MARUDHAR KESARI JAIN COLLEGE FOR WOMEN (AUTONOMOUS)

Vaniyambadi – 635 751

PG Department of Chemistry

for

Undergraduate Programme

Bachelor of Science in Chemistry

From the Academic Year 2025-26

(Third Semester)

Semester - I						
Code	Course Title	Hours Distribution				C
		L	T	P	S	
24UFTA11	Tamil - 1	4	1	0	0	3
24UFEN11	English - 1	4	1	0	0	3
24UCHC11	CC - 1 General Chemistry -I	3	1	2	0	5
24UCHC12P	CC - 2 Quantitative Inorganic Estimation (Titrimetry) & Inorganic Preparation – I (Practical)	0	0	4	0	3
24UBCA11	EC - 1 AL Biochemistry - I	3	1	0	0	3
24UBCS11	SEC - 1 Health and Nutrition	1	0	1	0	2
24UBCS12P	SEC - 2 Biochemistry Practical - I	0	0	2	0	2
24UCHF11	FC- Food Chemistry	1	1	0	0	2
					30	**23**

Semester - II						
Code	Course Title	Hours Distribution				C
		L	T	P	S	
24UFTA21	Tamil - 2	4	1	0	0	3
24UFEN21	English - 2	4	1	0	0	3
24UCHC21	CC – 3 General Chemistry-II	3	1	2	0	5
24UCHC22P	CC - 4 Qualitative Organic Analysis and Preparation of Organic Compounds – II (Practical)	0	0	4	0	2
24UBCA21	EC - 2 AL Biochemistry - II	3	1	0	0	4
24UBCA22P	EC - 3 Biochemistry Practical - II	0	0	2	0	2
24UCHS21	SEC – 3 Dairy Chemistry	1	0	1	0	2
24UCHA21	AEC – 1 Life Skills through Yoga	1	1	0	0	2
					30	**23**

Semester - III						
24UFTA31	Tamil - 3	4	1	0	0	3
24UFEN31	English - 3	4	1	0	0	3
24UCHC31	CC – 5 General Chemistry-III	3	1	2	0	5
24UCHC32P	CC – 6 Qualitative Inorganic Analysis (Practical)	0	0	4	0	2
24UPHA31	EC - 4 AL Physics -I	3	1	0	0	4
24UPHA32P	EC - 5 AL Physics (Practical)	0	0	2	0	2
24UCHS31 24UCHS32	SEC - 4 Entrepreneurial Skills in Chemistry SEC - 5 Pesticide Chemistry	0	0	2	0	2
24UCHA31	AEC – 2 Human Values and Ethics	1	1	0	0	2
					30	**23**

Semester - IV						
24UFTA41	Tamil - 4	4	1	0	0	3
24UFEN41	English - 4	4	1	0	0	3
24UCHC41	CC – 7 General Chemistry -IV	3	1	2	0	5
24UCHC42P	CC - 8 Physical Chemistry Practical – I (Practical)	0	0	4	0	2
24UBCA41	EC - 6 AL Physics -II	3	1	0	0	4
24UBCA42P	EC - 7 AL Physics (Practical)	0	0	2	0	2
24UCHS41	SEC – 5 Instrumental methods of Chemical Analysis	1	0	1	0	2
24UCHA41	AEC – 3 Environmental Studies	1	1	0	0	2
					30	**23**

Semester - V						
	CC -9 Organic Chemistry -I	4	1	0	0	4
	CC- 10 Organic Chemistry–I (Practical)	0	0	4	0	4
	CC - 11 Inorganic Chemistry - I	2	1	1	0	4
	CC - 12 Inorganic Chemistry - I (Practical)	0	0	3	0	2
	EC - 8 Industrial Chemistry	4	1	0	0	4
	EC - 9 Biochemistry	4	1	0	0	4
	AEC – 4 Social	1	1	0	0	2

Semester - VI						
	CC - 13 Physical Chemistry- II	4	1	0	0	4
	CC - 14 Physical Chemistry Practical - II (Practical)	0	0	5	0	3
	CC - 15 - Project	0	0	0	5	4
	EC - 10 Fundamentals of Spectroscopy	4	1	0	0	4
	EC - 11 Nano Science/ Polymer Science/ Pharmaceutical Chemistry	4	1	0	0	4
	PEC - 1Communicative Skills	1	1	0	0	2
	SLC - 1Chemistry in				3	2

	Responsibilities and Upliftment							Everyday Life							
	Internship				2	2									
					30	**26**								**30**	**23**
														141+2*	

Students must complete at least one online course (MOOC) from platforms like SWAYAM, NPTEL, or Nanmudalvan within the fifth semester. Additionally, engaging in a specified Self-learning Course is mandatory to qualify for the degree, and successful participation will be acknowledged with an extra credit of 2*.

Part – 1 & 2	Tamil & English	8	SEC	Skill Elective Course	5
CC	Core Course	15	FC	Foundation Course	1
EC-AL	Elective Course – Allied	7	AEC	Ability Enhancement Course	4
EC	Elective Course– Major	4	SLC	Self-Learning Course	1

2ND YEAR: THIRD SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24UCHC31	**Core Course 5 - General Chemistry –III**	**Core**	**3**	**1**	**2**	**0**	**5**	**6**	**25**	**75**	**100**

Learning Objectives	
LO1	To explain gas behavior using kinetic theory, distribution laws, and equations of state.
LO2	To describe and differentiate the properties of liquids and solids, including crystal structures and their characterization.
LO3	To analyze radioactive decay processes and evaluate the applications of nuclear energy, including the design and function of nuclear reactors.
LO4	To evaluate the structure, reactivity, and synthesis of aliphatic and aromatic halogen compounds and alcohols
LO5	To justify the selection of reagents and conditions in aromatic alcohol synthesis by analyzing reaction mechanisms and competing reactions.

Unit	Content	Hours
1	**Gaseous State:** Kinetic Molecular Model of a Gas - Postulates and derivation from the kinetic gas equation; The Maxwell – Boltzmann distribution of speed of molecules, collision frequency, collision diameter, mean free path and viscosity of gases. Real gases: Derivations from ideal gas behaviour (Andrew's and Amagat's plots), equation of states for real gas - van der Waal's equation.	18
2	**Liquid and Solid State:** Properties of Liquids - Surface tension, viscosity and their applications. Crystalline and amorphous – differences - geometry, isotropy and anisotropy, melting point, isomorphism, polymorphism. Crystals - size and shape; laws of crystallography; symmetry elements - plane, centre and axis; Miller indeces, unit cells ads space lattices; X-ray diffraction - Bragg's equation.	18
3	**Nuclear Chemistry:** Natural radioactivity - alpha, beta and gamma rays, half-life period, Fajan-Soddy group displacement law, Geiger-Nattal rule; isotopes, isobars, isotones, mirror nuclei, nuclear isomerism, radioactive decay series, magic numbers; Units – Curie, Rutherford, Roentgen. Nuclear energy - fission, fusion and nuclear reactor - components and its function.	18
4	**Halogen Derivatives:** Aliphatic Halogen compounds: Nomenclature, preparation, properties and uses of CH_2Cl_2, $CHCl_3$ and CCl_4. Aromatic Halogen compounds: Aryl and alkyl	18

	halides: Nomenclature, preparation, properties and uses of benzyl chloride. Mechanism of nucleophilic aromatic substitution – benzyne intermediate. Alcohols: Nomenclature, classification, preparation, properties and uses.	
5	**Aromatic Alcohols:** Phenol, resorcinol, quinol, picric acid and benzyl alcohol - nomenclature, classification, preparation, properties and uses. Important methods of preparation - hydrolysis, reduction of benzaldehyde, Cannizzaro reaction, Grignard synthesis. Electrophilic substitution reactions: Reimer-Teimen, Kolbe, Schmidt, Gatermann synthesis, Libermann, nitro reaction, phthalein reaction.	18

CO	Course Outcomes Students will be able to
CO1	Predict and explain the behavior of ideal and real gases using kinetic theory, distribution laws, and equations of state.
CO2	Characterize and differentiate the properties of liquids and solids, including crystal structures.
CO3	Analyze radioactive decay processes and evaluate the applications of nuclear energy, including reactor design and function.
CO4	Evaluate the structure, reactivity, and synthesis of aliphatic and aromatic halogen compounds and alcohols.
CO5	Justify synthetic strategies for aromatic alcohols by analyzing reaction mechanisms and outcomes.
Textbooks:	
1.	B.R. Puri, L.R. Sharma and M.S. Pathania, "*Principles of Physical Chemistry*", 46th ed., Vishal Publishing, 2020.
2.	B.R. Puri, L.R. Sharma and K.C. Kalia, "*Principles of Inorganic Chemistry*", 30th ed., Milestone Publishers and Distributors, New Delhi, 2009.
3.	P.L. Soni and Mohan Katyal, "*Textbook of Inorganic Chemistry*", 20th ed., Sultan Chand & Sons, 2006.
4.	M.K. Jain and S.C. Sharma, "*Modern Organic Chemistry*", 4th ed., Vishal Publishing, 2003.
5.	Jerry March, "*Advanced Organic Chemistry: Reactions, Mechanisms, and Structure*", 6th ed., John Wiley & Sons, 2007.
Reference Books:	
1.	P.W. Atkins & Julio de Paula, "*Atkins' Physical Chemistry*", 11th ed., W. H. Freeman and Company, 2017.
2.	A. Carey Francis, "*Organic Chemistry*", 7th ed., Tata McGraw-Hill Education Pvt., Ltd., New Delhi, 2009.
3.	Loveland, W. D., Morrissey, D. J., & Seaborg, G. T, "*Modern Nuclear Chemistry",* 2nd ed., John Wiley & Sons, 2017.
4.	P.L. Soni, and H.M.Chawla, "*Text Book of Organic Chemistry*", 29th ed., Sultan Chand & Sons,New Delhi, 2007.
5.	J.D. Lee, "*Concise Inorganic Chemistry*", 5th ed., Blackwell Science, 2005.
Web resources:	
1.	https://unacademy.com/content/wp-content/uploads/sites/2/2022/10/Gaseous-State-Notes-1.pdf
2.	https://www.toppr.com/guides/chemistry/states-of-matter/the-gaseous-state
3.	https://www.google.com/url?sa=E&source=gmail&q=https://chem.libretexts.org/
4.	https://www.google.com/url?sa=E&source=gmail&q=https://www.khanacademy.org/science/chemistry
5.	https://www.google.com/url?sa=E&source=gmail&q=https://ocw.mit.edu/courses/chemistry/

Mapping with Programme Outcomes and Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	3	3	3	2	3	2	2	2	3	3	3
CO2	3	3	3	2	3	2	2	2	3	3	3
CO3	3	3	3	2	3	2	2	2	3	3	2
CO4	3	3	3	2	3	1	2	2	3	2	3
CO5	3	3	3	2	3	1	2	2	2	3	3
Total	15	15	15	10	15	08	10	10	14	14	14
Average	**3.0**	**3.0**	**3.0**	**2.0**	**3.0**	**1.6**	**2.0**	**2.0**	**2.8**	**2.8**	**2.8**

3 – Strong, 2- Medium, 1- Low

2ND YEAR: THIRD SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24UCHC32P	**Core Course 6 - Qualitative Inorganic Analysis (Practical)**	**Core**	**0**	**0**	**4**	**0**	**2**	**4**	**25**	**75**	**100**

Learning Objectives	
LO1	To accurately observe and interpret reaction results to determine the presence of specific anions.
LO2	To effectively apply methods to remove interfering ions from a test solution.
LO3	To correctly categorize basic radicals into their respective groups.
LO4	To precisely identify individual cations through systematic testing.
LO5	To successfully determine the complete ionic composition of an unknown mixture.

Unit	Content	Hours
1	**Semi - Micro Qualitative Analysis** A. Analysis of simple acid radicals: Carbonate, sulphide, sulphate, chloride, bromide, nitrate	12
2	B. Analysis of interfering acid radicals: Fluoride, oxalate, borate, phosphate.	12
3	C. Elimination of interfering acid radicals and Identifying the group of basic radicals.	12
4	D. Analysis of basic radicals (group wise): Lead, copper, bismuth, cadmium, tin, antimony, iron, aluminium, zinc, manganese, nickel, cobalt, calcium, strontium, barium, magnesium, ammonium ions.	12
5	E. Analysis of a mixture - I to VI containing two cations and two anions (of which one is interfering type)	12

SCHEME OF VALUATION

QUALITATIVE INORGANIC ANALYSIS (PRACTICAL)

Internal assessment	25 Marks
External assessment	75 Marks
Total	100 Marks
Max. Marks	75 Marks
Each radical with procedure (Spotting for each radical - 5 Marks; Fixing the group - 5 Marks)	20 Marks
Analysis	40 Marks
Record	10 Marks
Viva voce	5 Marks

CO	Course Outcomes Students will be able to
CO1	Perform and interpret qualitative tests to accurately identify common and interfering anions in a solution.
CO2	Systematically group and classify acid radicals based on their chemical properties and reactions.
CO3	Demonstrate the ability to recognize, manage, and eliminate interfering anions to ensure accurate analysis.
CO4	Conduct group-wise qualitative analysis to identify specific cations in a solution.
CO5	Design and execute a comprehensive qualitative analysis procedure to determine the composition of unknown mixtures containing both common and interfering ions.

Textbooks:	
1.	V. Venkateswaran, R. Veeraswamy and A.R. Kulandivelu, "*Basic Principles of Practical Chemistry*", 2nd ed., Sultan Chand & Sons, New Delhi, 1997.
2.	G.S. Turpin, "*Practical Inorganic Chemistry"*, 1st ed., Wentworth Press, 2016.
3.	J. Derek Woollins, "*Inorganic Chemistry: A Textbook*", 1st ed., Oxford University Press, 2010.
4.	H.K. Sharma, "*An Advanced Course in Practical Chemistry*", 1st ed., Vikas Publishing House, 2007.
5.	K.R. Mahajan and A.G. K. Gogia, "*Experiments in Inorganic Chemistry*", New Age International Publishers, 2010.
Reference Books:	
1.	G. Svehla, "*Vogel's Qualitative Inorganic Analysis*", 7th ed., Pearson Education India, 1996.
2.	R. A. Day & A. L. Underwood, "*Quantitative Analysis*", Reprint, Prentice Hall, 1999.
3.	I. L. Marr & B. W. Rockett, "*Practical Inorganic Chemistry*", Reprint, Van Nostrand Reinhold, 1977.
4.	J. L. Sharma, "*A Textbook of Qualitative Inorganic Analysis*", 1st ed., Laxmi Publications, 2013.
5.	F. A. Cotton, G. Wilkinson, C. A. Murillo & M. Bochmann, "*Advanced Inorganic Chemistry*", 6th ed., Wiley, 1999.
Web resources:	
1.	https://www.vlab.co.in/broad-area-chemical-sciences
2.	https://egyankosh.ac.in/bitstream/123456789/79535/1/Unit-1.pdf
3.	mgywomenscollege.ac.in/templateEditor/kcfinder/upload/files/Vogel%27s%20Textbook%20Of%20Macro%20And%20SemiMicro%20Qualitative%20Inorganic%20Analysis%205th%20ed%20-%20G.Svehla.pdf
4.	https://allen.in/jee/chemistry/qualitative-analysis
5.	https://ncert.nic.in/pdf/publication/sciencelaboratorymanuals/classXII/chemistry/lelm107.pdf

Mapping with Programme Outcomes and Programme Specific Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	2	3	3	2	3	2	2	3	3	3	3
CO2	3	2	2	2	3	2	2	2	3	3	2
CO3	3	2	3	2	3	2	2	2	3	3	2
CO4	3	3	3	2	3	2	2	3	3	3	3
CO5	2	2	3	2	3	2	2	2	2	2	3
Total	13	13	14	10	15	10	10	12	14	14	13
Average	**2.6**	**2.6**	**2.8**	**2.0**	**3.0**	**2.0**	**2.0**	**2.2**	**2.8**	**2.8**	**2.6**

3 – Strong, 2- Medium, 1- Low

2ND YEAR: THIRD SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24UCHA31	**Allied Chemistry - I**	**EC-3**	**3**	**1**	**0**	**0**	**4**	**4**	**25**	**75**	**100**

Learning Objectives	
LO1	To predict molecular properties using MO theory and analyze nuclear processes.
LO2	To classify and discuss fuel gases and silicone properties/applications.
LO3	To relate structure/bonding to properties using electronic effects.
LO4	To apply thermodynamic principles and interpret phase diagrams.
LO5	To perform volumetric calculations and select separation methods.

Unit	Content	Hours
1	**Chemical Bonding and Nuclear Chemistry**: Chemical Bonding: Molecular Orbital Theory - bonding, antibonding and non-bonding orbitals. Molecular orbital diagrams for Hydrogen, Helium, Nitrogen; discussion of bond order and magnetic properties. Nuclear Chemistry: Fundamental particles - Isotopes, Isobars, Isotones and Isomers. Nuclear binding energy - mass defect - calculations. Nuclear fission and nuclear fusion - differences – Applications of radioisotopes.	12
2	**Industrial Chemistry Fuels:** Fuel gases: Natural gas, water gas, semi water gas, carbureted water gas, producer gas, CNG, LPG and oil gas (manufacturing details not required). Silicones: Synthesis, properties and uses of silicones.	12
3	**Fundamental Concepts in Organic Chemistry Hybridization:** Orbital overlap, hybridization and geometry of CH_4, C_2H_2 and C_6H_6. Electronic effects: Inductive effect and consequences on K_a and K_b of organic acids and bases, electromeric, mesomeric, hyper conjugation and steric- examples.	12
4	**Thermodynamics and Phase Equilibria:** Thermodynamics: Types of systems, reversible and irreversible processes, isothermal and adiabatic processes and spontaneous processes. Statements of first law and second law of thermodynamics. Phase Equilibria: Phase rule - definition of terms in it. Applications of phase rule to water system.	12
5	**Analytical Chemistry:** Introduction to qualitative and quantitative analysis. Principles of volumetric analysis. Separation and purification techniques – extraction, distillation and crystallization. Chromatography: principle and application of column, paper and thin layer chromatography.	12

CO	Course Outcomes Students will be able to
CO1	Apply MO theory to predict molecular properties such as bond order and magnetism, and analyze nuclear processes including radioactive decay and nuclear reactions.
CO2	Classify various fuel gases and discuss the properties and applications of silicones in industrial and consumer contexts.
CO3	Correlate molecular structure and bonding with physical and chemical properties by analyzing electronic effects such as inductive, resonance, and hyperconjugation.
CO4	Utilize thermodynamic principles to analyze chemical systems and interpret phase diagrams to understand phase equilibria.
CO5	Conduct accurate volumetric calculations and select appropriate separation methods based on the physical and chemical properties of mixture components.
Textbooks:	
1.	F. Albert Cotton, Geoffrey Wilkinson, Paul L. Gaus, "*Basic Inorganic Chemistry*", 3rd ed., Wiley, 1995.
2.	B.K. Sharma, "*Industrial Chemistry*", 16th ed., Goel Publishing House, 2017.
3.	Jonathan Clayden, Nick Greeves, Stuart Warren, Peter Wothers, "*Organic Chemistry*", 2nd ed., Oxford University Press, 2012.
4.	P.W. Atkins, J. de Paula, "*Atkins' Physical Chemistry*", 11th ed., Oxford University Press, 2017.
5.	Douglas A. Skoog, Donald M. West, F. James Holler, Stanley R. Crouch, "*Fundamentals of Analytical Chemistry*", 9th ed., Cengage Learning, 2013.
Reference Books:	
1.	James E. Huheey, Ellen A. Keiter, Richard L. Keiter, "*Inorganic Chemistry: Principles of Structure and Reactivity*", 4th ed., Pearson, 1997.
2.	M.G. Fontana, "*Industrial Chemistry*", 3rd ed., McGraw-Hill, 2005.
3.	Paula Yurkanis Bruice, "*Organic Chemistry*", 8th ed., Pearson, 2016.
4.	J. Rajaram, J.C. Kuriacose, "*Thermodynamics for Chemists*", 1st ed., S Chand, 1999.
5.	Gary D. Christian, "*Analytical Chemistry*", 7th ed., Wiley, 2003.
Web resources:	
1.	www.khanacademy.org/science/chemistry
2.	https://chem.libretexts.org
3.	https://chem.libretexts.org/Bookshelves/Organic_Chemistry
4.	https://ocw.mit.edu/courses/chemistry/
5.	https://chem.libretexts.org/Bookshelves/Analytical_Chemistry

Mapping with Programme Outcomes and Programme Specific Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	3	3	3	2	3	1	2	2	3	3	3
CO2	3	3	3	2	3	1	2	3	2	3	3
CO3	3	3	3	2	2	1	2	2	3	3	3
CO4	3	3	3	2	2	1	2	2	3	2	3
CO5	3	3	3	2	3	1	2	3	2	3	2
Total	15	13	13	10	13	05	10	12	13	14	14
Average	**3.0**	**3.0**	**3.0**	**2.0**	**2.6**	**1.0**	**2.8**	**2.4**	**2.6**	**2.8**	**2.8**

3 – Strong, 2- Medium, 1- Low

2ND YEAR: THIRD SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24UCHA32P	**Allied Chemistry Practical - I**	**EC-4**	**0**	**0**	**2**	**0**	**2**	**2**	**25**	**75**	**100**

Learning Objectives	
LO1	To perform standard titration procedures accurately.
LO2	To demonstrate proficiency in using volumetric glassware (burette, pipette, volumetric flask) and other laboratory equipment essential for titrations safely.
LO3	To perform stoichiometric calculations to determine the concentration of an unknown solution using titration data.
LO4	To explain the underlying chemical principles of the specific type of titration being performed (acid-base, redox, or complexometric).
LO5	To analyze titration data, including identifying sources of error and evaluating the precision and accuracy of their results.

Unit	Content	Hours
1	**VOLUMETRIC ANALYSIS** 1. Estimation of sodium hydroxide using standard sodium carbonate. 2. Estimation of hydrochloric acid using standard oxalic acid.	6
2	3. Estimation of ferrous sulphate using standard Mohr's salt. 4. Estimation of oxalic acid using standard ferrous sulphate.	6
3	5. Estimation of potassium permanganate using standard sodium hydroxide.	6
4	6. Estimation of magnesium using EDTA.	6
5	7. Estimation of zinc using EDTA. 8. Estimation of ferrous ion using diphenyl amine as indicator.	6

SCHEME OF VALUATION

ALLIED CHEMISTRY PRACTICAL-I

(For Physics – II year/III Semester)

Internal assessment: 25 Marks

External assessment: 75 marks

Total: 100 marks

Max. Marks: 75

Record: 15 Marks

Volumetric Analysis: 60 Marks

Volumetric Analysis : 60 Marks (Maximum)

Short Procedure : 10 Marks

Error upto 2 % : 50 Marks

2 to 3 % : 40 Marks

3 to 4 % : 30 Marks

4 to 5 % : 20 Marks

> 5 % : 10 Marks

Arithmetic error : Deduct 1 mark

Wrong calculation : Deduct 20 % of marks scored

No calculation : Deduct 40 % of marks scored

CO	Course Outcomes Students will be able to
CO1	Design, carry out, record and interpret the results of volumetric titration.
CO2	Gain an understanding of the safe use of standard flask and volumetric pipettes, burette.
CO3	Perform stoichiometric calculations to determine the concentration of unknown solutions using data obtained from titration experiments.
CO4	Explain the underlying chemical principles governing various types of titrations, including acid-base, redox, and complexometric titrations, and their applications.
CO5	Analyze titration data, identify potential sources of error, and evaluate the precision and accuracy of experimental results.
Textbooks:	
1.	A.I. Vogel, "*A Textbook of Quantitative Inorganic Analysis"*, 5th ed., Longman, 1989.
2.	J. Mendham, R.C. Denney, J.D. Barnes, M. Thomas, "*Vogel's Textbook of Quantitative Chemical Analysis"*, 6th ed., Pearson, 2000.
3.	Douglas A. Skoog, Donald M. West, F. James Holler, Stanley R. Crouch, "*Fundamentals of Analytical Chemistry"*, 9th ed., Cengage Learning, 2013.
4.	Daniel C. Harris, "*Quantitative Chemical Analysis"*, 9th ed., W. H. Freeman, 2015.
5.	R.A. Day & A.L. Underwood, "*Quantitative Analysis*", 6th ed., Prentice Hall, 1991.
Reference Books:	
1.	Gary D. Christian, "*Analytical Chemistry"*, 7th ed., Wiley, 2013.
2.	Douglas A. Skoog, F. James Holler, Stanley R. Crouch, "*Principles of Instrumental Analysis"*, 7th ed., Cengage Learning, 2017.
3.	G. Svehla, "*Vogel's Qualitative Inorganic Analysis"*, 7th ed., Pearson, 1996.
4.	Douglas A. Skoog, Donald M. West, F. James Holler, "*Analytical Chemistry: An Introduction"*, 7th ed., Saunders College Publishing, 2000.
5.	David Harvey, "*Modern Analytical Chemistry"*, 1st ed., McGraw-Hill, 2000.
Web resources:	
1.	https://www.wiredchemist.com/chemistry/instructional/laboratory-tutorials/volumetric-analysis?utm_source=chatgpt.com
2.	https://www.coursesidekick.com/chemistry/1516334?utm_source=chatgpt.com
3.	https://www.youtube.com/watch?v=INN9pdpHte0&utm_source=chatgpt.com
4.	https://en.wikipedia.org/wiki/Titration?utm_source=chatgpt.com
5.	https://geo1.tcu.edu/richards/Lab%204.pdf?utm_source=chatgpt.com

Mapping with Programme Outcomes and Programme Specific Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	3	3	3	2	3	2	2	2	3	3	3
CO2	3	3	3	2	2	2	2	3	2	3	3
CO3	3	3	3	2	3	2	2	3	3	2	3
CO4	3	3	3	2	3	2	2	2	3	3	3
CO5	3	3	3	2	2	2	2	2	3	3	3
Total	15	15	15	10	13	10	10	12	14	14	14
Average	**3.0**	**3.0**	**3.0**	**2.0**	**2.6**	**2.0**	**2.0**	**2.4**	**2.8**	**2.8**	**2.8**

3 – Strong, 2- Medium, 1- Low

2ND YEAR: THIRD SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24UCHS31	**Entrepreneurial Skills in Chemistry**	**SEC-4**	**0**	**0**	**2**	**0**	**2**	**2**	**25**	**75**	**100**

Learning Objectives	
LO1	To identify food adulterants, classify food additives, and explain their functions/risks.
LO2	To conduct food adulteration tests and interpret results.
LO3	To develop entrepreneur skills in students.
LO4	To provide hands on experience to prepare and develop products.
LO5	To develop start ups.

Unit	**Content**	**Hours**
1-2	**Food Chemistry** Food adulteration - contamination of food items with clay stones, water and toxic chemicals - common adulterants. Food additives, natural and synthetic anti-oxidants, glazing agents (hazardous effect), food colourants, preservatives, leavening agents, baking powder and baking soda, yeast, MSG, vinegar. **Dyes** Classification – natural, synthetic dyes and their characteristics – basic methods and principles of dyeing.	12
3-5	**Hands on Experience (Students can choose any four)** 1. Detection of adulterants in food items like coffee, tea, pepper, chilli powder, turmeric powder, butter, ghee, milk, honey etc., by simple techniques. 2. Preparation of jam, squash and jelly, gulkand, cottage cheese. 3. Preparation of products like candles, soap, detergents, cleaning powder, shampoos, pain balm, tooth paste/powder and disinfectants in small scale. 4. Extraction of oils from spices and flowers. 5. Testing of water samples using testing kit. 6. Dyeing – cotton fabrics with natural and synthetic dyes. Printing – tie and dye, batik.	18

SCHEME OF VALUATION

ENTREPRENEURIAL SKILLS IN CHEMISTRY (PRACTICAL)

Internal assessment	25 Marks
External assessment	75 Marks
Total	100 Marks
Max. Marks	75 Marks
Experiment Execution	20 Marks
Presentation of Product Outcome	40 Marks
Record	10 Marks
Viva voce	5 Marks

CO	Course Outcomes Students will be able to
CO1	Identify common food adulterants and contaminants, classify food additives, explain their functions and potential risks, and interpret relevant regulations.
CO2	Gain practical skills in formulating and preparing food and household products, understanding ingredient functions, processing, and quality control.
CO3	Learn and apply basic entrepreneurial principles, including opportunity identification, market analysis, and product development, to create a basic business plan.
CO4	Perform and interpret simple food adulteration tests, understanding the implications for food safety.
CO5	Develop product concepts, prototypes, and marketing plans, exploring the potential for startup ventures.
Textbooks:	
1.	S. George and V. Muralidharan, "*Fibre to Finished Fabric – A Simple Approach*", 1st ed., Publication Division, University of Madras, Chennai, 2007.
2.	H.D. Belitz, W. Grosch and P. Schieberle, "*Food Chemistry"*, 4th ed., Springer, 2009.
3.	Vibha A. Joshi, "*Food Adulteration and Safety"*, 1st ed., Oxford Book Company, 2011.
4.	David S. Clydesdale, "*Food Chemistry: Principles and Applications*", 2nd ed., Aspen Publishers, 2004.
5.	S.S. Bhattacharya and A.R. Patel, "*Natural Dyes: Sources, Chemistry, and Applications"*, 1st ed., Woodhead Publishing, 2017.
Reference Books:	
1.	A. Larry Branen, P.M. Davidson and S. Salminen, "*Food Additives"*, 2nd ed., CRC Press, 2001.
2.	Yeshajahu Pomeranz and Clifton E. Meloan, "*Food Analysis: Theory and Practice"*, 3rd ed., Springer, 2000.
3.	Leo M.L. Nollet, "*Handbook of Food Analysis"*, 2nd ed., CRC Press, 2004.
4.	Asim Kumar Roy Choudhury, "*Principles of Textile Finishing and Dyeing"*, 1st ed., CRC Press, 2017.
5.	John Shore, "*Dyeing: History, Science and Practice*", Revised ed., Society of Dyers and Colourists, 2013.
Web resources:	
1.	https://librarysearch.ohsu.edu/discovery/fulldisplay?adaptor=Local+Search+Engine&context=L&docid=alma99332551176001451&lang=en&mode=advanced&offset=0&query=sub%2Cexact%2C+Food+composition+%2CAND&search_scope=Everything&tab=Everything&vid=01ALLIANCE_OHSU%3AOHSU&utm_source=chatgpt.com
2.	https://pmc.ncbi.nlm.nih.gov/articles/PMC9818512/?utm_source=chatgpt.com
3.	https://rosemaryandpinesfiberarts.de/natural-dyeing-resources/?utm_source=chatgpt.com
4.	https://spinoffmagazine.com/dyeing-resources-for-the-beginner-dyer/?utm_source=chatgpt.com
5.	https://researchguides.library.tufts.edu/dyes?utm_source=chatgpt.com

Mapping with Programme Outcomes and Programme Specific Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	3	3	3	2	3	3	3	3	3	3	3
CO2	3	3	3	3	2	3	2	3	3	3	3
CO3	3	3	3	3	3	3	3	3	3	3	3
CO4	3	3	3	3	2	3	3	3	3	3	3
CO5	3	3	3	3	3	3	2	2	3	3	3
Total	15	15	15	14	13	15	13	14	15	15	15
Average	**3.0**	**3.0**	**3.0**	**2.8**	**2.6**	**3.0**	**2.6**	**2.8**	**3.0**	**3.0**	**3.0**

3 – Strong, 2- Medium, 1- Low

2ND YEAR: THIRD SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24UCHS32	**Pesticide Chemistry**	**SEC-5**	**0**	**0**	**2**	**0**	**2**	**2**	**25**	**75**	**100**

Learning Objectives	
LO1	To understand the historical context of pesticide use and gain a foundational knowledge of the chemical nature of pesticides.
LO2	To gain in-depth knowledge of the chemistry, properties, synthesis, degradation, metabolism, and formulations of key insecticide classes.
LO3	To learn the sources, pathways, environmental fate, and impacts of pesticide residues.
LO4	To assess the effects of pesticide residues on living organisms and learn methods for their analysis.
LO5	To understand the principles, types, and applications of biopesticides as alternatives to synthetic pesticides.

Unit	Content	Hours
1	**Pesticides Chemistry and Toxicity**: History of pesticides. Chemistry of Pesticides: Brief introduction to classes of pesticides, structures, chemical names, physical and chemical properties. Toxicity of pesticides: Acute and chronic toxicity in mammals, birds, aquatic species etc. Methods of analysis of pesticides.	6
2	**Insecticides:** Study of following insecticides with respect to structure, chemical name, properties, synthesis, degradation, metabolism, formulations. Organophosphates and Phosphothionates: Monocrotophos, and parathion-methyl. Organochlorine – Endosulfan, heptachlor; Carbamate: Methomyl, Propoxur.	6
3	**Pesticides Residues:** Application of agrochemicals, dissemination pathways of pesticides, causes of pesticide residues, remedies. Pesticides residues in atmosphere, water and soil. Absorption, retention and transport in soil, effects on microorganism, soil condition and fertility.	6
4	**Pesticide Residues Effect and Analysis:** Effects of pesticides residue on human life, birds and animals - routes for exposure to pesticides, action of pesticides on living system. Analysis of pesticides residues - sample preparation, extraction of pesticides residues simple methods and schemes of analysis, multi-residue analysis.	6

5	**Biopesticides:** Pheromones, attractants, repellents – Introduction, types and application (8- Dodecen-1-ol, 10-cis-12-hexadecadienoic, Trimedlure, Cue- lure, methyl eugenol, N,N-Diethyl-m-toluamide, Dimethyl phthalate, Icaridin). Baits-Metaldehyde, Iron (II) phosphate, Indoxacarb, Zinc Phosphide, Bromadiolone.	6

CO	Course Outcomes Students will be able to
CO1	Describe the history of pesticide use and explain the basic chemical structures and properties of common pesticide classes.
CO2	Identify, classify, and describe the chemical properties, synthesis, degradation, metabolism, and formulations of major insecticide classes.
CO3	Explain the sources, pathways, environmental fate, and ecological impacts of pesticide residues.
CO4	Assess the effects of pesticide residues on living organisms and perform basic analytical techniques for their detection and quantification.
CO5	Explain the principles, classify the types, and describe the applications of biopesticides as alternatives to synthetic pesticides.
Textbooks:	
1.	R. Krieger, "*Hayes' Handbook of Pesticide Toxicology"*, 3rd ed., Academic Press, 2010.
2.	N. N. Melnikov, "*Chemistry of Pesticides"*, 1st ed., Springer, 1971.
3.	M. Stoytcheva, "*Pesticides - Formulations, Effects, Fate"*, 1st ed., InTechOpen, 2011.
4.	P. D. Larkin, "*Analytical Methods for Pesticide Residues"*, 1st ed., Wiley, 2013.
5.	Opender Koul, "*Microbial Biopesticides: Opportunities and Challenges"*, 1st ed., CRC Press, 2013.
Reference Books:	
1.	J. R. Plimmer, "*Pesticide Chemistry and Bioscience: The Food-Environment Challenge"*, 1st ed., Springer, 2001.
2.	C. Tomlin, "*The Pesticide Manual: A World Compendium"*, 17th ed., BCPC, 2015.
3.	J. C. Varela, "*Pesticide Residues in Food and Drinking Water"*, 1st ed., Wiley, 2005.
4.	G. J. Hall, "*Pesticides and Human Health"*, 1st ed., Springer, 2020.
5.	H. Schmutterer, "*The Neem Tree: Source of Unique Natural Products for Integrated Pest Management"*, 2nd ed., Wiley-VCH, 2002.
Web resources:	
1.	https://www.epa.gov/pesticide-science-and-assessing-pesticide-risks
2.	https://www.epa.gov/caddis/insecticides
3.	https://www.fao.org/agriculture/crops/thematic-sitemap/theme/pests/code/pesticide-residues/en/
4.	https://www.who.int/news-room/fact-sheets/detail/pesticide-residues-in-food
5.	https://www.epa.gov/ingredients-used-pesticide-products/what-are-biopesticides

Mapping with Programme Outcomes and Programme Specific Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	3	3	3	3	3	3	3	3	3	3	3
CO2	3	3	3	3	2	3	3	3	3	2	2
CO3	3	3	2	2	3	3	3	3	3	3	2
CO4	3	3	3	3	3	3	3	3	3	2	3
CO5	3	3	3	3	3	3	3	3	2	3	3
Total	15	15	14	14	14	15	15	15	14	13	13
Average	**3.0**	**3.0**	**2.8**	**2.8**	**2.8**	**3.0**	**3.0**	**3.0**	**2.8**	**2.8**	**2.8**

3 – Strong, 2- Medium, 1- Low

Continuous Internal Assessment (CIA) Test

The following procedure will be followed for the award of internal marks:

CIA Exam I: Three hours duration for 75 marks (First 2 ½ Units)
CIA Exam II cum Model Exam: Three hours duration for 75 marks (Full Syllabus)

Internal Mark Distribution	Theory & Practical
CIA – I (75 Marks)	5
CIA – II (75 Marks)	5
Library Usage in Hours	5
Attendance	5
Assignment / Seminar / Observation	5
Internal Marks	**25**

Format to Entering in all Continue Internal Assessment (CIA) Tests and Internal Marks

Reg. No.	Name	CIA - 1	CIA - 2	Marks Conversion	Library Usages	Attendance	Assignment / Seminar / Observation	Total Marks	Remarks

Recommendations for Entering Library Usage:

Library usage for UG in hours	Marks to be awarded
Minimum 10 Hours	5

Attendance:

Attendance Earned	Category	Marks to be Awarded
91% and above	Highly Regular	5
75% but below 90%	Regular	4
65% but below 74%	Shortage	3
55% but below 64%	Detained	2
Below 54%	Redo	0

THEORY QUESTION PAPER PATTERN END SEMESTER EXAMINATIONS FOR UG & PG DEGREE PROGRAMMES - 3 HOURS DURATION

Part A	To answer All the 10 Short Questions (Two Questions from each UNIT)	10 X 2 = 20 Marks
Part B	To answer All the 5 questions (either or, type) (One Question from each UNIT)	5 X 5 = 25 Marks
Part C	To answer 3 questions (out of 5 questions) (One question from each UNIT)	3 X 10 = 30 Marks
TOTAL		**75 Marks**
(Equal Weightage should be given to each unit)		