UPL -University of Sustainable Technology

SRICT Institute of Science & Research

Syllabus of 1st Year M. Sc. Chemistry

UPL UNIVERSITY OF SUSTAINABLE TECHNOLOGY

UPL University of Sustainable Technology

SRICT- Institute of Science & Research

AY-2025-2026

UPL -University of Sustainable Technology

SRICT Institute of Science & Research

UPL University of Sustainable Technology, Ankleshwar				
SRICT-Institute of Science and Research (SRICT-ISR)				
1st Year M. Sc. Chemistry				
SEM	**TYPE OF COURSE**	**COURSE CODE**	**NAME OF SUBJECT**	**Credits**
1	MAJOR	CHM400-4C	Reactive Intermediates	4
	MAJOR	CHM401-4C	Inorganic Chemistry	4
	MAJOR	CHM402-4C	Photochemistry & Quantum Mechanics	4
	MINOR	CHE400-4C	Practicals in Chemistry -V	4
	OJT	CHO400-4C	On Job Training-I	6
			Total Credits	22
2	MAJOR	CHM403-4C	Chemistry of Dyes & Dye Intermediates	4
	MAJOR	CHM404-4C	Unit Processes & Reagents	4
	MAJOR	CHM405-4C	Analytical Techniques	4
	MINOR	CHE402-4C	Practicals in Chemistry -VI	4
	OJT	CHO401-4C	On Job Training-II	6
			Total Credits	22

UPL -University of Sustainable Technology

SRICT Institute of Science & Research

Teaching/Exam Scheme

M. Sc. 1st Semester

Sr. No.	Course Code	Category of course	Course title	Hour s Per week			Total hrs.	Credits	CCE	SEE	Total Marks
				L	T	P					
1	CHM400-4C	Major Course	Reactive Intermediates	4		-	4	4	50	50	100
2	CHM401-4C	Major Course	Inorganic Chemistry	4		-	4	4	50	50	100
3	CHM402-4C	Major Course	Photochemistry & Quantum Mechanics	4		-	4	4	50	50	100
4	CHE400-4C	Minor Course	Practicals in Chemistry -V	-	-	8	8	4	50	50	100
5	CHO400-4C	OJT	On Job Training-I	-	-	-	-	6	75	75	150
			Total	12	-	8	20	22	200	200	550

UPL University of Sustainable Technology

SRICT Institute of Science & Research

Master of Science

Course Code: CHM400-4C

Course Name: Reactive intermediates

Semester:I

w.e.f.: July 2025

Type of course: Major Course

Prerequisite: Should have underlying knowledge of basics organic chemistry.

Rationale: At the end of the course, the students should be able to describe the basic understanding and concepts of organic reactive intermediate in chemistry, like Free radicals, Carbocation, Carbanions, Carbenes, Phosphorus ylides, Nitrenes, Enamines and Benzyne.

Teaching and Examination Scheme:

Credits				Examination Marks		Total Marks
L	T	P	Total	CCE Marks	SSE Marks	
4	-	-	4	50	50	100

Contents:

Sr. No.	Content	Total Hours
	SECTION - A	
1	**Free radicals** Introduction, Common features of intermediate, preparation, characteristics, stability, Allylic halogenation (NBS), Coupling of alkenes and arylation of aromatic compounds by diazonium salts. Sandmayer reactions. Free radical rearrangements, Hunsdicker reaction, Birch Reduction.	**9**
2	**Carbocation** Generation, structure, stability and reactions of – Carbocation: Classical and non-classical, Carbocation rearrangements- Demjanov, Pinacole-Pinacolone, Wagner-Meerwein rearrangement, Friedel-Crafts alkylation, Bayer-Villiger rearrangement	**9**
3	**Carbanions**	**12**

	Introduction, preparation, types, characteristics, stability, reactions involving Carbanions, Dieckmann reaction, Aldol condensation, Claisen condensation, Perkin reaction, Benzoin condensation,	
SECTION - B		
4	**Carbenes** Introduction, preparation, types, characteristics, stability, reactions involving Carbenes, Arndt-Eistert, Reimer-Tiemann, Simmons-Smith cyclopropanation, carbylamine reaction.	**9**
5	**Nitrenes** Introduction, preparation, characteristics, stability, reactions involving Nitrenes. Hoffmann, Curtius, Smidth, Lossen Rearrangements	**9**
6	**Enamines & Benzyne** Introduction, preparation, characteristics, stability, reactions involving Enamines & Benzyne. Mannich reaction, Pictet–Spengler reaction, Storke Enamines reaction, Michael addition, Diels Alder reaction.	**12**

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks (%)					
R Level	U Level	A Level	N Level	E Level	C Level
25	**30**	**10**	**15**	**10**	**10**

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)

Text Books:

1. Bansal, R.K. 2007. A Textbook of Organic Chemistry. India: NEW AGE International Pvt Ltd.
2. Ahluwalia, V. K. 2010. Organic Reaction Mechanism. India: Narosa Publishing House.
3. Kürti, L. and Czakó, B. 2005. Strategic Applications of Named Reactions in Organic Synthesis: Background and Detailed Mechanisms. USA:Elsevier Academic Press.
4. Grossman, R. 2008. Art of Writing reasonable organic reaction mechanism, New York: Springer-Verlag.

Reference Books:

1. Singh, M.S., Reactive Intermediates in Organic Chemistry: Structure, Mechanism, and Reactions, ISBN: 978-3-527-67827-3, 1st Edition, John Wiley & Sons, 2014.
2. Robert A. Moss, Matthew S. Platz, Maitland Jones Jr., Reactive Intermediate Chemistry, ISBN:9780471233244, John Wiley & Sons, Inc., 2004.
3. Samuel McManu, Organic reactive intermediates, 1st Edition, ISBN: 9780124143111, Elsevier, 2012.
4. Christopher J. Moody and Gordon H. Whitham, Reactive Intermediates, ISBN: 9780198556725, Oxford University press, 1992.
5. Bradford P. Mundy, Michael G. Ellerd, Frank G. Favaloro Jr., Name Reactions and Reagents in Organic Synthesis, 2nd Edition, ISBN: 978-0-471-22854-7, 2005.

Course Outcomes:

After completing this course, student will be able to

Sr. No.	CO statement	Marks % weightage
CO-1	Describe various phenomenon and aspects of Free radicals.	15%
CO-2	Explain basic conceptual understanding of Carbocation.	15%
CO-3	Discuss concepts and chemistry of Carbanions.	20%
CO-4	Discuss theory and understanding of Carbenes.	15%
CO-5	Define and understand various aspects of Phosphorus ylides & Nitrenes.	15%
CO-6	Discuss vitality of Enamines & Benzyne.	20%

List of Open Source Software/learning website:

1. https://data.testprepkart.com/Online_Preparation/JEE/JEE%20Chemistry/15_JEE_Chemistry_General%20Organic%20Chemistry/9_JEE_Chemistry_General%20Organic%20Chemistry_Reaction%20Intermediates.pdf
2. https://www.uomustansiriyah.edu.iq/media/lectures/6/6_2024_02_17!04_46_21_PM.pdf
3. https://www.faculty.uobasrah.edu.iq/uploads/teaching/1659801644.pdf.
4. https://onlinecourses.nptel.ac.in/noc22_cy34/preview#:~:text=Reactive%20intermediates%22%20is%20an%20important,role%20in%20various%20organic%20transformations.
5. https://epgp.inflibnet.ac.in/epgpdata/uploads/epgp_content/S000005CH/P000660/M010066/ET/s000005ch-p000660-m010066-et-v1.pdf
6. http://burton.chem.ox.ac.uk/rearrangements-and-reactive.pdf
7. https://www.lnigchrm.in/wp-content/uploads/2015/09/Organic-Syntheses-Based-on-Name-Reactions-A-Practical-Guide-to-750 ..... pdf

UPL University of Sustainable Technology

SRICT Institute of Science & Research

Master of Science

Course Code: CHM401-4C

Course Name: Inorganic Chemistry

Semester:I

w.e.f.: July 2025

Type of course: Major Course

Prerequisite: Should have an underlying knowledge of coordination chemistry and preliminary organometallic chemistry.

Rationale: At the end of the course, students will have knowledge about reaction mechanism, catalysis and cluster compounds.

Teaching and Examination Scheme:

Teaching Scheme				Examination Marks		Total Marks
L	T	P	Total	CCE Marks	SSE Marks	
4	-	-	4	50	50	100

Contents:

Sr. No.	Content	Total Hours
	SECTION - A	
1	**Reaction Mechanism-I** Introduction to inorganic reaction mechanisms. Thermodynamic and Kinetic stability, Inert and Labile Complexes, Classification of ligand substitution reaction mechanism, associative, dissociative, interchange. Ligand field effects and reaction rates, Mechanism of substitution in octahedral complexes and square planar complexes, Trans- effect, theories of trans effect.	**9**
2.	**Reaction Mechanism-II:** Mechanism of nucleophilic substitution in square planar complexes. Oxidation Reduction Reaction / Redox Reaction, Outer-sphere and inner-sphere electron transfer reaction-characteristics and controlling factors, ligand transfer, role of bridging ligand, chemical mechanism of electron transfer, complementary and non-complimentary redox reactions. racemization in octahedral complexes.	**9**
3	**Structure and Properties of Solids:** Description of Crystal Structures, Close Packed Structures, AB, AB_2 and A_2B_3 types common structures, Factors affecting the properties of Solid, Structure of	**12**

	mixed oxides-spinel, inverse spinel, ilmenite, perovskite, crystal defects-intrinsic and extrinsic, thermodynamics of crystal defects, Schottky and Frenkel defects; color centers, dislocations; electronic properties of solids: conductors, semiconductors, insulators, superconductors; ferroelectricity, anti-ferroelectricity, piezoelectricity, pyroelectricity, cooperative magnetism.	
SECTION - B		
4	**Catalysis by Organometallic Compounds:** Study of the following industrial processes and their mechanism: 1. Alkene hydrogenation (Wilkinsons Catalyst), 2. Hydroformylation (Co salts), 3. Wacker Process, 4. Synthetic gasoline (Fischer Tropsch reaction), 5. Synthesis gas by metal carbonyl complexes.	**9**
5	**Nanomaterials:** The scope and challenges of nanomaterials, definition, nano versus bulk, top-down and bottom-up approaches, Stabilization of nanostructures, Synthesis of metallic, semiconducting and oxide nanoparticles, examples of 0D, 1D, 2D and 3D nanostructures, concept of quantum confinement and its effect on optical properties of metallic and semiconducting nanoparticles, idea of quantum dot, electrical and magnetic properties of nanostructured materials, superparamagnetism, fullerenes and carbon nanotubes, basic characterization tools for nanomaterials, Scherrer's formula, applications of nanomaterials.	**9**
6	**Cage, Metal Clusters and Ring Compounds:** Cage compounds- higher boron hydrides- structure and reactivity, equation of balance-styx numbers, Lipscomb topological diagrams, Wades rules, Jemmis' unifying electron counting rule, carboranes, metallocarborane, metalloborranes and heteroboranes, phosphorous cage compounds, metal clusters- cluster classification, skeletal electron counting, bonding in metal clusters, polyhedral skeleton electron pair theory (PSEPT), isolobal and isoelectronic relationships, capping rules, Zintl ions.	**12**

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks (%)					
R Level	U Level	A Level	N Level	E Level	C Level
25	**30**	**10**	**15**	**10**	**10**

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)

Text Books:

1. Lee J. D., Concise Inorganic Chemistry, 5th Edition, Oxford University Press, 2008.
2. Asim K. Das Fundamental Concepts of Inorganic Chemistry, Vol. 5. CBS Publications &

Distributors.
3. Elias, B. D. Gupta, Basic Organometallic Chemistry, Universities Press (ed. 2), 2013.
4. Gurudeep Raj, Goel, Advanced Inorganic Chemistry, 2nd Edition, Pub. House, Meerut, 1974.
5. Huheey, J. E.; Keiter, E.A. & Keiter, R.L. Inorganic Chemistry, Principles of Structure and Reactivity 4th Ed., Pearson,2006.
6. Introduction to Nanomaterials and Nanoscience by Asim K Das and Mahua Das, CBS Publications & Distributor

Reference Books:

1. F.A. Cotton, G Wilkinson, Basics of Inorganic Chemistry, 3rd Edition, Wiley International, 2007.
2. Ajai Kumar, Coordination Chemistry, 7th Edition, Pub. House, Aaryush, 2020.

Course Outcomes:

After completing this course, student will be able to

Sr. No.	CO statement	Marks % weightage
CO-1	Describe basics inorganic reaction mechanisms.	15%
CO-2	Explain mechanism of substitution in square planar complexes, Outer-sphere and inner-sphere electron transfer reaction	15%
CO-3	Discuss structure of mixed oxides, crystal defects, electronic properties of solids.	20%
CO-4	Discuss the catalysis by organometallic compounds	15%
CO-5	Discuss the scope and challenges of nanomaterials	15%
CO-6	Discuss cage, metal clusters, and ring Compounds.	20%

List of Open Source Software/learning website:

- https://emb-iitk.vlabs.ac.in/exp/tem-analysis/
- https://www.rsc.org/pe
- https://archive.nptel.ac.in/courses/

UPL University of Sustainable Technology

SRICT Institute of Science & Research

Master of Science

Course Code: CHM402-4C

Course Name: Photochemistry & Quantum Mechanics

Semester:I

w.e.f.: July 2024

Type of Course: Major course

Prerequisite: Should have fundamental knowledge of general chemistry.

Rationale: At the end of the course students will have knowledge of quantum mechanics and photochemistry.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks		Total Marks
L	T	P	C	CCE Marks	SEE Marks	
4	-	-	4	50	50	100

Contents:

Sr. No.	Content	Total Hrs.
	SECTION-A	
1	**Basics of Photochemistry** Interaction of radiation with matter, the difference between thermal and photochemical processes. Laws of photochemistry: Grotthuss- Draper law, Stark-Einstein law, absorbance & molar absorptivity, consequence of light absorption by molecules, electronic transitions in molecules, potential energy curves for primary photochemical process,	**12**
2	**Photophysical reactions:** Jablonski diagram depicting various processes occurring in the excited state, Luminescence, qualitative description of fluorescence, types of fluorescence, phosphorescence, Chemiluminescence, non-radiative processes (internal conversion, intersystem crossing), quantum yield, photosensitized reactions – energy transfer processes (simple examples), quenching.	**09**
3	**Quantum Mechanics-I:** Failures of Classical Physics, Black-body radiation, Planck's radiation law, photoelectric effect, heat capacities of solids, Bohr's model of the hydrogen atom and its defect, Compton effects, de-Broglie hypothesis, Heisenberg uncertainty principle.	**09**
	SECTION-B	
4	**Quantum Mechanics-II:** Postulates of quantum mechanics, quantum mechanical operators, eigenfunction &	**12**

	eigenvalue, linear and Hermitian operators, commutation, probabilistic interpretation, well-behaved function, normalization of the wave function, Schrödinger equation and its application to free particle and "particle-in-a-box": quantization of energy levels, zero-point energy, eigenfunctions, nodal properties, extension to two- and three-dimensional boxes, separation of variables, degeneracy, selection rule and application of the present model.	
5	**Photochemical reactions:** Photochemical reactions, kinetics of photochemical reaction. photochemical reaction between hydrogen and bromine, photochemical reaction between hydrogen and chlorine, Kinetics of decomposition of HI, decomposition of ethane, energy transfer in photochemical reactions	**09**
6	**Surface Chemistry:** Adsorption - physisorption and chemisorption's - adsorption of gases by solids - adsorption isotherms - Freundlich adsorption isotherm - derivation of Langmuir adsorption isotherm, statement and explanation of BET isotherm - applications of adsorption - determination of surface area.	**09**

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
25	**30**	**10**	**15**	**10**	**10**

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E:Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)

Text Books:

1. Principles of Physical Chemistry, Puri, Sharma, Pathania, Vishal Publishing House, 2008.
2. Essentials of Physical Chemistry, Arun Bahl, B S Bahl, G D Tuli, S. Chand 2000.
3. Atkin's Physical Chemistry, 8th Edn., Peter Atkins, Julio de Paula, Oxford University Press, 2006.
4. Quantum Chemistry, Ira N. Levine, Pearson Education India.
5. Quantum Chemistry, R. K. Prasad, New Age International.
6. Fundamentals of photochemistry, K K Rohatgi Mukherjee, New Age International

Reference Books:

1. Physical Chemistry, 3rd Edn. Gilbert W. Castellan, 1983
2. Principles of Physical Chemistry, Samuel H. Maron & Carl F. Prutton, 4th Edn. Macmillan,1965.
3. Physical Chemistry – A Molecular Approach, Donald A . McQuarrie, John D. Simon, Viva Books,1997.
4. Turro, Nicholas J., Modern molecular photochemistry, Benjamin/Cummings Pub. Co., 1978.
5. Nicholas J. Turro, V. Ramamurthy, and J. C. Scaiano, Principles of Molecular Photochemistry, University Science Books, ISBN- 1891389572, 2009.
6. J.D. Coyle, Introduction to Organic Photochemistry, ISBN- 9780471909750, Wiley Publisher, 1986.
7. Nicholas J. Turro, V. Ramamurthy, Juan Scaiano, Modern Molecular Photochemistry of Organic

Molecules, ISBN- 9781891389252, University Science Books, 2010.

Course Outcomes:

After completing this course, student will be able to

Sr. No.	CO statement	Marks % weightage
CO-1	Students will know about the laws of photochemistry and the interaction of radiation with matter.	20%
CO-2	Students will know about the Jablonski diagram, fluorescence, phosphorescence, and chemiluminescence.	15%
CO-3	Students will recognize black body radiation and uncertainty principle.	15%
CO-4	Students will be able to postulates of quantum mechanics, quantum mechanical operators, and particles in a 1D box.	20%
CO-5	Students will be able to write kinetics of photochemical reaction.	15%
CO-6	Students will be able to understand physisorption and chemisorption and different isotherm.	15%

UPL University of Sustainable Technology

SRICT Institute of Science & Research

Master of Science

Course Code: CHE400-4C

Course Name: Practicals in Chemistry-V

Semester: I

w.e.f.: July 2025

Type of Course: Minor course

Prerequisite: Should have fundamental knowledge glassware's and apparatus used in chemistry lab.

Rationale: At the end of the course students will have knowledge of physical chemistry and synthesis of organic compounds using chemical synthesis.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks		Total Marks
L	T	P	C	CCE Marks	SEE Marks	
-	-	8	4	50	50	100

Contents:

Sr. No.	Content	Total Hrs. 120
SECTION-A: Physical Practicals		
	1. To determine the molar absorptivity of each of the two solutions (A) and (B) and also find out the concentration of the supplied unknown solution colorimetrically. 2. To determine the concentration of the mixture of the given two solutions colorimetrically. 3. Determination of the distribution coefficient of ammonia between chloroform and water. 4. To determine the rate of acid-catalyst iodination of acetone in the presence of excess acid & acetone at room temperature. 5. To determine the solubility of silver chloride in water potentiometrically. 6. Determination of strengths of hydrochloric acid and acetic acid in their mixture pH metrically. 7. To determine the formula of a complex between Cu^{+2} and NH_3 by distribution method. 8. Determination of Critical Micellar Concentration (C.M.C.). of a surface-active agent.	**60**
SECTION-B: Organic Practicals		

	Organic synthesis & separation: 1. To prepare Hippuric acid from Glycine 2. To prepare Phenyl urea from Aniline 3. To prepare 3-methyl, 1- phenyl pyrazolone from Ethyl acetoacetate. 4. To prepare N-Benzylideneaniline (Schiff base) from aniline 5. To prepare Resacetophenone from resorcinol 6. To prepare Benzylideneacetophenone (Chalcone) from Acetophenone **Qualitative analysis of organic Solid & Liquid mixture (Binary and Ternary)** 1. Acid+Phenol 2. Phenol + Neutral 3. Amine + Neutra 4. Amine + Phenol 5. Soild+Liquid+Solid 6. Liquid+Liquid+Solid 7. Soild+ Solid+Liquid	**60**

Reference Books:

1. Furniss, B. S.,Hannafold, A. J.,Smith, P. W. G., Tatchell, A. R., Vogel's Textbook of Practical Organic Chemistry, 5th Ed., Pearson Education India, (1989)
2. Comprehensive Practical Organic Chemistry: Preparations and Quantitative Analysis,V K Ahluwalia & R. Aggarwal Universities Press., (2001)
3. An Advance Course in practical Chemistry, A K. Nad, B. Mahapatra and A. Ghoshal.Agarwal, O. P., Advanced Practical Organic Chemistry, Krishna Prakashan, Meerut (2014).
4. Ahluwalia, V. K.; Aggarwal, R., Comprehensive Practical Organic Chemistry: Preparation and Quantitative Analysis, Universities Press (2000).
5. Mitra, A. K., A Handbook of Practical Organic Chemistry, ISBN-9788193853030, Techno world publishrs, 2011.
6. Reinhart K, Brandle, M. P., Practical Organic Synthesis: A Student's Guide, ISBN- 978-0-470-02965-7 2006.
7. Advanced-Physical-Chemistry-Experiments-by-J-N-Gurtu-&-Amit-Gurtu, Pragati Prakashan, 2008
8. A Textbook of Physical Chemistry: Experimental Aspects In Physical Chemistry (SI Units) Volume 7 by KL Kapoor

Course Outcomes:

After completing this course, student will be able to

Sr. No.	CO statement	Marks % weightage
CO-1	Determination of concentration of unknown solution via colormetrically.	10%

CO-2	Able to determine distribution coefficient and the rate of acid-catalyst iodination reaction.	20%
CO-3	Determine the solubility product of AgCl, CMC value of surfactant.	20%
CO-4	Understand concepts of preparation of pharmaceutical organic molecules.	20%
CO-5	Acquainted with the practical rearrangement of organic molecules.	10%
CO-6	Acquainted with the synthesis of commercially important organic molecules.	20%

Distribution of Practical Marks

A Level	B Level	C Level	D Level
10	**15**	**15**	**10**

Legends:

A= Conduction of Practical

B= Regular Record Writing

C= Viva –Voce

D= Understanding of Experiments

UPL University of Sustainable Technology

SRICT Institute of Science & Research

Master of Science

Course Code:CHO400-4C

Course Name: On Job Training-I

Semester:I

w.e.f.: July 2025

Considering that some students choose academics and research as their career while others prefer industrial jobs, the students shall get two options to meet their specific need – (i) Plan A: Research Project, and (ii) Plan B: on the Job Training. The program coordinator and placement officer shall conduct an orientation session so that the students can take informed decision to choose between the two options.

On Job Training-I

Type of Course: OJT

Prerequisite: Basic Knowledge of chemical processes and operations.

Rationale: To provide students with practical, real-world experience, focusing on work experience, professional activities, or cooperative education, at the end of the course, students will learn about the application of Chemistry concepts in modern chemical industries. This will also provide the students an opportunity to practically use their chemical science-based skills in a life-science industry.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks		Total Marks
L	T	P	C	CCE Marks	SEE Marks	
0	0	180	6	75	75	150

Content:

Sr. No.	Content	Total Hrs.
1	The students shall carry out 1-month internship in an industry of national/international repute. They must prepare an internship report on a specific template provided by the University. Upon completion of the internship, students are required to present their work before the expert committee. Students must Submit 01 copy of their spiral internship report to the department.	180

UPL University of Sustainable Technology

SRICT Institute of Science & Research

Teaching/Exam Scheme

M. Sc. 2nd Semester

Sr. No.	Course Code	Category of course	Course title	Hours Per week			Total con. hrs.	Credits	CCE	SEE	Total Marks
				L	T	P					
1	CHM403-4C	Major Course	Chemistry of Dyes & Dye Intermediates	4	-	-	4	4	50	50	100
2	CHM404-4C	Major Course	Unit Processes & Reagents	4	-	-	4	4	50	50	100
3	CHM405-4C	Major Course	Analytical Techniques	4	-	-	4	4	50	50	100
4	CHE402-4C	Minor Course	Practicals in Chemistry -VI	-	-	8	8	4	50	50	100
5	CHO401-4C	OJT	On Job Training-II	-	-	-	-	6	75	75	150
			Total	12	-	8	20	22	275	275	550

UPL University of Sustainable Technology

SRICT Institute of Science & Research

Master of Science

Course Code: CHM403-4C

Course Name: Chemistry of Dyes & Dye Intermediates

Semester: II

w.e.f.: July 2025

Type of course: Major Course

Prerequisite: Should have underlying knowledge of dyes and pigments.

Rationale: At the end of the course, the students will gain a comprehensive understanding of the chemistry, classification, synthesis, and applications of dyes and pigments across various industries. They will learn about the physical and chemical properties that influence color stability, solubility, and performance, as well as the environmental and safety aspects of colorants.

Teaching and Examination Scheme:

Teaching Scheme				Examination Marks		Total Marks
L	T	P	Total	CCE Marks	SSE Marks	
4	-	-	4	50	50	100

Contents:

Sr. No.	Content	Total Hours
	SECTION - A	
1	**BASIC CONCEPTS OF DYE AND PIGMENTS-** Introduction of Dyes and Pigments, Different classes of organic and inorganic pigments and their applications with examples. Relation between color and chemical Constitution, Witt's theory, Armstrong's theory, Nietzki's theory, Valence bond theory, Molecular orbital theory, Fastness Properties, Exhaustion and fixation properties.	9
2	**STUDIES OF SOME INDUSTRIAL DYES-I:** General nature, classification, structural variation, synthesis and application of fibres of the following classes of dyes: (i)Reactive dyes (ii)Triphenylmethane dyes (TPM) (iii)Acid dyes Synthesis of only the following: Procion Brilliant Blue MR, Procion Brilliant Red H-3B, Remazol Brilliant Blue R, Malachite Green, CrystalViolet, Acid Yellow 73, Acid Red 1, Acid Black 24	9
3	**AZO DYES:** General Introduction: Diazotization, mechanism and different methods of diazotization and laws of coupling. Synthesis of the following: Disperse Red 13, Acid Blue 92, MordantBlack 3, Acid Black 1, Acid Blue 113, Direct Blue 15, Direct Violet 1, Direct Red 28, Naphthol AS-BR, Fast Orange GGD.	12
	SECTION - B	

4	**ANTHRAQUINONE DYES** : Vat Dyes and Solubilized Vat dyes, Aciddyes, Mordant dyes and dyes for cellulose acetate. Synthesis of only the following: Indanthrene Orange 7RK, Indanthrene Yellow FFRK, Indanthrene Khakhi 2G, Indanthrene Orange FFRK, Indanthrene Yellow 4GK, Indanthrene Scarlet B, Caledon Jade Green XBN, Anthracene BlueSWX, Indanthrene Brilliant Orange GR, Celliton Fast Blue FFG.	**9**
5	**STUDIES OF SOME INDUSTRIAL DYES-II:** General nature, classification, structural variation, synthesis and application of fibres ofthe following classes of dyes: (i)Disperse dyes (ii)Indigoid and Thio- indigoid dyes (iii)Cationic dyes Synthesis of the following: Disperse Yellow 16, Disperse Blue 14, Celliton Fast Yellow 7G, Ciba Blue 2B, Indanthrene Brilliant Pink R, Bismarck Brown, Chrysoidine Y, Methylene Blue, Acridine Yellow G,Disperse Orange 29	**9**
6	**BASIC OPERATIONS IN DYEING PROCESS:** Preparation of the fibres, Preparation of the dyebath, application of the dyebath and finishings, Various methods of dyeing: Direct dyeing, Vat dyeing, Mordant dyeing, Disperse dyeing and Formation of dye on the fibre, Dyeing of wool with the acid dyes, Dyeing with the reactive dyes, Fastness properties: Colour fastness, Light fastness, Subimation fastness and Burnt gas fumes fastness.	**12**

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks (%)					
R Level	U Level	A Level	N Level	E Level	C Level
25	**30**	**10**	**15**	**10**	**10**

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)

Text Books:

1. Sharma, B. K., "*Industrial Chemistry",*Goel publishing house, ISBN: 8187224002, 9788187224006, 1997.
2. Austin, G. T, *Shreve's Chemical Process Industries*, 4th Edition NY: McGraw Hill, ISBN 13: 9780070571457, 1998.
3. Kirk, R. E., *Encyclopedia of Chemical Technology*, 5th Edition, NY: Wiley-blackwell ISBN-13: 9780471484943, 2004.
4. Clockal, I., *Handbook of Colourants Chemistry*, ISBN- 9783110776997, Vol 1, Deutsche NationalBibliothek, 2023.
5. Gurses, A., Açıkyıldız, M., Kübra, G., Sadi Gürses., M. *Dyes and Pigemnts*, ISSN 2191-5407, Springer, 2016

Reference Books:

1. T.I., Kakhiya, Dyes, Colors & Pigments, Copyright © Tarek Kakhia.
2. H.B, Singh, K.A. Bharathi, Handbook of natural dyesand pigments, Woodhead Publishing India Pvt Ltd, New Delhi, ISBN: 978-93-80308-54-8, 2014.
3. Handbook of Colorants Chemistry. Volume 1: Dyes and Pigments Fundamentals, ISBN-9783110776997, 2023.

Course Outcomes:

After completing this course, student will be able to

Sr. No.	CO statement	Marks % weightage
CO-1	Recollect the various fundamental theories of color and constitution	15%
CO-2	Classify the dyes based on their uses and structure	15%
CO-3	Examine the azo dyes for their synthesis and application	20%
CO-4	Determine the dying process and dying operation for fabric	15%
CO-5	Explain the synthetic applications of various set of dyes	15%
CO-6	Prepare the synthesis of dyes of different classes	20%

List of Open Source Software/learning website:

1. https://nios.ac.in/media/documents/313coursee/l34a.pdf
2. https://gdcvidavaluru.ac.in/userfiles/DR%20B_%20SUjATHAPIGMENTS.pdf
3. https://www.scribd.com/document/816039769/handbook-of-colorants-chemistry-dyes-and-pigments-fundamentals
4. https://scispace.com/pdf/structure-and-properties-of-dyes-and-pigments-3o3yqedjl1.pdf
5. https://content.e-bookshelf.de/media/reading/L-7687624-bc9cf881a6.pdf
6. https://tarek.kakhia.org/books_eng/Dyes_Colors_Pigments.Tarek_Kakhia.pdf
7. https://www.scribd.com/document/538965909/Woodhead-Publishing-India-in-Textiles-Har-Bhajan-Singh-Kumar-Avinash-Bharati-Handbook-of-Natural-Dyes-and-Pigments-Woodhead-Publishing-India-Pvt
8. file:///C:/Users/386/Downloads/9783319338903-c2.pdf
9. https://nptel.ac.in/courses/116104044
10. http://elearn.psgcas.ac.in/nptel/courses/video/116102052/lec3.pdf

UPL University of Sustainable Technology

SRICT Institute of Science & Research

Master of Science

Course Code: CHM404-4C

Course Name: Unit Processes & Reagents

Semester:II

w.e.f.: July 2025

Type of course: Major Course

Prerequisite: Should have underlying knowledge of basic unit processes.

Rationale: At the end of the course, the students should be able to understand the manufacturing of various inorganic and organic chemicals, the process flow diagram and various process parameters and can able to solve engineering problems during production and understanding the mechanisms of various unit processes. They should also be able to understand of preparation, structures, mode of actions and applications of reagents used in organic reactions and rearrangements

Teaching and Examination Scheme:

Teaching Scheme				Examination Marks		Total Marks
L	T	P	Total	CCE Marks	SSE Marks	
4	-	-	4	50	50	100

Contents:

Sr. No.	Content	Total Hours
	SECTION - A	
1	**Halogenation, Alkylation & Acylation** Principle, Reagents, Mechanism, Kinetics, Applications involving Industrial Product manufacturing using following unit processes: ❖ Halogenation ❖ Alkylation ❖ Acylation	**9**
2	**Oxidation, Hydrogenation & Reduction** Principle, Reagents, Mechanism, Kinetics, Applications involving Industrial Product manufacturing using following unit processes: ❖ Oxidation ❖ Hydrogenation ❖ Reduction	**9**
3	**Nitration, Sulphonation & Esterification**	**12**

	Principle, Reagents, Mechanism, Kinetics, Applications involving Industrial Product manufacturing using following unit processes: ❖ Nitration ❖ Sulphonation ❖ Esterification	
SECTION - B		
4	**Hydration, Hydrolysis, Aammonolysis & Amination** Principle, Reagents, Mechanism, Kinetics, Applications involving Industrial Product manufacturing using following unit processes: ❖ Hydration ❖ Hydrolysis ❖ Aammonolysis ❖ Amination	**9**
5	**Reagents-I** Preparation, Properties, Mechanism of Action & Applications involving name reaction or rearrangement of following Reagents: ❖ Dicyclohexylcarbodiimide (DCC) ❖ Diethylazodicarboxylate (DEAD) ❖ Dibenzosuberyl (DBS) ❖ Diisopropyl carbodimide (DIC) ❖ M-dimethoxybenzene (DMB) ❖ 2,3-dicloro-5,6-dicyano benzoquinone (DDQ)	**9**
6	**Reagent-II** Preparation, Properties, Mechanism of Action & Applications involving name reaction or rearrangement of following Reagents: ❖ N-Bromosuccinamide (NBS) ❖ Sodamide ❖ Triphenylphosphene (TPP) ❖ Lead tetra acetate (LTA) ❖ Carbonyldiimidazole (CDI) ❖ $LiAlH_4$ (LAH)	**12**

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks (%)					
R Level	U Level	A Level	N Level	E Level	C Level
25	**30**	**10**	**15**	**10**	**10**

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)

Text Books:

1. Agrawal, O. P., "*Organic Chemistry: Reactions And Reagents"*. India: GOEL Publishing House., 1996.
2. Groggins, P. H., "*Unit Processes in Organic Synthesis"*. India: Tata McGraw Hill, 1995
3. Finar, I., *Organic Chemistry*, 5th Edition, Delhi: Pearson education, 2005.
4. Furter, William F, "*Chemical process industry*", DOI:https://doi.org/10.1036/1097-8542.127600, 2014.
5. Bradford P., Michael G., Frank G, *"Name Reactions and Reagents in Organic Synthesis"*, Second Edition, ISBN:9780471739876, 2013.

Reference Books:

4. Narayan, C.M., Unit Operations and Unit Processes, Vol.1 & 2, CBS Publishers, New Delhi, India, 2000.
5. Organic Reactions and Organic Reactions and Their Mechanisms Their Mechanisms, http://polymer.zju.edu.cn/attachments/2012-11/01-1352193505-80382.pdf
6. Pearson, A.J, Handbook of Reagents for Organic Synthesis, 4 volume set, John Wiley & Sons Ltd,ISBN- 978-047198789-5, 1999.
7. Saverio F, Vito C, Joana L, Jacquelyne A. Read, Encyclopedia of Reagents for Organic Synthesis, ISBN: 9780470842898| DOI: 10.1002/047084289X, John Wiley & Sons, Ltd., 2001.

Course Outcomes:

After completing this course, student will be able to

Sr. No.	CO statement	Marks % weightage
CO-1	Describe various phenomenon and aspects advanced concepts of unit processes like Halogenation, Alkylation & Acylation.	15%
CO-2	Explain basic conceptual understanding of Oxidation, Hydrogenation & Reduction.	15%
CO-3	Discuss concepts and chemistry of Nitration, Sulphonation & Esterification.	20%
CO-4	Discuss theory and understanding of Hydration, Hydrolysis, Aammonolysis & Amination.	15%
CO-5	Define and understand various aspects of organic reagents-I.	15%
CO-6	Discuss vitality of organic reagents-II.	20%

List of Open Source Software/learning website:

1. file:///C:/Users/admin/Downloads/HS2109.pdf
2. http://www.sgtbkhalsadu.ac.in/colleges/dbtevents/1127260320121552021.pdf
3. https://chem.ucr.edu/documents/curricularmaterials/neumantextbook/Chapter17.pdf
4. https://epgp.inflibnet.ac.in/epgpdata/uploads/epgp_content/food_technology/unit_operations_in_food_processing/01.introduction_to_unit_operations_and_processes/et/116_et_m1.pdf
5. https://www.merriam-webster.com/dictionary/reduction.
6. https://unacademy.com/content/jee/study-material/chemistry/nitration/
7. http://shodhganga.inflibnet.ac.in/bitstream/10603/120094/12/12_chapter%205.pdf
8. https://chemistry-europe.onlinelibrary.wiley.com/doi/10.1002/slct.202004695
9. https://www.sigmaaldrich.com/IN/en/product/aldrich/z338249?utm_source=google&utm_medium=cpc&utm_campaign=15000381723&utm_content=129438260635&gad_source=1&gclid=Cj0KCQjwhMq-BhCFARIsAGvo0KchJIgBTasu9MX61csHMahZccwJ_PSuWw7KwX-ZhMJSK_MstPJ0zW0aAgllEALw_wcB
10. https://onlinecourses.nptel.ac.in/noc22_cy55/preview
11. https://www.thermofisher.com/in/en/home/chemicals/organic-chemistry/organic-synthesis-reagents.html

UPL University of Sustainable Technology

SRICT Institute of Science & Research

Master of Science

Course Code: CHM405-4C

Course Name: Analytical Techniques

Semester: II

W.E.F.: - July 2026

Type of course: Major Course

Prerequisite: Should have underlying knowledge of basics of Analytical Chemistry, good laboratory practices and Analytical titrations.

Rationale: At the end of the course, students will have knowledge about good laboratory practices and different analytical titration methods.

Teaching and Examination Scheme:

Teaching Scheme				Examination Marks		Total Marks
L	T	P	Total	CCE Marks	SSE Marks	
4	-	-	4	50	50	100

Contents:

Sr. No.	Content	Total Hours
	SECTION - A	
1	**Introduction of Theory of Errors:** Sources & classification of errors. Statistical treatment of analytical data & presentation of result. Sampling of solids, liquids & gases. Evaluation & validation of analytical methods. Basics of Good laboratory practices. Primary and Secondary standards, Principles of volumetric analysis.	**10**
2.	**Chromatography:** Different chromatographic Techniques: 1. Column Chromatography: Preparation of column and its applications. 2. Thin-Layer Chromatography: Selection of stationary and mobile phase, Detection techniques –Elementary idea of HPTLC. 3. Gas Chromatography: Selection of mobile phase – Selection of stationary phase	**10**

	in GLC and GSC. Various Detectors and column Used in GC. Applications of GC. Principle of HPLC, Instrumentation of HPLC in brief, Method of introducing sample and applications of HPLC.	
3	**Thermogravimetry:** Introduction and classification of thermoanalytical methods; thermogravimetric analysis (TGA): definition, types of TGA, instrumentation, TGA curve, factors affecting TGA curves. Limitation and advantages of TGA, and applications of TGA. Differential thermal analysis (DTA): definition, theoretical basis of DTA, instrumentation, factors affecting the DTA curve, application of DTA, advantages and disadvantages of DTA. Differential scanning calorimetry (DSC): Definition, comparison of DTA and DSC techniques, instrumentation, factors affecting DSC curves.	**10**
SECTION - B		
4	**IR Spectrophotometry:** IR Spectroscopy: Introduction: Theory, Instrumentation: single beam, double beam spectrophotometers. IR region, types of vibrations: IR spectra: group frequency, group frequency region, finger print 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. Structure elucidation based on IR.	**10**
5	**NMR Spectroscopy-I :** Theory, principles and Instrumentation of ^{1}H NMR spectroscopy, Aspects of PMR spectra – number of signals, chemical shift, factors influencing chemical shift, shielding and deshielding, chemical shift values and correlation for protons bonded to carbons (aliphatic, olefinic, aldehydic, aromatic), effect of deuteration, spin-spin coupling, (n+1) rule, factors effecting coupling constant J. ^{13}C NMR spectroscopy Types of ^{13}C NMR Spectra: proton coupled and decoupled ^{13}C spectra, calculations of chemical shifts of aliphatic, olefinic, alkyne, aromatic, hetero aromatic and carbonyl carbons. 2D NMR Techniques Preliminary idea of 2D NMR Structure elucidation based on NMR	**10**
6	**Mass Spectrometry:** Theory and principles of mass spectroscopy; Instrumentation; low and high resolution mass spectra; Ionization techniques – Electron Impact (EI) ionization,	**10**

	Chemical Ionization (CI), and Electron spray Ionization (ESI); Determination of molecular weight and molecular formula, nitrogen rule, detection of molecular ion peak, metastable ion peak; Fragmentations – rules governing the fragmentations, McLafferty rearrangement; Interpretation of mass spectra of different class of compounds.	

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks (%)					
R Level	U Level	A Level	N Level	E Level	C Level
25	**30**	**10**	**15**	**10**	**10**

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)

Text Books:

1. R.M. Silverstein and F.X. Webster, Spectroscopic Identification of Organic Compounds, 6th Edition (2003) John Wiley, New York.

2. Introduction to Spectroscopy, D. L. Pavia, G. M. Lampman and G. S. Kriz, 3rdedition (Thomson Brooks/Cole)

3. Organic Spectroscopy, William Kemp, 3rd edition (Palgrave)

4. Spectroscopy of Organic Compounds, P. S. Kalsi, 5th edition (New Age International Publishers)

5. Elementary Organic Spectroscopy: Principles and Chemical applications (revised edition), Y. R. Sharma (S. Chand Publishing)

6. Analytical Chemistry: Principles and Techniques: Larry G. Hargis (Prentice-Hall International edition)

Reference Books:

1. Modern Analytical Chemistry by David Harvey, McGraw Hill Higher Education.

2. College Analytical Chemistry, Mangaonkar, Teckchandani, Sathe, Ghalsasi, Jain, Himalaya Publishing House.

3. Analytical Chemistry by Alka L. Gupta, PragatiPrakashan.

Course Outcomes:

After completing this course, student will be able to

Sr. No.	CO statement	Marks % weightage
CO-1	Express and calculate errors and learn GLP.	15%
CO-2	Develop basic and advanced chromatographic techniques.	15%
CO-3	Learn various thermogravimetric methods.	20%
CO-4	Describe theory and principal of IR spectra, Instrumentation, application.	15%
CO-5	Discuss the various theory of NMR Spectroscopy and their principle.	15%
CO-6	Evaluate the various theories related to the MASS Spectroscopy.	20%

List of Open Source Software/learning website:

- https://www.library.qmul.ac.uk/subject-guides/chemistry/useful-websites/
- https://blog.feedspot.com/chemistry_websites/

UPL University of Sustainable Technology

SRICT Institute of Science & Research

Master of Science

Course Code: CHE402-4C

Course Name: Practicals in Chemistry-VI

Semester: II

w.e.f.: July 2025

Type of Course: Minor course

Prerequisite: Should have fundamental knowledge experiments in chemistry laboratory.

Rationale: At the end of the course students will have knowledge of analytical chemistry and qualitative analysis of organic solid & siquid mixtures.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks		Total Marks
L	T	P	C	CCE Marks	SEE Marks	
	-	8	4	50	50	100

Contents:

Sr. No.	Content	Total Hrs. 120
	SECTION-A: Analytical Practicals	
	1. Determination of % purity of Asprin in the given tablet. 2. Determination of available chlorine in bleaching powder. 3. Determination of acetic acid in vinegar. 4. Determination of ascorbic acid in vitamin C tablets. 5. Determination of calcium and magnesium in water sample. 6. Determination of saponification value of oil. 7. Determination of dissolved oxygen and chemical oxygen demand. 8. Simultaneous estimation of calcium (II) and zinc (II) by EDTA titration. 9. Simultaneous estimation of lead (II) and magnesium (II) by EDTA titration. 10. Separation of amino acids/ dyes/ drugs by TLC.	**60**
	SECTION-B: Organic Practicals	
	Organic synthesis & separation: 1. To prepare Benzilic acid from Benzil	**60**

	2. To prepare *p*- Bromo Nitrobenzene from Bromo benzene 3. To prepare Acetanilide from Aniline 4. To prepare *p*-bromo aniline from *p*-bromo acetanilide 5. Preparation of *p*- Nitro aniline from Acetanilide 6. To prepare *m*-Nitroaniline from *m*-Dinitrobenzene 7. Preparation of biodiesel fuel from refined vegetable oil **Qualitative analysis of organic Solid & Liquid mixture (Binary and Ternary)** 1. Acid + Phenol 2. Phenol + Neutral 3. Amine + Neutral 4. Amine + Phenol 5. Soild + Liquid + Solid 6. Liquid +Liquid + Solid 7. Soild + Solid + Liquid	

Reference Books:

1. Analytical Chemistry Practice, John H. Kennedy, Saunders College Publishing, Second Edition 1990.
2. Vogels Textbook of Quantitative Chemical Analysis, 6th Edition, 2002.
3. Vogel's Text Book of quantitative analysis", by Mendham, Denney et. al.,6th edition, Prentice Hall, 2009.
4. Quantitative Chemical Analysis", by Daniel C. Harris, 7th edition, W.H. Freeman and Company, New York, 2007.
5. Comprehensive Practical Organic Chemistry: Preparations and Quantitative Analysis,V K Ahluwalia & R. Aggarwal Universities Press., (2001)
6. An Advance Course in practical Chemistry, A K. Nad, B. Mahapatra and A. Ghoshal.Agarwal, O. P., Advanced Practical Organic Chemistry, Krishna Prakashan, Meerut (2014).
7. Ahluwalia, V. K.; Aggarwal, R., Comprehensive Practical Organic Chemistry: Preparation and Quantitative Analysis, Universities Press (2000).

Course Outcomes:

After completing this course, student will be able to

Sr. No.	CO statement	Marks % weightage
CO-1	Learn quantitative analysis of components present in given compounds.	10%
CO-2	Study estimation of ions by titrations.	20%
CO-3	Analysis of components by chromatographic methods.	20%
CO-4	Understand concepts of synthesis of organic molecules.	20%

CO-5	Acquainted with the qualitative analysis of solid organic molecules.	10%
CO-6	Acquainted with the qualitative analysis of liquid organic molecules.	20%

Distribution of Practical Marks

A Level	B Level	C Level	D Level
10	**15**	**15**	**10**

Legends:

A= Conduction of Practical

B= Regular Record Writing

C= Viva –Voce

D= Understanding of Experiments

UPL University of Sustainable Technology

SRICT Institute of Science & Research

Master of Science

Course Code:CHO401-4C

Course Name: On Job Training-II

Semester:II

w.e.f.: July 2025

Considering that some students choose academics and research as their career while others prefer industrial jobs, the students shall get two options to meet their specific need – (i) Plan A: Research Project, and (ii) Plan B: on the Job Training. The program coordinator and placement officer shall conduct an orientation session so that the students can take informed decision to choose between the two options.

On Job Training

Type of Course: OJT

Prerequisite: Basic Knowledge of chemical processes and operations.

Rationale: To provide students with practical, real-world experience, focusing on work experience, professional activities, or cooperative education, at the end of the course, students will learn about the application of Chemistry concepts in modern chemical industries. This will also provide the students an opportunity to practically use their chemical science-based skills in a life-science industry.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks		Total Marks
L	T	P	C	CCE Marks	SEE Marks	
0	0	180	6	75	75	150

Content:

Sr. No.	Content	Total Hrs.
1	The students shall carry out 1-month internship in an industry of national/international repute. They must prepare an internship report on a specific template provided by the University. Upon completion of the internship, students are required to present their work before the expert committee. Students must Submit 01 copy of their spiral internship report to the department.	180