGA), and Thermometric Titration (TT). Emphasis will be on safe laboratory practices, problem-solving abilities, and effective communication of results. By course completion, students will be well-prepared for advanced Analytical Chemistry studies and future careers in scientific research and various industries.
Course Objective	CO1. Understand the role, types, and methods of Analytical Chemistry, and select appropriate methods for various analytical problems. CO2. Demonstrate safe laboratory practices, handle reagents, and prepare samples, while maintaining accurate records and performing basic quantitative analysis. CO3. Gain comprehensive knowledge of UV-Visible Spectrophotometry principles, including electronic transitions, spectral effects, while understanding the impact of solvents and mastering the instrumentation and sampling techniques. CO4. Acquire the knowledge of the principles of solvent extraction, including the distribution law and the various extraction processes CO5. Learn and apply the principles and applications of Thermal Method of Analysis, focusing on Thermo-gravimetric Analysis and Thermometric Titration.
Minimum weeks per Semester	15 (Including Class work, examination, preparation, holidays etc.)
Last Review / Revision	August 2023
Pre-requisite	Elementary knowledge of Chemistry
Teaching Methodology	Class Room Teaching, Use of ICT, Class exercise, Discussion and Assignment
Evaluation Method	40% Continuous Assessment (CA) 60% End Semester Examination (ESE)

Course Content:

Units	Particulars	% Weightage of Unit	Minimum Nos. of Hours
1	**Introduction and Basic Tools of Analytical Chemistry** Role of Analytical Chemistry, Type of Analysis, Analytical Methods, Classification of Classical and Instrumental Method of Analysis, Selecting an Analytical Method, Steps involved in Quantitative analysis, Neatness and cleanliness of laboratory, selecting and handling of reagents, Organic reagents used in inorganic analysis, Safety in the laboratory, Handling of laboratory notebook, laboratory Operation and Practises, Sample handling and sample preparation.	25 %	15
2	**UV-Visible Spectrophotometry** Types of electronic transition, auxochrome, chromophore, Bathochromic effect, Hypso chromic effect, Hyper chromic effect, Hypo chromic effect, Factor affecting lambda max like resonance, hyper conjugation, hydrogen bonding, steric effect, Woodward's rules for α, β-unsaturated ketones, Diene systems, aromatic system, Effect of solvent on absorption bands, law of absorption with derivation, Instrumentation, Sampling, Application.	25 %	15
3	**Solvent Extraction** The distribution Law, Extraction Process, Extractants, factor Affecting Extraction, Technique for Solvent Extraction, The Distribution Coefficient, The Distribution Ratio, Mechanism of Extraction; weak Acids and bases, Extraction of a metal as chelate compound, Extraction involving Ion pairs and solvates, Craig Counter Current Extraction and its apparatus, Numerical.	25 %	15
4	**Thermal Method of Analysis** Introduction, Type of Thermal Analysis, Thermo-gravimetric Analysis, Instrumentation, Thermo-balance, Furnace, Programmer, Sample, Crucible, Temperature Calibration, The atmosphere, Thermo-gravimetric analysis of various samples. Thermometric Titration (TT), Introduction, Instrument, Applications of Thermometric Titration.	25 %	15

REFERENCE:

1. Instrumental Method of Chemical Analysis by G. R. Chatwal and S. K. Anand
2. Quantitative Analysis by R. A. Day & A. L. Underwood, 6 th ed. Pub. Prentice Hall of India ltd,.
3. Analytical Chemistry by Gary D. Christian
4. Instrumental Analysis by Willard, Merritt, Dean and Settle
5. Vogel's Textbook of Quantitative Chemical Analysis, Fifth Edition.
6. Chromatography Concept and Contrast, James M. Miller
7. Introduction to Spectroscopy By Pavia, Lampman, Kriz, Vyvyan
8. Thermal Methods of Analysis Principles, Applications and Problems by P. J. Haines
9. Thermometric Titrimetry by L. S. Bark, S. M. Bark, R. Belcher and H. Freise
10. Instrumental Methods of Chemical Analysis by B.K. Sharma

11. Analytical Chemistry by Alka L. Gupta
12. Organic Spectroscopy Principle and application by Jag Mohan
13. Spectroscopy by H. Kaur, Pragati Prakashan

COURSE OUTCOMES:

Upon successful completion of the course, the learner shall be able to:

CO 1	Able to understands method development steps of an Analysis
CO 2	Apply the knowledge of spectral data to identify the compounds
CO 3	Able to understand the thermal method of analysis for gravimetry and titration.

COURSE OUTCOMES MAPPING

Unit No.	Title of the Unit	Course Outcomes		
		CO 1	CO 2	CO 3
1	Introduction and Basic Tools of Analytical Chemistry			
2	UV-Visible Spectrophotometry			
3	Solvent Extraction			
4	Thermal Method of Analysis			

COURSE ARTICULATION MATRIX

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1						
CO2						
CO3						

VANITA VISHRAM WOMEN'S UNIVERSITY, SURAT
SCHOOL OF SCIENCE AND TECHNOLOGY
Department of Chemistry
M.Sc. Chemistry Program
Semester I

CH21300: INORGANIC & ORGANIC CHEMISTRY PRACTICAL -I

Credit 4 **Contact Hour per week: 8**

Outline of the Course:

Course type	Practical
Purpose of Course	Higher study in chemistry is a current need of the competitive environment. The M.Sc. Chemistry and chemistry programmes provides knowledge and skill-based training to the students to flourish in research and in the professional career. The course offers a deep understanding of concept, theory and experiments that make students reach knowledge of chemistry. The dissertation in the end semester provides a research environment for the student to build a career in the research field.
Course Objective	CO1. Student will be able to learn Inorganic Qualitative Analysis of of mixture having 3 positive and 3 negative radical CO2. To understand the separation techniques of organic mixtures CO3. Identification of organic molecules through different reactions. CO4. Purification of compounds through the crystallization and its derivatization.
Minimum weeks per Semester	15 (Including Class work, examination, preparation, holidays etc.)
Last Review / Revision	August 2023
Pre-requisite	Elementary knowledge of Chemistry Practicals
Teaching Methodology	Class Room Teaching, Use of ICT, Class exercise, Discussion and Assignment
Evaluation Method	40% Continuous Assessment (CA) 60% End Semester Examination (ESE)

Course Content:

Unit	Experiments
I	**Inorganic Qualitative Analysis:** (Minimum 5 Separations) Mixture having 6 radical 3 positive, 3 Negative including 2 less familiar from the following: (1) Molybdenum (2) Tungsten (3) Lithium (4) Thorium (5) Zirconium (6) Cerium (7) Vanadium (8) Beryllium
II	**Inorganic Preparation:** (Minimum 4 preparation) i. Hexa-amine nickel (II) chloride ii. Mohr's salt (Ferrous Ammonium sulfate) iii. Sodium trioxalato ferrate trihydrate iv. Sodium cobaltinitrite v. Tetraamine cupric sulfate vi. Reineek's salt (Ammonium tetrathiocyanate diamine Chromate)
III	**Organic Qualitative Analysis :** (Minimum 6 separation) Qualitative analysis of given organic mixture: (Minimum eight mixtures) Tertiary mixture to be given. (S+S+S), Semisolids or (L+L+L). Type determination. Separation by physical and chemical methods. (both permitted in case of liquids)
IV	**Thin Layer Chromatography** (Minimum 2)

REFERENCE:

1. Quantitative Chemical Analysis, R.B. Fischer and D.G. Peters, 3rd Edition, D.B. Saunders Company, 1968 or latest edition.
2. Laboratory directions for analytical separation and determinations, C.T. Kenner, MacMillan Company, New York, 1971.
3. Inorganic Qualitative analysis, A.I. Vogel, 5th Edition, ELBS/ Longman, 1989.
4. ogel's text books of Quantitative Chemical Analysis, Revised by G.H. Jeffery, J. Bassett, J. Mendham and R.C. Danney, Fifth Edition, ELBS/ Longman, 1989.
5. Spot tests in inorganic analysis, F. Feigel, 5th Edition, Elsevier (1958).
6. Colorimetric methods of analysis, Snell and Snell, D. Van Nostrand, latest edition. E.D.T.A. titrations, latest edition, Fleshka, Pergamon process.
7. A text book of practical organic chemistry – A. I. Vogel
8. Practical organic Chemistry – Mann and Saunders
9. A handbook of quantitative and qualitative analysis – H. T. Clarke
10. Comprehensive Practical Organic Chemistry: Qualitative Analysis V K Ahluwalia & S. Dhingra.
11. Comprehensive Practical Organic Chemistry: Preparations and Quantitative Analysis V K Ahluwalia & R. Aggarwal Universities Press.
12. An Advance Course in practical Chemistry, A K. Nad, B. Mahapatra and A. Ghoshal

COURSE OUTCOMES:

Upon successful completion of the course, the learner shall be able to:

CO1	An ability to conduct experiments to develop intellectual and laboratory skills.
CO2	Impart skills and knowledge in compound estimate through preparatory tests including compound nature, colour, and solubility: dry and wet tests for acid, basic, and interfering radicals; radical removal; group separation; and group analysis.
CO3	The students can use their understanding of salt analysis to estimate the chemicals present in water, and other substances after developing their skills in this area.

COURSE OUTCOMES MAPPING

Unit No.	Title of the Unit	Course Outcomes		
		CO 1	CO 2	CO 3
1	Inorganic Qualitative Analysis			
2	Inorganic Preparation			
3	Organic Qualitative Analysis			
4	Thin Layer Chromatography			

COURSE ARTICULATION MATRIX

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1						
CO2						
CO3						

VANITA VISHRAM WOMEN'S UNIVERSITY, SURAT
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Department of Chemistry
M.Sc. Chemistry Program
Semester I

CH21310 : PHYSICAL AND ANALYTICAL CHEMISTRY PRACTICAL -I

Credit 4 **Contact Hour per week: 8**

Outline of the Course:

Course type	Theory
Purpose of Course	Higher study in chemistry is a current need of the competitive environment. The M.Sc. Chemistry and chemistry programmes provides knowledge and skill-based training to the students to flourish in research and in the professional career. The course offers a deep understanding of concept, theory and experiments that make students reach knowledge of chemistry. The dissertation in the end semester provides a research environment for the student to build a career in the research field.
Course Objective	CO1. Use of pH metry and potentiometry for titrations for suitable chemical reaction. CO2. Determination of CMC of a given surfactant by different physico-chemical methods. CO3. Verification of Onsager's equation by conductometry.
Minimum weeks per Semester	15 (Including Class work, examination, preparation, holidays etc.)
Last Review / Revision	August 2023
Pre-requisite	Elementary knowledge of Chemistry Practicals
Teaching Methodology	Class Room Teaching, Use of ICT, Class exercise, Discussion and Assignment
Evaluation Method	40% Continuous Assessment (CA) 60% End Semester Examination (ESE)

Course Content:

Physical Chemistry Practicals (Any Four)

1. Determine the dissociation constant of a given monobasic acid pH-metrically.
2. Determine the amount of ferrous sulphate / ferrous ammonium sulphate in a given flask potentiometrically using cerric salt solution.
3. Verification of Onsager's equation and determination of equivalent conductance at infinite dilution of strong electrolytes
4. Determine the CMC of a surfactant by conductivity measurements.
5. Calculate the molar absorptivity of each of the given two solutions (A) and (B) and also find out concentration of supplied unknown solution colorimetrically.
6. Investigation the reaction between K2S2O8 and KI at two different temperatures and calculate the energy of activation for the reaction.
7. To study the phase diagram of a three-component system Water – acetic acid – chloroform.

Analytical Chemistry Practicals (Any Four)

1. Analysis of Dolomite sample for its chemical constituent.
2. Analysis of Pyrolusite sample for its chemical constituent.
3. Determination of Ka1 and Ka2 of phosphoric acid by pH metry
4. Simultaneous determination of Cr+3 & Co+2 in a mixture.
5. Spectrophotometric determination of the Fe+3 ion concentration with 1,10 Phenanthroline using calibration curve method.
6. Experiment for mole ratio method or Job's method to study the metal ligand mole composition of complexes.
7. To separate a mixture of Ni+2 & Fe+2 by complexation with DMG and extracting the Ni2+-DMG complex in chloroform, and determine its concentration by spectrophotometry.

REFERENCE:

1. Advanced Physical Chemistry Practicals by J. B. Yadav
2. Vogel's Textbook of Quantitative Chemical Analysis, Fifth Edition.

COURSE OUTCOMES:

Upon successful completion of the course, the learner shall be able to:

CO 1	Find dissociation constant of a given acid and amount of complex salt by suitable methods.
CO 2	Understand the micellization process and can find the CMC of a given surfactant.
CO 3	Study and analyse the phase diagram of a three-component system.

COURSE OUTCOMES MAPPING

Unit No.	Title of the Unit	Course Outcomes		
		CO 1	CO 2	CO 3
1	Physical Chemistry Practicals			
2	Analytical Chemistry Practicals			

COURSE ARTICULATION MATRIX

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1						
CO2						
CO3						

12 Teaching Methodology

A teaching method comprises the principles and methods used by teachers to enable student learning. In order to achieve its objective of focused process- based learning and holistic development, the teacher/faculty may use a variety of knowledge delivery methods:

12.1 Lectures/Class works:

Lectures should be designed to provide the learners with interesting and fresh perspectives on the subject matter. Lectures should be interactive in a way that students work with their teachers to get new insights in the subject area, on which they can build their own bridges to higher learning. Classwork has the ability to enhance relationships between teachers and students. Create goal- oriented tasks for students to prepare and enable self-learning.

12.2 Discussions/ Seminars/Presentation:

Discussions / seminars / presentation are critical components of learning and can be used as a platform for students to be creative and critical with old and new ideas. Besides developing critiquing skills, arriving at consensus on various real-life issues and discussion groups lead to innovative problem-solving and ultimately to success.

12.3 Case Studies/ Self-Study:

Real case studies, wherever possible, should be encouraged in order to challenge students to find creative solutions to complex problems of individual, community, society and various aspects of the knowledge domain concerned. Technology is transforming higher Education learning and teaching through various case studies to improve overall standards.

12.4 Practical/Problem sheet:

Practical ability is the essential requirement for computer science undergraduates' ability structure, and it emphasizes that computer science undergraduates should have a good grasp of theory from practice and then apply the theory to practice, improving them own software developing skills and employability.

12.5 Assignments:

Computer science assignments not only help students overcome their fear and stress but also help them learn more interesting facts about the subjects of computer science which are part of their syllabus and also out of curriculum.

12.6 Industrial Tours:

Computer Science students have to know the things practically through interaction, working methods and employment practices. Moreover, it gives exposure from an academic point of view. Main aim of the industrial visit is to provide an exposure to students about the practical working environment.

12.7 Team Work:

Teamwork based projects challenge the student to apply the technical knowledge they gain in college to solve meaningful and complex problems. Positive collaboration in the form of team work is critical in the classroom environment, for which it is necessary to transcend one's prejudices and predilections so as to achieve the desired outcomes. In the process of teamwork, learners will acquire the skills of managing knowledge acquisition and other collaborative learners, thereby understanding how to incorporate and balance personalities.

13 Keywords

- Masters of Science (M.Sc.) in Chemistry
- Symmetry
- Bioinorganic Chemistry
- Non-Transition Elements
- Aromaticity
- Stereochemistry
- Chemical Kinetics

- Colloids
- Thermodynamics
- Analytical Chemistry
- UV-Visible spectroscopy
- TGA