# 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** | **US07** |
| **Duration** | **2 years [PG]** |
| **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.<br><br>**PO2: Cognitive and Problem-Solving Skills:** Develop critical, analytical thinking and problem-solving skills.<br><br>**PO3: Societal and Environmental Impact:** Address and develop solutions for societal and environmental needs at local, regional, and national levels.<br><br>**PO4: Research-Related Skills**: Develop research skills in defining problems, formulating and testing hypotheses, analyzing, interpreting, and drawing conclusions from data.<br><br>**PO5: Employability and Entrepreneurship:** Enhance employability and entrepreneurship among students, along with ethical and communication skills.<br><br>**PO6: Self-Directed Learning**: Work independently and engage in lifelong learning and continuous professional development.<br><br>**PO7: Moral and Ethical Awareness/Reasoning**: Understand the importance of ethical behavior in professional contexts and be able to recognize and address ethical dilemmas.<br><br>**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.<br><br>**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.<br><br>**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 | |

# 6. Skeleton & Syllabus

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

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

**L-Lecture** **T-Tutorial** **P-Practical** **S-Seminar** **C-Credit**

Students must complete at least one online course (MOOC) from platforms like SWAYAM, NPTEL, or Naan Mudhalvan 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*.

# 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:**<br>1. Estimation of Borax – Standard Sodium Carbonate<br>2. Estimation of Sodium Hydroxide – Standard Sodium Carbonate<br>3. Estimation of HCl – Standard Oxalic acid | 12 |
| 2 | **Complexometry:**<br>1. Estimation of Magnesium using EDTA<br>2. Estimation of Zinc using EDTA | 12 |
| 3 | **Dichrometry:**<br>1. Estimation of Ferrous Iron using Diphenyl amine/N-Phenylanthranillic acid as indicator | 12 |
| 4 | **Precipitation Titration:**<br>1. Estimation of Chloride in neutral medium (Demonstration experiment). | 12 |
| 5 | **Permanganometry:**<br>1. Estimation of Ferrous Sulphate – Standard FAS<br>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<br>2. Estimation of sodium carbonate using standard sodium hydroxide | 6 |
| 2 | 3. Estimation of hydrochloric acid using standard oxalic acid<br>4. Estimation of ferrous sulphate using standard Mohr's salt | 6 |
| 3 | 5. Estimation of oxalic acid using standard ferrous sulphate<br>6. Estimation of potassium permanganate using standard sodium hydroxide | 6 |
| 4 | 7. Estimation of Ca (II) using EDTA solution<br>8. Estimation of Mg (II) using EDTA solution | 6 |
| 5 | 9. Estimation of total hardness of water<br>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**<br>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**<br>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.<br>**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)**<br>General characteristics of elements of **Group 15**; chemistry of $H_2N$-$NH_2$, $NH_2OH$, $NH_3$ and $HNO_3$. Chemistry of $PH_3$, $PCl_3$, $POCl_3$, $P_2O_5$.<br>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).<br>**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)<br>**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**<br>**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.<br>**Alkynes:** Nomenclature, general methods of preparation, properties; acidic nature of terminal alkynes and acetylene. | 18 |
| 5 | **Hydrocarbon Chemistry - II**<br>**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.<br>**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**<br>Safety rules, symbols and first-aid in chemistry laboratory.<br>Basic ideas about Bunsen burner, its operation and parts of the flame.<br>Chemistry laboratory glassware – basic information and uses. | | | | | | | | | 4 | |
| 2, 3 & 4 | **Qualitative Organic Analysis**<br>a) Preliminary examination<br>b) Detection of special elements - nitrogen, sulphur and halogens<br>c) Aromatic and aliphatic nature<br>d) Test for saturation and unsaturation<br>e) Identification of functional groups<br>f) Confirmation of functional groups<br>• monocarboxylic acid, dicarboxylic acid<br>• monohydric phenol, dihydric phenol<br>• Aldehyde | | | | | | | | | 40 | |

| | | |
|---|---|---|
| | • carbohydrate (reducing or non-reducing sugars)<br>• Primary amine<br>• monoamide, diamide | |
| 5 | **Preparation of Organic Compounds (Any 3)**<br>i. Bromination - 2,4,6 tribromo aniline from aniline<br>ii. Bromination - p-bromo acetanilide from acetanilide<br>iii. Oxidation - benzoic acid from Benzaldehyde<br>iv. Preparation of Benzanilide from Aniline<br>v. Salicylic Acid from Methyl Salicylate<br>vi. Preparation of Tribromo Phenol from Phenol<br>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**<br>The analysis must be carried out as follows:<br>(a) Preliminary Tests<br>(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)**<br>Phenol, Acids (mono & di), Aldehyde and Carbohydrate | 6 |
| 5 | **Identification of Functional group tests (Presence of special elements)**<br>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**

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