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 2024-25

CONTENT

LEARNING OUTCOMES BASED CURRICULUM FRAMEWORK FOR UNDERGRADUATE EDUCATION

1. Preamble

Chemistry plays a pivotal role in all aspects of physical & biological sciences, engineering, agriculture, medicine, and allied health disciplines. The knowledge of chemistry is essential for student to make the sustainable development and face the upcoming societal change. To impart the basic knowledge of science to young women community, the Department of Chemistry started B.Sc. Programme in the year 2017 followed by M.Sc. Chemistry Programme at 2020. The department offers Chemistry program with the aim of producing chemists with high professional competence, in carrying out both basic and applied chemistry research. The department has well equipped with the latest instruments required to carry out practical experiments in the laboratories and separate library with all needed books.

The faculty members have contributed research towards publication of several research papers in national and international conferences and peer reviewed journals. The research has been carried out in frontier areas of chemistry such as environmental chemistry, electrochemistry, nano materials, coordination chemistry, synthetic organic chemistry, photochemistry, polymer chemistry, and green chemistry. As extension activities, our faculty members and students visit remote villages and various industries in training them to develop entrepreneurial skills and competencies.

In the forthcoming academic year, B.Sc. & M.Sc. Chemistry syllabus provides an integrated and unified approach towards chemical sciences covering all branches of chemistry and following Choice Based Credit System with Outcome Based Education. The curriculum is rigorous in accord to international standards and covers theory and practical courses with full emphasis to construct intellectual assets. In the final semester, the PG students are encouraged to carry out research project in reputed research institutions to enhance their exposure level and placement abilities.

2. PROGRAMME OUTCOMES (PO)

Programme	**B.Sc., Chemistry**
Programme Code	**24UCH**
Duration	**3 years [UG]**
Programme Outcomes	**PO1: Disciplinary Knowledge:** Acquire knowledge in chemistry and apply the knowledge in their day-to-day life for betterment of self and society. **PO2: Cognitive and Problem-Solving Skills:** Develop critical, analytical thinking and problem-solving skills. **PO3: Societal and Environmental Impact:** Address and develop solutions for societal and environmental needs at local, regional, and national levels. **PO4: Research-Related Skills**: Develop research skills in defining problems, formulating and testing hypotheses, analyzing, interpreting, and drawing conclusions from data. **PO5: Employability and Entrepreneurship:** Enhance employability and entrepreneurship among students, along with ethical and communication skills. **PO6: Self-Directed Learning**: Work independently and engage in lifelong learning and continuous professional development. **PO7: Moral and Ethical Awareness/Reasoning**: Understand the importance of ethical behavior in professional contexts and be able to recognize and address ethical dilemmas. **PO8: Lifelong Learning and Adaptability:** Be prepared for lifelong learning and professional development, including the ability to adapt to changes in technology, business practices, and economic conditions.

3. PROGRAMME SPECIFIC OUTCOMES (PSO)

Programme Specific Outcomes:	**PSO1: Placement:** Apply principles of organic, inorganic, and physical chemistry to design and synthesize novel compounds, contributing to advancements in pharmaceuticals, materials science, and sustainable industries. **PSO2: Research and Development:** Develop expertise in Nano Science and Green Chemistry to design and implement sustainable, pollution-free technologies with high accuracy, fostering innovation in environmental protection, industrial applications, and entrepreneurship. **PSO3: Contribution to the Society:** Integrate practical expertise in compound analysis to ensure precision in quality control, research, and innovation, contributing to industrial growth and societal well-being.

4. Eligibility for Admission:

Candidates for admission to the first year of the Bachelor of Science Degree of Chemistry course shall be required to have passed the Higher Secondary Examination with Chemistry and Physics / Mathematics / Biology as main subjects by the Government of TamilNadu or any equivalent.

5. Methods of Evaluation and Assessments

Methods of Evaluation		
Internal Evaluation		25 Marks
External Evaluation	End Semester Examination	75 Marks
	Total	**100 Marks**
Methods of Assessment		
Recall (K1)	Simple definitions, MCQ, Recall steps, Concept definitions	
Understand / Comprehend (K2)	MCQ, True/False, Short essays, Concept explanations, short summary or overview	
Application (K3)	Suggest idea/concept with examples, suggest formulae, solve problems, Observe, Explain	
Analyze (K4)	Problem-solving questions, finish a procedure in many steps, Differentiate Between various ideas, Map knowledge	
Evaluate (K5)	Longer essay/Evaluation essay, Critique or justify with pros and cons	
Create (K6)	Check knowledge in specific or offbeat situations, Discussion, Debating or Presentations	

Semester – I						
Code	Course Title	Hours Distribution				C
		L	T	P	S	
24UFTA11	Tamil - I	4	1	0	0	3
24UFEN11	English - I	4	1	0	0	3
24UCHC11	CC - 1 General Chemistry -I	3	1	2	0	5
24UCHC12P	CC - 2 Practical - Quantitative Inorganic Estimation (Titrimetry) & Inorganic Preparation – I	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 AL Practical - Biochemistry - 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 – II	4	1	0	0	3
24UFEN21	English – II	4	1	0	0	3
24UCHC21	CC – 3 General Chemistry-II	3	1	2	0	5
24UCHC22P	CC - 4 Practical - Qualitative Organic Analysis and Preparation of Organic Compounds – II	0	0	4	0	2
24UBCA21	EC - 2 AL Biochemistry – II	3	1	0	0	4
24UBCA22P	EC - 3 AL Practical - Biochemistry – II	0	0	2	0	2
24UCHS21	SEC – 3 Dairy Chemistry	1	0	1	0	2
24UAEC21	AEC – 1 Life Skills through Yoga	1	1	0	0	2
					30	**23**

Semester – III						
24UFTA31	Tamil - III	4	1	0	0	3
24UFEN31	English - III	4	1	0	0	3
24UCHC31	CC – 5 General Chemistry-III	3	1	2	0	5
24UCHC32P	CC – 6 Practical - Qualitative Inorganic Analysis	0	0	4	0	2
24UPHA31	EC - 4 AL Physics-I	3	1	0	0	4
24UPHA32P	EC - 5 AL Practical - Physics-I	0	0	2	0	2
24UCHS31P 24UCHS32	SEC - 4 Practical - Entrepreneurial Skills in Chemistry Pesticide Chemistry	0	0	2	0	2
24UAEC31	AEC – 2 Human Values and Professional Ethics	1	1	0	0	2
					30	**26**

Semester - IV						
24UFTA41	Tamil – IV	4	1	0	0	3
24UFEN41	English – IV	4	1	0	0	3
24UCHC41	CC – 7 General Chemistry -IV	3	1	2	0	5
24UCHC42P	CC - 8 Practical - Physical Chemistry Practical – I	0	0	4	0	2
24UPHA41	EC - 7 AL Physics -II	3	1	0	0	4
24UBTA41	EC - 6 AL – Bioinformatics& Biostatistics	3	1	0	0	4
24UPHA41P	EC -9 AL Practical - Physics-II	0	0	2	0	2
24UBTA41P	EC - 7 AL Practical – Lab in Bioinformatics& Biostatistics	0	0	3	0	2
24UCHS41	Forensic Science	1	0	1	0	2
24UAEC41	AEC – 3 Environmental Studies and Disaster Management	1	1	0	0	2
					30	**29**

Semester – V						
24UCHC51	CC -9 Organic Chemistry -I	4	1	0	0	4
24UCHC52	CC - 10 Inorganic Chemistry - I	3	1	0	0	4
24UCHC53P	CC – 11 Gravimetric Estimation Practical	0	0	3	0	2
24UCHC54	CC - 12 Industrial Chemistry	3	1	0	0	4
24UCHE51	EC - 8 Physical	4	1	0	0	4

Semester – VI						
24UCHC61	CC - 13 Organic Chemistry - II	4	1	0	0	4
24UCHC62	CC - 14 Inorganic Chemistry – II	4	1	0	0	3
24UCHC63P	CC – 15 Project	0	0	0	5	4
24UCHE61 24UCHE62	EC – 10 Physical Chemistry-II / Pharmaceutical Chemistry	4	1	0	0	4
24UCHE63	EC 11 Nano Science/	4	1	0	0	4

24UCHE52	Chemistry - I / Cosmetic Chemistry						24UCHE64	Textile Chemistry					
24UCHE53 24UCHE54	EC – 9 Fundamentals of Spectroscopy/ Petrochemical Technology	4	1	0	0	4	24UCHP61	PEC – 1 Quality Control and Assurance in Chemical Industries	1	1	0	0	2
24UAEC51	AEC – 4 Gender Equality and Social Inclusion	1	1	0	0	2	24UCHL61	SLC - 1 Polymer Chemistry	0	0	0	3	2
24UCHIN51	Internship	0	0	0	0	2						**30**	**23**
24UCHIK51	IKS - Indigenous Science & Technology	1	1	0	0	0							
					30	**26**							
												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

1ST YEAR: FIRST SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24UCHC11	Core Course 1 - General Chemistry – I	Core	3	1	2	0	5	6	25	75	100

Learning Objectives	
LO1	To understand the various atomic models and atomic structures.
LO2	To correlate the wave particle duality of matter.
LO3	To understand the periodic table, periodicity in properties and its applications.
LO4	To correlate the nature of chemical bonding and chemical behaviour.
LO5	To understand the fundamental concept of organic chemistry.

Unit	Content	Hours
1	**Atomic Structure and Periodic Trends:** History of atom (J.J.Thomson, Rutherford); Moseley's Experiment and Atomic number, Atomic Spectra; Electronic Configuration of Atoms and ions- Hund's rule, Pauli'exclusion principle and Aufbau principle; Black-Body Radiation and Planck's quantum theory - Bohr's model of atom.	18
2	**Introduction to Quantum Mechanics:** Classical mechanics Wave mechanical model of atom, Postulates of quantum mechanics Formulation of Schrodinger wave equation -Probability and electron density, Atomic radii, Ionic and Covalent radii; ionization energy, electron affinity, electronegativity-electronegativity scales, applications of electronegativity.	18
3	**Structure and Bonding - I:** Born Haber cycle; polarisation Ion polarisation – polarising power and polarizability; Fajans' rules - effects of polarization, Shapes of orbitals, overlap of orbitals – σ and π-bonds; hybridization; principles of VSEPR theory - Partial ionic character of covalent bond - dipole moment, application to molecules.	18

4	**Structure and Bonding - II:** VB theory – application to hydrogen molecule,limitations of VBT; MO theory - bonding, antibonding and non-bonding orbitals, bond order; comparison of VB and MO theories. Coordinate bond: Metallic bond VB Definition, conductors, insulator, semiconductor – types, applications of semiconductors - Vander Waals forces, Hydrogen bonding and its Types.	18
5	**Basic Concepts in Organic Chemistry and Electronic Effects:** Types of bond cleavage – heterolytic and hemolytic types of reagents - electrophiles, nucleophiles, free radicals. Inductive effect - reactivity of alkyl halides, inductomeric and electromeric effects. Resonance – resonance energy, Types of organic reactions - addition, substitution, elimination reaction.	18

CO	Course Outcomes
CO1	Explain the atomic structure, wave particle duality of matter, periodic properties bonding, and properties of compounds.
CO2	Classify the elements in the periodic table, types of bonds, reaction intermediates electronic effects in organic compounds, types of reagents.
CO3	Apply the theories of atomic structure, bonding, to calculate energy of a spectral transition, Δx, Δp electronegativity, percentage ionic character and bond order
CO4	Evaluate the relationship existing between electronic configuration, bonding, geometry of molecules and reactions; structure reactivity and electronic effects
CO5	Construct MO diagrams, predict trends in periodic properties, assess the properties of elements, and explain hybridization in molecules and organic reaction mechanisms.
Textbooks:	
1	Madan R. D. and Sathya Prakash, "Modern Inorganic Chemistry", 2nd ed., S. Chand and Company, New Delhi, 2003.
2	Rao C. N. R. "University General Chemistry", Macmillan Publication, New Delhi, 2000.
3	Puri B. R. and Sharma L. R. "Principles of Physical Chemistry", 38th ed., Vishal Publishing Company, Jalandhar, 2002.
4	Bruce P. Y. and Prasad K. J. R. "Essential Organic Chemistry", Pearson Education, New Delhi, 2008.
5	Dash U. N, Dharmarha O. P. and Soni P. L. " Textbook of Physical Chemistry", Sultan Chand & Sons, New Delhi, 2016.
Reference Books:	
1	Maron S. H. and Prutton C. P. " Principles of Physical Chemistry", 4th ed., The Macmillan Company, Newyork, 1972.
2	Lee J. D. "Concise Inorganic Chemistry", 4th ed., ELBS William Heinemann, London, 1991.
3	Gurudeep Raj. "Advanced Inorganic Chemistry", 26th ed., Goel Publishing House, Meerut, 2001.
4	Atkins P. W. and Paula J. "Physical Chemistry", 10th ed., Oxford University Press, New York, 2014.
5	Huheey J. E. "Inorganic Chemistry: Principles of Structure and Reactivity", 4th ed., Addison, Wesley Publishing Company, India, 1993.
Web resources:	
1	https://openstax.org/details/books/chemistry-2e
2	https://chem.libretexts.org/Bookshelves/Organic_Chemistry
3	https://faculty.cengage.com/titles/9781305957404
4	https://www.mheducation.com/prek-12/program/chang-chemistry-ap-edition-2023-14e/MKTSP-GEC10M0.html
5	https://ocw.mit.edu/courses/8-04-quantum-physics-i-spring-2016/

Mapping with Programme Outcomes and Programme Specific Outcomes

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

3 – Strong, 2- Medium, 1- Low

1st YEAR: FIRST SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24UCHC12P	**Core Course 2 - Quantitative Inorganic Estimation (Titrimetry) & Inorganic Preparation–I (Practical)**	**Core**	**0**	**0**	**4**	**0**	**3**	**4**	**25**	**75**	**100**

Learning Objectives	
LO1	To understand laboratory safety and handling glasswares
LO2	To understand volumetric estimations
LO3	To correlate acid base titration and standard solutions
LO4	To understand precipitation titration
LO5	To understand the complexometric titrations using EDTA

Unit	Content	Hours
1	**Acidimetry:** 1. Estimation of Borax – Standard Sodium Carbonate 2. Estimation of Sodium Hydroxide – Standard Sodium Carbonate 3. Estimation of HCl – Standard Oxalic acid	12
2	**Complexometry:** 1. Estimation of Magnesium using EDTA 2. Estimation of Zinc using EDTA	12
3	**Dichrometry:** 1. Estimation of Ferrous Iron using Diphenyl amine/N-Phenylanthranillic acid as indicator	12
4	**Precipitation Titration:** 1. Estimation of Chloride in neutral medium (Demonstration experiment).	12
5	**Permanganometry:** 1. Estimation of Ferrous Sulphate – Standard FAS 2. Estimation of Oxalic acid – Standard Oxalic acid	12

SCHEME OF VALUATION

24UCHC12P - QUANTITATIVE INORGANIC ESTIMATION (TITRIMETRY) & INORGANIC PREPARATION–I (PRACTICAL)

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
CO1	Explain the basic principles involved in titrimetric analysis and inorganic preparations.
CO2	Compare the methodologies of different titrimetric analysis.
CO3	Estimate the amount of a substance present in a given solution.
CO4	Assess the yield of different inorganic preparations and identify the end point of various titrations.
CO5	Describe the measurable skills, abilities, knowledge in qualitative analysis.
Textbooks:	
1	Venkateswaran V, Veeraswamy R, and Kulandivelu A. R. "Basic Principles of Practical Chemistry", 2nd ed., Sultan Chand & Sons, New Delhi, 1997.
2	Nad A. K, Mahapatra B, and Ghoshal A. "An Advanced Course in Practical Chemistry", 3rd ed., New Central Book Agency, Kolkata, 2007.
3	Jeffery G. H, Bassett J, Mendham. J and Denney R. C, "Vogel's Textbook of Quantitative Chemical Analysis", 5th ed., Ergodebooks, Houston, TX, U.S.A, 2006.
4	Vogel A. I. "Qualitative Analysis and Inorganic Preparation", 7th ed., ELBS and Prentice Hall, 2010.
5	Svehla G. "Vogel's Qualitative Inorganic Analysis", 7th ed., Pearson Education, 2012.
Reference Books:	
1	Mendham J, Denney R. C, Barnes J. D, Thomas M, and Sivasankar B. "Vogel's Textbook of Quantitative Chemical Analysis", 6th ed., Pearson Education Ltd, New Delhi, 2009.
2	Vogel M. L. A, and Arthur I. "Vogel's Textbook of Quantitative Chemical Analysis", 6th ed., Pearson Education, 2002.
3	Svehla G. "Vogel's Quantitative Inorganic Analysis," 7th ed., Pearson Education Ltd., 2012.
4	Jeffery G. Hammond and Richard Annunziata,"Mendham and Denney's Quantitative Analysis and Separations", 8th ed., Wiley, 2003.
5	Daniel C. Harris, "Quantitative Chemical Analysis", 8th ed., W. H. Freeman & Co., 2010.
Web resources:	
1	https://www.bookrix.com
2	https://chemdictionary.org/titration-indicator/
3	https://www.nist.gov/chemistry
4	https://www.rsc.org/
5	http://chemgroups.ucdavis.edu/~larsen/ChemWiki.html

Mapping with Programme Outcomes and Programme Specific Outcomes

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

3 – Strong, 2- Medium, 1- Low

1ST YEAR: FIRST SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24UCHA11	**Allied / Generic - 1 Allied Chemistry**	**Allied**	**3**	**1**	**0**	**0**	**3**	**4**	**25**	**75**	**100**

Learning Objectives	
LO1	To understand chemical bonding and nuclear chemistry.
LO2	To know about the important materials used in industries.
LO3	To understand the various fundamental concepts in organic chemistry.
LO4	To correlate types of thermodynamics process.
LO5	To understand separation and purification techniques.

Unit	Content	Hours
1	**Chemical Bonding and Nuclear Chemistry:** Chemical Bonding**:** Molecular Orbital Theory-bonding, anti-bonding 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.	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. Fertilizers: Urea, NPK fertilizer, superphosphate, triple superphosphate.	12
3	**Fundamental Concepts in Organic Chemistry:** Hybridization: Orbital overlap, hybridization and geometry of CH_4, C_2H_4 and C_6H_6. Electronic effects: Inductive effect, electromeric effect, mesomeric effect, hyper conjugation and steric effects - examples. Reaction mechanisms: Types of reactions –	12

	aromaticity (Huckel's rule) – aromatic electrophilic substitution: nitration, halogenation, Friedel-Craft's alkylation and acylation.	
4	**Thermodynamics and Phase Equilibria:** Thermodynamics: Types of systems, reversible and irreversible processes, Statements of first law and second law of thermodynamics. Carnot's cycle and efficiency of heat engine. Entropy and its significance. Relationship between Gibbs free energy and entropy. Phase equilibria: Gibb's phase rule, terms involved.	12
5	**Analytical Chemistry:** 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
CO1	Gain in-depth knowledge about the theories of chemical bonding, nuclear reactions and its applications.
CO2	Evaluate the efficiencies and uses of various fuels and fertilizers.
CO3	Explain the type of hybridization, electronic effect and mechanism involved in the organic reactions.
CO4	Apply various thermodynamic principles, systems and phase rule.
CO5	Explain various methods to identify an appropriate method for the separation of chemical components.
Textbooks:	
1	Arun Bahl S. and Bahl B. S, "Advanced Organic Chemistry", S. Chand and Company, New Delhi, 23rd ed., 2012.
2	Soni P. L. and Chawla H. M, "Text Book of Organic Chemistry", Sultan Chand & Sons, New Delhi, 29th ed., 2007.
3	Gopalan R, "Analytical Chemistry", Sultan Chand & Sons, 2017.
4	Puri B. R, Sharma L. R. and Madan S. Pathania, "Principles of Physical Chemistry", Vishal Publishing Co., 48th ed., 2024.
5	Veeraiyan V. and Vaithyanathan S, "Text book of Ancillary Chemistry", Priya Publications, Karur, 2006.
Reference Books:	
1	Soni P. L. and Mohan Katyal, "Textbook of Inorganic Chemistry", Sultan Chand & Sons, New Delhi, 20th ed., 2006.
2	Sharma B. K, "Industrial Chemistry", GOEL publishing House, Meerut, 16th ed., 2014.
3	Puri B. R. and Sharma L. R, "Textbook of Physical Chemistry", 47th ed., 2020.
4	Puri, Sharma, Pathania and Kaur, "Textbook of Physical Chemistry", Vishal Publishing Co., New Delhi, 2018.
5	Veeraiyan V, "Textbook of Ancillary Chemistry", Priya Publications, Karur, 1st ed., 2009.
Web resources:	
1	https://www.khanacademy.org/science/hs-chemistry/x2613d8165d88df5e:nuclear-chemistry-hs
2	https://pubs.acs.org/journal/enfuem
3	https://m.youtube.com/watch?v=8c4urO_h1Ds
4	https://www.energy.gov/nnsa/national-nuclear-security-administration
5	https://en.wikipedia.org/wiki/Molecular_orbital

Mapping with Programme Outcomes and Programme Specific Outcomes

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

3 – Strong, 2- Medium, 1- Low

1ST YEAR: FIRST SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24UCHS11	**SEC - 1 (NM) Foundation Course in Chemistry**	**NME**	**1**	**0**	**1**	**0**	**2**	**2**	**25**	**75**	**100**

Learning Objectives	
LO1	To provide a broad foundation in chemistry that stresses scientific reasoning and analytical problem solving with a molecular perspective.
LO2	To provide students with the skills required to succeed in graduate school, the chemical industry, or professional school.
LO3	Students will demonstrate scientific understandings of the structure of matter and of its physical and chemical transformations.
LO4	Students will apply appropriate theories to predict chemical structure, reactivity, and physical properties.
LO5	Aim is long-term and provides overall direction, while objectives are short-term and measurable.

Unit	**Content**	**Hours**
1	**Atomic properties & Periodic Properties:** Mendeleev's periodic laws and table - modern periodic laws – Periodicity of property and magic numbers Size of atoms and (Atomic and lonic radii) - Metallic radii, Atomic radius, Van der Waals radius, Ionization energy, Isoelectronic species – Electronic affinity - Electronegativity (Pauling, Allred and Rochow's scale, Mulliken), Applications of electronegativity.	6
2	**Nomenclature & Hybridization:** Covalent bond - Formation of sigma and pi bond, Differences between sigma and pi bond, Homolytic and heterolytic cleavage of covalent bond - Tetra valency of carbon. Hybridization sp, sp^2 and sp^3 hybridizations.	6

	IUPAC system of nomenclature of common organic compounds (upto C-10). Naming of organic compounds with one functional group - Halogen compounds, alcohols, phenol, aldehydes, ketones, carboxylic acids and its derivatives.	
3	**Solutions & Thermodynamics:** Mathematical concepts – Function of a real variable, differentiation – Derivative of a function, integration - Methods of integration; Concentration units – Normality, molarity, molality, mole ratio; oxidation number - Oxidation number calculation. Gaseous state - Gas law - Boyle's Law, Charles law, Avogadro hypothesis. Thermodynamics - Zeroth, first, second, third law - Terminology in thermodynamics	6
4	**Data Analysis:** Data analysis - Theory of errors - Idea of significant figures and it's importance with examples - Difference between precision and accuracy - Methods of expressing precision and accuracy. Error analysis - Methods of minimizing errors - Problems related to mean, median, standard deviation, confidence limit.	6
5	**Chromatography:** Chromatography - Introduction - Classification of chromatographic method - Paper Chromatography - Principle, theory, Rf values - TLC - Principle; Adsorption - Column and Ion exchange Chromatography - Principle, theory; comparison between partition and adsorption chromatography.	6

CO	Course Outcomes
CO1	Students at the end of the course will have acquired a good knowledge of the concepts of atoms and chemical bonds.
CO2	They will be able to understand and use the fundamental principles which characterize the properties of matter and how it reacts.
CO3	Students will gain an understanding of chemical reactions and strategies to balance them.
CO4	The relative quantities of reactants and products.
CO5	The fundamental properties of atoms, molecules, and the various states of matter.
Textbooks:	
1	John Moore, Conrad Stanitski, and Peter Fergusson, "Chemistry: The Molecular Science", W. H. Freeman & Co., 4th ed., 2010.
2	Morris Hein, Susan Arena, "Foundations of College Chemistry", John Wiley & Sons, 16th ed., 2017.
3	Stephen J. Benkovic, Stephen C. Harvey, "Basic Mathematics for Chemists", Springer, 2nd ed. 2017.
4	Jerry Sarquis, Paul C. Sorg, David A. Ucko, "Guided Inquiry Experiments for General Chemistry: Practical Problems and Applications", John Wiley & Sons, 1st ed., 2009.
5	Raymond Chang and Kenneth A. Goldsby, "General Chemistry", McGraw-Hill Education, 12th ed., 2020.
Reference Books:	
1	David W. Oxtoby, H. Pat Gillis, and Laurie J. Butler, "Principles of Modern Chemistry", Cengage Learning, 8th ed., 2017.
2	Nivaldo J. Tro, "Chemistry: A Molecular Approach" Pearson, 4th ed., 2017.
3	David R. Klein, "General Chemistry I as a Second Language: Mastering the Fundamental Skills", Wiley, 1st ed., 2007.
4	John A. Olmsted, Gregory M. Williams, Robert C. Burk, "Chemistry", Pearson Canada, 4th ed., 2015.
5	Theodore L. Brown, H. Eugene LeMay, and Bruce E. Bursten, "Chemistry: The Central Science", Pearson, 14th ed., 2017.
Web resources:	
1	https://www.gutenberg.org/
2	https://openlibrary.org/
3	https://webbook.nist.gov/chemistry/
4	https://www.nist.gov/itl/sed/topic-areas/measurement-uncertainty
5	https://link.springer.com/

Mapping with Programme Outcomes and Programme Specific Outcomes

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

3 – Strong, 2- Medium, 1- Low

1ST YEAR: FIRST SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24UCHS12	SEC-2 Chemistry Practical for Physical and Biological Sciences - I	SEC	0	0	2	0	2	2	25	75	100

Learning Objectives	
LO1	Demonstrate accurate use of volumetric glassware, including burettes, pipettes, and volumetric flasks.
LO2	Differentiate between types of titrations (acid-base, redox, complexometric, and precipitation titrations).
LO3	Prepare standard solutions and perform standardization procedures to determine the exact concentration of titrants.
LO4	Calculate the concentration of analytes from titration data using appropriate formulas and stoichiometric relationships.
LO5	Select suitable indicators for various types of titrations based on their pH range and the expected equivalence point.

Unit	Content	Hours
1	1. Estimation of sodium hydroxide using standard sodium carbonate 2. Estimation of sodium carbonate using standard sodium hydroxide	6
2	3. Estimation of hydrochloric acid using standard oxalic acid 4. Estimation of ferrous sulphate using standard Mohr's salt	6
3	5. Estimation of oxalic acid using standard ferrous sulphate 6. Estimation of potassium permanganate using standard sodium hydroxide	6
4	7. Estimation of Ca (II) using EDTA solution 8. Estimation of Mg (II) using EDTA solution	6
5	9. Estimation of total hardness of water 10. Estimation of ferrous ion using diphenyl amine as indicator	6

SCHEME OF VALUATION

24UCHS12 - CHEMISTRY PRACTICAL FOR PHYSICAL AND BIOLOGICAL SCIENCES - I

(For Biochemistry and ND (FSM) – I year/I 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
CO1	Gain an understanding of the use of standard flask and volumetric pipettes, burette.
CO2	Design, carry out, record and interpret the results of volumetric titration.
CO3	Apply their skill in the analysis of water/hardness.
CO4	Analyze the chemical constituents in allied chemical products.
CO5	Describe the measurable skills, abilities, knowledge in qualitative analysis.
Textbooks:	
1	Venkateswaran V, Veerasamy R and Kulandaivelu A. R, "Basic Principles of Practical Chemistry", Sultan Chand & Sons, 2nd ed., 1997.
2	Vogel A. I, Tatchell A. R, Furnis B. S, Hannaford A. J and Smith P. W. G, "Vogel's Textbook of Practical Organic Chemistry", Prentice Hall, 5th ed., 1989.
3	Donald L. Pavia, Gary M. Lampman, George S. Engel & Roger G. Gries, "Experimental Organic Chemistry", Cengage Learning, 2005.
4	Jerry Mohrig, Craig Hammond & Paul F. Snyder, "Techniques in Organic Chemistry", Macmillan Learning, 4th ed., 2014.
5	Mann F. G and Saunders B. C, "Practical Organic Chemistry", Pearson Education, 4th ed., 1975.
Reference Books:	
1	Ralph J. Fessenden and Joan S. Fessenden, "Organic Chemistry Laboratory Manual", Brooks/Cole, 3rd ed., 1982.
2	Middleton H, "Organic Qualitative Analysis", Longmans, Green and Co., 1st ed., 1951.
3	Bansal R. K, "Laboratory Manual of Organic Chemistry", New Age International Publishers, 5th ed., 2010.
4	John Leonard, Barry Lygo and Garry Procter, "Advanced Practical Organic Chemistry", CRC Press, 3rd ed., 2013.
5	Lisa Nichols, Organic Chemistry Laboratory Techniques", LibreTexts, 1st ed., 2016.
Web resources:	
1	https://webbook.nist.gov/chemistry/
2	https://www.organic-chemistry.org/
3	https://www.routledge.com/Advanced-Practical-Organic-Chemistry/Leonard-Lygo-Procter/p/book/9781439860977
4	https://chem.libretexts.org/Bookshelves/Organic_Chemistry/Organic_Chemistry_Lab_Techniques_(Nichols)
5	https://www.academia.edu/43215226/Advanced_Practical_Organic_Chemistry_Third_Edition

Mapping with Programme Outcomes and Programme Specific Outcomes

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

3 – Strong, 2- Medium, 1- Low

1ST YEAR: FIRST SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24UCHF11	**Foundation Course - Food Chemistry**	**FC**	**1**	**1**	**0**	**0**	**2**	**2**	**2**	**75**	**100**

Learning Objectives	
LO1	To understand the food adulteration and poisons.
LO2	Relate the properties and structures of chemical components and ingredients to the functional and chemical properties of foods.
LO3	To correlate food additives and preservation.
LO4	To understand basic analysis of major and trace food components.
LO5	To correlate physical and chemical interactions between food components and their impact on quality.

Unit	Content	Hours
1	**Food Adulteration:** Sources of food, types, advantages and disadvantages. Food adulteration - contamination of wheat, rice, milk, butter etc. with clay stones, water and toxic chemicals - Common adulterants, Ghee adulterants and their detection. Detection of adulterated foods by simple analytical techniques.	6
2	**Food Poison:** Food poisons - natural poisons (alkaloids - nephrotoxin) - pesticides, (DDT, BHC, Malathion) - Chemical poisons - First aid for poison consumed victims. Materials for food packing - Limitations and advantages.	6
3	**Food Additives:** Food additives - artificial sweeteners – Saccharin - Cyclomate and Aspartate Food flavours -esters, aldehydes and heterocyclic compounds – Food colours Emulsifying agents – preservatives - leavening agents.	6
4	**Beverages:** Beverages - soft drinks - soda - fruit juices - alcoholic beverages - examples. Carbonation-addiction to alcohol – diseases of liver and social problem.	6
5	**Edible Oils:** Fats and oils - Sources of oils - production of refined vegetable oils - preservation. Saturated and unsaturated fats - iodine value - role of MUFA and PUFA in preventing heart diseases - determination of iodine value, RM value, saponification value and their significance.	6

CO	Course Outcomes
CO1	Learn about Food adulteration - Contamination of Wheat, Rice, Milk, Butter.
CO2	Get an awareness about food poisons like natural poisons (alkaloids - nephrotoxin) Pesticides, DDT, BHC and Malathion.
CO3	Get an exposure on food additives, artificial sweeteners, Saccharin, Cyclomate and Aspartate in the food industries.
CO4	Acquire knowledge on beverages, soft drinks, soda, fruit juices and alcoholic beverages examples.
CO5	Study about fats and oils - Sources of oils - production of refined vegetable oils - preservation. Saturated and unsaturated fats – MUFA and PUFA.
Textbooks:	
1	Chopra H. K. and Panesar P. S. "Food chemistry", Narosa publishing house, 2010.
2	Jayashree Ghosh, "Fundamental Concepts of Applied Chemistry", S. Chand & Co. Publishers, 2nd ed, 2006.
3	Chopra H. K. and Panesar P. S. "Food Chemistry", Narosa Publishning House, 2010.
4	Rakesh Sharma L. "Food Chemistry", Evincepub Publishing, 2022.
5	Subbulakshmi G, Shobha A Udipi, Padmini S Ghugre. "Food processing and preservation", New Age International Publishers, 2nd ed, 2021.
Reference Books:	
1	Belitz H. D. and Werner Grosch. "Food Chemistry", Springer Science & Business Media, 4th ed., 2009.
2	Swaminathan M. "Food Science and Experimental Foods", Ganesh and Company, 1979.
3	Hasenhuettl, Gerard, Hartel L. and Richard. W. "Food Emulsifiers and their Applications", Springer, New York, 2nd ed., 2008.
4	Srilakshmi B, "Food Science", New Age International (P) Ltd., New Delhi, 3rd ed., 2005.
5	John M. deMan, John W. Finley, W. Jefferey Hurst and Chang Yong Lee, "Principles of Food Chemistry", Springer, 4th ed., 2018.
Web resources:	
1	https://www.fssai.gov.in/
2	https://www.mayoclinic.org/diseases-conditions/food-poisoning/symptoms-causes/syc-20356230
3	https://www.fda.gov/food/food-additives-and-gras-ingredients-information-consumers/understanding-how-fda-regulates-food-additives-and-gras-ingredients
4	https://www.britannica.com/topic/beverage
5	https://www.catena.ro/ce-este-si-cum-recunoasteti-o-toxiinfectie-alimentara

Mapping with Programme Outcomes and Programme Specific Outcomes

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

3 – Strong, 2- Medium, 1- Low

BRIDGE COURSE SYLLABUS 2024-2025

Course Objectives

- To understand basics of chemistry
- To develop working skills with qualitative and quantitative.
- To acquire basic knowledge in atomic structure, periodic tables, organic compounds.

Unit I: Atomic Structure

Structure of an atom, atomic number, atomic weight, stable and unstable atoms, molecules Atomic Orbitals, quantum, numbers – Azimuthal, magnetic and spin Quantum numbers and their significance. Pauli's exclusion principle, Hund's rule & Aufbau principle. Classification of s, p, d & f block elements.

Unit II: Periodic trends & Thermodynamics

Periodic table trends–Electron configuration, atomic radii, Ionization energy, Electronegativity, Electron affinity, Metallic characters. Thermodynamics- definition, types of thermodynamics laws and application of thermodynamics

Unit III: Principles Chemical Analysis

Definition - Molarity, normality and mole fraction-Types of titrimetric reactions acid - base, redox, precipitation and complex metric titrations, Indicators neutralization, redox, adsorption and metal ion indicators, Ionic bond or electrovalent bonds, covalent bonds, Vander Waals bond, Hydrogen bonds, a hydro bond– pH, Effect of change in pH-Buffer system.

Unit IV: Organic Compounds

Carbohydrates, Lipids, Proteins, and Nucleic acids components and its uses.

Unit V: Higher studies & Job opportunities

Bachelor of Education, Post Graduation, Specialized Post Graduation, and Recruitment for Chemistry graduates - Govt Jobs, Private Jobs.

1ST YEAR: SECOND SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24UCHC21	**Core Course 3 - General Chemistry –II**	**Core**	**3**	**1**	**2**	**0**	**5**	**6**	**25**	**75**	**100**

Learning Objectives	
LO1	To understand the different definitions of acids and bases (Arrhenius, Bronsted-Lowry, Lewis), their properties, and their reactions.
LO2	To calculate pH, pOH, and equilibrium concentrations of acids, bases, and their salts using the appropriate equations.
LO3	To apply the principles of ionic equilibria, including solubility product, common ion effect, and hydrolysis of salts.
LO4	To describe the properties and reactions of elements in the s- and p- blocks of the periodic table, including alkali metals, alkaline earth metals, and representative elements.
LO5	To identify and name different types of hydrocarbons (alkanes, alkenes, alkynes, and aromatics), and understand their structures, properties, and reactions.

Unit	**Content**	**Hours**
1	**Acids, bases and Ionic equilibria** Concepts of Acids and Bases - Arrhenius concept, Bronsted-Lowry concept, Lewis concept; pH scale, pH of solutions; Degree of dissociation, common ion effect, factors affecting degree of dissociation; acid base indicators, theory of acid base indicators, Buffer solutions – types, mechanism of buffer action in acid and basic buffer, Henderson- Hasselbalch equation.	18
2	**Chemistry of s - Block Elements** Hydrogen: Position of hydrogen in the periodic table. Alkali metals: Comparative study of the elements with respect to	18

	oxides, hydroxides, halides, carbonates and bicarbonates. Diagonal relationship of Li with Mg. Anomalous behaviour of Be. **Chemistry of p - Block Elements (Group 13 & 14)** preparation and structure of diborane and borazine. Chemistry of borax. Extraction of Al and its uses. Alloys of Al. Comparison of carbon with silicon. Carbon-di-sulphide – Preparation, properties, structure and uses. Percarbonates, per monocarbonates and per dicarbonates.	
3	**Chemistry of p- Block Elements (Group 15-18)** General characteristics of elements of **Group 15**; chemistry of H_2N-NH_2, NH_2OH, NH_3 and HNO_3. Chemistry of PH_3, PCl_3, $POCl_3$, P_2O_5. General properties of elements of **group16** - Structure and allotropy of elements - chemistry of ozone - Classification and properties of oxides - oxides of sulphur SO_2, SO_3 – Oxy acids of sulphur (Caro's and Marshall's acids). **Chemistry of Halogens: Group 17** General characteristics of halogen with reference to electro- negativity, electron affinity, oxidation states and oxidizing power. Halogen acids (HF, HCl, HBr and HI) **Noble gases:** Position in the periodic table. Preparation, properties and structure of XeF_2, XeF_4, XeF_6 and $XeOF_4$; uses of noble gases.	18
4	**Hydrocarbon Chemistry-I** **Alkadienes:** Nomenclature - classification – isolated, stability of conjugated dienes; mechanism of electrophilic addition to conjugated dienes - 1, 2 and 1, 4 additions; free radical addition to conjugated dienes – Diels-Alder reactions — polybutadiene, polyisoprene (natural rubber), vulcanisation, polychloroprene. **Alkynes:** Nomenclature, general methods of preparation, properties; acidic nature of terminal alkynes and acetylene.	18
5	**Hydrocarbon Chemistry - II** **Benzene:** Source, structure of benzene, stability of benzene ring, molecular orbital picture of benzene, aromaticity, Huckel's (4n+2) rule and its applications. Electrophilic substitution reactions - General mechanism of aromatic electrophilic substitution - nitration, sulphonation, halogenation, Friedel-Craft's alkylation and acylation. **Polynuclear Aromatic hydrocarbons**: electrophilic substitution reaction, nitration, sulphonation, halogenation, Friedel – Crafts acylation & Diels-Alder reaction and Haworth synthesis.	18

CO	Course Outcomes
CO1	To explain the concept of acids, bases and ionic equilibria; periodic properties of s and p block elements, preparation and properties of aliphatic and aromatic hydrocarbons.
CO2	To discuss the periodic properties of sand p- block elements, reactions of aliphatic and aromatic hydrocarbons and strength of acids.
CO3	To classify hydrocarbons, types of reactions, acids and bases, examine the properties s and p-block elements, reaction mechanisms of aliphatic and aromatic hydrocarbons.
CO4	To explain theories of acids, bases and indicators, buffer action and important compounds of s-block elements.
CO5	To assess the application of hard and soft acids indicators, buffers, compounds of s and p- block elements and hydrocarbons.
Textbooks:	
1	Madan R. D. and Sathya Prakash, "*Modern Inorganic Chemistry*", 2nd ed., S. Chand and Company, New Delhi, 2003.
2	Sathya Prakash, Tuli G. D, Basu S. K. and Madan R. D, "*Advanced Inorganic Chemistry*", 17th ed., S.Chand and Company, New Delhi, 2003.
3	Bahl B. S, Arul Bhal, "*Advanced Organic Chemistry*", 3rd ed., S.Chand and Company, New Delhi, 2003.
4	Tewari K. S, Mehrothra S. N and Vishnoi N. K, "*Text book of Organic Chemistry*", 2nd ed., Vikas Publishing House, New Delhi, 1998.
5	Puri B. R, Sharma L. R, "*Principles of Physical Chemistry*", 38th ed., Vishal Publishing Company, Jalandhar, 2002.
Reference Books:	
1	Maron S. H and Prutton C. P, "*Principles of Physical Chemistry*", 4th ed., The Macmillan Company, Newyork, 1972.
2	Barrow G. M, "*Physical Chemistry*", 5th ed., Tata McGraw Hill, New Delhi, 1992.
3	Lee J. D, "*Concise Inorganic Chemistry*", 4th ed., ELBS William Heinemann, London, 1991.
4	Huheey J. E, "*Inorganic Chemistry: Principles of Structure and Reactivity*", 4th ed., Addison Wesley Publishing Company, India, 1993.
5	Gurudeep Raj, "*Advanced Inorganic Chemistry Vol – I*", 26th ed., Goel Publishing House, Meerut, 2001.
Web resources:	
1	https://onlinecourses.nptel.ac.in
2	http://cactus.dixie.edu/smblack/chem1010/lec ture_notes/4B.html
3	http://nptel.ac.in/courses/104101090/
4	Lecture 1: Classification of elements and periodic properties http://nptel.ac.in/courses/104101090/
5	https://aklectures.com/lecture/introduction-to-acids-and-bases/arrhenius-bronsted-lowry-and-lewis-acids-and-bases

Mapping with Programme Outcomes and Programme Specific Outcomes

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

3 – Strong, 2- Medium, 1- Low

1ST YEAR: SECOND SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24UCHC22P	**Core Course 4 - Qualitative Organic Analysis and Preparation of Organic Compounds - II (Practical)**	**Core**	**0**	**0**	**4**	**0**	**2**	**4**	**25**	**75**	**100**
Learning Objectives											
LO1	To recall basic safety rules, symbols, and first-aid procedures in a chemistry laboratory.										
LO2	To perform qualitative organic analysis tests to identify functional groups in unknown compounds.										
LO3	To differentiate between aromatic and aliphatic compounds, as well as saturated and unsaturated compounds.										
LO4	To prepare derivatives of specific functional groups to confirm their presence in organic compounds.										
LO5	To prepare organic compounds through various synthetic methods, including nitration, halogenation, oxidation, and rearrangement reactions.										
Unit	**Content**									**Hours**	
1	**Chemistry Lab Safety** Safety rules, symbols and first-aid in chemistry laboratory. Basic ideas about Bunsen burner, its operation and parts of the flame. Chemistry laboratory glassware – basic information and uses.									4	
2, 3 & 4	**Qualitative Organic Analysis** a) Preliminary examination b) Detection of special elements - nitrogen, sulphur and halogens c) Aromatic and aliphatic nature d) Test for saturation and unsaturation e) Identification of functional groups f) Confirmation of functional groups • monocarboxylic acid, dicarboxylic acid • monohydric phenol, dihydric phenol • Aldehyde									40	

	• carbohydrate (reducing or non-reducing sugars) • Primary amine • monoamide, diamide	
5	**Preparation of Organic Compounds (Any 3)** i. Bromination - 2,4,6 tribromo aniline from aniline ii. Bromination - p-bromo acetanilide from acetanilide iii. Oxidation - benzoic acid from Benzaldehyde iv. Preparation of Benzanilide from Aniline v. Salicylic Acid from Methyl Salicylate vi. Preparation of Tribromo Phenol from Phenol vii. Preparation of Benzoic acid from Benzamide	16

SCHEME OF VALUATION

24UCHC22P - QUALITATIVE ORGANIC ANALYSIS AND PREPARATION OF ORGANIC COMPOUNDS (PRACTICAL)

Internal assessment	: 25 Marks
External assessment	: 75 Marks
Total	: 100 Marks
Max. Marks	: 75 Marks
Record	: 10 Marks
Viva voce	: 5 Marks
Preparation	**: 20 Marks** (quantity: 10 & quality: 10)
Organic Analysis	: 40 Marks

Organic Analysis	**: 40 Marks**
Preliminary Test	: 10 Marks
Aliphatic or Aromatic	: 5 Marks
Saturated or Unsaturated	: 5 Marks
Tests for Special Elements	: 10 Marks
Functional group Tests	: 10 Marks

CO	Course Outcomes
CO1	To demonstrate a comprehensive understanding of laboratory safety practices, including the ability to identify and respond appropriately to potential hazards.
CO2	To accurately identify the functional groups present in unknown organic compounds using a variety of chemical tests.
CO3	To effectively differentiate between aromatic and aliphatic compounds, as well as saturated and unsaturated compounds.
CO4	To successfully prepare and analyze derivatives of specific functional groups to confirm their presence in organic compounds.
CO5	To successfully synthesize a variety of organic compounds using different reaction types, including nitration, halogenation, oxidation, and rearrangement reactions.

Textbooks:	
1	Venkateswaran, V.; Veeraswamy, R.; Kulandaivelu, A.R, "*Basic Principles of Practical Chemistry*", 2nd ed.; Sultan Chand: New Delhi, 2012.
2	Manna, A.K, "*Practical Organic Chemistry*", Books and Allied: India, 2018.
3	Gurtu, J. N; Kapoor, R, "*Advanced Experimental Chemistry (Organic)*", Sultan Chand: New Delhi, 1987.
4	Furniss,B. S.; Hannaford, A. J.; Smith, P. W. G.; Tatchell, A.R, "*Vogel's Textbook of Practical Organic Chemistry*", 5th ed.; Pearson: India, 1989.
5	Paquette, Leo A, "*Principles of Modern Organic Chemistry: A Laboratory Course*", 5th ed.; Brooks/Cole, 2003.
Reference Books:	
1	Mayo, Donald W.; Pike, Ronald M.; Butcher, Sidney L, "*Microscale Organic Laboratory Techniques*", 4th ed.; Prentice Hall, 2003.
2	Armarego, Wilfred L. F.; Chai, Christina L. L, "*Purification of Laboratory Chemicals*", 6th ed.; Butterworth-Heinemann, 2009.
3	Kemp, Thomas J, "*Experimental Organic Chemistry*", 3rd ed.; Freeman, 2007.
4	Mohrig, James R.; Morrill, Thomas C.; Johnson, David R.; Wilkinson, Helen R, "*Techniques in Organic Chemistry: A Microscale Approach*", 4th ed.; Freeman, 2010.
5	Furniss, B. S.; Hannaford, A. J.; Smith, P. W. G.; Tatchell, A. R. V, "*Vogel's Textbook of Practical Organic Chemistry*", 5th ed.; Pearson: India, 1989.
Web resources:	
1	https://www.masterorganicchemistry.com/
2	https://www.chemtube3d.com
3	https://www.khanacademy.org/
4	https://ocw.mit.edu/
5	https://online.stanford.edu/

Mapping with Programme Outcomes and Programme Specific Outcomes

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

3 – Strong, 2- Medium, 1- Low

1ST YEAR: SECOND SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24UCHA21	**Elective Course - 2 Chemistry - II**	**Elective**	**3**	**1**	**0**	**0**	**4**	**4**	**25**	**75**	**100**

Learning Objectives	
LO1	To understand the mechanisms of polymerisation and their impact on polymer properties.
LO2	To analyze real-world problems and apply the fundamental principles of photochemical reactions to identify potential solutions.
LO3	To apply the concepts of electrochemistry to analyze the behavior of batteries and fuel cells.
LO4	To encompasses the core concepts of corrosion delves into the application of protective coatings, such as paints, enamels, and lacquers, to safeguard materials from corrosion.
LO5	To assess various pharmaceutical drugs, including sulfa drugs, antibiotics, anesthetics, antiseptics, analgesics, antipyretics, tranquilizers, and sedatives.

Unit	Content	Hours
1	**Polymer Chemistry -** Introduction, classification of polymers, types of polymerisation, addition polymerization - mechanism of free radical polymerization, condensation and copolymerization. Thermoplastic and thermosetting polymers, difference between thermoplastic and thermosetting polymers, preparation, properties and uses of Polythene, PVC, Teflon, Nylon 6,6 and Polyesters.	12
2	**Photochemistry** - Grothus-Draper's law and Stark-Einstein's law of photochemical equivalence, Quantum yield - Hydrogen-chloride reaction. Jablonskii diagram - Phosphorescence, fluorescence, chemiluminescence and photosensitization and photosynthesis (definition with examples).	12

3	**Electrochemistry** - Electrolytes – Definition and Examples – Classification - Specific and Equivalent Conductance – Ostwald's Dilution Law and its Limitations. Batteries - primary and secondary batteries - difference between primary and secondary batteries. Lead storage battery - cell diagram, cell reaction and uses. Fuel cell H_2-O_2 fuel cell - explanation with diagram.	12
4	**Corrosion and Protective Coatings** - Corrosion - types, corrosion control methods. Electrochemical corrosion and its prevention - Electroplating and Electroless plating - applications. Paints - Components of Paint – Requisites of a Good Paint - Pigments – Classification of Pigments based on Colour. Dyes – Definition – Classification based on Constitution and Application – Chromophores and Auxochromes. Enamels and Lacquers - composition and uses.	12
5	**Pharmaceutical Chemistry -** Sulpha Drugs – Preparation and uses of Sulphapyridine and Sulphadiazine - mode of action of Sulpha drugs - Antibiotics - Uses of Penicillin, Chloramphenicol and Streptomycin - Anaesthetics - General and Local Anaesthetics - Antiseptics - Analgesics, Antipyretics, Tranquilizers, Sedatives - Examples and their applications.	12

CO	Course Outcomes
CO1	Critically evaluate the properties and applications of different types of polymers to select the most suitable materials for specific purposes.
CO2	To explain the laws of photochemistry and calculate quantum yields.
CO3	Construct electrochemical cells, such as batteries and fuel cells, based on theoretical principles.
CO4	Ability to design and implement effective corrosion prevention strategies for various materials and environments.
CO5	Develop new pharmaceutical compounds with improved efficacy and reduced toxicity.
Textbooks:	
1	Fried, J. R, "*Polymer Science and Engineering*", Prentice Hall, 3rd ed., 2003.
2	Turro, N. J., "*Modern Molecular Photochemistry of Organic Molecules*", University Science Books, 1991.
3	Newman, J, "*Electrochemical Engineering",* Prentice Hall", 3rd ed., 2004.
4	Fontana, M. G., & Staehle, R. H, "*Corrosion Engineering*", McGraw-Hill, 4th ed., 2017.
5	Albert, A. A., & Phillips, D. J, "*Medicinal Chemistry: An Introductory Text*", Wiley, 5th ed., 2002.
Reference Books:	
1	Atkins, P. W., & de Paula, J, "P*hysical Chemistry*", Oxford University Press, 10th ed., 2014.
2	Gilbert, A., & Baggott, J., "*Essentials of Molecular Photochemistry*", Blackwell Scientific Publications, 1991.
3	Shriver, D. F., & Atkins, P. W, "*Inorganic Chemistry*", W. H. Freeman, 5th ed., 2010.
4	Bardwell, A. J, "*Principles of Corrosion Engineering*", Butterworth-Heinemann, 2nd ed., 2009.
5	Lehninger, A. L., Nelson, D. L., & Cox, M. M, "*Principles of Biochemistry*", W. H. Freeman, 5th ed., 2013.
Web resources:	
1.	https://new.nsf.gov/funding/opportunities/polymers
2.	https://webbook.nist.gov/chemistry/
3.	https://en.wikipedia.org/wiki/Electrochemistry
4.	https://www.sciencedirect.com/science/article/pii/S1452398124001548
5.	https://www.drugs.com/

Mapping with Programme Outcomes and Programme Specific Outcomes

	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	2	2	2	2	2	3	2	2	2	2
CO3	3	3	3	2	3	3	3	3	3	3	3
CO4	3	3	3	3	3	3	3	2	3	3	3
CO5	3	3	3	3	3	3	3	3	3	3	3
Total	15	14	14	13	14	14	15	13	14	14	14
Average	**3.0**	**2.8**	**2.8**	**2.6**	**2.8**	**2.8**	**3.0**	**2.6**	**2.8**	**2.8**	**2.8**

3 – Strong, 2- Medium, 1- Low

1ST YEAR: SECOND SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24UCHA22P	**Elective Course - 3 Chemistry Practical for Physical and Biological Sciences - II**	**Elective**	**0**	**0**	**2**	**0**	**2**	**2**	**25**	**75**	**100**

Learning Objectives	
LO1	To understand different types of organic compounds with respect to their properties.
LO2	To determine the various elements in organic compounds.
LO3	To identify the various organic functional groups.
LO4	To find the components and structure of an unknown organic molecule.
LO5	To solve problems related to the identification of organic molecules through a series of tests and observations.

Unit	Content	Hours
1	**Systematic Analysis of Organic Compounds** The analysis must be carried out as follows: (a) Preliminary Tests (b) To distinguish between aliphatic and aromatic compounds.	6
2	To distinguish – Saturated and unsaturated compounds.	6
3	Detection of special elements (N, S, Halogens).	6
4	**Identification of Functional group tests (Absence of special elements)** Phenol, Acids (mono & di), Aldehyde and Carbohydrate	6
5	**Identification of Functional group tests (Presence of special elements)** Presence aromatic primary amine, Amides (mono & di).	6

SCHEME OF VALUATION

24UCHA22P - CHEMISTRY PRACTICAL FOR PHYSICAL AND BIOLOGICAL SCIENCES - II

(For Biochemistry and ND (FSM) – I year/II Semester)

Internal assessment	: 25 Marks
External assessment	: 75 Marks
Total	: 100 Marks
Max. Marks	: 75 Marks
Record	: 10 Marks
Viva voce	: 5 Marks
Organic Analysis	: 60 Marks

Organic Analysis	**: 60 Marks**
Preliminary Test	: 10 Marks
Aliphatic or Aromatic	: 5 Marks
Saturated or Unsaturated	: 5 Marks
Tests for Special Elements	: 10 Marks
Confirmation Tests	: 15 Marks
Functional groups Tests	: 15 Marks

CO	Course Outcomes
CO1	To gain an understanding of the use of standard flask and volumetric pipettes, burette.
CO2	To design, carry out, record and interpret the results of volumetric titration.
CO3	To apply their skill in the analysis of water/hardness.
CO4	To analyze the chemical constituents in allied chemical products.
CO5	To describe the measurable skills, abilities, knowledge in qualitative analysis.
Textbooks:	
1	Venkateswaran V, Veerasamy R and Kulandaivelu A. R, "*Basic Principles of Practical Chemistry*", Sultan Chand & Sons, 2nd ed., 1997.
2	Vogel A. I, Tatchell A. R, Furnis B. S, Hannaford A. J and Smith P. W. G, "*Vogel's Textbook of Practical Organic Chemistry*", Prentice Hall, 5th ed., 1989.
3	Donald L. Pavia, Gary M. Lampman, George S. Engel & Roger G. Gries, "*Experimental Organic Chemistry*", Cengage Learning, 2005.
4	Jerry Mohrig, Craig Hammond & Paul F. Snyder, "*Techniques in Organic Chemistry*", Macmillan Learning, 4th ed., 2014.
5	Mann F. G and Saunders B. C, "*Practical Organic Chemistry*", Pearson Education, 4th ed., 1975.
Reference Books:	
1	Ralph J. Fessenden and Joan S. Fessenden, "*Organic Chemistry Laboratory Manual*", Brooks/Cole, 3rd ed., 1982.
2	Middleton H, "*Organic Qualitative Analysis*", Longmans, Green and Co., 1st ed., 1951.
3	Bansal R. K, "*Laboratory Manual of Organic Chemistry*", New Age International Publishers, 5th ed., 2010.
4	John Leonard, Barry Lygo and Garry Procter, "*Advanced Practical Organic Chemistry*", CRC Press, 3rd ed., 2013.
5	Lisa Nichols, "*Organic Chemistry Laboratory Techniques*", LibreTexts, 1st ed., 2016.
Web resources:	
1	https://webbook.nist.gov/chemistry/
2	https://www.organic-chemistry.org/
3	https://www.routledge.com/Advanced-Practical-Organic-Chemistry/Leonard-Lygo-Procter/p/book/9781439860977
4	https://chem.libretexts.org/Bookshelves/Organic_Chemistry/Organic_Chemistry_Lab_Techniques_(Nichols)
5	https://www.academia.edu/43215226/Advanced_Practical_Organic_Chemistry_Third_Edition

Mapping with Programme Outcomes and Programme Specific Outcomes

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

3 – Strong, 2- Medium, 1- Low

1ST YEAR: SECOND SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24UCHS21	**SEC-3 Diary Chemistry**	**SEC**	**1**	**0**	**1**	**0**	**2**	**2**	**25**	**75**	**100**

Learning Objectives	
LO1	To understand about the physical properties of milk.
LO2	To describe the steps involved in pasteurization processes.
LO3	To identify common adulterants in ghee and explain the causes and prevention of rancidity.
LO4	To analyze the manufacturing processes for reconstituted milk and condensed milk.
LO5	To assess the health benefits and potential applications of fermented milk products.

Unit	Content	Hours
1	**Composition of Milk:** Milk - general composition of milk - constituents of milk - lipids, proteins, carbohydrates, vitamins and minerals - physical properties of milk - colour, odour, acidity - Factors affecting the composition of milk - Adulterants, preservatives with neutralizer - examples. Estimation of fat.	6
2	**Processing of Milk:** Microbiology of milk - destruction of micro - organisms in milk - physico – chemical changes taking place in milk due to processing - boiling, pasteurization – types of pasteurization - Bottle, Batch and HTST (High Temperature Short Time) – Vacuum pasteurization – Ultra High Temperature Pasteurization.	6
3	**Fermentation and Preservation of Milk Products:** Fermentation of milk - cultured milk - butter milk - bulgarious milk - acidophilous milk – Yogurt indigenous products - Khoa and Chhena - Ice cream - stabilizers - milk powder - milk preservation techniques - milk spoilage, traditional preservation methods, chemical preservatives and biological preservatives.	6
4	**Dairy Products and their Packaging:** Cream - gravitational and centrifugal methods of separation of cream - estimation of fat in cream. Butter - desi butter - salted butter, estimation of acidity and moisture content in butter. Ghee - rancidity - antioxidants and synergists. Packaging materials for dairy products - packaging materials, functions and design considerations.	6
5	**Specialized Milk Products:** Standardised milk - reconstituted milk - flow diagram of manufacture - Homogenized milk - flavoured milk - vitaminised milk - toned milk - Incitation milk - Vegetable toned milk - humanized milk - condensed milk.	6

CO	Course Outcomes
CO1	To understand about general composition of milk – constituents and its physical properties.
CO2	To acquire knowledge about pasteurization of Milk and various types of pasteurization - Bottle, Batch and HTST Ultra High Temperature Pasteurization.
CO3	To learn about Cream and Butter their composition and how to estimate fat in cream and Ghee
CO4	To explain about Homogenized milk, flavoured milk, vitaminised milk and toned milk
CO5	To have an idea about how to make milk powder and its drying process - types of drying process
Textbooks:	
1	K. Bagavathi Sundari, "*Applied Chemistry*", MJP Publishers, 1st ed., 2006.
2	K. S. Rangappa and K.T. Acharya, "*Indian Dairy Products*", Asia Publishing House New Delhi, 1st ed., 1974.
3	M. P. Mathur, D. Datta Roy and P. Dinakar, "*Indian Council of Agricultural Research*", 1st ed., 2008.
4	Saurav Singh, "*A Textbook of Dairy Chemistry*", Daya Publishing House, 1st ed., 2013.
5	P. L. Choudhary, "*A Textbook of Dairy Chemistry*", Bio-Green Book Publishers, 1st ed., 2021.
Reference Books:	
1	Robert Jenness and S. Patom, "*Principles of Dairy Chemistry*", S.Wiley, New York, 2005.
2	F. P. Wond, "*Fundamentals of Dairy Chemistry*", Springer, Singapore, 2006.
3	Sukumar De, "*Outlines of Dairy Technology*", Oxford University Press, New Delhi, 1st ed., 1980.
4	P. F. Fox and P. L. H. Mcsweeney, "*Dairy Chemistry and Biochemistry*", Springer, 2nd ed., 2016.
5	P. F. Fox, T. Uniacke-Lowe, P. L. H. McSweeney and J. A. OMahony, "*Dairy Chemistry and Biochemistry*", Springer, 2nd ed., 2015.
Web resources:	
1	http://repository.ottimmo.ac.id/38/1/Dairy%20Science%20and%20Technology%20%28CRC%202005%29.pdf
2	https://www.fda.gov/food/guidance-regulation-food-and-dietary-supplements/food-safety-modernization-act-fsma
3	https://ndri.res.in/
4	https://fil-idf.org/
5	https://dairy.unl.edu/

Mapping with Programme Outcomes and Programme Specific Outcomes

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

2nd YEAR: FOURTH SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24UCHC41	**Core Course 7 - General Chemistry –IV**	**Core**	**3**	**1**	**2**	**0**	**5**	**6**	**25**	**75**	**100**

Learning Objectives	
LO1	To define and apply the first law of thermodynamics to calculate heat, work, and energy changes for various processes.
LO2	To apply the second law of thermodynamics to understand entropy and free energy, and use these concepts to predict reaction spontaneity.
LO3	To describe the periodic trends and properties of d-block elements and compare them with non-transition elements.
LO4	To name and predict the products of reactions involving ethers, epoxides, aldehydes, and ketones, including important named reactions.
LO5	To understand the structure, properties, and reactions of carboxylic acids and their derivatives, including their acidic nature and key named reactions.

Unit	Content	Hours
1	**Thermodynamics I:** Terminology – Intensive, extensive variables, state, path functions; isolated, closed and open systems; isothermal, adiabatic, isobaric, isochoric, cyclic, reversible and irreversible processes; First law of thermodynamics – Concept and significance of heat (q), work (w), internal energy (E), enthalpy (H); calculations of q, w, E and H for reversible, irreversible expansion of ideal and real gases under isothermal and adiabatic conditions; relation between heat capacities (Cp & Cv); Hess's law and its applications; Zeroth law of thermodynamics - Absolute Temperature scale.	18
2	**Thermodynamics II:** Second Law of thermodynamics - Limitations of first law; Carnot's cycle; Concept of entropy, entropy change for reversible and irreversible processes, entropy of mixing, calculation of entropy changes of an ideal gas and a van der Waals gas with changes in temperature, volume and pressure, entropy and disorder. Free energy and work functions - Need for free energy functions, Gibbs free energy, Helmholtz free energy - their variation with temperature, pressure and volume, criteria for spontaneity.	18

3	**General Characteristics of d-block elements Transition Elements:** Electronic configuration - General periodic trend variable valency, oxidation states, stability of oxidation states, colour, magnetic properties, catalytic properties and tendency to form complexes. Comparative study of transition elements and non transition elements – Group study of Titanium, Vanadium, Chromium, Manganese, Iron, Cobalt, Nickel groups.	18
4	**Ethers, Thio ethers and Epoxides:** Nomenclature, isomerism, general methods of preparations, reactions involving cleavage of C-O linkages. Reactions of epoxides with alcohols, ammonia derivatives and $LiAH_4$ Thioethers - nomenclature, structure, preparation, properties and uses. **Aldehydes and Ketones:** Nomenclature, structure and reactivity of aliphatic and aromatic aldehydes and ketones; general methods of preparation and physical properties. Aldol, Cannizzaro's reaction, Benzoin condensation. Oxidation of aldehydes. Baeyer - Villiger oxidation of ketones. Reduction: Clemmensen reduction. Addition reactions of unsaturated carbonyl compounds: Michael addition.	18
5	**Carboxylic Acids:** Nomenclature, structure, preparation and reactions of aliphatic and aromatic mono carboxylic acids. Physical properties, acidic nature, effect of substituent on acidic strength. HVZ reaction, Claisen ester condensation, decarboxylation. Reactions of dicarboxylic acids, hydroxy acids and unsaturated acids. **Carboxylic acid Derivatives:** Preparations of aliphatic and aromatic acid chlorides, esters, amides and anhydrides. Nucleophilic substitution reaction at the acyl carbon of acyl halide, anhydride, ester, amide. Schottan- Baumann reaction. Claisen condensation and Curtius rearrangement. Keto – enol tautomerism.	18

CO	Course Outcomes Students will be able to
CO1	To apply the first law of thermodynamics to solve problems involving heat, work, internal energy, and enthalpy changes for ideal and real gases under various conditions.
CO2	To evaluate the spontaneity of a chemical process by calculating and interpreting entropy and free energy changes.
CO3	To analyze and predict the chemical and physical behavior of d-block elements based on their electronic configurations and periodic trends.
CO4	To synthesize and predict the outcomes of key reactions for ethers, epoxides, aldehydes, and ketones, demonstrating a mastery of their chemical reactivity.
CO5	To correlate the structure of carboxylic acids and their derivatives with their chemical properties, and predict the products of important synthetic reactions.
Textbooks:	
1.	B.R. Puri and L.R. Sharma, "Principles of Physical Chemistry", Shoban Lal Nagin Chand and Co., 33rd ed., 1992.
2.	K. L. Kapoor, "A Textbook of Physical chemistry", (volume-2 and 3), Macmillan, India Ltd, 3rd ed., 2009.
3.	P.L. Soni and Mohan Katyal, "Textbook of Inorganic Chemistry", Sultan Chand & Sons, 20th ed., 2006.
4.	M. K. Jain, S. C. Sharma, "Modern Organic Chemistry", Vishal Publishing, 4th ed., 2003.
5.	S.M. Mukherji, and S.P. Singh, "Reaction Mechanism in Organic Chemistry", Macmillan India Ltd., 3rd ed., 1994.
Reference Books:	
1.	Maron, S. H. and Prutton C. P. "Principles of Physical Chemistry", 4th ed., The Macmillan Company, Newyork, 1972.
2.	Lee, J. D. "Concise Inorganic Chemistry", 4th ed., ELBS William Heinemann, London, 1991.
3.	Gurdeep Raj, "Advanced Inorganic Chemistry", 26th ed., Goel Publishing House, Meerut, 2001.
4.	Atkins, P.W. & Paula, J. "Physical Chemistry", 10th ed., Oxford University Press, New York, 2014.
5.	Huheey, J. E. "Inorganic Chemistry: Principles of Structure and Reactivity", 4th ed., Addison Wesley Publishing Company, India, 1993.
Web resources:	
1.	https://www.physics.ox.ac.uk/system/files/file_attachments/basic_thermo.pdf
2.	https://bingweb.binghamton.edu/~suzuki/ThermoStatFIles/1.5%20Review%203%20%20Phys.131%20Entropy%20Carnot%20cycle.pdf
3.	https://chem.libretexts.org/Bookshelves/General_Chemistry/Map:_General_Chemistry_(Petrucci_et_al.)/23:_The_Transition_Elements/23.1:_General_Properties_of_Transition_Metals%5B1

4.	https://chem.libretexts.org/Courses/Nassau_Community_College/Organic_Chemistry_I_and_II/14:_Ethers_Epoxides_and_Thioethers
5.	https://sist.sathyabama.ac.in/sist_coursematerial/uploads/SCY1315.pdf

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: FOURTH SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24UCHC42P	**Core Course 8 - Practical - Physical Chemistry Practical - I**	**Core**	**0**	**0**	**4**	**0**	**2**	**4**	**25**	**75**	**100**

Learning Objectives	
LO1	To experimentally determine the rate law and rate constant for a chemical reaction.
LO2	To experimentally measure the heat change associated with chemical and physical processes.
LO3	To use conductance measurements to determine a cell constant and the concentration of an unknown solution.
LO4	To determine the molecular weight of an unknown compound by measuring the freezing point depression of a solvent.
LO5	To construct and analyze a Freundlich adsorption isotherm by studying the adsorption of a substance on a solid surface.

Unit	Content	Hours
1	**Chemical kinetics** 1. Determination of rate constant of acid catalysed hydrolysis of an ester (methyl acetate). 2. Determination of order of reaction between iodide and persulphate (initial rate method).	16
2	**Thermochemistry** 1. Determination of heat of neutralisation of a strong acid by a strong base. 2. Determination of heat of hydration of copper sulphate.	16
3	**Electrochemistry – Conductance measurements** 1. Determination of cell constant 2. Precipitation titration ($BaCl_2$ Vs Na_2SO_4 only)	12
4	**Colligative property** Determination of molecular weight of an organic compound by Rast method using naphthalene or diphenyl as solvent.	8
5	**Adsorption** Construction of Freundlich isotherm for the adsorption of acetic acid on activated charcoal	8

SCHEME OF VALUATION

PRACTICAL - PHYSICAL CHEMISTRY PRACTICAL - I

Internal assessment	25 Marks
External assessment	75 Marks
Total	100 Marks
Max. Marks	75 Marks
Experiment	45 Marks
Record	10 Marks
Manipulation, Tabulation and Calculation	15 Marks

1) Kinetics

Graph : 10 Marks
Below a factor of 10 : 35
By a factor of 10 : 25
More than a factor of 10 : 15

2) Molecular weight

Error upto 10 %: 45
20 %: 35
30 %: 25
> 30 %: 15

3) Effect of electrolyte on CST

Graph: 10
Error upto 10 %: 35
20 %: 25
30 %: 15
> 30: 10

4) Conductance Equivalent conductance: 25 marks

Error upto 10 % : 25
Upto 15 % : 15
>15 % : 10

5) Cell constant : 20 marks

Error upto 10 % : 20
Upto 15 % : 15
>15 % : 10

6) Conductometric titration

Graph: 10
Upto 2 % : 35
2.1 to 3 % : 30
3.1 to 4 % : 25
4.1 to 5 % : 20
> 5% : 15

CO	Course Outcomes Students will be able to
CO1	To perform experiments to determine the rate law and rate constant for a given reaction, and use this data to predict how reaction rates change under different conditions.
CO2	To design and execute experiments to measure the heat change of chemical reactions and physical changes, and apply these values to thermodynamic calculations.
CO3	To utilize conductance data to calculate the cell constant and accurately determine the concentration of an unknown electrolytic solution.
CO4	To experimentally determine the molecular weight of a non-volatile substance by applying the principle of freezing point depression.
CO5	To collect experimental data to construct a Freundlich adsorption isotherm and use the isotherm to understand the adsorption process of a solute on an adsorbent.

Textbooks:	
1.	Atkins, P.W. and de Paula, J., "Atkins' Physical Chemistry," 11th ed., Oxford University Press, 2018.
2.	Atkins, P.W. and de Paula, J., "Elements of Physical Chemistry," 7th ed., Oxford University Press, 2017.
3.	Levine, I.N., "Physical Chemistry," 6th ed., McGraw-Hill Education, 2011.
4.	Castellan, G.W., "Physical Chemistry," 3rd ed., Addison-Wesley Publishing Company, 1983.
5.	Barrow, G.M., "Physical Chemistry," 5th ed., McGraw-Hill Education, 1988.
Reference Books:	
1.	Laidler, K. J. and Meiser, J. H., "Physical Chemistry," 4th ed., Houghton Mifflin Harcourt, 2003.
2.	Cox, J. D. and Pilcher, G., "Thermochemistry of Organic and Organometallic Compounds," Academic Press, 1970.
3.	Bard, A. J. and Faulkner, L. R., "Electrochemical Methods: Fundamentals and Applications," 3rd ed., Wiley, 2022.
4.	Ira N. Levine, "Physical Chemistry", 6th ed., McGraw-Hill Education, 2011
5.	Gregg, S. J. and Sing, K. S. W., "Adsorption, Surface Area, and Porosity," 2nd ed., Academic Press, 1982.
Web resources:	
1.	https://www.khanacademy.org/science/chemistry/chemical-kinetics
2.	https://chem.libretexts.org/Bookshelves/Physical_and_Theoretical_Chemistry_Textbook_Maps/Supplemental_Modules_(Physical_and_Theoretical_Chemistry)/Thermochemistry
3.	https://chem.libretexts.org/Bookshelves/Physical_and_Theoretical_Chemistry_Textbook_Maps/Supplemental_Modules_(Physical_and_Theoretical_Chemistry)/Electrochemistry/Conductance
4.	https://www.khanacademy.org/science/chemistry/solutions-and-mixtures/colligative-properties/a/colligative-properties
5.	https://chem.libretexts.org/Bookshelves/Physical_and_Theoretical_Chemistry_Textbook_Maps/Supplemental_Modules_(Physical_and_Theoretical_Chemistry)/Adsorption_and_Catalysis/Adsorption

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	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: FOURTH SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24UCHA41	**AL Chemistry - II**	**EC-6**	**3**	**1**	**0**	**0**	**4**	**4**	**25**	**75**	**100**

Learning Objectives	
LO1	To apply IUPAC nomenclature and theories of coordination chemistry, and experimentally determine the hardness of water using the EDTA or Zeolite methods.
LO2	To classify and illustrate the structures of carbohydrates and understand the properties of amino acids and the roles of DNA and RNA.
LO3	To explain the principles of galvanic cells and use them for conductometric titrations and pH determination, while also understanding buffer solutions and electroplating.
LO4	To determine the order of a reaction, calculate its half-life, and explain the role of catalysts and the Arrhenius equation.
LO5	To explain the core principles of photochemistry and the laws governing it, and describe the various processes of light absorption and emission.

Unit	Content	Hours
1	**Co-ordination Chemistry and Water Technology:** Co-ordination Chemistry: Definition of terms - IUPAC Nomenclature - Werner's theory - EAN rule - Pauling's theory – Postulates - Applications to $[Ni(CO)_4]$, $[Ni(CN)_4]^{2-}$, $[Co(CN)_6]^{3-}$ Chelation - Biological role of Haemoglobin and Chlorophyll (elementary idea) – Applications in qualitative and quantitative analysis. Hardness of water, determination of hardness of water using EDTA method, zeolite method	12
2	**Carbohydrates and Amino acids:** Classification, preparation and properties of glucose, fructose and sucrose. Discussion of open chain ring structures of glucose and fructose. Glucose – fructose interconversion. Properties of starch and cellulose. Amino acids: Classification - preparation and properties of alanine. RNA and DNA (elementary idea only).	12
3	**Electrochemistry:** Galvanic cells - Standard hydrogen electrode - calomel electrode - standard electrode potentials - electrochemical series. Strong and weak electrolytes - ionic product of water - pH, pKa, pKb. Conductometric titrations - pH determination by colorimetric method – buffer solutions and its biological applications - electroplating - Nickel and chrome plating – Types of cells -fuel cells- corrosion and its prevention.	12
4	**Kinetics and Catalysis:** Order and molecularity. Integrated rate expression for I and II (2A Products) order reactions. Pseudo first order reaction, methods of determining order of a reaction – Half-life period – Catalysis - homogeneous and heterogeneous, catalyst used in	12

	Contact and Haber's processes. Concept of energy of activation and Arrhenius equation.	
5	**Photochemistry:** Grothus-Draper's law and Stark-Einstein's law of photochemical equivalence, Quantum yield - Hydrogen-Chloride and Hydroge-Bromide reaction. Jablonski Diagram - Phosphorescence, fluorescence, chemiluminescence and photosensitization and photosynthesis (definition with examples).	12

CO	Course Outcomes Students will be able to
CO1	To apply coordination chemistry principles to name complex compounds and to analyze the role of complexation in determining the hardness of water using volumetric methods.
CO2	To differentiate between major classes of carbohydrates and amino acids, illustrate their structures, and describe the fundamental biological functions of DNA and RNA.
CO3	To demonstrate an understanding of electrochemical cells and their applications, including the practical use of conductometric titrations and pH determination, as well as the principles of electroplating.
CO4	To experimentally determine reaction kinetics, predict reaction rates using the half-life and Arrhenius equation, and explain the function of different types of catalysis.
CO5	To explain the fundamental laws of photochemistry and apply them to describe processes of light absorption and emission, such as fluorescence and phosphorescence.
Textbooks:	
1.	F. Albert Cotton, Geoffrey Wilkinson, Paul L. Gaus, "*Basic Inorganic Chemistry*", 3rd ed., Wiley, 1995.
2.	V.Veeraiyan, "*Textbook of Ancillary Chemistry*", High mount publishing house, Chennai, 1st ed., 2009.
3.	S.Vaithyanathan, "*Text book of Ancillary Chemistry*", Priya Publications, Karur, 2006.
4.	Arun Bahl, B.S.Bahl, "*Advanced Organic Chemistry*", S.Chand and Company, New Delhi, 23rd ed., 2012.
5.	P. W. Atkins, J. de Paula, J. Keeler, "Atkins' Physical Chemistry", Oxford University Press, Oxford, 11th ed., 2018.
Reference Books:	
1.	James E. Huheey, Ellen A. Keiter, Richard L. Keiter, "*Inorganic Chemistry: Principles of Structure and Reactivity*", 4th ed., Pearson, 1997.
2.	P.L.Soni, Mohan Katyal, "*Text book of Inorganic Chemistry*", Sultan Chand and Company, New Delhi, 20th ed., 2007.
3.	Paula Yurkanis Bruice, "*Organic Chemistry*", 8th ed., Pearson, 2016.
4.	P.L.Soni, H.M.Chawla, "*Text Book of Organic Chemistry*", Sultan Chand & Sons, New Delhi, 29th ed., 2007.
5.	R.Puri, L.R.Sharma, M.S.Pathania, "*Text book Physical Chemistry*", Vishal Publishing Co., New Delhi, 47th ed., 2018.
Web resources:	
1.	https://nou.edu.ng/coursewarecontent/CHM%20423%20MARCH%202021_0.pdf
2.	https://byjus.com/chemistry/carbohydrates/
3.	https://www.nagwa.com/en/explainers/269168626823/
4.	https://chem.libretexts.org/Bookshelves/Physical_and_Theoretical_Chemistry_Textbook_Maps/Supplemental_Modules_(Physical_and_Theoretical_Chemistry)/Kinetics
5.	https://chem.libretexts.org/Bookshelves/Physical_and_Theoretical_Chemistry_Textbook_Maps/Supplemental_Modules_(Physical_and_Theoretical_Chemistry)/Photochemistry

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: FOURTH SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24UCHA41P	**Chemistry Practical for Physical and Biological Sciences - II**	**EC-7**	**0**	**0**	**2**	**0**	**2**	**2**	**25**	**75**	**100**

Learning Objectives	
LO1	Different types of organic compounds with respect to their properties.
LO2	Determination of elements in organic compounds.
LO3	Identification of organic functional groups.
LO4	Identify the components and structure of an unknown organic molecule.
LO5	Skills to solve problems related to the identification of organic molecules through a series of tests and observations.

Unit	Content	Hours
1	**Systematic Analysis of Organic Compounds** **The analysis must be carried out as follows:** **Preliminary Tests** 1. To distinguish between aliphatic and aromatic compounds.	6
2	2. To distinguish – Saturated and unsaturated compounds.	6
3	3. Detection of special elements (N, S, Halogens).	6
4	I. Identification of Functional group tests (Absence of special elements) - Phenol, Acids (mono & di), Aldehyde and Carbohydrate	6
5	II. Identification of Functional group tests (Presence of special elements) - Presence aromatic primary amine, Amides (mono & di).	6

SCHEME OF VALUATION

CHEMISTRY PRACTICAL FOR PHYSICAL AND BIOLOGICAL SCIENCES - II

(For Mathematics / Physics – II year/IV Semester)

Internal assessment : 25 Marks

External assessment : 75 Marks

Total : 100 Marks

Max. Marks : 75 Marks

Record : 10 Marks

Viva voce : 5 Marks

Organic Analysis : 60 Marks

Organic Analysis : 60 Marks

Preliminary Test : 10 Marks

Aliphatic or Aromatic : 5 Marks

Saturated or Unsaturated : 5 Marks

Tests for Special Elements : 10 Marks

Confirmation Tests : 15 Marks

Functional groups Tests : 15 Marks

CO	Course Outcomes Students will be able to
CO1	To demonstrate a comprehensive understanding of laboratory safety practices, including the ability to identify and respond appropriately to potential hazards.
CO2	To accurately identify the functional groups present in unknown organic compounds using a variety of chemical tests.
CO3	To effectively differentiate between aromatic and aliphatic compounds, as well as saturated and unsaturated compounds.
CO4	To competently analyze the special elements like nitrogen, sulphur and halogens in the given compounds.
CO5	To successfully prepare the specific functional groups to confirm their presence in organic compounds.
Textbooks:	
1.	Venkateswaran V, Veerasamy R and Kulandaivelu A. R, "*Basic Principles of Practical Chemistry*", Sultan Chand & Sons, 2nd ed., 1997.
2.	J. Mendham, R.C. Denney, J.D. Barnes, M. Thomas, "*Vogel's Textbook of Quantitative Chemical Analysis"*, Pearson, 6th ed., 2000.
3.	Donald L. Pavia, Gary M. Lampman, George S. Engel & Roger G. Gries, "*Experimental Organic Chemistry*", Cengage Learning, 2005.
4.	Jerry Mohrig, Craig Hammond & Paul F. Snyder, "*Techniques in Organic Chemistry*", Macmillan Learning, 4th ed., 2014.
5.	Mann F. G and Saunders B. C, "*Practical Organic Chemistry*", Pearson Education, 4th ed., 1975.
Reference Books:	
1.	Ralph J. Fessenden and Joan S. Fessenden, "*Organic Chemistry Laboratory Manual*", Brooks/Cole, 3rd ed., 1982.
2.	Middleton H, "*Organic Qualitative Analysis*", Longmans, Green and Co., 1st ed., 1951.
3.	Bansal R. K, "*Laboratory Manual of Organic Chemistry*", New Age International Publishers, 5th ed., 2010.
4.	John Leonard, Barry Lygo and Garry Procter, "A*dvanced Practical Organic Chemistry*", CRC Press, 3rd ed., 2013.
5.	Lisa Nichols, "*Organic Chemistry Laboratory Techniques*", LibreTexts, 1st ed., 2016.
Web resources:	
1.	https://www.scribd.com/document/22912118/systematic-organic-analysis
2.	https://celqusb.files.wordpress.com/2018/04/kupdf-com_systematic-identification-of-organic-compounds-wiley-shrinerhermannmorrillcurtinfuson.pdf
3.	https://ncert.nic.in/pdf/publication/sciencelaboratorymanuals/classXI/chemistry/kelm207.pdf
4.	https://archive.org/details/dli.ernet.288570
5.	https://www.scribd.com/document/29184298/systematic-qualitative-organic-analysis

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	2	2	3	2
CO2	2	3	3	3	2	3	3	2	3	3	3
CO3	3	3	2	2	3	3	3	2	3	3	3
CO4	3	3	2	3	2	3	3	2	2	3	3
CO5	3	3	3	3	3	3	3	2	3	2	3
Total	14	15	13	14	13	15	15	10	13	14	14
Average	**2.8**	**3.0**	**2.6**	**2.8**	**2.6**	**3.0**	**3.0**	**2.0**	**2.6**	**2.8**	**2.8**

3 – Strong, 2- Medium, 1- Low

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24UPHA41	ALLIED PHYSICS –II	Elective	**4**	**0**	**0**	**0**	**4**	**4**	**25**	**75**	**100**

Learning Objectives	
LO1	To understand the basic concepts of optics
LO2	To understand the basic concepts of atomic physics, and its principle
LO3	Basic concepts of nuclear physics and its reaction
LO4	Basic concepts of relativity
LO5	To understand semiconductor physics, and its applications in electronics

Unit	Content	Hours
1	**OPTICS:** Definition of interference – air wedge – determination of diameter of a thin wire by air wedge – diffraction – diffraction of light vs sound – normal incidence – experimental determination of wavelength using diffraction grating (no theory) – polarization – polarization by double refraction – Snell's law Brewster's law .	15
2	**ATOMIC PHYSICS:** Mass number – atomic number – nucleons – vector atom model – various quantum numbers – Pauli's exclusion principle – electronic configuration – periodic classification of elements –photo electric effect – Einstein's photoelectric equation – applications of photoelectric effect	15
3	**NUCLEAR PHYSICS:** nuclear energy- mass defect- binding energy- Magic numbers – shell model– radioactivity – uses – half life – mean life - radio isotopes and uses –controlled and uncontrolled chain reaction – nuclear fission – energy released in nuclear fission – critical size- atom bomb – nuclear fusion – differences between fission and fusion	15
4	**INTRODUCTION TO RELATIVITY**: Frames of reference and their types – postulates of special theory of relativity – Lorentz transformation equations – derivation – length contraction – time dilation- Variation of Mass with velocity– twin paradox – mass-energy equivalence	15
5	**SEMICONDUCTOR PHYSICS:** Introduction about semiconductor- P-N junction diode – forward and reverse biasing – characteristic of diode – Zener diode – V-I characteristic of Zener diode – Application of Zener diode : voltage regulator – Half/full wave bridge rectifier – construction and working – advantages (no mathematical treatment) – USB cell phone charger –introduction to e-vehicles and EV charging stations.	15

CO	Course Outcomes Students will be able to
CO1	Explain the concepts of interference and diffraction using principles of superposition of waves and rephrase the concept of polarization based on wave patterns.
CO2	Outline the basic foundation of different atom models and various experiments establishing quantum concepts.
CO3	Summarize the properties of nuclei, nuclear forces structure of atomic nucleus and nuclear models.
CO4	To describe the basic concepts of relativity like equivalence principle, inertial frames and Lorentz transformation.
CO5	Summarize the working and principles of semiconductor.
Textbooks:	
1.	R. Murugesan (2005), Allied Physics, S. Chand and Co, New Delhi.
2.	K. Thangaraj and D. Jayaraman (2004), Allied Physics, Popular Book Depot, Chennai.
3.	Brijlal and N. Subramanyam (2002), Textbook of Optics, S. Chand and Co, New Delhi.
4.	R. Murugesan (2005), Modern Physics, S. Chand and Co, New Delhi.
5.	A. Subramaniyam Applied Electronics, 2nd Edn., National Publishing Co., Chennai.
Reference Books:	
1.	Resnick Halliday and Walker (2018), Fundamentals of Physics, 11th Edn., John Willey and Sons, Asia Pvt. Ltd., Singapore.
2.	A.Beiser (1997), Concepts of Modern Physics, Tata Mc Graw Hill Publication, New Delhi.
3.	Thomas L. Floyd (2017), Digital Fundamentals, 11th Edn., Universal Book Stall, New Delhi.
4.	V.K.Metha (2004), Principles of electronics, 6th Edn. ,S. Chand and Company, New Delhi.
Web resources:	
1.	https://www.youtube.com/watch?v=s8qImMzQKeU
2.	https://www.youtube.com/watch?v=9VKUnE3mpHk
3.	https://www.youtube.com/watch?v=wIzjQoMYlhs
4.	https://www.youtube.com/watch?v=9A0bMiuQVLs
5.	https://www.youtube.com/watch?v=CXFtbpYaBXw

Mapping with Programme Outcomes and Programme Specific Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	3	2	2	2	2	2	2	2	3	2	2
CO2	3	2	2	2	2	2	2	2	3	2	2
CO3	3	2	2	2	2	2	2	2	3	2	2
CO4	3	2	2	2	2	2	2	2	3	3	2
CO5	3	2	2	2	3	2	2	2	3	3	2
Total	15	10	10	10	11	10	10	10	15	12	10
Average	**3**	**2**	**2**	**2**	**2.2**	**2**	**2**	**2**	**3**	**2.3**	**2**

3 – Strong, 2- Medium, 1- Low

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24UPHA41P	**Practical– Allied Physics - II**	Elective	0	0	2	0	2	2	25	75	100

Learning Objectives

LO	ApplyvariousPhysicsconceptstounderstandconceptsofLight,electricityandmagnetism and waves, set up experimentation to verify theories, quantify and analyse, able to do error Analysis and correlate results

Unit	Content (Any eight experiments)	Hours
1	1. Radius of curvature of lens by forming Newton' srings (N and λ are given). 2. Thickness of a wire using air wedge. 3. Wavelength of mercury lines using spectrometer and grating. 4. Refractive index of material of the lens by minimum deviation. 5. Refractive index of liquid using liquid prism (hollow prism). 6. Determination of AC frequency using sono meter. 7. Specific resistance of a wire using PO box. 8. Thermal conductivity of poor conductor using Lee's disc. 9. Determination of figure of merit of table galvanometer. 10. Determination of Earth's magnetic field using field along the axis of a coil. 11. Characterization of Zener diode (Forward and Reverse). 12. Construction of Zener/ IC regulated power supply (IC7805). 13. Construction of AND,OR gates using diodes and NOT gate using transistor. 14. NOR gate as a universal building block (AND,OR,NOT gates). 15. Verification of transverse vibrations using sono meter.	30

CO	Course Outcomes Students will be able to
CO	Know the wavelengths of light ray components semi conductors. Study the logic gates and verify their truth tables.

Textbooks:

1	Srinivasan M.N., Balasubramanian S.& Renganathan R.,AText book of Practical Physics, Sulthan Chand & Sons, New Delhi, 2000.

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24UBTA41	BIOINFORMATICS AND BIOSTATISTICS	Elective	3	1	0	0	4	4	25	75	100

Learning Objectives	
LO1	Acquire knowledge about the Developments and Applications of Bioinformatics.
LO2	Gain knowledge about the importance of the bioinformatics, databases, tools and software of bioinformatics and explain different types of Biological Databases.
LO3	Understand the basics of sequence alignment, sequence analysis and Protein structure prediction method.
LO4	Demonstrate the basic methods of data collection, graph construction and sampling techniques and Calculate measures of central tendency
LO5	Correlate and analyze biological data through various statistical methods and interpret biological data via various probabilistic distribution methods.

Unit	Content	Hours
1	**Vector Analysis** Vector functions – Derivative of a Vector function – Scalar & Vector Point function – Gradient of Scalar point function – Gradient –Directional derivatives – Unit Vector normal to a surface – Angle between the surfaces – Divergence, Curl. **Chapter 8: Sections: 8.1 - 8.4 (Exclude Theorems)**	15
2	**Vector Analysis (Contd.)** Line integrals – Surface integrals – Volume integrals – Guass, Stoke's and Green's theorems (without proof) – Simple Problems based on theorems. **Chapter 8: Sections: 8.5 - 8.6**	15
3	**Partial Differential Equations** Formation of partial differential equations by eliminating arbitrary constants and arbitrary functions – Solutions of standard types of first order equations: f(p, q) = 0, f(x ,p, q) = 0, f(y, p, q) = 0 , f (z, p, q) = 0, f_1(x, p) = f_2 (y, q). **Chapter 6: Sections: 6.1 – 6.3**	15
4	**Laplace Transforms** Definition–Laplacetransformsofe^{at},e^{-at},$cosat$,$sinat$,$coshat$, $sinhat$,t^n,$e^{at}f(t)$,$e^{-at}f(t)$,$t^nf(t)$,$f'(t)$,$f''(t)$–Simple Problems. **Chapter7:Sections:7.1.1-7.1.4**	15
5	**Laplace Transforms (Contd..)** Inverse Laplace transforms–Applications to solutions of linear differential equations of order 1 and 2 – Simple Problems. **Chapter7:Sections:7.2–7.3**	15

COURSE OUTCOMES The students will be able to	
CO1	Discuss and analyze the concept of gradient, divergence, curl and its properties
CO2	Recognize the importance of Green's, Gauss and Stoke's theorem in vector integrals.
CO3	Find solution of first order linear partial differential equations.
CO4	Know the knowledge of basics on Laplace Transform.
CO5	Find solution of second order differentiation by using inverse Laplace Transform.

RECOMMENDED TEXT	
1	Prof P. Duraipandian, Dr. S. Udayabaskaran, Allied Mathematics, Volume – II, Muhil publishers, Chennai, 2009.
REFERENCEBOOKS	
1	P.R. Vittal, Allied Mathematics, Margham Publications, Chennai, 1999.
2	S. Narayanan, P. Kandhasamy, R. Hanumantha Rao and T.K. Manickavasagom Pillai, Ancillary Mathematics, Volume II, S. Viswanathan Printers, Chennai 2010..
3	P. Kandsamy and K.Thilagavathy , Allied Mathematics Volume – II ,S. Chand & Company , New Delhi, 2024.
4	Shanti Narayan, P.K. Mittal, Differential Calculus, S. Chand & Co, New Delhi, 2005
5	A. Singaravelu, Allied Mathematics, Meenakshi Agency, Chennai, 2001
Website and e - Learning Sources	
1	e-books, tutorials on MOOC/SWAYAM courses on the subject

Mapping with Programme Outcomes and Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	2	3	2	3	2	3	3	3	2	2	2
CO2	3	2	2	3	3	2	2	2	2	3	3
CO3	3	2	2	3	3	2	3	2	2	3	2
CO4	3	3	2	3	3	3	3	3	3	2	3
CO5	3	2	2	3	2	3	2	3	2	3	3
Total	14	12	10	15	13	13	13	13	11	13	13
Average	2.8	2.4	2	3	2.6	2.6	2.6	2.6	2.2	2.6	2.6

3–Strong, 2–Medium, 1– Low

2nd YEAR: FOURTH SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24UCHS41	**Instrumental Methods of Chemical Analysis**	**SEC-5**	**1**	**0**	**1**	**0**	**2**	**2**	**25**	**75**	**100**

Learning Objectives	
LO1	To apply the principles of gravimetric analysis, while understanding and minimizing errors in quantitative measurements.
LO2	To use AAS & FES instrumentation to quantify trace metal ions in samples and address common interferences.
LO3	To apply spectroscopic laws to use UV-Vis and IR instruments for both qualitative and quantitative analysis.
LO4	To explain the principles of thermal analysis (TGA, DTA, DSC) and electro-analytical methods (polarography) for material characterization.
LO5	To utilize solvent extraction and chromatographic techniques to separate and purify chemical components.

Unit	Content	Hours
1	**Qualitative and Quantitative Aspects of Analysis** Errors – Types of Errors, Accuracy, Precision, Minimization of Errors. Significant Figures. Methods of Expressing Precision: Mean, Median, Average Deviation, Standard Deviation, Confidence Limits. Principles of gravimetric analysis - characteristics of precipitating agents - choice of precipitants - conditions of precipitation - specific and selective precipitants - DMG, cupferron, salicylaldehyde, ethylene diamine - use of sequestering agent - co-precipitation, Post precipitation difference.	6
2	**Atomic Absorption and Flame Emission Spectroscopy**: Basic principles of instrumentation (choice of source, monochromator, detector, choice of flame and Burner designs) of AAS and FES. Techniques of atomization and sample introduction; Sources of chemical interferences and their method of removal. Techniques for the quantitative estimation of trace level of metal ions from water samples.	6
3	**UV-Visible and IR Spectroscopy** **Fundamentals of Spectroscopy:** Origin of spectra, interaction of radiation with matter, fundamental laws of spectroscopy and selection rules, Beer-Lambert's law. **UV-Visible Spectrometry:** Basic principles, instrumentation (choice of source, monochromator and detector) for single and double beam instrument; Applications - Estimation of metal ions	6

	from aqueous solution, geometrical isomers, keto-enol tautomers. **Infrared Spectroscopy:** Basic principles and instrumentation (choice of source, monochromator & detector) for single and double beam instrument.	
4	**Thermal and Electro-analytical Methods of Analysis** TGA and DTA- Principle, Instrumentation, methods of obtaining Thermograms, factors affecting TGA/DTA, Thermal analysis of silver nitrate, calcium oxalate and calcium acetate. DSC- Principle, Instrumentation and applications. **Electroanalytical methods:** polarography - principle, instrumentation and applications. Cyclic Voltammetry - principle.	6
5	**Separation and purification techniques** Classification, principle, Factors affecting - Solvent Extraction – Liquid - Liquid Extraction. Chromatography: Classification - adsorption, partition and ion exchange - Column, TLC, Paper, Gas and HPLC - Principle, Choice of Adsorbents, Solvents, Preparation of Column, Development of chromatograms and Rf value.	6

Demonstration of Instruments

The following instrumental practices will be performed as demonstrations, focusing on both the operational principles and analytical applications:

- **Instrument Component Familiarization (General):** Hands-on demonstration of the basic operational components (source, monochromator, detector, etc.) common to spectroscopic instruments.
- **Flame Emission Spectrophotometer (FES):** Quantitative Analysis and Calibration Curve Generation for a trace metal (e.g., Na or K) to determine an unknown concentration.
- **Photo Colorimeter & UV-Visible Spectrophotometer:** Verification of Beer-Lambert's Law and λmax determination for a colored solution (e.g., a metal-ligand complex).
- **Gas Chromatography-Mass Spectrophotometer (GC-MS):** Separation and Identification of Volatile Compounds in a mixture, utilizing both chromatographic retention time and mass spectral library matching.
- **High-Performance Liquid Chromatography (HPLC):** Separation of a simple mixture (e.g., food dyes or small molecules) using two different mobile phase compositions to illustrate the concept of resolution control and method development.

CO	Course Outcomes Students will be able to
CO1	To perform accurate gravimetric analysis, correctly calculating results and identifying and minimizing sources of error in quantitative chemical measurements.
CO2	To operate AAS & FES instruments to quantitatively determine the concentration of trace metal ions in a sample and apply appropriate methods to overcome chemical interference.
CO3	To interpret UV-Vis and IR spectra to elucidate the structure of molecules and determine the concentration of substances in a solution using Beer-Lambert's law.
CO4	To use thermal analysis and electro-analytical techniques to characterize the thermal stability and electrochemical properties of materials.
CO5	To select and apply suitable separation techniques like solvent extraction or chromatography to effectively isolate and purify components from a mixture.
Textbooks:	
6.	R. Gopalan, P. S. Subramanian and K. Rengarajan, "*Elements of Analytical Chemistry*", Sultan Chand, New Delhi, 2007.
7.	Douglas A. Skoog, Donald M. West, F. James Holler, Stanley R. Crouch, "*Fundamentals of Analytical Chemistry*", Brooks/Cole, 9th ed., 2013.
8.	R.A. Day and A.L. Underwood, "*Quantitative Analysis*", 6th ed., Prentice Hall of India Private Ltd., New Delhi, 1993.
9.	Vogel, A. I., Jeffery, G. H., Bassett, J., Mendham, J., & Denney, R. C, "*A Textbook of Quantitative Inorganic Analysis",* The English Language Book Society of Longman, 5th ed., 1989.
10.	Daniel C. Harris, "*Quantitative Chemical Analysis*", W. H. Freeman, 9th ed., 2015.
Reference Books:	
5.	Frank A. Settle, "*Handbook of Instrumental Techniques for Analytical Chemistry*", Prentice Hall, 1st ed., 1997.
6.	Walter J. Price, "*Atomic Absorption Spectrometry*", Heyden & Son Ltd., 2nd ed., 1985.
7.	Donald L. Pavia, Gary M. Lampman, George S. Kriz, "*Introduction to Spectroscopy*", Brooks/Cole, 5th ed., 2015.
8.	Allen J. Bard, Larry R. Faulkner, "*Electrochemical Methods: Fundamentals and Applications*", Wiley, 3rd ed., 2022.
9.	Erich Heftmann, "*Chromatography: Fundamentals and Applications of Chromatographic and Electrophoretic Methods*", Elsevier, 6th ed., 2004.
Web resources:	
6.	https://uou.ac.in/sites/default/files/slm/CHE(N)-121.pdf
7.	https://www.technologynetworks.com/analysis/articles/atomic-absorption-spectroscopy-principles-and-applications-356829
8.	https://byjus.com/chemistry/principle-of-uv-visible-spectroscopy/
9.	https://mvpsvktcollege.ac.in/wp-content/uploads/2022/11/14-TYTMA.pdf
10.	https://www.britannica.com/science/separation-and-purification/Chromatography

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	2	3	3	3
CO2	2	3	3	3	2	3	3	2	3	3	3
CO3	3	3	3	2	3	3	3	2	3	3	3
CO4	3	3	3	3	3	3	3	2	3	3	3
CO5	3	2	3	3	3	3	3	2	3	3	3
Total	14	14	15	14	14	15	15	10	15	15	15
Average	**2.8**	**2.8**	**3.0**	**2.8**	**2.8**	**3.0**	**3.0**	**2.0**	**3.0**	**3.0**	**3.0**

3 – Strong, 2- Medium, 1- Low

2nd YEAR: FOURTH SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24UCHS41	**Forensic Science**	**SEC-5**	**1**	**0**	**1**	**0**	**2**	**2**	**25**	**75**	**100**

Learning Objectives	
LO1	To understand the classification of poisons, their effects, and the use of antidotes and analytical methods in poisoning cases.
LO2	To identify the properties of explosive materials and describe the use of metal detectors and other security measures.
LO3	To describe methods for detecting forgery of documents and counterfeiting of currency using techniques like AAS.
LO4	To analyze trace evidence (e.g., footprints, fibers) and biological substances (e.g., blood, hair) in a forensic context.
LO5	To explain the causes of Aids, drug misuse, and the use of gas chromatography for metabolite analysis, as well as the chemistry of arson.

Unit	Content	Hours
1	**Poisons:** Poisons - types and classification Heavy metal contamination (Hg, Pb, Cd) of seafoods - use of neutron activation analysis in detecting arsenic in human hair. Treatment in cases of poisoning – use of antidotes for common poisons.	6
2	**Crime Detection** Accidental explosion during manufacture of matches and fireworks (as in Sivakasi). Human bombs - possible explosives (gelatin sticks and RDX) - metal detector devices and other security measures for VVIP.	6
3	**Forgery and Counterfeiting** Documents - different types of forged signatures - simulated and traced checking silver line water mark in currency notes – alloy analysis using AAS to detect counterfeit coins – detection of gold purity in 22 carat ornaments – detecting gold plated jewels.	6
4	**Tracks and Traces** Tracks and traces - small tracks and police dogs - foot prints - costing of foot prints walking pattern– glass fracture - tool marks - paints - fibres - Analysis of biological substances - blood, semen, saliva, urine and hair - Cranial	6

	analysis (head and teeth) .	
5	**Medical Aspects** Aids - causes and prevention - misuse of scheduled drugs - burns and their treatment by plastic surgery. Metabolite analysis using mass spectrum - Gas chromatography- Arson -natural fires and arson - burning characteristics and chemistry of combustible materials -nature of combustion.	6

CO	**Course Outcomes** Students will be able to
CO1	To apply forensic toxicology to identify poisons and their effects.
CO2	To explain the chemistry of explosives and its role in crime detection.
CO3	To use instrumental analysis to detect forgery and counterfeiting.
CO4	To analyze trace and biological evidence to solve crimes.
CO5	To apply analytical methods to investigate drug misuse and arson.
Textbooks:	
1.	S.A. Iqbal and M. Liviu, "*Textbook of Forensic Chemistry"*, 1st ed., Discovery Publishing House Private Limited, 2011.
2.	Kelly M. Elkins, "*Introduction to Forensic Chemistry"*, 1st ed., CRC Press, Taylor & Francis Group, 2019.
3.	Javed I. Khan, Thomas J. Kennedy, and Donnell R. Christian, Jr., "*Basic Principles of Forensic Chemistry"*, 1st ed., Humana Press, 2012.
4.	A.K. Bapuly, "*Forensic Science – Its Application in Crime Investigation"*, 1st ed., Paras Medical Publisher, 2006.
5.	B.R. Sharma, "*Scientific Criminal Investigation"*, 1st ed., Universal Law Publishing Co. Pvt. Ltd., 2006.
Reference Books:	
1.	Richard Saferstein, "*Criminalistics: An Introduction to Forensic Science (College Version)"*, 8th ed., Prentice Hall, 2003.
2.	Suzanne Bell, "*Forensic Chemistry"*, 2nd International ed., Pearson, 2014.
3.	Jay Siegel, "*Forensic Chemistry: Fundamentals and Applications"*, 1st ed., Wiley-Blackwell, 2015.
4.	Max M. Houck and Jay A. Siegel, "*Fundamentals of Forensic Science"*, Elsevier Academic Press, 2006.
5.	Henry C. Lee, Timothy Palmbach, and Marilyn T. Miller, "*Henry Lee's Crime Scene Book"*, Elsevier Academic Press, 2006.
Web resources:	
1.	https://www.medicalnewstoday.com/articles/322144
2.	https://www.forensicsciencesimplified.org/csi/
3.	https://www.forensicscolleges.com/forensic-specialties/document-examiner
4.	https://www.sciencelearn.org.nz/resources/1892-forensic-evidence-tracks-and-

	traces
5.	https://open.umn.edu/opentextbooks/textbooks/734

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	2	3	3	3	3	3	3	3	2	3
CO5	3	3	3	3	3	3	3	3	2	3	3
Total	15	14	14	14	14	15	15	15	14	13	13
Average	**3.0**	**2.8**	**2.8**	**2.8**	**2.8**	**3.0**	**3.0**	**3.0**	**2.8**	**2.8**	**2.8**

3 – Strong, 2- Medium, 1- Low

3rd YEAR: FIFTH SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24UCHC51	**ORGANIC CHEMISTRY - I**	**Core**	**4**	**1**	**0**	**0**	**4**	**5**	**25**	**75**	**100**

Learning Objectives	
Student will be able	
LO1	To understand stereoisomerism in chiral compounds and geometric isomerism in olefins, and to learn the conformations of ethane and butane.
LO2	To learn the preparation and properties of aromatic and aliphatic nitro compounds and amines.
LO3	To recall the preparation of different dyes, food colours, and additives.
LO4	To Illustrate the preparation and properties of five-membered heterocycles like pyrrole, furan, and thiophene.
LO5	To gain knowledge about the preparation and properties of six-membered heterocycles like pyridine, quinoline, and iso quinoline.

Unit	Content	Hours
1	**Stereochemistry** Fischer Projection, Newmann and Sawhorse Projection formulae and their interconversions; Geometrical isomerism: cis–trans, syn-anti isomerism, E/Z notations. **Optical Isomerism:** Optical activity, specific rotation, asymmetry, enantiomers, distereoisomers, meso structures - molecules with one and two chiral centres, racemisation- methods of racemisation; C.I.P rules. R and S notations for one and two chirality (stereogenic) centres. Molecules with no asymmetric carbon atoms – allenes and biphenyls. Conformational analysis of ethane.	15
2	**Chemistry of Nitrogen Compounds – I** **Nitroalkanes-**Nomenclature, isomerism, preparation from alkyl halides, halo acids, alkanes; physical properties; reactions – reduction, halogenations, Grignard reagent. **Aromatic nitro compounds-**Nomenclature, preparation – nitration, from diazonium salts; reactions - reduction of nitrobenzene in different medium. **Amines: Aliphatic amines-**Nomenclature, isomerism, preparation – Hofmann's degradation reaction, Gabriel's phthalimide synthesis, alkylation, acylation.	15
3	**Chemistry of Nitrogen Compounds – II** **Aromatic amines** – Nomenclature, preparation – from nitro	15

	compounds, Hofmann's method; Schmidt reaction, properties - basic nature, ortho effect; reactions –reaction with nitrous acid, aldehydes, oxidation, Electrophilic substitution reactions, coupling reactions. Distinction between primary, secondary and tertiary amines - aliphatic and Aromatic Diazonium compounds Diazomethane, Benzene diazonium chloride -preparations and synthetic applications. **Dyes-**Theory of colour and constitution; classification based on structure and application; preparation –Martius yellow, aniline yellow, methyl orange, Dyes Industry, Food colour and additives.	
4	**Heterocyclic compounds** Nomenclature and classification. General characteristics – aromatic character and reactivity. Five-membered heterocyclic compounds. Pyrrole – preparation, Properties and uses. Furan – preparation, Properties and uses; Diels Alder reactions, Electrophilic substitution reaction. Thiophene synthesis - from acetylene; reactions – reduction; oxidation; electrophilic substitution reactions.	15
5	**Six-membered heterocyclic compounds** Pyridine – synthesis - from acetylene, Physical properties; reactions -basic character, oxidation, reduction, electrophilic substitution reactions; nucleophilic substitution- uses Condensed ring systems Quinoline – preparation - Skraup synthesis and Friedlander's synthesis; Isoquinoline – preparation by the Bischler – Napieralski reaction, reduction, oxidation; electrophilic substitution.	15

CO	**Course Outcomes** **Students will be able**
CO1	To assign RS notations to chirals and EZ notations to olefins and explain conformations of ethane and butane.
CO2	To explain preparation and properties of aromatic and aliphatic nitro compounds and amines
CO3	To learn about colour and constitution of dyes and food additives
CO4	To discuss preparation and properties of five membered heterocycles like pyrrole, furan and Thiophene.
CO5	To design the preparation and properties of six membered heterocycles like pyridine, quinoline and iso quinoline.

Textbooks:

1. M.K. Jain, S.C.Sharma, Modern Organic Chemistry, Vishal Publishing, 4th reprint, 2009.
2. S.M. Mukherji, and S.P. Singh, Reaction Mechanism in Organic Chemistry, Macmillan India Ltd., 3rd ed, 2009.
3. Arun Bahl and B.S. Bahl, Advanced organic chemistry, New Delhi, S.Chand & Company Pvt. Ltd., Multicolour ed, 2012.
4. P.L. Soni and H.M. Chawla, Text Book of Organic Chemistry, Sultan Chand & Sons, New Delhi, 29th ed, 2007.
5. C.N.Pillai, Text Book of Organic Chemistry, Universities Press (India) Private Ltd.,

	2009.
Reference Books:	
1.	R. T. Morrison and R. N. Boyd, Organic Chemistry, Pearson Education, Asia, 6th ed, 2012.
2.	T.W.Graham Solomons, Organic Chemistry, John Wiley & Sons, 11th ed, 2012.
3.	A. Carey Francis, Organic Chemistry, Tata McGraw-Hill Education Pvt. Ltd., New Delhi, 7th ed, 2009.
4.	I. L. Finar, Organic Chemistry, Vol. (1& 2), England, Wesley Longman Ltd, 6th ed, 2006.
5.	J. A. Joule, and G. F. Smith, Heterocyclic Chemistry, Wiley, 5th ed, 2010.
Webresources:	
1.	www.epgpathshala.nic.in
2.	www.nptel.ac.in
3.	http:/swayam.gov.in

Mapping with Programme Outcomes and Programme Specific Outcomes

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

3 – Strong, 2- Medium, 1- Low

3rd YEAR: FIFTH SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24UCHC52	**INORGANIC CHEMISTRY -I**	**Core**	**3**	**1**	**0**	**0**	**4**	**4**	**25**	**75**	**100**

Learning Objectives

Student will be able to

LO1	Apply the principles of nomenclature, isomerism, and bonding theories in coordination Compounds
LO2	Interpret Crystal Field Theory to explain electronic structure, magnetic properties, stability,
LO3	Evaluate the preparation methods, structure, bonding, and chemical properties of metal carbonyls.
LO4	Compare and interpret the electronic configuration, oxidation states, and characteristic properties of lanthanoids and actinoids.
LO5	Explain and assess the synthesis, structure, properties, and applications of inorganic polymers.

Unit	Content	Hours
1	**Co-ordination Chemistry - I** IUPAC Nomenclature of coordination compounds, Isomerism in coordination compounds. Werner's coordination theory – effective atomic number –Interpretation of geometry and magnetic properties by Pauling's theory – geometry of coordination compounds with co-ordination number 4 &6. Chelates – types of ligands forming chelates – stability of chelates, applications of chelates in qualitative and quantitative analysis– application of DMG and oxine in gravimetric analysis –estimation of hardness of water using EDTA, metal ion indicators. Role of metal chelates in living systems – haemoglobin and chlorophyll	12
2	**Co-ordination Chemistry - II** Crystal field theory –Crystal field splitting of energy levels in octahedral and tetrahedral complexes, Crystal field stabilization energy (CFSE), spectro chemical series - calculation of CFSE in octahedral and tetrahedral complexes - factors influencing the magnitude of crystal field splitting, crystal field effect on ionic radii, lattice energies, heats of ligation with water as a ligand (heat of hydration), interpretation of magnetic properties, spectra of [Ti(H2O)6]3+ - Jahn – Teller effect. Stability of complexes in	12

	aqueous solution, stability constants- factors affecting the stability of a complex ion, thermodynamic and kinetic stability (elementary idea). Comparison of VBT and CFT.	
3	**Organometallic compounds Metal Carbonyls** Mono and poly nuclear carbonyls, General methods of preparation of carbonyls – general properties of binary carbonyls. **Bonding in carbonyls** – structure and bonding in carbonyls of Ni, Fe, Cr, Co, Mn, Ru and Os. EAN rule as applied to metal carbonyls. Ferrocene-Methods of preparation, physical and chemical properties	12
4	**Inner transition elements (Lanthanoids and Actinoids)** General characteristics of f-block elements - Comparative account of lanthanoids and actinoids - Occurrence, Oxidation states, Magnetic properties, Colour and spectra - Lanthanoids and Actinoids, Separation by ion-Exchange and Solvent extraction methods - Lanthanoids contraction-Chemistry of thorium and Uranium-Occurrence, Ores, Extraction, properties and uses - Preparation, Properties and uses of ceric ammonium sulphate, thorium dioxide and uranyl acetate.	12
5	**Inorganic polymers** **General properties** – classification of inorganic polymers based on element in the backbone (Si, S, B and P). **Preparation and properties of Silicones -** Silicones based polymer (polydimethylsiloxane and polymethylhydrosiloxane) phosphorous based polymer (polyphosphazines and polyphophonitrilic chloride), sulphur based polymer (polysulfide and polymeric sulphur nitride), boron based polymers (borazine polymers) – industrial applications of inorganic polymers.	12

CO	**Course Outcomes** **Students will be able to**
CO1	Analyze the principles of nomenclature, isomerism, and bonding theories in coordination compounds,
CO2	Interpret Crystal Field Theory to explain electronic structure, magnetic properties, stability, and Jahn–Teller distortions
CO3	Describe and evaluate the methods of preparation and the chemical properties of metal carbonyls, with emphasis on structure and bonding.
CO4	Compare and interpret the electronic configuration, oxidation states, and characteristic properties of lanthanoids and actinoids.
CO5	Explain and assess the synthesis, structure, and properties of inorganic polymers, highlighting their industrial and practical applications.
Textbooks:	
1.	Puri B R, Sharma L R, Kalia K C (2011), Principles of Inorganic Chemistry, 31thEdition, Milestone Publishers & Distributors, Delhi.
2.	Satya Prakash, Tuli G. D., Basu S. K., Madan R. D. (2009),Advanced Inorganic Chemistry, 18th Edition, S. Chand & Co., New Delhi
3.	Lee J D, (1991), Concise Inorganic Chemistry, 4th Edition, ELBS William Heinemann,

	London.
4.	W V Malik, G D Tuli, R D Madan, (2000), Selected Topics in Inorganic Chemistry, S. Chand and Company Ltd.
5.	A. K. De, Text book of Inorganic Chemistry, Wiley East Ltd, seventh edition, 1992.
Reference Books:	
1.	Madan R D, Sathya Prakash, (2003), Modern Inorganic Chemistry, 2nd ed ., S.Chand and Company, New Delhi.
2.	Gopalan R, (2009) Inorganic Chemistry for Undergraduates, Ist Edition, University Press (India) Private Limited, Hyderabad
3.	Sivasankar B, (2013) Inorganic Chemistry. Ist Edition, Pearson, Chennai
4.	Alan G. Sharp (1992), Inorganic Chemistry, 3rd Edition, Addition- Wesley, England
5.	Peter Atkins, Tina Overton, Jonathan Rourke and Mark Weller, Inorganic Chemistry, Oxford University Press, sixth edition, 2014.
Web resources:	
1.	https://www.geeksforgeeks.org/chemistry/isomerism-in-coordination-compounds/
2.	https://byjus.com/chemistry/crystal-field-theory/?utm_source
3.	https://www.britannica.com/science/metal-carbonyl?utm_source

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	15	15	10	14	05	10	12	13	14	14
Average	**3.0**	**3.0**	**3.0**	**2.0**	**2.8**	**1.0**	**2.8**	**2.4**	**2.6**	**2.8**	**2.8**

3 – Strong, 2- Medium, 1- Low

3rd YEAR: FIFTH SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24UCHC53P	**Core - GRAVIMETRIC ESTIMATION PRACTICAL**	**Core**	**0**	**0**	**3**	**0**	**2**	**3**	**25**	**75**	**100**

Learning Objectives	
Student will able to	
LO1	Apply gravimetric principles to precipitate and quantitatively determine sulphate ions as barium sulphate
LO2	Demonstrate the procedure for quantitative estimation of barium by converting it into barium sulphate precipitate.
LO3	Prioritize precipitation methods to estimate barium as barium chromate under controlled conditions.
LO4	Perform gravimetric estimation of lead by precipitating it as lead chromate
LO5	Estimating precipitation and conversion techniques to estimate calcium as calcium oxalate monohydrate.

Unit	Content	Hours
1	Estimation of Sulphate as Barium Sulphate.	9
2	Estimation of Barium as Barium Sulphate.	9
3	Estimation of Barium as Barium Chromate	9
4	Estimation of Lead as Lead Chromate.	9
5	Estimation of Calcium as Calcium Oxalate Monohydrate.	9

SCHEME OF VALUATION

PRACTICAL - GRAVIMETRIC ESTIMATION

Internal assessment	25 Marks
External assessment	75 Marks
Total	100 Marks
Max. Marks	75 Marks
Experiment	45 Marks
Record	15Marks
Procedure	10 Marks
Viva Voce	5 Marks

Error upto 2 % : 50

2.1 - 3 % : 40

3.1 - 4 % : 30

4.1 - 5 % : 20

>5 % : 10

a. Among the duplicate results, the value more favorable to the candidate must be taken.

b. When no duplicate result is given deduct 5 marks.

c. If the two results differ by more than 2 % deduct 5 marks.

d. For each independent arithmetical error deduct 1 mark.

e. For incomplete or wrong calculation deduct 20 %.

f. For no calculation deduct 40 %.

g. If the experiment is not completed due to an accident, award 5 marks.

CO	**Course Outcomes** Students will be able to
CO1	Analyze and accurately estimate sulphate content in a given sample using gravimetric precipitation techniques.
CO2	Determine the concentration of barium in a sample through gravimetric analysis and interpret the reliability of results obtained.
CO3	Compare and analyze gravimetric methods for barium estimation and assess the suitability of chromate precipitation
CO4	Evaluate the accuracy and limitations of gravimetric methods in determining lead concentration in samples
CO5	correlate the quantitative estimation of calcium and interpret experimental data considering sources of error and precision
Textbooks:	
1.	Elements of Analytical Chemistry – 2nd ed., (often cited), S. Chand & Company, 2003.
2.	Qualitative Inorganic Analysis, A.I. Vogel – 7th ed., Prentice Hall.
3.	G. Svehla, "Vogel's Text book of Inorganic Qualitative Analysis",4th ed., ELBS, London.
4.	G. H. Jeffery, J. Bassett, J. Mendham, and R. C. Denney, "Vogel's Textbook of Quantitative Inorganic Analysis", 6th ed., Wiley, 2002.
5.	A. JeyaRajendran, "Microanalytical Techniques in Chemistry: Inorganic Qualitative Analysis", 1st ed., United Global Publishers, 2021.
Reference Books:	
1.	G. Pass, and H. Sutcliffe, "Practical Inorganic Chemistry", 1st ed., Chapman Hall, 1965.
2.	W. G. Palmer, "Experimental Inorganic Chemistry", 1st ed., Cambridge University Press, 1954.

3.	A. I. Vogel, "Qualitative Inorganic Analysis", 3rd ed., Longmans, 1961.
4.	F. A. Cotton and G. Wilkinson, "A*dvanced Inorganic Chemistry*", 6th ed., Wiley Interscience, 1988.
5.	Gary L. Miessler and Donald A. Tarr, "Inorganic Chemistry", 5th ed., Pearson Prentice Hall, 2010
Web resources:	
1.	https://www.khanacademy.org/science/chemistry/chemical-kinetics
2.	https://www.masterorganicchemistry.com/
3.	https://ocw.mit.edu/
4.	https://www.khanacademy.org/science/chemistry/solutions-and-mixtures/colligative-properties/a/colligative-properties
5.	https://www.google.com/url?sa=E&source=gmail&q=https://www.sciencedirect.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	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

3rd YEAR: FIFTH SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24UCHC54	**INDUSTRIAL CHEMISTRY**	**Core**	**3**	**1**	**0**	**0**	**4**	**4**	**25**	**75**	**100**

Learning Objectives

Student will be able

LO1	To understand the behavior, classifications and characteristics of fuels.
LO2	To familiarize the preparation of cosmetics.
LO3	To discuss the manufacture of sugar, paper, cement and leather and food processing.
LO4	To compare the applications of abrasives, lubricants and other industrial products.
LO5	To highlight the intellectual property rights.

Unit	Content	Hours
1	**Survey of Indian Industries and mineral resources in India Fuels**: Classification, characteristics of fuels. Solid fuels: coal - classification; analysis of coal- proximate analysis and ultimate analysis; calorific value-determination, carbonisation of coal. **Liquid fuels**: Petroleum - characteristics; Gasoline aviation petrol-knocking in internal combustion engines, antiknock agents; unleaded petrol-octane number, cetane number. **Gaseous fuel:** advantages over solid and liquid fuels; water gas, producer gas, carburetted water gas - preparations - uses. Natural gas: LPG-composition, advantages, application; gobar gas production, composition, advantages, application. Propellants – rocket fuels (basic idea)	12
2	**Cosmetics** **Skin care:** powders, ingredients; creams and lotion-cleansing, moisturising, all purpose shaving cream, sunscreen; make up preparations. **Dental care:** tooth pastes – ingredients. **Hair care:** shampoos-types, ingredients; conditioners-types, ingredients. Perfumes: natural-plant origin-parts of the plant used, chief constituents. **Soaps and Detergents** Soaps-properties, manufacture of soap-batch process; types-transparent soap, toilet soap, powder soap and liquid soap – ingredients. Detergents-definition, properties-cleansing action; soapless detergents anionic, cationic and non-ionic (general idea only); uses of detergents as surfactants. Biodegradability of soaps and detergents.	12

3	**Sugar Industry** Manufacture from sugar cane; recovery of sugar from molasses; testing and estimation of sugar. **Food Preservation and processing** Food spoilage – causes; Food preservation - methods – high temperature, low temperature, drying, radiation; Food additives – preservatives, flavours, colours, anti-oxidants, sweetening agents; hazards of using food additives; Food standards – Agmark and Codex alimentarius.	12
4	**Abrasives** Definition, characteristics, types-natural and synthetic; natural abrasives – diamond, quartz – composition, uses; synthetic abrasives – aluminium carbide, boron carbide, synthetic graphite – composition and uses. **Leather Industry** Structure and composition of skin, hide; Manufacture of leather – pretanning process – curing, liming, beating, pickling; methods of tanning vegetable, chrome – one bath, two bath process; finishing. **Paper Industry** Manufacture of pulp - mechanical, chemical processes; sulphate pulp, rag pulp; manufacture of paper- beating, refining, filling, sizing, colouring, calendaring; cardboard.	12
5	**Lubricants** Definition, classification-liquid, semi-solid, solid and synthetic; properties-viscosity index, flash point, cloud point, pour point, aniline point and drop point; greases-properties, types; cutting fluids, selection of lubricants. **Cement Industry** Cement – types, raw materials; manufacture-wet process, constituent of cement, setting of cement; properties of cement-quality, setting time, soundness, strength; mortar, concrete, RCC; curing and decay of concrete. **Intellectual Property Rights** Introduction to Intellectual Property Rights – Patents - Factors for patentability - Novelty, Non obviousness, Industrial applications - Patent offices in India: Trademark - Types of trademarks- Certification marks, logos, brand names, signatures, symbols and service marks	12

CO	**Course Outcomes** **Students will be able**
CO1	To summarize the properties of fuels which include petroleum, water gas, natural gas and propellants.
CO2	To evaluate the cosmetic products, soaps, detergents.
CO3	To study different manufacture of sugar, food spoilages and food additives.
CO4	To discuss the properties of abrasives, manufacture of leather and paper.
CO5	To explain properties and manufacture of lubricants and cement, and intellectual property rights.
Text books:	
1	Gopalan, R., Subramaniam, P.S. and Rengarajan, K., Elements of Analytical Chemistry, S. Chand & Co., New Delhi, 2003.
2	Usharani, S., Analytical Chemistry, 1st ed., Macmillan India Ltd., 2002.
3	Banwell, C.N. and McCash, E.M., Fundamentals of Molecular Spectroscopy, 4th ed.,

	Tata McGraw-Hill, New Delhi, 2017.
4	James A. Kent, Tilak V. Bommaraju, Scott D. Barnicki, *Handbook of Industrial Chemistry*, Springer, 13th Edition, 2017.
5	Sharma, B.K., Spectroscopy, 22nd ed., Goel Publishing House, 2011.
Reference Books:	
1	R. Gopalan, P.S. Subramaniam and K. Rengarajan, "Elements of Analytical Chemistry", S. Chand & Co., New Delhi, 2003.
2	S. Usharani, "Analytical Chemistry", 1st ed., Macmillan India Ltd., 2002.
3	C.N. Banwell and E.M. McCash, "Fundamentals of Molecular Spectroscopy", 4th ed., Tata McGraw-Hill, New Delhi, 2017.
4	U.N. Dash, "Analytical Chemistry: Theory and Practice", 2nd ed., Sultan Chand & Sons, 2005.
5	B.K. Sharma, "Spectroscopy", 22nd ed., Goel Publishing House, 2011.
Web resources:	
1	http://www.sciencecases.org/irradiation/irradiation_notes.asp
2	http://discovery.kcpc.usyd.edu.au//9.5.5/
3	https://www.wipo.int/about-ip/en/

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	2	3	3	3	3	3	3	3	3	3	3
CO3	3	3	3	3	3	3	3	3	3	3	3
CO4	3	2	3	3	3	3	3	3	3	3	3
CO5	3	3	3	3	3	3	3	3	3	3	3
Total	**14**	**14**	**15**	**15**	**15**	**15**	**15**	**15**	**15**	**15**	**15**
Average	**2.8**	**2.8**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**

3 – Strong, 2- Medium, 1- Low

3rd YEAR: FIFTH SEMESTER

Course Code	Course name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total Marks
24UCHE51	PHYSICAL CHEMISTRY – I	Elective	4	1	0	0	4	5	25	75	100

Learning objectives	
Student will be able	
LO1	To understand Gibbs free energy, Helmholtz free energy, Ellingham's diagram, and partial molar properties.
LO2	To understand chemical kinetics and different types of chemical reactions.
LO3	To learn about adsorption, homogeneous and heterogeneous catalysis.
LO4	To understand colloids and macromolecules.
LO5	To learn photochemistry, fluorescence, and phosphorescence.

Unit	Content	Hours
1	**Thermodynamics - III** Gibbs-Helmholtz equation – derivations and applications; Maxwell relationships, thermodynamic equations of state; Ellingham Diagram-application. Partial molar properties – chemical potential, Gibbs Duhem equation, variation of chemical potential with temperature and pressure, chemical potential of a system of ideal gases, Gibbs- Duhem-Margules equation.	15
2	**Chemical Kinetics** Rate of reaction - Average and instantaneous rates, factors influencing rate of reaction - molecularity of a reaction - rate equation - order of reaction. order and molecularity of simple and complex reactions, Rate laws - Rate constants – derivation of rate constants and characteristics for zero, first order, second and third order (equal initial concentration) , Arrhenius equation. Theories of reaction rates – Collision theory– Failure of collision theory. Lindemann's theory of unimolecular reaction. Comparison of collision theory and ARRT.	15
3	Adsorption – Chemical and physical adsorption and their general characteristics- distinction between them Different types of isotherms – Freundlich and Langmuir. Adsorption isotherms and their limitations – BET theory, Michaelis- Menten and Briggs- Haldene equation – Catalysis – general characteristics of catalytic reactions, auto catalysis, promoters, negative catalysis, poisoning of a catalyst – theories of homogenous and heterogeneous catalysis – Kinetics of Acid – base and	15

	enzyme catalysis. Heterogenous catalysis.	
4	**Colloids and Surface Chemistry** Colloids: Types of Colloids, Characteristics Colloids (Lyophilic and Lyophobic sols), Preparation of Sols- Dispersion methods, aggregation methods, Properties of Sols- Optical properties, Electrical properties - Electrical double layer, Electro Kinetic properties- Macromolecules: Molecular weight of Macromolecules-Number average molecular weight- average molecular weight, Determination of Molecular weight of molecules	15
5	**Photochemistry** Laws of photo chemistry – Lambert – Beer, Grotthus – Draper and Stark – Einstein. Quantum efficiency. Photochemical reactions – rate law – Kinetics of H2-Cl2, H2-Br2 and H2-I2 reactions, comparison between thermal and photochemical reactions. Fluorescence – applications including fluorimetry – sensitised fluorescence, phosphorescence – applications - chemiluminescence and photosensitization.	15

CO	**Course Outcomes** **Students will be able**
CO1	To explain Gibbs and Helmholtz free energy functions, partial molar quantities and Ellinghams.
CO2	To apply the concepts of chemical kinetics to predict the rate of the reaction and order of the reaction, demonstrate the effect of temperature on reaction rate, and the significance of free energy and entropy of activation.
CO3	To compare chemical and physical adsorption, Freundlich and Langmuir adsorption isotherms, and differentiate between homogenous and heterogeneous catalysis.
CO4	To demonstrate the types and characteristics of colloids, preparation of sols and emulsions, and determine the molecular weights of macromolecules.
CO5	To utilize the concepts of photochemistry in fluorescence, phosphorescence, chemiluminescence and color perception of vision.

Textbooks:	
1.	B.R. Puri and L.R. Sharma, Principles of Physical Chemistry, Shoban Lal Nagin Chand and Co., 48th ed., 2021.
2.	Peter Atkins, and Julio de Paula, James Keeler, Physical Chemistry, Oxford University press, International 11th ed., 2018.
	Arun Bahl, B.S. Bahl, G. D. Tuli Essentials of physical chemistry, 28th ed., 2019, S, Chand & Co.
4.	S. K. Dogra and S. Dogra, Physical Chemistry through Problems: New Age International, 4th ed., 1996.
5.	J. Rajaram and J.C. Kuriacose, Thermodynamics, Shoban Lal Nagin Chand and CO., 1986.
Reference Books:	
1.	J. Rajaram and J.C. Kuriacose, Chemical Thermodynamics, Pearson, 1st ed., 2013.
2.	Keith J. Laidler, Chemical kinetics, 3rd ed., Pearson, 2003.

3.	P. W. Atkins, and Julio de Paula, Physical Chemistry, Oxford University press, 7th ed., 2002.
4.	K. L. Kapoor, A Textbook of Physical Chemistry, Macmillan India Ltd, 3rd ed., 2009.
5.	B.R. Puri, L.R. Sharma and M.S. Pathania, Principles of Physical Chemistry, Shobanlal Nagin Chand and Co. Jalendhar, 41st , ed., 2001.
Web resources:	
1.	https://nptel.ac.in
2.	https://swayam.gov.in
3.	www.epgpathshala.nic.in

Mapping with Programme Outcomes and Programme Specific Outcomes

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

3 – Strong, 2- Medium, 1- Low

3rd YEAR: FIFTH SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24UCHE52	**COSMETIC CHEMISTRY**	**Elective**	**4**	**1**	**0**	**0**	**4**	**5**	**25**	**75**	**100**

Learning Objectives

Student will be able

LO1	To understand the basic concepts and scope of cosmetic chemistry.
LO2	To identify various ingredients used in cosmetic formulations.
LO3	To describe the formulation of creams, lotions, and sunscreens.
LO4	To apply quality control measures for these products.
LO5	To identify the role of pigments, binders, and solvents.

Unit	Content	Hours
1	**Introduction to Cosmetic Chemistry** Definition and scope of cosmetic chemistry. Classification of cosmetics (skin, hair, oral, decorative). Basic structure and function of skin and hair. Regulatory aspects and safety evaluation of cosmetic products.	15
2	**Raw Materials Used in Cosmetics** Types of ingredients – surfactants, emollients, humectants, preservatives, and fragrances. Role of natural and synthetic compounds in formulations. Coloring agents and additives. Safety and stability of raw materials.	15
3	**Skin Care Products** Formulation and functions of creams, lotions, sunscreens, and moisturizers. Role of pH and active ingredients in skin care. Anti-aging and herbal cosmetics. Basic evaluation methods for skin products.	15
4	**Hair Care and Oral Care Products** Composition and preparation of shampoos, conditioners, hair oils, and dyes. Types of oral care products like toothpaste and mouthwash. Role of detergents, abrasives, and fluorides. Quality control of hair and oral products.	15
5	**Decorative Cosmetics and Quality Control** Formulation of lipsticks, face powders, nail polish, and perfumes. Role of pigments, binders, and solvents. Packaging and labeling requirements. Quality assurance, stability testing, and recent trends in cosmetic formulations.	15

CO	Course Outcomes **Students will be able to**
CO1	Recall fundamental concepts, classification, and regulatory aspects of cosmetic chemistry.
CO2	Identify and explain the role of various raw materials used in cosmetic formulations.
CO3	Apply knowledge to understand and evaluate skin, hair, and oral care products.
CO4	Analyze the formulation and function of decorative cosmetics and their ingredients.
CO5	Demonstrate understanding of quality control, safety evaluation, and modern trends in cosmetic products.
Text books:	
1	Perry Romanowski **&** Randy Schueller Beginning Cosmetic Chemistry: Practical Knowledge for the Cosmetic Industry 3rd Edition (Revised)**,** 2009
2	Anthony J. O'Lenick Organic Chemistry for Cosmetic Chemists Reprinted Edition**,** 2008
3	D. F. Williams **&** W. H. Schmitt Chemistry and Technology of the Cosmetics and Toiletries Industry 2nd Edition (Reprint available)**,** 2014
4	Perry Romanowski **&** Randy Schueller Beginning Cosmetic Chemistry: An Overview for Chemists 2nd Edition**,** 2003
5	André O. Barel, Marc Paye & Howard I. Maibach Handbook of Cosmetic Science and Technology 4th Edition (Reprint)**,** 2021
Reference Books:	
1	Pankaj A. Jadhav et al. Textbook of Cosmetic Science 1st Edition (Reprint 2025), 2022/2025
2	Rajdip Utane & S. K. Kharkate *Chemistry for B.Sc. Students: Cosmetic Chemistry and Food Adulteration* 1st Edition**,** 2026
3	A. A. Kulkarni, Vikram Gharge et al. *Cosmetic Science* 4th Edition**,** 2024
4	Ralph G. Harry (Revised by Wilkinson & Moore) *Harry's Cosmeticology* 8th Edition**,** 2012
5	Perli Kranti Kumar et al. *A Text Book on Cosmetic Science for B. Pharmacy IV Year* 1st Edition**,** 2025
Web resources:	
1	https://www.cosmetichemistry.com/?utm_
2	https://cosmeticchemist.org/online-resources-in-beauty-and-cosmetics
3	https://www.orgsyn.org/?utm_

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	2	3	3	3	3	3	3	3	3	3	3
CO3	3	3	3	3	3	3	3	3	3	3	3
CO4	3	2	2	3	3	3	3	3	3	3	3
CO5	3	3	3	3	3	3	3	3	3	3	3
Total	**14**	**14**	**14**	**15**	**15**	**15**	**15**	**15**	**15**	**15**	**15**
Average	**2.8**	**2.8**	**2.8**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**

3 – Strong, 2- Medium, 1- Low

3rd YEAR: FIFTH SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24UCHE53	FUNDAMENTALS OF SPECTROSCOPY	Elective	4	1	0	0	4	5	25	75	100

Learning Objectives

Student will be able

LO1	To understand the electrical and magnetic properties of molecules and to interpret spectroscopic data related to molecular structure and bonding.
LO2	To understand the principles of UV–Visible, IR, Raman, and Mass spectrometry and to learn their instrumentation.
LO3	To identify functional groups and structural features of organic and inorganic compounds using spectral techniques.
LO4	To determine molecular formula, bond parameters, and structural components from spectral data.
LO5	To solve problems related to structural elucidation of unknown molecules using combined spectroscopic methods (UV–Vis, IR, Raman, NMR, and MS).

Unit	Content	Hours
1	**Electrical and Magnetic Properties of Molecules** Dipole moment – polar and non-polar molecules – significance in determining molecular structure. Magnetic properties – diamagnetism and paramagnetism – magnetic susceptibility – determination using Gouybalance. Microwave spectroscopy – rotational spectra of diatomic molecules – determination of bond length – importance in understanding molecular structure and bonding.	15
2	**Ultraviolet and Visible Spectroscopy** Electronic spectra of diatomic molecules – Born–Oppenheimer approximation – vibrational coarse structure and rotational fine structure – Franck–Condon principle – dissociation energy and Birge–Sponer method – pre-dissociation – electronic transitions ($\sigma\rightarrow\sigma^*$, $\pi\rightarrow\pi^*$, $n\rightarrow\sigma^*$, $n\rightarrow\pi^*$). Applications of UV spectroscopy – Woodward–Fieser rules for conjugated dienes and α,β-unsaturated ketones – elementary problems. Colorimetry – principle (Beer–Lambert law) and applications – estimation of Fe^{3+}.	15
3	**Infrared Spectroscopy** Vibrational spectra of diatomic molecules – harmonic and anharmonic oscillator models – vibration–rotation spectra – selection rules. Applications of IR spectroscopy – determination of force constant, moment of inertia and internuclear distance – isotopic shift – structural analysis of simple organic and inorganic molecules.	15
4	**Raman Spectroscopy** Rayleigh and Raman scattering – Raman shift – basic principle of Raman effect. Vibrational Raman spectra – selection	15

	rules – mutual exclusion principle. Instrumentation (block diagram) and simple applications of Raman spectroscopy.	
5	**Mass Spectrometry** Principle of mass spectrometry – methods of ionisation – basic instrumentation – mass spectrum and types of ions. Determination of molecular formula – fragmentation patterns – structural elucidation – McLafferty rearrangement and Retro Diels–Alder reaction (simple examples). Introduction to structure determination using combined spectral data (NMR, MS, IR and UV–Visible spectroscopy).	15

CO	**Course Outcomes** **Students will be able to**
CO1	Demonstrate a clear understanding of electrical and magnetic properties of molecules, including dipole moment, magnetic susceptibility, and the application of microwave spectroscopy in determining molecular structure and bond length.
CO2	Explain the principles of UV–Visible spectroscopy, interpret electronic transitions, and apply spectroscopic rules and Beer–Lambert law for structural analysis and quantitative estimation.
CO3	Describe vibrational spectroscopy principles and apply IR spectroscopy to determine molecular parameters and identify functional groups in organic and inorganic compounds.
CO4	Understand the fundamental principles of Raman spectroscopy, including scattering phenomena, selection rules, and instrumentation, and apply them in molecular structure analysis.
CO5	Apply the principles of mass spectrometry to determine molecular formula, interpret fragmentation patterns, and solve structural elucidation problems using combined spectral techniques (NMR, MS, IR and UV–Visible spectroscopy).
Text books:	
1	Gopalan, R., Subramaniam, P.S. and Rengarajan, K., Elements of Analytical Chemistry, S. Chand & Co., New Delhi, 2003.
2	Usharani, S., Analytical Chemistry, 1st ed., Macmillan India Ltd., 2002.
3	Banwell, C.N. and McCash, E.M., Fundamentals of Molecular Spectroscopy, 4th ed., Tata McGraw-Hill, New Delhi, 2017.
4	Dash, U.N., Analytical Chemistry: Theory and Practice, 2nd ed., Sultan Chand & Sons, 2005.
5	Sharma, B.K., Spectroscopy, 22nd ed., Goel Publishing House, 2011.
Reference Books:	
1	R. Gopalan, P.S. Subramaniam and K. Rengarajan, "Elements of Analytical Chemistry", S. Chand & Co., New Delhi, 2003.
2	S. Usharani, "Analytical Chemistry", 1st ed., Macmillan India Ltd., 2002.
3	C.N. Banwell and E.M. McCash, "Fundamentals of Molecular Spectroscopy", 4th ed., Tata McGraw-Hill, New Delhi, 2017.
4	U.N. Dash, "Analytical Chemistry: Theory and Practice", 2nd ed., Sultan Chand & Sons, 2005.
5	B.K. Sharma, "Spectroscopy", 22nd ed., Goel Publishing House, 2011.

Web resources:	
1	http://vallance.chem.ox.ac.uk/pdfs/SymmetryLectureNotes2004.pdf2.http://chemistry.rutgers.edu/undergrad/chem207/SymmetryGroupTheory.html
2	http:/swayam.gov.i
3	www.epgpathshala.nic.in

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	2	3	3	3	3	3	3	3	3	3	3
CO3	3	3	3	3	3	3	3	3	3	3	3
CO4	3	2	3	3	3	3	3	3	3	3	3
CO5	3	3	3	3	3	3	3	3	3	3	3
Total	14	**14**	**15**	**15**	**15**	**15**	**15**	**15**	**15**	**15**	**15**
Average	**2.8**	**2.8**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**

3 – Strong, 2- Medium, 1- Low

3rd YEAR: FIFTH SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24UCHE54	PETROCHEMICAL TECHNOLOGY	Elective	4	1	0	0	4	5	25	75	100

Learning Objectives

Student will be able

LO1	To understand the scope and importance of the petrochemical industry.
LO2	To recognize environmental concerns associated with refining operations.
LO3	To explain basic reaction pathways involved in petrochemical conversions.
LO4	To identify different petrochemical-based products and their uses.
LO5	To illustrate the importance of sustainable and green practices.

Unit	Content	Hours
1	**Introduction to Petrochemical Industry** Overview of the petrochemical industry and its importance in modern society. Classification of petrochemicals – olefins, aromatics, and synthesis gas derivatives. Basic raw materials such as crude oil and natural gas. Concept of feedstocks and primary petrochemical building blocks. Growth and scope of the petrochemical sector.	15
2	**Petroleum Refining Processes** Composition and properties of crude oil. Primary refining processes such as distillation (atmospheric and vacuum). Secondary processes including cracking, reforming, and isomerization. Production of fuels like LPG, petrol, diesel, and kerosene. Environmental issues associated with refining.	15
3	**Petrochemical Feedstocks and Intermediates** Production and properties of major feedstocks like ethylene, propylene, butadiene, benzene, toluene, and xylene. Methods of production such as steam cracking and catalytic reforming. Conversion of feedstocks into important intermediates. Industrial significance of these chemicals. Basic reaction mechanisms involved.	15
4	**Petrochemical Products and Applications** Manufacture of polymers such as polyethylene, polypropylene, PVC, and polystyrene. Production of synthetic fibers, rubbers, and resins. Use of petrochemicals in plastics, detergents, fertilizers, and pharmaceuticals. Applications in everyday life and industry. Economic importance of petrochemical products.	15
5	**Environmental Impact and Safety Measures** Environmental pollution caused by petrochemical industries (air, water, and soil). Waste management and pollution control techniques. Concept of green	15

	petrochemistry and sustainable practices. Industrial safety measures and hazard management. Regulatory guidelines and future trends.	

CO	Course Outcomes Students will be able to
CO1	Recall the fundamentals of petrochemical industry, classification, and feedstocks.
CO2	Explain petroleum refining processes and identify major products obtained.
CO3	Describe the production and significance of petrochemical intermediates and feedstocks.
CO4	Apply knowledge to understand the manufacture and applications of petrochemical products.
CO5	Analyze environmental impacts and demonstrate awareness of safety and sustainability in petrochemical industries.
Text books:	
1	Frank Dreher, Elsa Jungman, Kazutami Sakamoto & Howard I. Maibach (Editors) Handbook of Cosmetic Science and Technology 5th Edition, 2022 / 2023 (Recent Edition)
2	André O. Barel, Marc Paye & Howard I. Maibach (Editors) *Handbook of Cosmetic Science and Technology* 4th Edition (Reprint), 2014 / Reprint 2021
3	Hilda Butler (Editor) *Poucher's Perfumes, Cosmetics and Soaps* 10th Edition (Reprint available), 2000
4	Ralph G. Harry (Revised by Wilkinson & Moore) *Harry's Cosmeticology* 8th Edition (Reprint available), 2012
5	Florence Barrett-Hill Cosmetic Chemistry: For the Skin Treatment Therapist 1st Edition, 2013
Reference Books:	
1	Wilfried Rähse (Editor) Cosmetics and Toiletries: Development, Production and Use 1st Edition (Reprint available), 2015
2	Zoe Diana Draelos & Lauren A. Thaman (Editors) Cosmetic Formulation of Skin Care Products 2nd Edition, 2016
3	Leslie Baumann Cosmetic Dermatology: Principles and Practice 3rd Edition, 2022
4	S. K. Singh *Handbook on Cosmetics (Processes, Formulae with Testing Methods)* 1st Edition, 2010
5	Santi Kulprathipanja, James E. Rekoske, and Daniel WeiModern, Petrochemical Technology: Methods, Manufacturing and Applications, 1st Edition, 2021
Web resources:	
1	https://www.petroskills.com/training?utm_source
2	https://www.polymerupdateacademy.com/?utm_source
3	Society of Petroleum Engineers (SPE) | Oil & Gas Membership Association

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	2	3	3	3	3	3	3	3	3	3	3
CO3	3	3	3	3	3	3	3	3	3	3	3
CO4	3	3	3	2	3	3	3	3	3	3	3
CO5	3	3	3	3	3	3	3	3	3	3	3
Total	**14**	**15**	**15**	**14**	**15**	**15**	**15**	**15**	**15**	**15**	**15**
Average	**2.8**	**3**	**3**	**2.8**	**3**	**3**	**3**	**3**	**3**	**3**	**3**

3 – Strong, 2- Medium, 1- Low

3rd YEAR: FIFTH SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24UCHIK51	**IKS Indigenous Science & Technology**	**IKS**	**1**	**1**	**0**	**0**	**0**	**2**	**25**	**75**	**100**

Learning Objectives

Students will be able to

LO1	To understand and identify the major phases of Indian civilization and their contributions.
LO2	To describe the methods of metal extraction, processing, and fabrication employed in ancient Indian metallurgy.
LO3	To recognize and apply the basic principles of herbal remedies and medicinal plants in promoting health and wellness.
LO4	To explain the core concepts, principles, and the eight branches (Ashtanga Ayurveda) of the Ayurvedic system of medicine.
LO5	To discuss the contemporary importance of traditional Indian systems in healthcare and scientific development.

Unit	Content	Hours
1	**Foundation of IKS** Overview of Indian Knowledge Traditions – Evidence from Archaeology – Paleolithic, Harappan civilizations – New Stone Age and Stone Age societies. Iron Epoch in India – Vitreous materials and glazing – Scientific thought in Vedic texts – Classical Sanskrit scholarly works – Upanishadic & Kalpasutra insights – Arthashastra's connection to scientific practices .	6
2	**Ceramic Craft and Metallurgical Practices** Earthenware Vedic phase –Chemical methods and proto-chemistry – Metals and their fabrication Vitreous substances – Fired clay products Metal fabrication –extraction and processing – Iron extraction and processing –Textual references.	6
3	**Herbal Remedies from India** Therapeutic applications of Fenugreek (Methi) — *Trigonella foenum-graecum,* Lemongrass — *Cymbopogon citratus* Curative properties of multiple seasonings – cinnamon, cardamom,– Healing attributes of leafy vegetables and fodder plants.	6
4	**Healing Practices during the Vedic Era** Evolution of healthcare concepts – Blend of logical thinking with early beliefs – Healthcare wisdom in post-Vedic scriptures – Medical practices in Buddhist writings Ayurveda as a distinguished discipline – Timeline of classical compendia – Subject matter of Ayurvedic compilations –	6

	Ayurveda with its eight traditional branches – Additional healthcare systems of old India – The eight components of Ayurveda.	
5	**Wellness and Healing in Regional Customs** Features of Indigenous Healthcare Practices – Exchange between knowledge systems – Regional healthcare practices, ecological balance and overall wellness. Nature-derived resources and wellness – Preservers of healthcare wisdom – Inner aspects of wellbeing – Transformations and current issues.	6

CO	**Course Outcomes** **Students will be able to**
CO1	Explain the evolution of Indian Knowledge Traditions using archaeological and textual evidence.
CO2	Interpret scientific ideas in Vedic and classical texts and relate them to early scientific practices.
CO3	Examine traditional ceramic and metallurgical practices with reference to historical evidence.
CO4	Describe the therapeutic uses of selected Indian herbs and their role in traditional healthcare.
CO5	Analyze the development and principles of ancient Indian healthcare systems including Ayurveda.
Textbooks:	
1.	A Compact Account of Science in India, edited by D. M. Bose, S. N. Sen and B. V. Subbarayappa; INSA; 2009.
2.	Science and Technology in Medieval India – A Source Reference in Sanskrit, Arabic and Persian by A. Rahman, M. A. Alvi, S. A. Khan Ghori and K. V. Samba Murthy; 1982.
3.	Scientific and Technological Interactions between India and Soviet Central Asia (Medieval Era), edited by B. V. Subbarayappa; 1985.
4.	Scientific and Technical Learning in India, 1781–1900 by S. N. Sen; 1991.
5.	Chronicle of Technology in India, Vol. I, edited by A. K. Bag; 1997; Vol. II, edited by Harbans Mukhia; 2012; Vol. III, edited by K. V. Mital; 2001.
Reference Books:	
1.	Indian Knowledge Systems by Kapil Kapoor and Awadhesh Kumar Singh; D. K. Printworld; 2005.
2.	Introduction to Indian Knowledge Systems: Concepts and Applications by B. Mahadevan, Vinayak Rajat Bhat and Nagendra Pavana R. N.; PHI Learning; 2022.
3.	Indian Knowledge Systems by Dilipkumar A. Ode et al.; Redshine Publication; 2024
4.	Indian Knowledge Systems (IKS): A Family and Community Sciences Perspective by Uma Iyer et al.; Kaav Publications; 2023
5.	Traditional Knowledge Systems in India: Sustainability, Ecology and Resource Governance, edited by Ranbir Chander Sobti, Sudarshan Verma and Vipin Sobti; Springer; 2026.
Webresources:	
1.	ABSS_Report_Session_15.pdf
2.	Indian Knowledge Systems (IKS)
3.	srcc.edu/sites/default/files/IKS JAN 2023.pdf

Mapping with Programme Outcomes and Programme Specific Outcomes

	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	3	3
CO3	3	2	2	2	3	3	3	2	3	3	3
CO4	3	3	3	3	3	3	3	3	3	3	3
CO5	3	3	3	3	3	3	3	3	3	3	3
Total	15	14	14	14	14	15	15	14	15	15	15
Average	**3.0**	**2.8**	**2.8**	**2.8**	**2.8**	**3.0**	**3.0**	**2.8**	**3.0**	**3.0**	**3.0**

3 – Strong, 2- Medium, 1- Low

3rd YEAR: SIXTH SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24UCHC61	**ORGANIC CHEMISTRY – II**	**Core**	**4**	**1**	**0**	**0**	**4**	**5**	**25**	**75**	**100**

Learning Objectives	
Student able to	
LO1	To classify alkaloids and terpenes, and analyze their methods of isolation along with their chemical and physical properties.
LO2	To explain the preparation methods of saccharides and evaluate their structural and functional properties.
LO3	To describe and interpret the industrial manufacture of key biomolecules with relevant chemical processes.
LO4	To compare and differentiate various molecular rearrangements based on mechanism and reaction conditions.
LO5	To demonstrate the preparation of organometallic compounds and analyze their properties and applications.

Unit	Content	Hours
1	**Alkaloids** Classification, isolation, general properties- Hofmann Exhaustive Methylation; Structure elucidation – Coniine, piperine, nicotine. **Terpenes:** Classification, Isoprene rule, isolation and structural elucidation of Citral, Geraniol.	15
2	**Carbohydrates** Definition and Classification of Carbohydrates with examples. Relative configuration of sugars.Definition of enantiomers, diastereomers, epimers and anomers with suitable examples. **Monosaccharides**– configuration – D and L hexoses – aldohexoses and ketohexoses.Glucose, Fructose – Occurrence, preparation, properties, reactions, structural elucidation, uses. Interconversions of sugar series –aldose to ketose and ketose to aldose. **Disaccharides** – sucrose - preparation, properties and uses (no structural elucidation). **Polysaccharides** – Source, constituents and biological importance of Homo polysaccharides- starch, hetero polysaccharides – hyaluronic acid, heparin.	15
3	**Molecular rearrangements:** Molecular Rearrangement: Type of rearrangements, Mechanism for Benzidine, Favorskii, Clasien, Fries, Hofmann, Curtius, Schmidt and Beckmann, Pinacol-Pinacolone Rearrangement	15

4	**Special reagents in organic synthesis** AIBN, 9BBN, BINAP/BINOL, BOC, DABCO, DCC, DIBAL. **Organometallic compounds in Organic Synthesis** Preparation, Properties and applications. Grignard Reagents, Organo Lithium Compounds, Wilkinson, Metal Carbonyl, Zeiss's Salt	15
5	**Green Chemistry:** Principles, chemistry behind each principle and applications in chemical synthesis. Green reaction media – green solvents, green reagents and catalysts; tools used like microwave and ultra-sound in chemical synthesis.	15

CO	**Course Outcomes** Students will be able to
CO1	To explain isolation and properties of alkaloids and terpenes.
CO2	To describe preparation and reactions of mono and disaccharides.
CO3	To classify biomolecules and natural products based on their structure, properties, reactions and uses.
CO4	To evaluate molecular rearrangements like benzidine, Hoffmann etc.,
CO5	To preparation and properties of organolithium compounds.

Textbooks:

1. M.K.Jain, S. C.Sharma, Modern Organic Chemistry, Vishal Publishing, 4th reprint, 2009.
2. S.M. Mukherji, and S.P. Singh, Reaction Mechanism in Organic Chemistry, Macmillan India Ltd., 3rd ed., 2009.
3. Arun Bahl and B.S. Bahl, Advanced organic chemistry, New Delhi, S. Chand & Company Pvt. Ltd., Multicolour ed., 2012.
4. P. L.Soni and H. M. Chawla, Text Book of Organic Chemistry, Sultan Chand & Sons, New Delhi, 29th ed., 2007.
5. C Bandyopadhyay; An Insight into Green Chemistry; Published on 2020.

Reference Books:

1. R. T. Morrison and R. N. Boyd, Organic Chemistry, Pearson Education, Asia, 6th ed., 2012.
2. T.W.Graham Solomons, Organic Chemistry, John Wiley & Sons, 11th ed., 2012.
3. A. Carey Francis, Organic Chemistry, Tata McGraw-Hill Education Pvt. Ltd., New Delhi,7th ed.,2009.
4. I. L. Finar, Organic Chemistry, Vol. (1& 2), England, Wesley Longman Ltd, 6th ed., 2006.
5. J. A. Joule, and G. F. Smith, Heterocyclic Chemistry, Wiley, 5th ed., 2010.

Web resources:

1. www.epgpathshala.nic.in
2. www.nptel.ac.in
3. http:/swayam.gov.in

Mapping with Programme Outcomes and Programme Specific Outcomes

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

3 – Strong, 2- Medium, 1- Low

3rd YEAR: SIXTH SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24UCHC62	**INORGANIC CHEMISTRY -II**	**Core**	**4**	**1**	**0**	**0**	**3**	**5**	**25**	**75**	**100**

Learning Objectives	
Student able to	
LO1	To explain the concept of trace elements and analyze their roles in biological systems and radio active elements.
LO2	To describe the mechanisms of iron transport and evaluate its storage in biological systems.
LO3	To classify metalloenzymes and explain their role in oxygen transport and related biochemical functions.
LO4	To summarize the structure of silicates and illustrate their practical applications.
LO5	To discuss the industrial applications of refractories, alloys, paints, and pigments, and analyze their functional significance.

Unit	Content	Hours
1	**Bioinorganic Chemistry** Essential and trace elements: Role of Na+, K+, Mg2+, Ca2+, Fe3+, Cu2+ and Zn2+ in biological systems. Effect of excess intake (Toxicity) of Metal ions – trace elements - As, Cd, Pb, Hg. **Nuclear Chemistry** Radioactivity, Nuclear fusion and Nuclear fission, half life period, binding energy, mass defect N/Z ratio for stability, Radioactive decay types (α,β,γ) carbon dating, Applications of radioactive elements and its Units Curie, Becquerel.	15
2	**Metal ion transport and storage** Iron – storage, transport - Transferrin and Ferretin; Iron-porphyrins – myoglobin, haemoglobin – oxygen transport - Bohr effect; Sodium/potassium pump, calcium pump; transport and storage - copper and zinc.	15
3	**Metallo enzymes** Isomerase and synthetases, structure of cyanocobalamin (Vitamin B12), nature of Co-C bond; Metalloenzymes - functions of carboxy peptidase A, zinc metalloenzyme – mechanism and uses, Zn-Cu enzyme - structure and function, carbonic anhydrase, Vitamin B-12 as transferase and isomerase - Iron-sulphur proteins - 2Fe-2S – rubredoxin, 4Fe-2S – ferridoxin, Iron sulphur cluster enzymes. Invivo and Invitro nitrogen fixation – biological functions of nitrogenase and molybdo enzymes.	15
4	**Silicates** Introduction – general properties of silicates, structure – types of silicates – ortho silicates(zircon), pyrosilicates (thortveitite), chain	15

	silicates(pyroxenes), ring silicates(beryl), sheet silicates (talc, mica, asbestos), silicates having three dimensional structure (feldspars, zeolites, ultramarines).	
5	**Industrial Applications of Inorganic Compounds** Refractories, pyrochemical, explosives. Alloys, Paints and pigments - requirements of a good paint; classification, constituents of paints – pigments, vehicles, thinners, driers, extenders, anti-knocking agents, antiskinning agents, plasticizers, binders-application; varnishes- oils, spirit; enamels. Nanocomposite Hydrogels: synthesis, characterization and uses. Industrial visits and internship mandatory.	15

CO	**Course Outcomes** Students will be able to
CO1	Ability to explain the importance of tracer elements on biological system also in radioactive elements.
CO2	Explain the metal ion transport, Bohr effect, Na, K, Ca pump
CO3	Illustrate the function of Vitamin B12, Zn-Cu enzyme, ferredoxin, cluster enzymes.
CO4	Classify silicates and analyze their structural characteristics and bonding.
CO5	Explain the manufacture of refractories, explosives, paints and pigments
Textbooks:	
1.	Madan R D, Sathya Prakash, (2003), Modern Inorganic Chemistry, 2nd ed., S.Chand and Company, New Delhi.
2.	Gopalan R, (2009) Inorganic Chemistry for Undergraduates, 1st ed., University Press (India) Private Limited, Hyderabad
3.	Sivasankar B, (2013) Inorganic Chemistry. 1st ed., Pearson, Chennai
4.	Alan G. Sharp (1992), Inorganic Chemistry, 3rd ed., Addition- Wesley, England
5.	Peter Atkins, Tina Overton, Jonathan Rourke and Mark Weller, Inorganic Chemistry, Oxford University Press, 6th ed., 2014.
Reference Books:	
1.	G.R.Choppin,J Rydberg, J.O.Liljeinzin Radiochemistry and Nuclear Chemistry 4th Edition 2013
2.	J.D.Lee Concise Inorganic Chemistry 5th Edition 2022
3.	James E.Huheey,Ellen A.Keiter,Richard L.Kieter Inorganic Chemistry: Principles of Structure and Reactivity 4th Edition 2021
4.	R.D.Madan Modern Inorganic Chemistry Revised Edition 2023
5.	Puri Sharma, Kalia Principles of Inorganic Chemistry 35th Edition 2024
Web resources:	
1.	https://www.britannica.com/science/trace-element
2.	https://www.prochinitalia.com/en/silicates/?utm_source=chatgpt.com
3.	https://www.geeksforgeeks.org/uses-of-alloys/?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	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	15	15	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

3rd YEAR: SIXTH SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24UCHE61	**PHYSICAL CHEMISTRY-II**	**Elective**	**4**	**1**	**0**	**0**	**4**	**5**	**25**	**75**	**100**

Learning Objectives

Student able to

LO1	To apply the Phase Rule to interpret phase diagrams and analyze equilibrium behavior in one- and two-component systems.
LO2	To analyze thermodynamic principles to predict and interpret chemical equilibrium in homogeneous and heterogeneous systems.
LO3	To evaluate principles of conductance and ionic transport to determine key physicochemical parameters of electrolyte solutions using experimental and theoretical methods.
LO4	To demonstrate electrochemical principles and EMF concepts to analyze reactions, perform measurements, and solve practical problems in energy systems and corrosion science.
LO5	To assess electrochemical principles to determine solution properties, perform potentiometric measurements, and evaluate industrial applications and corrosion control.

Unit	Content	Hours
1	**Phase rule** Definition of terms; derivation of phase rule ; application to one component systems – water and sulphur - super cooling, sublimation ; two component systems – solid liquid equilibria- simple eutectic (lead - silver and bismuth - cadmium), freezing mixtures (potassium iodide- water), compound formation with- congruent melting points (magnesium – zinc and ferric chloride – water system), peritectic. change (sodium – potassium), solid solution (gold-silver); copper sulphate – water system.	15
2	**Chemical equilibrium** Law of mass action – thermodynamic derivation – relationship between Kp and Kc –application to the homogeneous equilibria – dissociation of PCl5 gas,N2O4 gas –equilibrium constant and degree of dissociation - formation of HI, NH3 ,and SO3 –heterogeneous equilibrium – decomposition of solid calcium carbonate –Lechatelier principle – van't Hoff reaction isotherm – temperature dependence of equilibrium constant – van't Hoff reaction isochore – Clayperon equation – Clausius Clayperon equation and its applications.	15

3	**Binary liquid mixtures** Ideal liquid mixtures – non-ideal solutions – azeotropic mixtures – fractional distillation – partially miscible mixtures – phenol-water, triethylamine-water, nicotine-water – effect of impurities on critical solution temperature; immiscible liquids- steam distillation; Nernst distribution law – applications.	15`
4	**Electrical Conductance and Transference** Arrhenius theory of electrolytic dissociation – Ostwald's dilution law, limitations of Arrhenius theory; behavior of strong electrolytes – interionic effects – Debye Huckel theory –Onsager equation (no derivation), significance of Onsager equation, Wien effect. Ionic mobility – Discharge of ions on electrolysis (Hittorf's theoretical device), transport number – determination – Hittorf's method, moving boundary method – factors affecting transport number – determination of ionic mobility; Kohlrausch's law- applications; molar ionic conductance and viscosity (Walden's rule)	15
5	**Galvanic Cells and Applications** Electrochemical cell, Galvanic cell, representation, reversible and irreversible cells, EMF and its measurement – standard cell; relationship between electrical energy and chemical energy; sign of EMF and spontaneity of a reaction, thermodynamics and EMF – calculation of G, H, and S from EMF data; Nernst equation for electrode potential and cell EMF; Industrial component Galvanic cells- lead storage, Ni-Cd, Li and Zn-air, Al-air batteries Fuel cells – H2-O2 cell – efficiency of fuel cells. corrosion – mechanism, types and methods of prevention.	15

CO	**Course Outcomes** Students will be able to
CO1	Apply the Phase Rule to interpret and predict phase equilibria in single and multi-component systems for chemical and industrial applications.
CO2	Analyze chemical equilibria using thermodynamic principles to predict system behavior under varying physical and chemical conditions.
CO3	Evaluate electrolyte behavior by quantifying ionic transport and conductance and applying electrochemical principles to solve analytical problems.
CO4	Demonstrate conductometric methods to determine physicochemical parameters through the study of electrolyte behavior and ionic transport.
CO5	Assess electrochemical cells by applying thermodynamic principles to EMF and performing measurements for analytical, industrial, and corrosion-related applications.
Text books:	
1	B.R. Puri and L.R. Sharma, Principles of Physical Chemistry, Shoban Lal Nagin Chand and Co., 48th ed., 2021.
2	Peter Atkins, and Julio de Paula, James Keeler, Physical Chemistry, Oxford University press, International 11th ed., 2018.
3	Arun Bahl, B.S. Bahl, G. D. Tuli Essentials of physical chemistry, 28th ed., 2019, S. Chand & Co.

4	S. K. Dogra and S. Dogra, Physical Chemistry through Problems: New Age International, 4th ed., 1996.
5	J. Rajaram and J.C. Kuriacose, Thermodynamics, ShobanLal Nagin Chand and CO., 1986.
Reference Books:	
1	J. Rajaram and J.C. Kuriacose, Chemical Thermodynamics, Pearson, 1st ed., 2013.
2	Keith J. Laidler, Chemical kinetics, 3rd ed., Pearson, 2003.
3	P. W. Atkins, and Julio de Paula, Physical Chemistry, Oxford University press, 7th ed., 2002.
4	K. L. Kapoor, A Textbook of Physical Chemistry, Macmillan India Ltd, 3rd ed., 2009.
5	B.R. Puri, L.R. Sharma and M.S. Pathania, Principles of Physical Chemistry, Shobanlal Nagin Chand and Co. Jalendhar, 41st ed., 2001.
Web resources:	
1	https://nptel.ac.in
2	https://swayam.gov.in
3	www.epgpathshala.nic.in

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	2	3	3	3	3	3	3	3	3	3	3
CO3	3	3	3	3	3	3	3	3	3	3	3
CO4	3	2	3	3	3	3	3	3	3	3	3
CO5	3	3	3	3	3	3	3	3	3	3	3
Total	14	14	15	15	15	15	15	15	15	15	15
Average	2.8	2.8	3	3	3	3	3	3	3	3	3

3 – Strong, 2- Medium, 1- Low

3rd YEAR: SIXTH SEMESTER

Course Code	Course name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24UCHE62	**PHARMACEUTICAL CHEMISTRY**	**Elective**	**4**	**1**	**0**	**0**	**4**	**5**	**25**	**75**	**100**

Learning Objectives	
Student able to	
LO1	To understand the drug design and drug metabolism.
LO2	To familiarize the important Indian medicinal plants, common diseases and antibiotics.
LO3	To discuss the drugs for major diseases like cancer, diabetes and AIDS.
LO4	To compare the applications of analgesics and antipyretic agents.
LO5	To highlight the significance of clinical tests.

Unit	Content	Hours
1	**Introduction:** Important terminologies – drug, pharmacognosy, pharmacy, pharmacology, pharmacodynamics, pharmacokinetics, clinical pharmacology, pharmacotherapeutics, chemotherapy, toxicology, pharmacophore, antimetabolites, mutation, bacteria, virus, fungi, actinomycetes, vaccines, pharmacopeia, posology and therapeutic index. Sources of drugs – dosage forms – bio availability – routes of administration – absorption, distribution and elimination of drugs – drug metabolism – prescription terms **Development of Drugs:** classic steps – lead compounds – comparison of traditional and modern methods of development of drugs – drug design by method of variation – disjunction methods.	15
2	**Indian Medicinal Plants:** Introduction to Medicinal Plants –Definition and scope of medicinal plants, Importance in traditional and modern medicine– uses, Systems of medicine in India- Ayurveda, Siddha, Unani. Active Constituents of Medicinal Plants, Types of phyto constituents - Alkaloids, Terpenoids, Essential oils. **Therapeutic Uses of Medicinal Plants** - Antimicrobial, Anti-inflammatory, Antidiabetic, Anticancer	15
3	**Drugs for major diseases:** Cancer – common causes – chemotherapy – anti neoplastic agents – classification – adverse effects of cytotoxic agents; alkylating agents – chlorambucil; anti metabolites – methotrexate, fluouracil;. Diabetes – types – management of diabetes – insulin; Cardiovascular drugs – cardio glycosides; anti arrhythmic agents – quinidine, propranolol hydrochloride; anti hypertensive drugs – aldomet, pentoliniumtartarate;. AIDS – causes, symptoms and prevention – anti HIV drugs – AZT. DDC.	15`
4	**Analgesis and antipyretic agents:** Classification – action of analgesics	15

	– narcotic analgesics – morphine; synthetic analgesics – pethidine, methadone; **antipyretic** analgesics – salicylic acid derivatives, indolyl derivatives, p-aminophenol derivatives.	
5	**Anaesthetics** - Definition, characteristics, classification – general anaesthetics – volatile anaesthetics – nitrous oxide, ethers, cyclopropane, chloroform halothane, trichloro ethylene – storage, advantages and disadvantages; non-volatile anaesthetics – thiopental sodium; local anaesthetics – requisites – advantages – esters – cocaine, benocaine; amides– lignocaine, cinchocaine.	15

CO	**Course Outcomes** **Students will be able to**
CO1	Define pharmaceutical terminologies and identify types of IPR and trademarks.
CO2	Discuss drug development, structure–activity relationships, disease types, and factors influencing patentability.
CO3	Apply principles of drug design, hematological functions, and clinical parameter estimation for therapeutic use.
CO4	Explain the classification of analgesics and anesthetics and the physiological functions of plasma proteins.
CO5	Evaluate the significance of clinical tests such as blood urea, serum proteins, and coronary risk index.
Textbooks:	
1.	Jayashree Ghose, (1999), A text book of pharmaceutical chemistry, 2nd ed., S. Chand & company, New Delhi.
2.	Lakshmi S, (2004), Pharmaceutical chemistry, 3rd ed., Sultan chand & sons, Delhi.
3.	Tripathi K D, (2018), Essentials of medical pharmacology, 8th ed., Jaypee brothers medical publishers (P) Limited, New Delhi.
4.	Ashutosh Kar, (2018), Medicinal chemistry. 7th ed., New age international (P) Limited, Publishers, New Delhi.
5.	Srilakshmi, B. Food Science, 4th ed.; New Age International Publication, 2005.
Reference Books:	
1.	Jain, P.C.; Jain, M. Engineering Chemistry, 16th ed.; Dhanapet Rai: Delhi, 1992.
2.	Chatwal G R, (2013), Pharmaceutical chemistry, Inorganic (vol-I) 6th ed., Himalaya publishing house Bombay.
3.	Chatwal G R, (1999), Pharmaceutical chemistry, Organic (vol-II), Himalaya publishing house Bombay.
4.	Patrick G, (2002). Instant Notes Medicinal Chemistry, Viva Books Private Limited, New Delhi.
5.	Intellectual Property Rights, Neeraj Pandey, Khushdeep Dharni, Publisher, PHI Learning Pvt, Ltd., 2014
Web resources:	
1.	pubchem.ncbi.nlm.nih.gov
2.	www.chemspider.com
3.	www.ebi.ac.uk/chembl
4.	www.nptel.ac.in

Mapping with Programme Outcomes and Programme Specific Outcomes

	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	3	3	3	3	3	3	3
CO3	3	3	3	3	3	3	3	3	3	3	3
CO4	3	3	3	3	3	3	3	3	3	3	3
CO5	3	3	3	3	3	3	3	3	3	3	3
Total	15	15	15	15	15	15	15	15	15	15	15
Average	**3.0**	**3.0**	**3.0**	**3.0**	**3.0**	**3.0**	**3.0**	**3.0**	**3.0**	**3.0**	**3.0**

3 – Strong, 2- Medium, 1- Low

3rd YEAR: SIXTH SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24UCHE63	**NANO SCIENCE**	**Elective**	**4**	**1**	**0**	**0**	**4**	**5**	**25**	**75**	**100**

Learning Objectives

Student able to

LO1	To apply suitable synthesis and stabilization techniques to prepare nanomaterials with controlled size and surface characteristics.
LO2	To analyze size-dependent optical and electronic properties of metal and semiconductor nanomaterials
LO3	To explain the principles of UV–Visible spectroscopy, photoelectron spectroscopy, SEM, TEM, characterization.
LO4	To evaluate synthesis methods for semiconductor nanoparticles and their functional applications
LO5	To assess the use of nanomaterials in biomedical, environmental, agricultural, and electronic applications.

Unit	Content	Hours
1	**Introduction to nanoscience** Definition– nanoscience, nanoparticles, clusters, quantum dots, nanostructures and nanocomposites. Electron behaviour in free space, bulk material and nanomaterials. Synthesis and stabilization of nanomaterials	15
2	**Properties of materials on a nanoscale** Optical properties of metal and semiconductor nanomaterials properties, electronic properties. Chemical properties- chemical process on the surface of nanoparticles, catalysis, mechanical properties.	15
3	**Techniques employed for characterisation of nanomaterials** Spectroscopy – UV-visible, Photoelectron spectroscopy – Electron microscopy – Scanning Electron Microscopy (SEM), Transmission Electron Microscopy (TEM), Optical microscopy – confocal microscopy, X-ray diffraction (XRD) [Principle and Block diagram only].	15
4	**Special nanomaterials** Carbon Nano Structures Carbon nanotubes: Introduction – types Carbon based materials: Preparation and Characterization Fullerene, Graphene, properties. Semiconductor nanoparticles: synthesis – applications.	15
5	**Application of nanomaterials** Biomedical Applications – drug, biolabelling, artificial implants, cancer	15

	treatment. Sensors – Natural nanoscale sensors, chemical sensors, biosensors. Optics & Electronics – Nanomaterials in computer technology, HD TV , flat panel displays. Nanotechnology in agriculture nanomaterials for water purification, nanomaterials in food and packaging materials, fabric industry. Impacts of Nanotechnology in Various fields	

CO	Course Outcomes **Students will be able to**
CO1	Define and differentiate nanoscience, nanoparticles, clusters, quantum dots, nanostructures, and nanocomposites.
CO2	Analyze and correlate the optical, electronic, chemical, catalytic, and mechanical properties of nanomaterials with size-dependent and surface effects.
CO3	Explain the working principles and illustrate block diagrams of nanomaterial characterization techniques.
CO4	Classify carbon nanostructures, including carbon nanotubes, fullerenes, and graphene, and compare their structural, electronic, and mechanical properties.
CO5	Apply nanomaterials in biomedical, agricultural, environmental, sensor, electronic, and industrial domains by selecting appropriate materials based on functional requirements.
Textbooks:	
1.	Kulkarni, S.K., Nanotechnology: Principles and Practices, Capital Publishing Co., New Delhi.
2.	Pradeep, T., Nano: The Essentials – Understanding Nanoscience and Nanotechnology, Tata McGraw-Hill Publishing Company Limited, New Delhi, 2007.
3.	Shah, M.A. and Ahmad, T., Principles of Nanoscience and Nanotechnology, Narosa Publishing House, New Delhi, 2010.
4.	Murthy, B.S., Shankar, P., Raj, B., Rath, B.B. and Murday, J., Textbook of Nanoscience and Nanotechnology, Universities Press (India) Ltd., Hyderabad, 2012.
Reference Books:	
1	Sharma, P.K., Understanding Nanotechnology, Vista International Publishing House, Delhi, 2008.
2	Poole, C.P. Jr. and Owens, F.J., Introduction to Nanotechnology, John Wiley & Sons, Inc., 2003.
3	Viswanathan, B., Nano Materials, Narosa Publishing House, New Delhi, 2009.
4	Rao, C.N.R., Müller, A. and Cheetham, A.K. (eds.), Nanomaterials Chemistry: Recent Developments and New Directions, Wiley.
5	Zhang, J.Z., Optical Properties and Spectroscopy of Nanomaterials, World Scientific Publishing Pvt. Ltd., Singapore.
Web resources:	
1.	http://www.nanotechnology.com/docs/wtd015798.pdf
2.	http://nccr.iitm.ac.in/Nanomaterials.pdf

Mapping with Programme Outcomes and Programme Specific Outcomes

	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	3	3
CO3	3	3	3	3	3	3	3	3	3	3	3
CO4	3	3	3	3	3	3	3	3	3	3	3
CO5	3	3	3	3	3	3	3	3	3	3	3
Total	15	15	15	15	14	15	15	15	15	15	15
Average	**3.0**	**3.0**	**3.0**	**3.0**	**2.8**	**3.0**	**3.0**	**3.0**	**3.0**	**3.0**	**3.0**

3 – Strong, 2- Medium, 1- Low

3rd YEAR: SIXTH SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24UCHE64	**TEXTILE CHEMISTRY**	**Elective**	**4**	**1**	**0**	**0**	**4**	**5**	**25**	**75**	**100**

Learning Objectives

Student able to

LO1	Categorize fibres into natural cellulosic, protein, and synthetic types with examples like cotton, wool, polyester
LO2	Relate structure to property: Link chemical structure of cotton and jute to their strength, moisture absorption, and dye affinity
LO3	compare Count, Denier, Tex, and Staple Length for given fibre samples
LO4	Predict spinning properties of a fibre based on its elasticity, length, and fineness
LO5	Choose appropriate natural cellulose fibres for specific end uses like apparel vs technical textiles

Unit	Content	Hours
1	**General Classification of Fibres** - Chemical structure - Production - Properties - Count, Denier, Tex, Staple Length, Spinning Properties, Strength, Elasticity and Creep - Applications of the following Natural Cellulose Fibres (Cotton and Jute) - Natural Protein Fibres (Wool and Silk) - General characteristics.	15
2	**Chemical Structure, Production and properties of the following Synthetic Fibres** - Man- made Cellulose Fibres (Rayon and Modified cellulose fibres) - Polyamide Fibres (Different types of Nylons) - Preparation - Nylon degradation Polyester Fibres Preparation Degradation Polyacrylonitrile fibre - Preparation and Properties - Viscose fibre - Preparation and Properties - Identification tests for Cellulose, Cotton, Wool, Silk, Rayon, Acrylic, Viscose, Polyamide and Polyester Fibres.	15
3	**Impurities in Raw Cotton and Grey Cloth, Wool and Silk** - General principles of the Removal, Scouring - Purpose, Alkali Scouring and Acid Scouring - Bleaching (Methods - Hypochlorite, Peroxide and Bleaching Powder) - Desizing (Hydrolytic and Enzymatic), Kier Boiling and Chemicking - Dyeing of Polyester and Blends - Functions of Dispersing agents - Fibre swelling - Carrier dyeing - High temperature dyeing - Selection of dyestuff.	15
4	**Colour and Constitution** - A general treatment - Chromophores - Auxochromes - Bathochromes and Hypsochromes - Classification of dyes - Acidic, Basic, Direct, Mordant, Azoic, Ingrain, Vat and Reactive Dyes - Classification as per Chemical constitution - Azo dyes -	15

	Triphenyl Methane Dyes, Phthalein Dyes, Indigo and Anthraquinone Dyes - Structure, Preparation and Uses - Methyl Orange, Phenolphthalein and Malachite Green.	
5	**Dyeing - Dyeing of Wool and Silk** - Fastness properties of dyed materials - Dyeing of Nylon, Terylene and other Synthetic Fibres - Finishing - Finishes given to Fabrics - Mechanical finishes on Cotton, Wool and Silk - Method used in process of Mercerizing - Anticrease and Antishrink finishes - Water Proofing.	15

CO	**Course Outcomes** **Students will be able to**
CO1	Explain the chemical structure and properties of various textile fibres.
CO2	Differentiate natural and synthetic fibres using suitable fibre identification tests.
CO3	Describe the pre-treatment processes such as scouring and bleaching employed in textile industries.
CO4	Classify different types of dyes and explain the principles of dyeing used in textile processing.
CO5	**Discuss** the methods and industrial significance of the mercerizing process in textile industries.
Textbooks:	
1.	R. R. Mather, R. H. Wardman, *The Chemistry of Textile Fibres*, Royal Society of Chemistry Publishing, Cambridge, 2015.
2.	T. Bechtold, T. Pham, *Textile Chemistry*, De Gruyter Publishing, Berlin, 2019.
3.	A. K. Roy Choudhury, *Textile Chemistry: Theory, Processing and Manufacturing*, CRC Press, Taylor & Francis Group, Boca Raton, 2020.
4.	J. T. Marsh, *An Introduction to Textile Chemistry*, Chapman and Hall Ltd., London, 1948.
Reference Books:	
1.	E. R. Trotman, *Dyeing and Chemical Technology of Textile Fibres*, Charles Griffin & Company Ltd., London, 6th Edition, 2008.
2.	Menachem Lewin, Eli M. Pearce, *Handbook of Fibre Chemistry*, CRC Press, 3rd Edition, 2006.
3.	Arthur D. Broadbent, *Basic Principles of Textile Coloration*, Society of Dyers and Colourists, Bradford, 2001.
4.	V. A. Shenai, *Technology of Textile Processing*, Sevak Publications, Mumbai, Volumes I–VIII, 1990.
Web resources:	
1.	**https://www.lib.ncsu.edu/disciplines/textile-chemistry?utm_source**
2.	https://www.lib.ncsu.edu/disciplines/textile-chemistry
3.	https://www.lib.ncsu.edu/databases/textile-technology-index

Mapping with Programme Outcomes and Programme Specific Outcomes

	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	3	3	3	3	3	3	3
CO3	3	2	3	3	3	3	3	3	3	3	3
CO4	3	3	2	3	3	3	3	3	3	3	3
CO5	3	3	3	3	3	3	3	3	3	3	3
Total	15	14	14	15	15	15	15	15	15	15	15
Average	**3.0**	**2.8**	**2.8**	**3.0**	**3.0**	**3.0**	**3.0**	**3.0**	**3.0**	**3.0**	**3.0**

3 – Strong, 2- Medium, 1- Low

3rd YEAR: SIXTH SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24UCHP61	Quality Control and Assurance in Chemical Industries	PEC	1	1	0	0	2	2	25	75	100

Learning objectives	
LO1	To explain the principles of Total Quality Management and industrial quality systems.
LO2	To understand sampling, calibration, and standardization procedures in laboratories
LO3	To develop knowledge of inspection procedures and process validation methods.
LO4	To explain ISO, BIS, and other regulatory standards followed in chemical industries.
LO5	To study the applications of quality assurance practices in various chemical industries

Unit	Content	Hours
1	**Unit I – Fundamentals of Quality Control and Quality Assurance** Concepts of quality, quality control (QC), and quality assurance (QA). Importance of quality in chemical industries. Principles of Total Quality Management (TQM). Role of QC laboratories in industrial production. Introduction to quality standards and certification systems	6
2	**Unit II – Analytical Techniques and Laboratory Practices** Basic analytical methods used in quality testing of chemicals and industrial products. Sampling techniques, calibration of instruments, and standardization procedures. Good Laboratory Practices (GLP) and laboratory safety measures. Errors in analysis and methods of quality evaluation.	6
3	**Unit III – Process Control and Industrial Quality Monitoring** Quality monitoring during chemical manufacturing processes. Process variables and process optimization techniques. Statistical quality control methods and control charts. Inspection procedures and maintenance of quality records in industries. Introduction to process validation.	6
4	**Unit IV – Documentation, Regulatory Standards, and Certification** Documentation practices in chemical industries. Standard Operating Procedures (SOPs), audit systems, and quality manuals. ISO standards, BIS standards, and industrial regulatory guidelines. Environmental and safety regulations related to chemical industries. Importance of compliance and certification.	6
5	**Unit V – Industrial Applications and Quality Assurance Systems** Applications of quality assurance in pharmaceutical, polymer, food, textile, and petrochemical industries. Product testing and quality evaluation methods. Customer satisfaction and continuous quality improvement techniques. Case studies related to industrial quality failures and corrective actions. Career opportunities in quality control and assurance sectors.	6

CO	Course Outcomes Students will be able to
CO1	Explain the fundamental concepts of quality control, quality assurance, Total Quality Management, and quality standards.
CO2	Apply analytical techniques, sampling methods, calibration procedures, and Good Laboratory Practices.
CO3	Demonstrate knowledge of industrial process control, statistical quality control methods, and quality monitoring techniques.
CO4	Interpret documentation systems, Standard Operating Procedures, ISO standards, BIS regulations.
CO5	Analyze quality assurance applications in various chemical industries and evaluate industrial quality systems.
Textbooks:	
1.	Piotr Konieczka, Quality Assurance and Quality Control in the Analytical Chemical Laboratory: A Practical Approach, 3rd Edition, 2025.
2.	Minal Ghante, Manohar Potdar, Vidhya Bhusari, Modern Aspects of Pharmaceutical Quality Assurance, 1st Edition, 2024.
3.	Bernd W. Wenclawiak, Michael Koch, Evsovios Hadjicostas, Quality Assurance in Analytical Chemistry: Training and Teaching, Reprint Edition, 2013.
4.	Philip Carson, Nigel Dent, Good Clinical, Laboratory and Manufacturing Practices: Techniques for the QA Professional, 2007.
Reference Books:	
1.	Alastair J. Gilchrist, Making Quality Cosmetics: Good Manufacturing Practice and ISO 22716:2007, 2022.
2.	A. Singh ,Quality Control and Regulatory Affairs for Biopharmaceuticals 2024.
3.	Dale H. Besterfield, Total Quality Management, Revised Edition, 2018.
4.	David L. Goetsch and Stanley Davis, Quality Management for Organizational Excellence, 9th Edition, 2021.
Web resources:	
1.	Chemical Quality Assurance PDF Book
2.	Quality Assurance and Quality Control for Biopharmaceutical Products | Springer Nature Link
3.	ISO - International Organization for Standardization
4.	NABL India

Mapping with Programme Outcomes and Programme Specific Outcomes

	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	3	3
CO3	3	2	3	3	3	3	3	3	3	3	3
CO4	3	3	3	3	3	3	3	3	3	3	3
CO5	3	3	3	3	3	3	3	3	3	3	3
Total	15	14	15	15	14	15	15	15	15	15	15
Average	**3.0**	**2.8**	**3.0**	**3.0**	**2.8**	**3.0**	**3.0**	**3.0**	**3.0**	**3.0**	**3.0**

3 – Strong, 2- Medium, 1- Low

3rd YEAR: SIXTH SEMESTER

Course Code	Course name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24UCHL61	**POLYMER CHEMISTRY**	**Elective**	**0**	**0**	**0**	**3**	**2**	**3**	**25**	**75**	**100**

Learning objectives	
LO1	To discuss the classification of polymers, preparation of polymers.
LO2	To familiarize the kinetics of polymerization and characterization of polymers.
LO3	To discuss the analytical techniques used to characterize polymers.
LO4	To learn the reactions of polymers.
LO5	To highlight the specialty of polymers like PVC, PMMA.

Unit	Content	Hours
1	**Introduction:** Difference between polymer and macromolecule – classification – synthetic and natural, organic and inorganic, thermoplastic and thermosetting. Plastics, elastomers, fibres and liquid resings. Techniques of polymerization: Bulk, solution, emulsion and suspension polymerization.	9
2	**Kinetics of Polymerization:** Kinetics of condensation and addition polymerization; ionic, free radical, copolymerization and coordination polymerization – reactivity ratios – block and graft copolymers. Characterization of polymers; Appearance, feel and hardness, density, effect of heat, solubility, combustion, tensile strength, shear, stress, impact strength, mechanical thermo mechanical and rheological properties of polymers in viscoelastic state.	9
3	**Molecular weight and properties of polymers:** Molecular weight of polymers – Number Average and Weight Average, molecular weight distribution, determination of molecular weight. Thermal properties of polymers – glass transition temperature – state of aggregation and state of phase transitions, factors influencing glass transition temperature, importance of glass transition temperature, heat distortion temperature, TGA/DTA, crystallinity of polymers: crystalline behavior, degree of crystallinity.	9
4	**Reactions:** Reactions of polymers – hydrolysis, acidolysis, aminolysis, addition and substitution reaction (one example each). Polymer technology: Processing of polymers – casting, thermoforming, moulding – extrusion, compression, blow moulding – foaming, lamination, reinforcing – processing of fibres – melt, wet and dry spinning.	9
5	**Speciality of polymers:** Polyelectrolytes, conducting polymers, polymeric supports for solid phase synthesis, biomedical polymers, liquid crystalline polymers, electroluminescent polymers – two examples of each of these polymers. Polyethylene, PVC, PMMA, polyester, rubber-synthetic and natural. Polymer degradation: Types of degradation – thermal, mechanical, ultra sound, photo radiation and chemical degradation methods. Rubber-natural and synthetic-structure, mechanism of vulcanization. Biodegradable and non-biodegradable polymers.	9

CO	Course Outcomes Students will be able to
CO1	To summarize the properties of fuels which include petroleum, water gas, natural gas and propellants
CO2	To evaluate the cosmetic products, soaps, detergents..
CO3	To study different manufacture of sugar, food spoilages and food additives
CO4	To discuss the properties of abrasives, manufacture of leather and paper
CO5	To explain properties and manufacture of lubricants and cement, and intellectual property rights
Textbooks:	
1.	Gedde U.W., Hedenqvist M.S., Johansson M., Berglund L., Wohlert J., (2025), Fundamental Polymer Science, 3rd ed., Springer, Cham.
2.	Rudin A., Choi P., (2025), The Elements of Polymer Science and Engineering, 4th ed., Elsevier, USA.
3.	Sharma S., Bhende M.S., Patil S., Verma H.R., (2026), Advanced Polymer Science: Building Fundamentals to Understand Real-World Applications, 1st ed., CRC Press, USA.
4.	Elements of Polymer Science and Technology, 1st ed., Khanna Publishing House, India.
Reference Books:	
1.	Dencheva N.V., Denchev Z.Z., (2026), Synthesis, Characterization and Application of Polymer-Based Materials, 1st ed., MDPI Books
2.	Kothawade S.N., Pande V., Gattani S., Sumbe R., (2026), Polymer Nanocomposites: Advances in Design, Synthesis, and Applications, 1st ed., Springer, Cham.
3.	Ray S.S., Banerjee R., (2025), Polymer Blend Nanocomposites, 1st ed., Springer, Cham.
4.	Gupta R.K., Padmanabhan M., (2026), Polymer and Food Rheology: Applications to Single-Phase Systems, 1st ed., CRC Press, USA.
Web resources:	
5.	https://pubs.rsc.org/en/journals/journal/py
6.	https://www.sciencedirect.com/topics/materials-science/polymer-chemistry
7.	https://en.wikipedia.org/wiki/Polymer_science
8.	www.nptel.ac.in

Mapping with Programme Outcomes and Programme Specific Outcomes

	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	3	3	3	3	3	3	3
CO3	3	3	3	3	3	3	3	3	3	3	3
CO4	3	3	3	3	3	3	3	3	3	3	3
CO5	3	3	3	3	3	3	3	3	3	3	3
Total	15	15	15	15	15	15	15	15	15	15	15
Average	**3.0**	**3.0**	**3.0**	**3.0**	**3.0**	**3.0**	**3.0**	**3.0**	**3.0**	**3.0**	**3.0**

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)		