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

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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 abilities, 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:

<table>
<tr><td>Course Level</td><td colspan="7">PG</td></tr>
<tr><td>Program</td><td colspan="7">Postgraduate in Science</td></tr>
<tr><td>Duration</td><td colspan="7">2 years (4 semesters)</td></tr>
<tr><td>Examination Type</td><td colspan="7">Semester system (1-4 semesters)</td></tr>
<tr><td>Intake</td><td colspan="7">40</td></tr>
<tr><td>Eligibility</td><td colspan="7">Master degree in Chemistry</td></tr>
<tr><td rowspan="7">Mapping between POs and PSOs</td><td></td><td>PSO 1.</td><td>PSO 2.</td><td>PSO 3.</td><td>PSO 4.</td><td>PSO 5.</td><td>PSO 6.</td></tr>
<tr><td>PO 1.</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>PO 2.</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>PO 3.</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>PO 4.</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>PO 5.</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>PO 6.</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Job Positions</td><td colspan="7">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.</td></tr>
</table>

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)**	**Project/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	**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 2

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
2	Inorganic Chemistry-II (Th)	-	-	-	06
	Organic Chemistry-II (Th)				
	Physical Chemistry-II (Th)				
	Analytical Chemistry-II (Th)				
	Inorganic & Organic Chemistry Practical-II (Pr)				
	Physical & Analytical Chemistry Practical-II (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							Total Credit
				Contact Hours					CCE		SEE				CCE		SEE				
				Theory	Practical	Total	Total Credit	Credit	Max.	Passing	Max.	Passing	CCE+SEE Passing	Credit	Max.	Passing	Max.	Passing	CCE+SEE Passing	Total	
II (Chemistry)	CH21320	CC	Inorganic Chemistry-II (Theory)	4	0	4	4	4	40	16	60	24	40	0	0	0	0	0	0	100	4
	CH21330	CC	Organic Chemistry-II (Theory)	4	0	4	4	4	40	16	60	24	40	0	0	0	0	0	0	100	4
	CH21340	CC	Physical Chemistry-II (Theory)	4	0	4	4	4	40	16	60	24	40	0	0	0	0	0	0	100	4
	CH21350	CC	Analytical Chemistry-II (Theory)	4	0	4	4	4	40	16	60	24	40	0	0	0	0	0	0	100	4
	CH21360	CC	Inorganic Chemistry & Organic Chemistry Practicals-II (Practical)	0	8	8	4	0	0	0	0	0	0	4	40	16	60	24	40	100	4
	CH21370	CC	Physical Chemistry & Analytical Chemistry Practicals-II (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 II

CH21320: INORGANIC CHEMISTRY-II

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. Study of magnetic nature, their types, determination of magnetic susceptibilities CO 2. Gaining of idea based on Coordination of metal complex, Metal carbonyls: Classification, Bonding in metal carbonyls CO 3. Detailed study based on organometallic compounds, its rules and types. CO 4. Detailed study about inorganic reaction mechanism.
Minimum weeks per Semester	15 (Including Class work, examination, preparation, holidays etc.)
Last Review / Revision	August 2023
Pre-requisite	● Magnetic properties, and its method. ● Different carbonyls compounds, calculation based on CFSE ● Organometallic study of complex ● Basic inorganic reaction mechanism.
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	**Magnetic properties and electronic spectra of transition metal complex** Definition of magnetic properties, Types of magnetic bodies, The source of paramagnetism, Diamagnetism and Pascal's constant, example of Pascal's constant, Curie and Curie-Weiss law, Magnetic properties of transition elements, Determination of magnetic susceptibility by Gouy method, Faraday method and Null deflection method, Application of magnetic susceptibility measurements, Temperature-independent Paramagnetism, Orbital contribution to magnetic moment, Calculation of spin magnetic moment, Anomalous magnetic moment, Magnetic exchange coupling and Spin Crossover. Magnetic properties of inner transition metal complexes and their spin & orbital moments. Electronic spectra of metal complexes: La Porte rule, Tanabe-Sugano diagram and Orgel diagram for transition metal complex, Charge transfer spectra, Spectroscopic ground state.	25 %	15
2	**Coordination Chemistry of Metal Complexes** Crystal field theory: Crystal field effects in octahedral, tetrahedral, square planar, square pyramidal and trigonal bipyramidal complexes, Crystal Field Stabilization Energy (CFSE), Calculation of Crystal Field Stabilization Energies, Factors affecting crystal field splitting energies, Spectrochemical series: Jahn-Teller effect, Nephelauxetic effect, Ligand Field Theory, Term Symbols, Russell-Saunders coupling. Metal carbonyls: Classification, Bonding in metal carbonyls, Effective Atomic Number rule, Vibrational spectra of metal carbonyls for bonding and structural elucidation, Structure of mononuclear metal carbonyls like $Ni(CO)_4$ and $Cr(CO)_6$, Structure of polynuclear metal carbonyls like $Mn_2(CO)_{10}$ and $Fe_3(CO)_{12}$.	25 %	15
3	**Organometallic Chemistry** Classification, Unique reactions in organometallic chemistry like oxidative addition, migratory insertion and reductive elimination, Synthesis of organometallic compounds, Calculation of 18 electron rule and metal-metal bond, Fluxionality of complexes, Metal olefins: Zeiss's salt, Metallocene: Synthesis and electrophilic substitution reactions, Application of organometallic compound in homogeneous catalysis like Monsanto acetic acid synthesis, Cativa process, Hydroformylation reaction, Catalytic deuteration of benzene, Catalytic hydrogenation and Catalytic hydrocyanation of alkene, Wacker(Smith) process and in heterogeneous catalysis like Application of organometallic compounds in the production of speciality chemicals.	25 %	15

4	**Inorganic Reaction Mechanism** Ligand substitution reactions, Rates of ligand substitution, The classification of mechanisms, ligand substitution in square-planar complexes, the nucleophilicity of the entering group, the shape of the transition state, ligand substitution in octahedral complexes, rate laws and their interpretation, the activation of octahedral complexes, base hydrolysis, stereochemistry, isomerization reactions, redox reactions, the classification of redox, reactions, the inner-sphere mechanism, the outer-sphere mechanism.	25 %	15

REFERENCE:

1. Introduction to magnetochemistry by A. Earnshaw, Elsevier, 2013.
2. Elements of Magnetochemistry by R. L. Dutta, A. Syamal, Affiliated East-West Press, 1993.
3. Inorganic Chemistry, J.E. Huheey, K.A.Keiter and R.L.Keiter, Harper Cotton College Publications, 1993.
4. Concise Inorganic Chemistry by J.D. Lee, Chapman & Hall, 1996.
5. Principles of inorganic chemistry by B.R. Puri, L.R. Sharma & K.C. Kalia, Milestone Publishers, 2017.
6. Introduction to Coordination Chemistry by G. A. Lawrance, John Wiley & Sons, 2013.
7. Text Book of Coordination Chemistry by R. K. Sharma, Discovery Publishing House, 2007.
8. Inorganic Chemistry second edition by Catherine E. Housecroft and Alan G. Sharpe, Pearson, 2005.
9. Inorganic Chemistry by J. E .House, Academic Press, 2010.
10. Inorganic Chemistry by G. L. Miessler, P. J. Fischer, D. A. Tarr, Pearson, 2014.
11. Shriver and Atkins' Inorganic Chemistry by P. Atkins, T. Overton, OUP Oxford, 2010.
12. Concise coordination chemistry by M. J. Xavier, R. Gopalan, V. Ramalingam, Sangam Books Limited, 2001.
13. Organometallic Chemistry by R. C. Mehrotra, New Age International, 2007.
14. Basic Organometallic Chemistry: Concepts, Syntheses and Applications by B. D. Gupta, Universities Press, 2011.
15. The Organometallic Chemistry of the Transition Metals, R. H. Crabtree, John Wiley & Sons, 2014.
16. Organometallic Chemistry and Catalysis by D. SeeAstruc, Springer Science & Business Media, 2007.

COURSE OUTCOMES:

Upon successful completion of the course,

CO 1.	Students will gain the idea for determining the magnetic nature of the complex,
CO 2.	To understand the coordination numbers and geometric shapes of the complexes, recognize the ways of naming complexes and compare between the various theories of coordination.
CO 3.	Students will be able to know the nature of splitting of complexes and its energies, formation of organometallic compounds.
CO 4.	Obtain theoretical understanding of how inorganic reactions take place

COURSE OUTCOMES MAPPING

Unit No.	Title of the Unit	Course Outcomes			
		CO 1	CO 2	CO 3	CO 4
1	Magnetic properties and electronic spectra of transition metal complex				
2	Coordination Chemistry of Metal Complexes				
3	Organometallic Chemistry				
4	Inorganic Reaction Mechanism				

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 II

CH21330 : ORGANIC CHEMISTRY-II

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 5. Understanding the mechanism of organic reactions and its applications. CO 6. Basic oxidative addition, transmetallation, isomerization and reductive elimination used in organic reaction mechanism CO 7. Detailed concept of pericyclic reactions. (cycloaddition. electrocyclic, sigmatropic and group transfer reactions) CO 8. Chemistry of selected reagents and its usefulness in organic transformations. CO 9. Organic transformations using photochemistry (rearrangement, addition, cleavage, isomerization, dimerization reactions)
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	**Organic Name Reactions** General nature, method, mechanism and synthetic applications of the following reactions: (i) Johnson–Corey–Chaykovsky reaction (ii) Dakin reaction, (iii) Darzens glycidic ester synthesis, (iv) Wittig reaction (v) Willgerodt reaction, (vi) Peterson olefination (vii) H. V. Z. reaction, (viii) McMurry reaction (ix) Corey-Fuchs reaction (x) Michael addition (xi) Ugi reaction (xii) Mannich reaction	25 %	15
2	**Pericyclic Reaction** Introduction - Definition, Characteristics and Classification Molecular orbitals and symmetry properties of ethylene, 1,3-butadiene, 1,3,5- hexatriene and allyl systems. Electrocyclic Reactions: Woodward-Hoffmann Correlation diagram and derivation of selection rules, Conrotatory and disrotatory motions, FMO and PMO approach for 4n and (4n+2) Pi electron system and allyl systems. Cycloaddition Reactions: Antarafacial and suprafacial additions. FMO and PMO approach for 4n and (4n+2) Pi electron Systems (No correlation diagram), Diels-Alder reaction, stereoselectivity, Effect of substituents. Sigmatropic rearrangements: Suprafacial and antarafacial shifts involving H & C moieties, retention and inversion of configurations. The Cope and Claisen rearrangements, Ene reaction, 1, 3- dipolar cycloadditions. Examples of electrocyclic, cycloaddition and sigmatropic rearrangements.	25 %	15
3	**Organic Transformation and Reagents** I. Sharpless epoxidation II. Umpolung reagent (1,3-dithiane) III. Dess martin periodinane IV. DDQ V. Tri-n-butyltin hydride $(C_4H_9)_3SnH$ VI. Diisobutyl aluminum hydride (DIBAL-H) VII. Lithium diisopropylamide (LDA) VIII. OZONE IX. Crown ethers X. Wilkinson's Catalyst	25 %	15
4	**Photochemistry** A. Energy of molecules, photochemical energy, electronic excitation, Jablonski diagram, laws of photochemistry, quantum efficiency. B. Photochemistry of carbonyl compounds- α- cleavage of acyclic, cyclicand α-β unsaturated cleavage of carbonyl compounds, β-cleavage of, inter and intramolecular hydrogen abstraction, addition to carbon- carbon double bond, photo reduction of carbonyl compounds. C. Photo induce rearrangement of enones, dienones and alkenes. Photochemistry of alkenes and aromatic compounds- isomerization, dimerization and addition reactions.	25 %	15

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.

COURSE OUTCOMES:

Upon successful completion of the course,

CO 1.	Students will gain the understanding of major concepts, theoretical principles and chemistry of selected intermediates
CO 2.	Students will be able to understand many name reactions and their mechanism incorporated selected intermediates
CO 3.	Students are able to know about detailed concepts of substitution and elimination reaction and their mechanisms.
CO 4.	Students can gain knowledge about aromaticity and its theories.
CO 5.	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 II

CH21340 : PHYSICAL CHEMISTRY-II

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 understand the Debye Huckel Theory of ion-ion interactions. CO 2. To understand the concept of Quantum Mechanics in detail. CO 3. To study Isotopes Separation Methods, Particle Accelerators and Nuclear Projectiles. CO 4. Brief understanding of Surfactants.
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	**Electrochemistry** Debye-Huckel theory of interionic attraction (qualitative account only), relaxation effect and electrophoretic effect. Ionic strength, Activity coefficient and its determination by solubility and EMF method. Dissociation constant, relation between thermodynamic dissociation constant and dissociation function. Determination of dissociation constant of monobasic acid by conductance method and approximate EMF method, Numericals.	25 %	15
2	**Quantum Mechanics** Postulates, Schrodinger wave equation, I-D, 2-D, 3-D box, Simple Harmonic oscillator, Polar Coordinates of H-atom, separation of variables, Eigenvalue and eigen equation, expectation value, probability density, Ladders operator, ZPE, Slaters- Codon rule, Rigid rotator, ordinary angular Momentum, generalized angular momentum. Starks effect, Zeeman splitting.	25 %	15
3	**Nuclear Chemistry-II** (A) Isotopes Separation Methods: Stable and unstable isotopes, separation of isotopes by different methods, gaseous diffusion, thermal diffusion, distillation, chemical exchange methods, Bainbridge velocity focusing mass spectrograph, Dempsters direction focusing mass spectrograph (B) Particle Accelerators: Linear accelerator, Cyclotron, Numerical problems on Cyclotron (C) Nuclear Projectiles: particles used as projectiles, Merits and demerits of different projectiles	25 %	15
4	**Surfactants** Surface active agents, classification of Surface active agents, micellization, hydrophobic interaction, critical micellar concentration (CMC), factors affecting the CMC of surfactants, Krafft point and cloud point, counter ion binding to micelles, thermodynamics of micellization-mass action and phase separation model, solubilization, microemulsion, reverse micelles.	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 A. S. Bhal and G. D. Tuli, Pub : S. Chand
5. Modern Electrochemistry, Vol. 1 & 2, J.O.M. Bookris and A. K. N. Reddy.
6. Introduction to Electrochemistry by Glasstone.
7. Introduction to Molecular Spectroscopy, G. M. Barrow , McGraw – Hill.
8. R.M. Silverstein, G.C. Bassler & T.C. Morrill: Spectroscopic Identification of Organic Compounds, John Wiley & Sons.
9. Applications of absorption spectroscopy of organic compounds, John R. Dyer, Prentice

Hall India (2012).
10. Basic Principles of Spectroscopy, R. Chang, McGraw-Hill
11. Essentials of Nuclear Chemistry by H. J. Arnikar (Wiley Eastern Ltd., 1981).
12. Introduction to Colloid and Surface Chemistry by Shaw.
13. Micelles, Theoretical and Applied Aspects, V. Morol, Plenum.

COURSE OUTCOMES:

After completion the course, the learner shall be able to:

CO 1.	Explain qualitative interaction of ionic systems based on Debye-Huckel theory.
CO 2.	Having a detailed knowledge of quantum chemistry.
CO 3.	Knowledge for the separation of isotopes by different methods.
CO 4.	Study of Surfactants and their micellization process.

COURSE OUTCOMES MAPPING

Unit No.	Title of the Unit	Course Outcomes			
		CO 1	CO 2	CO 3	CO 4
1	Electrochemistry				
2	Quantum Mechanics				
3	Nuclear Chemistry-II				
4	Surfactants				

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 II

CH21350 : ANALYTICAL CHEMISTRY - II

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

Outline of the Course:

Course type	Theory
Purpose of Course	The purpose of this course is to provide students with a comprehensive understanding of analytical techniques essential in chemical analysis. Students will learn the principles and applications of IR Spectrophotometry, Liquid Chromatography (LC), Flame Emission Spectroscopy, and Water Pollutant Analysis. Through theoretical knowledge and practical experience, students will gain proficiency in interpreting IR spectra, performing LC analysis, using Flame Photometers, and assessing water quality. This course aims to equip students with essential skills for scientific research, industrial applications, and environmental analysis.
Course Objective	CO1. Understand the principles and instrumentation of IR Spectrophotometry, including single and double beam spectrophotometers, wave number measurement, and selection rules for vibrational frequencies. CO2. Analyze IR spectra and interpret functional groups, such as amino, carboxyls, hydroxyl, and ethers, to elucidate chemical structures. CO3. Differentiate between Normal and Reversed Phase Liquid Chromatography (LC), Low Pressure LC (LLC), and High Pressure LC (HPLC), and grasp the significance of each component in LC instrumentation. CO4. Comprehend the principles of Flame Emission Spectroscopy, including flame temperature, excitation, chemical reactions, and ionization in flames, and apply Flame Photometers and Flame Spectrophotometers for quantitative analysis. CO5. Evaluate water pollutants by measuring parameters like color, turbidity, conductivity, dissolved solids, acidity, alkalinity, hardness, chloride, sulfate, fluoride, phosphate, dissolved oxygen, chemical oxygen demand (COD), biochemical oxygen demand (BOD), and total organic carbon (TOC).
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	**IR Spectrophotometry** Theory, Instrumentation: single beam, double beam spectrophotometers, radiation sources, sample cells, monochromators, detectors, sample handling, Resolution, wave number measurement, Useful terms: IR region, types of vibrations: fundamental and overtones, linear and nonlinear molecule, equation for vibrational frequency, selection rule, coupling interactions, hydrogen bonding information, Fermi resonance. IR spectra: group frequency, group frequency region, fingerprint region, spectra interpretations (Amino, carboxyls, hydroxyl, ethers groups containing compounds) and structure elucidation. FTIR: principle, instrument design, and function of beam splitter, Advantages of FTIR vs. IR.	25 %	15
2	**Liquid Chromatography** Introductory Classification, Phase polarity: Normal Versus reversed, LLC, LSC, Law Pressure Vs High Pressure Liquid Chromatography, Isocratic and Gradient Elution, Stationary Phase, Mobile Phase, Classification of HPLC mode in brief, Instrumentation, and significance of each component, Sample introduction System, Pumps, Guard column, Detectors: UV absorption, RI detectors.	25 %	15
3	**Flame Emission Spectroscopy** Introduction, Principle, Flame and Flame Temperature, Excitation, Chemical reaction in flames, Ionisation in Flames, Spectra, Instrumentation, Flame Photometer, Flame Spectrophotometer, Factors affecting emission, Interference, Quantitative Analysis, Application and Limitation.	25 %	15
4	**Analysis of Water Pollutants** Objective of Water Analysis, Parameters of water analysis (Colour, Turbidity, Conductivity, Total Dissolved Solids, Acidity and Alkalinity, Hardness, chloride, sulphate, fluoride, phosphate), Measurement of dissolved oxygen, Chemical oxygen demand, Biochemical Oxygen Demand, Total Organic Carbon.	25 %	15
REFERENCE:			

1. Instrumental Analysis by Willard, Merritt, Dean and Settle
2. Principle of instrumental Analysis 7th edition by Skoog,holler and crouch
3. Instrumental Method of Chemical Analysis by G. R. Chatwal and S. K. Anand
4. Quantitative Analysis by R. A. Day & A. L. Underwood, 6 th ed. Pub. Prentice Hall of India ltd,.
5. Environmental Chemistry by Stanley E. Manhan
6. Analytical Chemistry by Gary D. Christian
7. Vogel's Textbook of Quantitative Chemical Analysis, Fifth Edition.
8. Chromatography Concept and Contrast, James M. Miller
9. Introduction to Spectroscopy By Pavia, Lampman, Kriz, Vyvyan
10. Thermal Methods of Analysis Principles, Applications and Problems by P. J. Haines
11. Thermometric Titrimetry by L. S. Bark, S. M. Bark, R. Belcher and H. Freise
12. Instrumental Methods of Chemical Analysis by B.K. Sharma
13. Analytical Chemistry by Alka L. Gupta
14. Organic Spectroscopy Principle and application by Jag Mohan
15. Spectroscopy by H. Kaur, Pragati Prakashan

COURSE OUTCOMES:

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

•	Able to understand fundamentals of IR spectroscopy and able to interpret spectral data.
•	Apply the knowledge of spectral data to identify the analytes
•	Able to understand the Emission spectroscopy and apply the knowledge to analyze water pollutants..

COURSE OUTCOMES MAPPING

Unit No.	Title of the Unit	Course Outcomes				
		CO 1	CO 2	CO 3	CO 4	CO 5
1	IR Spectrophotometry					
2	Liquid Chromatography					
3	Flame Emission Spectroscopy					
4	Analysis of Water Pollutants					

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 II

CH21360 : INORGANIC AND ORGANIC CHEMISTRY PRACTICAL -II

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. The course aims to equip students with practical skills in inorganic and organic chemistry CO2. Students will learn gravimetric and volumetric analysis techniques CO3. The course also covers the preparation of organic compounds through some key reactions. CO4. students will perform quantitative estimations of esters, formaldehyde, amides, and primary amines
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:

Inorganic Chemistry Practical (Credit 2)

1. Inorganic gravimetric estimation:

a. Estimation of Cu^{+2} as CuSCN
b. Estimation of Ca^{+2} as $CaC_2O_4.H_2O$
c. Estimation of Ba^{+2} as $BaSO_4$

2. Inorganic volumetric estimation (Any six)

a. Estimation of % Purity of Manganese Salt.
b. Estimation of Aluminium by back titration.
c. Estimation of Ca^{+2} and Pb^{+2} in the admixture.
d. Estimation of Carbonate-Bicarbonate in mixture using pH-meter.
e. Estimation of available chlorine (ClO^-) in bleaching powder.
f. Estimation of Iron in Iron Ore.
g. Estimation of Fe^{+2} and Cr^{+3} in the given admixture.
h. Analysis of Solder and Type metal (Alloy Analysis).

1. Preparation of organic compounds (Simple one or two step preparations involving different techniques) (Minimum six)

a. Diazotization reaction: Orange-I.
b. Friedl-Craft's reaction: Resacetophenone from Resorcinol.
c. Cannizzaro reaction: Benzoic acid from Benzaldehyde via KOH.
d. P-bromoaniline from Acetanilide via p-bromoacetanilide.
e. m-phenylenediamine from Nitrobenzene via m-dinitrobenzene.
f. β- Resorcilic acid from resorcinol.
g. P-chloro benzoic acid from p-toluidine via p-chloro toluene.
h. Aldol condensation: Chalcone from Benzaldehyde + Acetophenone (Claisen Schmidt reaction)
i. Gabriel phthalimide synthesis.
j. Preparation of Congo red dye from naphthionic acid via hydrozobenzene.

2. Quantitative Estimations: (Minimum three)

a. Estimation of ester + acid
b. Estimation of formaldehyde
c. Estimation of amide + acid
d. Determination of aromatic primary amines by either diazotization or indirect diazotization.
e. To determine the amount of acetamide in the given solution hydrolysis by NaOH.

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. Vogel'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

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

CH21370 : PHYSICAL AND ANALYTICAL CHEMISTRY PRACTICAL -II

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 / presentations 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
- Coordination Chemistry
- Organometallic
- Pericyclic reactions
- Organic Transformation
- Photochemistry
- Electrochemistry
- Nuclear Chemistry

- Chromatography
- Surfactant
- Spectrometry
- Pollutants