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**ANNAMALAI UNIVERSITY**

**Affiliated College**

 **205- B. Sc INDUSTRIAL CHEMISTRY**

Programme Structure and Scheme of Examination (under CBCS)

(Applicable to the candidates admitted from the academic year 2023 -2024 onwards)

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| --- | --- | --- | --- | --- | --- |
| Course Code | Part | Study Components & Course Title | Credit | Hours | Maximum Marks |
| CIA | ESE | Total |
|  |  | SEMESTER – I |  |  |  |  |  |
| 23UTAML11/23UHINL11/23UFREL11 | I |  Language – Iபொது தமிழ் – I/Hindi-I/French-I  | 3 | 6 | 25 | 75 | 100 |
| 23UENGL12 | II | General English – I | 3 | 6 | 25 | 75 | 100 |
| 23UICHC13 | III | Core – I | 5 | 5 | 25 | 75 | 100 |
| 23UICHP14 | Core –II : Practical-I: Quantitative Inorganic Estimation (titrimetry) and Inorganic Preparations | 5 | 4 | 25 | 75 | 100 |
| 23UICHE15 | Elective - I(Generic / Discipline Specific )Industrial Chemistry-I | 2 | 3 | 25 | 75 | 100 |
| 23UICHEP1 |  | Industrial chemistry Practicals-1 | 1 | 2 | 25 | 75 | 100 |
| 23UTAMB1623UTAMA16 | IV | Skill Enhancement Course – I (NME-I) /\*Basic Tamil – I /Advanced Tamil - I | 2 | 2 | 25 | 75 | 100 |
| 23UICHF17 | Skill Enhancement Course – I(Foundation Course)Introductory Chemistry | 2 | 2 | 25 | 75 | 100 |
|  |  | Total | 23 | 30 |  |  | 800 |
|  |  | SEMESTER – II |  |  |  |  |  |
| 23UTAML21/23UHINL21/23UFREL21 | I | Language – IIபொது தமிழ் – II/Hindi-II/French-II | 3 | 6 | 25 | 75 | 100 |
| 23UENGL22 | II | General English – II | 3 | 4 | 25 | 75 | 100 |
| 23UICHC23 | III | Core – III | 5 | 6 | 25 | 75 | 100 |
| 23UICHP24 | Core –IV Practical-II-Qualitative organic analysis And Preparation of Organic Compounds | 4 | 4 | 25 | 75 | 100 |
| 23UICHE25 | Departmental Elective - IGeneric / Discipline Specific-Industrial Chemistry-II  | 2 | 3 | 25 | 75 | 100 |
| 23UICHEP2 |  | Industrial Chemistry Practicals-II | 2 | 3 | 25 | 75 | 100 |
| 23UTAMB2623UTAMA26 | IV | Skill Enhancement Course – II (NME-II) /\*Basic Tamil – II /Advanced Tamil - II | 2 | 2 | 25 | 75 | 100 |
| 23USECG27 | Skill Enhancement Course – IIIInternet and its Applications (Common Paper) | 2 | 2 | 25 | 75 | 100 |
|  |  | Total | 23 | 30 |  |  | 800 |

**Non-major (NME) Electives offered to other Departments**

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| --- | --- | --- | --- | --- | --- | --- | --- |
| **Semester** | **Course Code** | **Course Title** | **H/W** | **C** | **CIA** | **ESE** | **Total** |
| I | 23UCHEN16 | Role of Chemistry in Daily Life | 2 | 2 | 25 | 75 | 100 |
| II | 23UCHEN26 | Dairy Chemistry | 2 | 2 | 25 | 75 | 100 |

\* PART-IV: NME / Basic Tamil / Advanced Tamil (Any one)

Students who have not studied Tamil upto 12th Standardand have taken any Language other than Tamil in Part-I, must choose Basic Tamil-I in First Semester & Basic Tamil-II in Second Semester.

Students who have studied Tamil upto 10th & 12th Standardand have taken any Language other than Tamil in Part-I, must choose Advanced Tamil-I in First Semester and Advanced Tamil-II in Second Semester.

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| Title of the Course  | GENERAL CHEMISTRY-I   |
| Paper No.  | Core I  |
| Category  | Core  | Year  | I  | Credits  | 4 | Course Code  |  23UICHC13 |
| Semester  | I  |
| Instructional hours per week  | Lecture  | Tutorial  | Lab Practice  | Total  |
| 4 | 1  | -  | 5 |
| Prerequisites  | Higher secondary chemistry  |
| Objectives of the course  | The course aims at giving an overall view of the * various atomic models and atomic structure
* wave particle duality of matter
* periodic table, periodicity in properties and its application in explaining the chemical behaviour
* nature of chemical bonding, and
* fundamental concepts of organic chemistry

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| Course Outline  | UNIT I Atomic structure and Periodic trends History of atom (J.J.Thomson, Rutherford); Moseley’s Experiment and Atomic number, Atomic Spectra; Black-Body Radiation and Planck’s quantum theory Bohr's model of atom;The Franck-Hertz Experiment; Interpretation of Hspectrum; Photoelectric effect, Compton effect; Dual nature of Matter- DeBroglie wavelength-Davisson and Germer experiment Heisenberg’s Uncertainty Principle; Electronic Configuration of Atoms and ions- Hund’s rule, Pauli’exclusion principle and Aufbau principle; Numerical problems involving the core concepts.  |
| Unit II Introduction to Quantum mechanics Classical mechanics, Wave mechanical model of atom, distinction between a Bohr orbit and orbital; Postulates of quantum mechanics; probability interpretation of wavefunctions, Formulation of Schrodinger wave equation - Probability and electron density-visualizing the orbitals -Probability density and significance of Ψ and Ψ2. Modern Periodic Table Cause of periodicity; Features of the periodic table; classification of elements Periodic trends for atomic size- Atomic radii, Ionic, crystal and Covalent radii; ionization energy, electron affinity, electronegativity-electronegativity scales, applications of electronegativity. Problems involving the core concepts   |

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|  | UNIT-III: Structure and bonding - I Ionic bond Lewis dot structure of ionic compounds; properties of ionic compounds; Energy involved in ionic compounds; Born Haber cycle – lattice energies, Madelung constant; relative effect of lattice energy and solvation energy; Ion polarisation – polarising power and polarizability; Fajans’ rules - effects of polarisation on properties of compounds; problems involving the core concepts. Covalent bond Shapes of orbitals, overlap of orbitals – σ and Π bonds; directed valency hybridization; VSEPR theory - shapes of molecules of the type AB2, AB3, AB4, AB5, AB6 and AB7 Partial ionic character of covalent bond-dipole moment, application to molecules of the type A2, AB, AB2, AB3, AB4; percentage ionic character- numerical problems based on calculation of percentage ionic character.  |
| UNIT-IV: Structure and bonding - II VB theory – application to hydrogen molecule; concept of resonance - resonance structures of some inorganic species – CO2, NO2, CO32-, NO3- ; limitations of VBT; MO theory - bonding, antibonding and nonbonding orbitals, bond order; MO diagrams of H2, C2, O2, O2+, O2-, O22-N2, NO, HF, CO; magnetic characteristics, comparison of VB and MO theories. Coordinate bond: Definition, Formation of BF3, NH3, NH4+, H3O+ properties Metallic bond-electron sea model, VB model; Band theory-mechanism of conduction in solids; conductors, insulator, semiconductor – types, applications of semiconductors Weak Chemical Forces - Vander Waals forces, ion-dipole forces, dipole-dipole interactions, induced dipole interactions, Instantaneous dipole-induced dipole interactions. Repulsive forces; Hydrogen bonding – Types, special properties of water, ice, stability of DNA; Effects of chemical force, melting and boiling points.  |
| UNIT-V:  Basic concepts in Organic Chemistry and Electronic effects  Types of bond cleavage – heterolytic and homolytic; arrow pushing in organic reactions; reagents and substrates; types of reagents - electrophiles, nucleophiles, free radicals; reaction intermediates – carbanions, carbocations, carbenes, arynes and nitrynes. Inductive effect - reactivity of alkyl halides, acidity of halo acids, basicity of amines; inductomeric and electromeric effects.  Resonance – resonance energy, conditions for resonance - acidity of phenols, basicity of aromatic amines, stability of carbonium ions, carbanions and free  |

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|  | radicals, reactivity of vinyl chloride, dipole moment of vinyl chloride and nitrobenzene, bond lengths; steric inhibition to resonance.  Hyperconjugation - stability of alkenes, bond length, orienting effect of methyl group, dipole moment of aldehydes and nitromethane  Types of organic reactions- addition, substitution, elimination and rearrangements   |
| Extended Professional Component (is a part of internal component only, Not to be included in the external examination question paper)  | Questions related to the above topics, from various competitive examinations UPSC/JAM /TNPSC and others to be solved (To be discussed during the Tutorial hours)  |
| Skills acquired from this course  | Knowledge, Problem solving, Analytical ability, Professional Competency, Professional Communication and Transferable skills.  |
| Recommended Text  | 1. Madan, R. D. and Sathya Prakash, Modern Inorganic Chemistry, 2nded.; 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, 38thed.;Vishal Publishing Company: Jalandhar, 2002.
4. Bruce, P. Y. and PrasadK. J. R. Essential Organic Chemistry, Pearson Education: New Delhi, 2008.
5. Dash UN, Dharmarha OP, 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,4thed.; 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, 26thed.; 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.
 |
| Website and e-learning source  | 1. https://onlinecourses.nptel.ac.in
2. http://www.mikeblaber.org/oldwine/chm1045/notes\_m.htm
3. http://www.ias.ac.in/initiat/sci\_ed/resources/chemistry/Inorganic.html
4. https://swayam.gov.in/course/64-atomic-structure-and-chemical-bonding 5) https://www.chemtube3d.com/
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| Course Learning Outcomes (for Mapping with POs and PSOs) On completion of the course the students should be able to 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, nature of H – bonding and organic reaction mechanisms.   |

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|   | PO1  | PO2  | PO3  | PO4  | PO5  | PO6  | PO7  | PO8  | PO9  | PO10  |
| CO1  | S  | S  | S  | S  | S  | S  | S  | M  | S  | M  |
| CO2  | M  | S  | S  | S  | M  | S  | S  | M  | M  | M  |
| CO3  | S  | S  | S  | M  | S  | S  | S  | M  | S  | M  |
| CO4  | S  | S  | S  | S  | S  | S  | S  | M  | M  | M  |
| CO5  | S  | M  | S  | S  | S  | S  | S  | M  | M  | S  |

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| CO /PSO  | PSO1  | PSO2  | PSO3  | PSO4  | PSO5  |
| CO1  | 3  | 3  | 3  | 3  | 3  |
| CO2  | 3  | 3  | 3  | 3  | 3  |
| CO3  | 3  | 3  | 3  | 3  | 3  |
| CO4  | 3  | 3  | 3  | 3  | 3  |
| CO5  | 3  | 3  | 3  | 3  | 3  |
| Weightage  | 15  | 15  | 15  | 15  | 15  |
| Weighted percentage of Course Contribution to Pos  | 3.0  | 3.0  | 3.0  | 3.0  | 3.0  |

Level of Correlation between PSO’s and CO’

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| Title of the Course  | Quantitative Inorganic Estimation (titrimetry) and Inorganic Preparatiions  |
| Paper No.  | Core II -Practical |
| Category  | Core  | Year  | I  | Credits  | 3 | Course Code  |  23UICHP14 |
| Semester  | I  |
| Instructional hours per week  | Lecture  | Tutorial  | Lab Practice  | Total  |
| -  |  | 3 | 3 |
| Prerequisites  | Higher secondary chemistry  |
| Objectives of the course  | This course aims at providing knowledge on * laboratory safety
* handling glasswares
* Quantitative estimation
* preparation of inorganic compounds
* To develop skill in finding out end points of various titrations

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| Course Outline  |  Unit I Chemical Laboratory Safety in Academic Institutions Introduction - importance of safety education for students, common laboratory hazards, assessment and minimization of the risk of the hazards, prepare for emergencies from uncontrolled hazards; concept of MSDS; importance and care of PPE; proper use and operation of chemical hoods and ventilation system; fire extinguishers-types and uses of fire extinguishers, demonstration of operation; chemical waste and safe disposal. Common Apparatus Used in Quantitative Estimation (Volumetric) Description and use of burette, pipette, standard flask, measuring cylinder, conical flask, beaker, funnel, dropper, clamp, stand, wash bottle, watch glass, wire gauge and tripod stand.   Principle of Quantitative Estimation (Volumetric)  Equivalent weight of an acid, base, salt, reducing agent, oxidizing agent; concept of mole, molality, molarity, normality; primary and secondary standards, preparation of standard solutions; theories of acid-base, redox, complexometric, iodimetric and iodometric titrations; indicators – types, theory of acid–base, redox, metal ion and adsorption indicators, choice of indicators.   |
| Unit II Quantitative Estimation(Volumetric) Preparation of standard solution, dilution from stock solution Permanganometry Estimation of sodium oxalate using standard ferrous ammonium sulphate   |

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|  | Dichrometry Estimation of ferric alum using standard dichromate (external indicator) Estimation of ferric alum using standard dichromate (internal indicator)  Iodometry Estimation of copper in copper sulphate using standard dichromate  Argentimetry Estimation of chloride in barium chloride using standard sodium chloride/ Estimation of chloride in sodium chloride (Volhard’s method) Complexometry Estimation of hardness of water using EDTA Estimation of iron in iron tablets Estimation of ascorbic acid  |
|     |
| Skills acquired from this course  | Knowledge, Problem solving, Analytical ability, Professional Competency, Professional Communication and Transferable skills.  |
| Recommended Text  | Reference Books: 1. Venkateswaran, V.; Veeraswamy, R.; Kulandivelu, A.R. Basic Principles of Practical Chemistry,2nd ed.; Sultan Chand &Sons: New Delhi, 1997.
2. Nad, A. K.; Mahapatra, B.; Ghoshal, A.; An advanced course in Practical Chemistry, 3rd ed.; New Central Book Agency: Kolkata, 2007.
 |
| Reference Books  | 1. Mendham, J.; Denney, R. C.; Barnes, J. D.; Thomas, M.; Sivasankar, B.; Vogel’s Textbook of Quantitative Chemical Analysis, 6th ed.; Pearson Education Ltd: New Delhi, 2000.  |
| Website and e-learning source  | Web References: 1)http://www.federica.unina.it/agraria/analytical-chemistry/volumetricanalysis 2)https://chemdictionary.org/titration-indicator/  |
| Course Learning Outcomes (for Mapping with POs and PSOs) On successful completion of the course the students should be able to CO1: explain the basic principles involved in titrimetric analysis and inorganic preparations. CO2: compare the methodologies of different titrimetric analysis. CO3: calculate the concentrations of unknown solutions in different ways and develop the skill to estimate the amount of a substance present in a given solution. CO4.Indetify the end point of various titrationsCO5 acquire knowledge on the systematic analysis of Mixture of salts., identify the cations and anions in the unknown substance.CO5: handle the common apparatus used in volumetric estimation. |

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|   | PO1  | PO2  | PO3  | PO4  | PO5  | PO6  | PO7  | PO8  | PO9  | PO10  |
| CO1  | S  | S  | S  | S  | S  | S  | S  | M  | S  | M  |
| CO2  | M  | S  | S  | S  | M  | S  | S  | M  | M  | M  |
| CO3  | S  | S  | S  | M  | S  | S  | S  | M  | S  | M  |
| CO4  | S  | S  | S  | S  | S  | S  | S  | M  | M  | M  |
| CO5 | S  | S  | S  | M  | S  | S  | S  | M  | S  | M  |

CO-PO Mapping (Course Articulation Matrix)

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| --- | --- | --- | --- | --- | --- |
| CO /PSO  | PSO1  | PSO2  | PSO3  | PSO4  | PSO5  |
| CO1  | 3  | 3  | 3  | 3  | 3  |
| CO2  | 3  | 3  | 3  | 3  | 3  |
| CO3  | 3  | 3  | 3  | 3  | 3  |
| CO4  | 3  | 3  | 3  | 3  | 3  |
| CO5 | 3  | 3  | 3  | 3  | 3  |
| Weightage  | 15  | 15  | 15  | 15  | 15 |
| Weighted percentage of Course Contribution to Pos  | 3.0  | 3.0  | 3.0  | 3.0  | 3.0  |

**Note: Scheme for Practical Evaluation.**

**Inorganic prepararation:15 marks**

**Record:10 marks**

**Procedure:10 marks**

**Volumetric estimation:40 marks**

**< 2% - 40 marks**

**2-3% - 30 marks**

**3-4% - 20 marks**

**> 4% -10 marks**

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| **Title of the Course**  | **Departmental elective- - I** |
| **Paper No.**  |  **Allied Theory - I-(Industrial Chemistry-I)** |
| **Category** | **Allied** | **Year** | **I** | **Credits** | **2** | **Course Code** | **23UICHE15** |
| **Semester** | **I** |
| **Instructional hours per week** | **Lecture**  | **Tutorial** |  | **Lab Practice** | **Total** |  |
| **2** | **1** |  | **-** | **3** |
| **Prerequisites** | **– Higher secondary Chemistry** |
| **Objectives of the course** | This course aims to provide a comprehensive knowledge to students and to enable them* To understand the significance of Inorganic Cementing Materials
* To know the details of, Portland cement, Glass, Ceramics, and Plasticity of Clay.
* To impart knowledge of Refractoriness and Portland cement.
* To be familiar with the details of adhesives.
* To understand the basic concepts and application of an Abrasives, Pulp and paper.
 |
| **Course Outline**  | **UNIT - I****INORGANIC CEMENTING MATERIALS** Introduction - Lime and its manufacture - Gypsum Plaster - Cement - Types of cement. - Chemical Composition. Manufacture of Portland cement - Chemical Composition of Portland Cement - Setting and Hardening of Portland Cement. The Heat of Hydration of Cement - Special Cement – Concrete and RCC - Decay of Concrete. |
|  | **UNIT-II** **GLASS AND CERAMICS** Introduction - Manufacture of Glass - Varieties of Glasses. Plasticity of Clay - White wares - Glazing - applications - Earthenware ‘sand stoneware’ – Optical Fibres.  |
|  | **UNIT-III** **REFRACTORIES** Introduction - Classification - Manufacture of Refractoriness - Cermets - Insulating refractoriness - Requirements of a refractory. Combustion - Mass analysis from volume analysis and vice-versa Flue gas analysis- efficiency of combustion |
|  | **UNIT-IV** **ADHESIVES**Introduction - Classification of adhesives - Adhesive Action - Development of Adhesive Strength. Solvent Responsive, Adhesives - Uses of Solvent Responsive, Adhesives. Chemically reactive, adhesives.  |
|  | **UNIT-V: ABRASIVES** Introduction - Natural Abrasives - Artificial Abrasives – Grinding Wheels. Pulp and paper - Introduction - Manufacture of pulp - Sulphate pulp - Soda pulp - Rag pulp - Beating, refining, filling, sizing and colouring - manufacture of paper. |
| **Extended Professional Component (is a part of internal component only, Not to be included in the external examination question paper)**  | Questions related to the above topics, from various competitive examinations UPSC/JAM /TNPSC others to be solved (To be discussed during the Tutorial hours) |
| Skills acquiredFrom this course | Knowledge Problem solving, Analytical ability, ProfessionalCompetency, Professional Communication and Transferable skills. |
| **Recommended Text** | [Handbook of Industrial Chemistry,](https://www.amazon.com/dp/1632386534?tag=uuid10-20) [Cory Simmons](https://bookauthority.org/author/Cory-Simmons), 2019[1. Ullmann's Encyclopedia of Industrial Chemistry, Vol. B1, Fundamentals of Chemical Engineering,](https://www.amazon.com/dp/3527201319?tag=uuid10-20" \t "_blank) [Hans-Jürgen Arpe](https://bookauthority.org/author/Hans-J%C3%BCrgen-Arpe).2. A.K. De, Environmental Chemistry, New Age International Pvt Ltd., 2nd edition, New Delhi.[3. Industrial Chemistry,](https://www.amazon.com/dp/1298791278?tag=uuid10-20" \t "_blank) Clerk Ranken,. [John A. Tyrell](https://bookauthority.org/author/John-A.-Tyrell),2 014. |
| **Reference Books** |  Stocchi: Industrial Chemistry, Vol-I, Ellis Horwood Ltd. UK 1. J. A. Kent: Riegelís Handbook of Industrial Chemistry, CBS

Publishers,New Delhi. 1. P. C. Jain, M. Jain: Engineering Chemistry, Dhanpat Rai & Sons, Delhi.
2. Practical’s and Calculation in Engineering Chemistry ñ S.S. Dara
3. K. De, Environmental Chemistry: New Age,

 International Pvt, Ltd, New Delhi. 1. S.P. MAHAJAN: Pollution control in process industries, Tata McGraw-Hill publishing Company Limited, New Delhi.
2. C.k. Varshney: Water Pollution and Management, Wiley Eastern

 Limited, Chennai |
| **Website and****e-learning source** | [www.epgpathshala.nic.in](http://www.epgpathshala.nic.in/) [www.nptel.ac.in](http://www.nptel.ac.in/)http:/swayam.gov.in |
| **Course Outcomes:** At the end of the course student will be able to**CO1:**  It aims at understanding the detailed specifications of Materials and analyzing **CO2:** Write down the Applications of Glasses, ceramics.**CO3:** Write down properties and testing of refractoriness and application in the steel industry.**CO4:**  Write down the development, Action, Strength and Uses of Adhesives**CO5:** Describe the Manufacture of pulp and Paper. |

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| **CO/PSO** | **PSO1** | **PSO2** | **PSO3** | **PSO4** | **PSO5** |
| **CO1** | 3 | 3 | 3 | 3 | 3 |
| **CO2** | 3 | 3 | 3 | 3 | 3 |
| **CO3** | 3 | 3 | 3 | 3 | 3 |
| **CO4** | 3 | 3 | 3 | 3 | 3 |
| **CO5** | 3 | 3 | 3 | 3 | 3 |
| **Weightage** | 15 | 15 | 15 | 15 | 15 |
| **Weighted percentage of Course Contribution to PSOs** | 3.0 | 3.0 | 3.0 | 3.0 | 3.0 |

**Level of Correlation between PSO’s and CO’s**

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| --- | --- | --- | --- | --- | --- |
| **CO/PO** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** |
| **CO1** | 3 | 3 | 3 | 3 | 3 |
| **CO2** | 3 | 3 | 3 | 3 | 3 |
| **CO3** | 3 | 3 | 3 | 3 | 3 |
| **CO4** | 3 | 3 | 3 | 3 | 3 |
| **CO5** | 3 | 3 | 3 | 3 | 3 |
| **Weightage** | 15 | 15 | 15 | 15 | 15 |
| **Weighted percentage of Course Contribution to PSOs** | 3.0 | 3.0 | 3.0 | 3.0 | 3.0 |

**Level of Correlation between PO’s and CO’s**

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| **Title of the Course** | **DEPARTMENTAL ELECTIVE-INDUSTRIAL CHEMISTRY PRACTICAL - I** |
| **Paper No.** |  **Allied Practical – I** |
| **Category** | **ALLIED** | **Year** | **I** | **Credits** | **1** | **Course Code** | **23UICHP24** |
| **Semester** | **1** |
| **Instructional hours per week** | **Lecture** | **Tutorial** |  | **Lab Practice** | **Total** |  |
| **-** | **-** |  | **2** | **2** |
| **Prerequisites** | **Core Practical-I& Industrial chemistry Practical - I** |
| **Objectives of the course** | * To know the percent purity of two commercially available Aspirin tablets using an acid-base titration.
* To understand the percentage of purity of sodium bicarbonate by conversion to sodium carbonate.
* To enable the learners to learn the principle of Thermo-gravimetric analysis, an accurate and responsive method of moisture.
* To know the basic concepts of Volumetric analysis.
* To train the students to become skilled person in saponification and also know the principles of chemical kinetics and to use them for stability testing and determination of expiry date of formulations.
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| **Course Outline**  | 1.Limit test fora)Sulphateb)Chloridec)Irond)Lead  2. Loss of moisture from any drug  3. Assay of Hydrogen peroxide 4. Assay of Sodium chloride or Potassium chloride  5.Assay of Zinc 6.\*Determination of saponification value of oil. \* Only for demonstration purposes.\* Only for demonstration purposes. |
| **Extended Professional Component (is a part of internal component only, Not to be included in the external examination question paper)**  | Questions related to the above topics, from various competitive examinations UPSC/JAM /TNPSC others to be solved (To be discussed during the Tutorial hours) |
| **Skills Acquired****From this Course** | Knowledge Problem solving, Analytical ability, ProfessionalCompetency, Professional Communication and Transferable skills. |
| **Recommended Text** | 1. [[Samuel Rideal](https://bookauthority.org/author/Samuel-Rideal), 2017, Industrial Chemistry- Being a Series of Volumes Giving a Comprehensive Survey of the Chemical Industries,](https://www.amazon.com/dp/1332617417?tag=uuid10-20)
2. [[James A. Audley](https://www.amazon.com/dp/1332315801?tag=uuid10-20" \t "_blank)](https://bookauthority.org/author/James-A.-Audley)[, 2018,Industrial Chemistry,Being a Series of Volumes Giving a Comprehensive Survey of the Chemical Industries,](https://www.amazon.com/dp/1332315801?tag=uuid10-20" \t "_blank)
3. [[Cory Simmons](https://www.amazon.com/dp/1632386534?tag=uuid10-20" \t "_blank)](https://bookauthority.org/author/Cory-Simmons)[,2019, Handbook of Industrial Chemistry,](https://www.amazon.com/dp/1632386534?tag=uuid10-20" \t "_blank)
4. [Ullmann's Encyclopedia of Industrial Chemistry, Vol. B1, Fundamentals of Chemical Engineering,](https://www.amazon.com/dp/3527201319?tag=uuid10-20" \t "_blank)[Hans-Jürgen Arpe](https://bookauthority.org/author/Hans-J%C3%BCrgen-Arpe),2021
5. [[Kent J.A.](https://www.amazon.com/dp/8123905440?tag=uuid10-20" \t "_blank)](https://bookauthority.org/author/Kent-J.A.)[, Riegel's Handbook of Industrial Chemistry,](https://www.amazon.com/dp/8123905440?tag=uuid10-20" \t "_blank)
6. [Clerk Ranken, 2015, Industrial Chemistry,](https://www.amazon.com/dp/1298791278?tag=uuid10-20" \t "_blank)
7. [[Dr. Darshan V Chaudhary](https://www.amazon.com/dp/1517220157?tag=uuid10-20" \t "_blank)](https://bookauthority.org/author/Dr.-Darshan-V-Chaudhary)[, 2015, Industrial Chemistry,](https://www.amazon.com/dp/1517220157?tag=uuid10-20" \t "_blank)
 |
| **Reference Books** | 1. Vogel’s textbook of chemical analysis 2. A.O.Thomas, 2003, Practial Chemistry, Scientific Book Centre, 8th+ Edition, Cannanore.3. PracticalChemistry-3 Volumes-S.Sundaramandothers.4. Felder R. M., and Rousseu R. W., 2000, Elementary Principles of Chemical Processes, Wiley Publications, 3rd Edition, New York.5. Crynes B. L., Fogler H. S., 1981, AICHE Modular Instruction Series  E: Kinetics, Vols. 1 and 2., New York. |
| **Website and****e-learning source** | https://www.vlab.co.in/broad-area-chemical-sciences [www.epgpathshala.nic.in](http://www.epgpathshala.nic.in/) [www.nptel.ac.in](http://www.nptel.ac.in/)http:/swayam.gov.in |
| **Course Outcomes:** | On Completion of the Practical, the students should be able to**CO1:**  Understand the chemical kinetics, physical and chemical properties, nature of pharmaceutical products and their stability. **CO2:**  Designed a method for the determination of hydrogen peroxide in aqueous solutions containing 20% to 705 hydrogen peroxide.**CO3:** Exposed to experimental details of Assay of various chemical compounds.**CO4:** Describe the steps involved Determine the purity of Sodium bicarbonate.**CO5:** Determine Loss of moisture from any drug and also find out the  Percentage of available chlorine present in the bleaching powder.. |

Scheme of Valuation:

Internal assessment: 25 Marks

External assessment: 75 Marks

Total: 100 Marks

Record: 10 Marks

Procedure: 10 Mark

Estimation:40 marks

Limit Test:15 marks

 For Estimation

Error upto

 2 % : 40

 2.1 – 3 % : 30

 3.1 – 4 % : 20

 4.1 – 5 % : 10

 >5 %

For incomplete or wrong calculation deduction 20 % of total marks scored.

For no calculation deduct 40% of total marks scored.

For each arithmetic error deduct I mark.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **CO/PSO** | **PSO1** | **PSO2** | **PSO3** | **PSO4** | **PSO5** |
| **CO1** | 3 | 3 | 3 | 3 | 3 |
| **CO2** | 3 | 3 | 3 | 3 | 3 |
| **CO3** | 3 | 3 | 3 | 3 | 3 |
| **CO4** | 3 | 3 | 3 | 3 | 3 |
| **CO5** | 3 | 3 | 3 | 3 | 3 |
| **Weightage** | 15 | 15 | 15 | 15 | 15 |
| **Weighted percentage of Course Contribution to PSOs** | 3.0 | 3.0 | 3.0 | 3.0 | 3.0 |

**Level of Correlation between PSO’s and CO’s**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **CO/PO** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** |
| **CO1** | 3 | 3 | 3 | 3 | 3 |
| **CO2** | 3 | 3 | 3 | 3 | 3 |
| **CO3** | 3 | 3 | 3 | 3 | 3 |
| **CO4** | 3 | 3 | 3 | 3 | 3 |
| **CO5** | 3 | 3 | 3 | 3 | 3 |
| **Weightage** | 15 | 15 | 15 | 15 | 15 |
| **Weighted percentage of Course Contribution to PSOs** | 3.0 | 3.0 | 3.0 | 3.0 | 3.0 |

**Level of Correlation between PO’s and CO’s**

|  |  |
| --- | --- |
| Title of the Course  | ROLE OF CHEMISTRY IN DAILY LIFE  |
| Paper No.  | SEC-I  |
| Category  | NME-1 | Year  | I  | Credits  | 2  | Course Code  | 23UCHEN16  |
| Semester  | I  |
| Instructional hours per week  | Lecture  | Tutorial  | Lab Practice  | Total  |
| 2  | -  | -  | 2  |
| Prerequisites  | Higher secondary chemistry  |
| Objectives of the course  | This course aims at providing an overall view of the * importance of Chemistry in everyday life
* chemistry of building materials and food
* chemistry of Drugs and pharmaceuticals
 |
| Course Outline  | UNIT-I General survey of chemicals used in everyday life. Air - components and their importance; photosynthetic reaction, air pollution, green - house effect and the impact on our life style. Water - Sources of water, qualities of potable water, soft and hard water, methods of removal of hardness-water pollution  |
| Unit-II Building materials - cement, ceramics, glass and refractories - definition, composition and application only. Plastics - polythene, PVC, bakelite, polyesters, melamine-formaldehyde resins -preparation and uses only.  |
| UNIT-III Food and Nutrition - Carbohydrates, Proteins, Fats - definition and their importance as food constituents – balanced diet – Calories minerals and vitamins (sources and their physiological importance). Cosmetics – tooth paste, face powder, soaps and detergents, shampoos, nail polish, perfumes - general formulation and preparations - possible hazards of cosmetic use.  |
| UNIT-IV Chemicals in food production – fertilizers - need, natural sources; urea, NPK fertilizers and super phosphate. Fuel – classification - solid, liquid and gaseous; nuclear fuel examples and uses.  |
| UNIT-V Pharmaceutical drugs - analgesics and antipyretics - paracetamol and aspirin. Colour chemicals - pigments and dyes - examples and applications. Explosives - classification and examples.  |
|  |  |
| Recommended Text  | 1.Food chemistry, H. K. Chopra, P. S. Panesar, Narosa publishing house, 2010. 1. A textbook of pharmaceutical chemistry by Jayashree Ghosh, S Chand publishing, 2012.
2. S. Vaithyanathan, Text book of Ancillary Chemistry; Priya Publications, Karur, 2006.
3. B. K, Sharma, Industrial Chemistry; GOEL publishing house, Meerut, sixteenth edition, 2014.Introduction to forensic chemistry, Kelly M. Elkins, CRC Press Taylor & Francis Group, 2019.
4. Jayashree Ghosh, Fundamental Concepts of Applied Chemistry, S. Chand &Co.Publishers, second edition, 2006.
 |
| Reference Books  | 1. Randolph. Norris Shreve, Chemical Process Industries, McGraw-Hill, Texas, fourthedition, 1977.
2. W.A.Poucher,JosephA.Brink,Jr.Perfumes,Cosmetics and Soaps,Springer, 2000.
3. A.K.De,EnvironmentalChemistry,NewAge InternationalPublicCo.,1990.
 |
| Website and e-learning source  | 1. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7044178/>
2. <https://byjus.com/question-answer/name-the-element-which-is-important-component-of-ceramics-glass-and-cement-csialca-1/>
3. <https://kids.britannica.com/students/article/food-and-nutrition/274373>
4. https://study.com/academy/lesson/pharmaceutical-drugs-definition-types.html
 |
| Course Learning Outcomes (for Mapping with POs and PSOs) On completion of the course the students should be able to CO1: learn about the chemicals used in everyday life as well as air pollution and water pollution. CO2: get knowledge on building materials cement, ceramics, glass and plastics, polythene, PVC bakelite, polyesters, CO3: acquire information about Food and Nutrition. Carbohydrates, Proteins, Fats Also have an awareness about Cosmetics Tooth pastes, face powder, soaps and detergents. CO4: discuss about the fertilizers like urea, NPK fertilizers and super phosphate. Fuel classification solid, liquid and gaseous; nuclear fuel - examples and uses CO5: have an idea about the pharmaceutical drugs analgesics and antipyretics like paracetamol and aspirin and also about pigments and dyes and its applications.  |



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| --- | --- | --- | --- | --- | --- |
| CO /PO  | PSO1  | PSO2  | PSO3  | PSO4  | PSO5  |
| CO1  | 3  | 3  | 3  | 3  | 3  |
| CO2  | 3  | 3  | 3  | 3  | 3  |
| CO3  | 3  | 3  | 3  | 3  | 3  |
| CO4  | 3  | 3  | 3  | 3  | 3  |
| CO5  | 3  | 3  | 3  | 3  | 3  |
| Weightage  | 15  | 15  | 15  | 15  | 15  |
| Weighted percentage of Course Contribution to Pos | 3.0  | 3.0  | 3.0  | 3.0  | 3.0  |

 Level of Correlation between PSO’s and CO’s

|  |  |
| --- | --- |
| **Title of the****Course** | **INTRODUCTORY CHEMISTRY** |
| **Paper No.** | **SEC – I (Foundation Course)** |
| **Category** | **SEC** | **Year** | I | **Credits** | 2 | **Course****Code** | **22UICHF17** |
| **Semester** | I |
| **Instructional hours per week** | **Lecture** | **Tutorial** | **Lab Practice** | **Total** |
| 2 | 0 | - | 2 |
| **Prerequisites** | Higher secondary chemistry |
| **Objectives of the Course** | To give insights into chemistry experiments for a beginner in1. Lab safety and Nature of chemicals.
2. Types of titrations and Concentration terms.
3. Semi micro analysis and precipitation techniques.
4. Organic analysis
5. Gravimetric Principles
 |
| **Course Outline** | UNIT-I: LAB SAFETY, CHEMICALS AND GLASSWARE1.1 laboratory hygiene and safety – first–aid techniques – general work culture inside the chemistry lab.1.2 Nature of chemicals – toxic, corrosive, explosive, inflammable, carcinogenic, other hazardous chemicals – safe storing and handling of chemicals – disposal of chemical wastes.1.3. Handling of glass wares- Calibration of pipette, standard measuring flask and burette.  |
|  | **UNIT-II**: **TITRIMETRIC METHODS OF ANALYSIS** |
|  | 2.1 Definitions of Molarity and Normality. Primary and secondary standards, Criteria for primary standards-Preparation of standard solutions.2.2 Concepts of Acids & Bases - pH of strong and weak acid solutions. Indicators-Theory and their choice.. 2.3 Types of titrations- Acid-base Titrations, Redox Titrations, Precipitation Titrations and Complexometric Titrations- Principles and theory.  |
|  | UNIT-III: SEMIMICRO METHODS3.1. Identification of interfering & non-interfering acid radicals - removal of interfering radicals (any one test for each). 3.2 Separation of cations into groups-Reagents involved and their principle3.3 Spot test analysis for ammonium, Pb, Cu, Mg, Mn and Ni. |
|  | **UNIT-IV: BASICS OF ORGANIC ANALYSIS** |
|  | 4.1 Preliminary and solubility tests for identifying organic compounds. Test for Aliphatic/Aromatic – Saturated/ Unsaturated compounds4.2 Detection of Nitrogen, Sulphur and halogens4.3– Test for functional groups: phenol, aldehyde, ketone, ester, carbohydrate, amine, amide & carboxylic acid (any one test for each).  |
|  | **UNIT V: GRAVIMETRIC METHODS** 5.1 Gravimetric analysis- principle, theory and calculation. 5.2 Steps of a gravimetric analysis: precipitation, digestion, filtration, washing, drying and weighing.5.2 Conditions for precipitation-choice of precipitants-advantages and disadvantages of using organic precipitants. |
| **Extended** **Professional****Component (is a****part of internal****component only,****Not to be included****in the external****examination****question paper)** | Questions related to the above topics, from various competitive examinations UPSC/ JAM /TNPSC others to be solved (To be discussed during the Tutorial hours) |
| **Skills acquired from this course** | Knowledge, Problem solving, Analytical ability, Professional Competency, Professional Communication and Transferable skills. |
| **Recommended Text** | 1. U.N. Dash, 2005, Analytical Chemistry: Theory and Practice, Sultan Chand and sons. Educational Publishers, 2nd Edition, New Delhi,
2. J.Bassett, R.C.Denney, G.H.Jerrey and J.Mendham, 1994,Vogel’s Text Book Of Inorganic Quantitative Analysis, ELBS, 5th Edition, London.
3. Gopalan R., Rangarajan K., Subramanian P.S. Elements of Analytical Chemistry, Sultan Chand & Sons, 2003
4. Svehla, 2012, Vogel’s Qualitative Analysis, Pearson Education, 7thEdition,New Delhi.
5. Venkateswaran V, Veeraswamy R, Kulandaivelu A R,1997,Basic Principles Of Practical Chemistry, Sultan Chand and Sons, 2nd Edition, New Delhi.
6. D.A. Skoog, D.M. West and F. J.Holler, 1990, Analytical chemistry,Saunders college publishing, 5th Edition, Philadelphia.
 |
| **Reference Books** | 1. Svehla, 2012, Vogel’s Qualitative Analysis, Pearson Education, 7thEdition,New Delhi.
2. Venkateswaran V, Veeraswamy R, Kulandaivelu A R,1997,Basic Principles Of Practical Chemistry, Sultan Chand and Sons, 2nd Edition, New Delhi
 |
|  | Knowledge, Problem solving, Analytical ability, Professional Competency, Professional Communication and Transferable skills. |
| **Website and****e-learning source** | 1. [https://www.tees.ac.uk/parttime\_courses/engineering\_&\_construction/certificate\_of\_credit\_foundation\_process\_chemistry\_(by\_flexible\_open\_learning).cfm](https://www.tees.ac.uk/parttime_courses/engineering_%26_construction/certificate_of_credit_foundation_process_chemistry_%28by_flexible_open_learning%29.cfm)
2. <https://le.ac.uk/courses/chemistry-with-foundation-year-bsc/2023>
3. <https://www.researchgate.net/publication/345381808_Foundations_for_Teaching_Chemistry_Chemical_Knowledge_for_Teaching>
4. <https://yuli-elearning.com/mod/resource/view.php?id=738>
5. <https://pubs.acs.org/doi/10.1021/acs.jchemed.1c00666>
 |
| **Course Learning Outcomes (for Mapping with POs and PSOs) On completion of the course the students should be able to** CO1: to understand laboratory safety and hygiene. CO2: to understand principle of titrations. CO3: to understand semi micro analysis. CO4: to understand basics of organic compound analysis. CO5: to understand about gravimetric analysis |

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** |
| **CO1** | S | S | S | S | S | S | S | M | S | M |
| **CO2** | M | S | S | S | M | S | S | M | M | M |
| **CO3** | S | S | S | M | S | S | S | M | S | M |
| **CO4** | S | S | S | S | S | S | S | M | M | M |
| **CO5** | S | M | S | S | S | S | S | M | M | S |

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| --- | --- | --- | --- | --- | --- |
| **CO/PSO** | **PSO1** | **PSO2** | **PSO3** | **PSO4** | **PSO5** |
| **CO1** | 2 | 2 | 2 | 2 | 2 |
| **CO2** | 2 | 2 | 2 | 2 | 2 |
| **CO3** | 2 | 2 | 2 | 2 | 2 |
| **CO4** | 2 | 2 | 2 | 2 | 2 |
| **CO5** | 2 | 2 | 2 | 2 | 2 |
| **Weightage** | 10 | 10 | 10 | 10 | 10 |
| **Weighted percentage of Course Contribution to Pos** | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 |

**Level of Correlation between PSO’s and CO’s**

**Semester II**

|  |  |
| --- | --- |
| Title of the Course  | GENERAL CHEMISTRY-II  |
| Paper No.  | Core III  |
| Category  | Core  | Year  | I  | Credits  | 4 | Course Code  |  23UCHEC23 |
| Semester  | II  |
| Instructional hours per week  | Lecture  | Tutorial  | Lab Practice  | Total  |
| 4 | 1  | -  | 5 |
| Prerequisites  | General Chemistry I  |
| Objectives of the course  | This course aims at providing an overall view of the * chemistry of acids, bases and ionic equilibrium
* properties of s and p-block elements
* chemistry of hydrocarbons
* applications of acids and bases
* compounds of main block elements and hydrocarbons

  |
| Course Outline  | UNIT-I Acids, bases and Ionic equilibria Concepts of Acids and Bases - Arrhenius concept, Bronsted-Lowry concept, Lewis concept; Relative strengths of acids, bases and dissociation constant; dissociation of poly basic acids, ionic product of water, pH scale, pH of solutions; Degree of dissociation, common ion effect, factors affecting degree of dissociation; acid base indicators, theory of acid base indicators – action of phenolphthalein and methyl orange, titration curves - use of acid base indicators; Buffer solutions – types, mechanism of buffer action in acid and basic buffer, Henderson-Hasselbalch equation; Salt hydrolysis - salts of weak acids and strong bases, weak bases and strong acids, weak acids and weak bases - hydrolysis constant, degree of hydrolysis and relation between hydrolysis constant and degree of hydrolysis; Solubility product - determination and applications; numerical problems involving the core concepts. |
|  | Unit-II Chemistry of s - Block Elements Hydrogen: Position of hydrogen in the periodic table. Alkali metals: Comparative study of the elements with respect to oxides, hydroxides, halides, carbonates and bicarbonates. Diagonal relationship of Li with Mg. Preparation, properties and uses of NaOH, Na2CO3, KBr, KClO3 alkaline earth metals. 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.  |
|  | UNIT-III Chemistry of p- Block Elements (Group 15-18) General characteristics of elementsof Group 15; chemistry of H2N-NH2, NH2OH, HN3 and HNO3. Chemistry of PH3, PCl3, PCl5, POCl3, P2O5 and oxy acids of phosphorous (H3PO3 and H3PO4).  General properties of elements of group16 - Structure and allotropy of elements - chemistry of ozone - Classification and properties of oxides - oxides of sulphur and selenium – Oxy acids of sulphur (Caro’s and Marshall’s acids).  Chemistry of Halogens: General characteristics of halogen with reference to electro-negativity, electron affinity, oxidation states and oxidizing power. Peculiarities of fluorine. Halogen acids (HF, HCl, HBr and HI), oxides and oxy acids (HClO4). Inter-halogen compounds (ICl, ClF3, BrF5 and IF7), pseudo halogens [(CN)2 and (SCN)2] and basic nature of Iodine.  Noble gases: Position in the periodic table. Preparation, properties and structure of XeF2, XeF4, XeF6 and XeOF4; uses of noble gases - clathrate compounds. |
|  | UNIT-IV Hydrocarbon Chemistry-I Petroproducts: Fractional distillation of petroleum; cracking, isomerisation, alkylation, reforming and uses  Alkenes-Nomenclature, general methods of preparation – Mechanism of elimination reactions – E1 and E2 mechanism - factors influencing – stereochemistry – orientation – Hofmann and Saytzeff rules. Reactions of alkenes – addition reactions – mechanisms – Markownikoff’s rule, Kharasch effect, oxidation reactions – hydroxylation, oxidative degradation, epoxidation, ozonolysis; polymerization.   Alkadienes Nomenclature - classification – isolated, conjugated and cumulated dienes; 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 – polymerisation – polybutadiene, polyisoprene (natural rubber), vulcanisation, polychloroprene.   Alkynes Nomenclature; general methods of preparation, properties and reactions; acidic nature of terminal alkynes and acetylene, polymerisation and isomerisation.  Cycloalkanes: Nomenclature, Relative stability of cycloalkanes, Bayer’s strain theory and its limitations. Conformational analysis of cyclohexane, mono and di substituted cyclohexanes. Geometrical isomerism in cyclohexanes.  |

|  |  |
| --- | --- |
|  | UNIT-V 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. Mono substituted and disubstituted benzene - Effect of substituent – orientation and reactivity. Polynuclear Aromatic hydrocarbons: Naphthalene – nomenclature, Haworth synthesis; physical properties, reactions – electrophilic substitution reaction, nitration, sulphonation, halogenation, Friedel – Crafts acylation & alkylation, preferential substitution at  - position – reduction, oxidation – uses. Anthracene – synthesis by Elbs reaction, Diels – Alder reaction and Haworth synthesis; physical properties; reactions - Diels-Alder reaction, preferential substitution at C-9 and C-10; uses.   |
| Extended Professional Component (is a part of internal component only, Not to be included in the external examination question paper) | Questions related to the above topics, from various competitive examinations UPSC/JAM /TNPSC others to be solved (To be discussed during the Tutorial hours)   |
| Skills acquired from this course  | Knowledge, Problem solving, Analytical ability, Professional Competency, Professional Communication and Transferable skills.  |
| Recommended Text  | 1. Madan R D, Sathya Prakash, (2003), Modern Inorganic Chemistry, 2nded,

S.Chand and Company, New Delhi. 1. Sathya Prakash, Tuli G D,Basu S K and Madan R D, (2003), Advanced Inorganic Chemistry, 17th ed., S.Chand and Company, New Delhi.
2. Bahl B S, Arul Bhal, (2003), Advanced Organic Chemistry, 3rd ed., S.Chand and Company, New Delhi.
3. Tewari K S, Mehrothra S N and Vishnoi N K, (1998), Text book of Organic Chemistry, 2nd ed., Vikas Publishing House, New Delhi.
4. Puri B R, Sharma L R, (2002), Principles of Physical Chemistry, 38th ed., Vishal Publishing Company, Jalandhar.

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| Reference Books  | 1. Maron S H and Prutton C P, (1972), Principles of Physical Chemistry, 4th ed., The Macmillan Company, Newyork.
2. Barrow G M, (1992), Physical Chemistry, 5th ed., Tata McGraw Hill, New Delhi.
3. Lee J D, (1991), Concise Inorganic Chemistry, 4thed., ELBS William Heinemann, London.
4. Huheey J E, (1993), Inorganic Chemistry: Principles of Structure and Reactivity, 4th ed., Addison Wesley Publishing Company, India.
5. Gurudeep Raj, (2001), Advanced Inorganic Chemistry Vol – I, 26th ed., Goel Publishing House, Meerut.
6. Agarwal O P, (1995), Reactions and Reagents in Organic Chemistry, 8thed., Goel Publishing House,Meerut.

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| Website and e-learning source  | https://onlinecourses.nptel.ac.inhttp://cactus.dixie.edu/smblack/chem1010/lecture\_notes/4B.html http://www.auburn.edu/~deruija/pdareson.pdfhttps://swayam.gov.in/course/64 -atomic-structure-and-chemical-bonding MOOC components http://nptel.ac.in/courses/104101090/ Lecture 1: Classification of elements and periodic properties http://nptel.ac.in/courses/104101090/   |

Course Learning Outcomes (for Mapping with POs and PSOs)

On completion of the course the students should be able to

CO1: 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: discuss the periodic properties of sand p- block elements, reactions of aliphatic and aromatic hydrocarbons and strength of acids

CO3: classify hydrocarbons, types of reactions, acids and bases, examine the properties s and p-block elements, reaction mechanisms of aliphatic and aromatic hydrocarbons CO4: explain theories of acids, bases and indicators, buffer action and important compounds of s-block elements

CO5: assess the application of hard and soft acids indicators, buffers, compounds of s and p- block elements and hydrocarbons

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|   | PO1  | PO2  | PO3  | PO4  | PO5  | PO6  | PO7  | PO8  | PO9  | PO10  |
| CO1  | S  | S  | S  | S  | S  | S  | S  | M  | S  | M  |
| CO2  | M  | S  | S  | S  | M  | S  | S  | M  | M  | M  |
| CO3  | S  | S  | S  | M  | S  | S  | S  | M  | S  | M  |
| CO4  | S  | S  | S  | S  | S  | S  | S  | M  | M  | M  |
| CO5  | S  | M  | S  | S  | S  | S  | S  | M  | M  | S  |

 CO-PO Mapping (Course Articulation Matrix)

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| CO /PO  | PSO1  | PSO2  | PSO3  | PSO4  | PSO5  |
| CO1  | 3  | 3  | 3  | 3  | 3  |
| CO2  | 3  | 3  | 3  | 3  | 3  |
| CO3  | 3  | 3  | 3  | 3  | 3  |
| CO4  | 3  | 3  | 3  | 3  | 3  |
| CO5  | 3  | 3  | 3  | 3  | 3  |
| Weightage  | 15  | 15  | 15  | 15  | 15  |
| Weighted percentage of Course Contribution to Pos  | 3.0  | 3.0  | 3.0  | 3.0  | 3.0  |

Level of Correlation between PSO&CO

|  |  |
| --- | --- |
| Title of the Course  | QUALITATIVE ORGANIC ANALYSIS AND PREPARATION OF ORGANIC COMPOUNDS  |
| Paper No.  | Core IV -Practical |
| Category  | Core  | Year  | I  | Credits  | 3 | Course Code  |  23UICHP24 |
| Semester  | II  |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Instructional hours per week  | Lecture  | Tutorial  | Lab Practice  | Total  |
| -  |  | 3 | 53 |
| Prerequisites  | General Chemistry II  |
| Objectives of the course  | This course aims at providing knowledge on * laboratory safety
* handling glass wares
* analysis of organic compounds
* preparation of organic compounds

  |
| Course Outline  | UNIT I Safety rules, symbols and first-aid in chemistry laboratory Basic ideas about Bunsen burner, its operation and parts of the flame. Chemistry laboratory glassware –basis information and uses   |
| Unit II  Qualitative Organic Analysis Preliminary examination, detection of special elements - nitrogen, sulphur and halogens Aromatic and aliphatic nature, Test for saturation and unsaturation, identification of functional groups using solubility tests Confirmation of functional groups * monocarboxylic acid, dicarboxylic acid
* monohydric phenol, polyhydric phenol
* aldehyde, ketone, ester
* carbohydrate (reducing and non-reducing sugars)
* primary, secondary, tertiary amine
* monoamide, diamide, thioamide
* anilide, nitro compound
* Preparation of derivatives for functional groups
 |
| UNIT III  Preparation of Organic Compounds 1. Nitration - picric acid from Phenol
2. Halogenation - p-bromo acetanilide from acetanilide
3. Oxidation - benzoic acid from Benzaldehyde
4. Microwave assisted reactions in water:
5. Methyl benzoate to Benzoic acid
6. Salicylic acid from Methyl Salicylate
7. Rearrangement - Benzil to Benzilic Acid
8. Hydrolysis of benzamide to Benzoic Acid

   |
|  | Unit-IV Separation and Purification Techniques (Not for Examination) 1. Purificationof organic compounds by crystallization (from water / alcohol) and distillation
2. Determination of melting and boiling points of organic compounds.

3.Steam distillation - Extraction of essential oil from citrus fruits/eucalyptus leaves. 4. Chromatography (any one) (Group experiment)  (i) Separation of amino acids by Paper Chromatography  (ii)Thin Layer Chromatography - mixture of sugars / plant pigments /permanganate dichromate.  (iii) Column Chromatography - extraction of carotene, chlorophyll and xanthophyll from leaves / separation of anthracene - anthracene picrate. 1. Electrophoresis – Separation of amino acids and proteins.

 (Demonstration) 1. Isolation of casein from milk/Determination of saponification value of oil or fat/Estimation of acetic acid from commercial vinegar. (Any one Group experiment) (4,5& 6–not for ESE)

  |
| Reference Books  | 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.

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| Website and e-learning source  |  <https://www.vlab.co.in/broad-area-chemical-sciences>  |
| Scheme of Valuation Max. marks(75)Record :10 Marks Preparation :15 MarksRecrystallisation :05 MarksOrganic Qualitative Analysis :45 MarksPreliminary Test :05 MarksDetection of Elements :05 MarksDetection of Functional Group :05 Marks Identification of the compound :05 MarksConfirmatory Test :15 Marks Derivatives preparation and its m.pt determination :10 Marks |

Course Learning Outcomes (for Mapping with POs and PSOs)

On completion of the course the students should be able to

CO1: observe the physical state, odour, colour and solubility of the given organic compound.

CO2: identify the presence of special elements and functional group in an unknown organic compound performing a systematic analysis.

CO3: compare mono and dicarboxylic acids, primary, secondary and tertiary amines, mono and diamides, mono and polyhydric phenols, aldehyde and ketone, reducing and non- reducing sugars and explain the reactions behind it.

CO4: exhibit a solid derivative with respect to the identified functional group.



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| CO /PO  | PSO1  | PSO2  | PSO3  | PSO4  | PSO5  |
| CO1  | 3  | 3  | 3  | 3  | 3  |
| CO2  | 3  | 3  | 3  | 3  | 3  |
| CO3  | 3  | 3  | 3  | 3  | 3  |
| CO4  | 3  | 3  | 3  | 3  | 3  |
| Weightage  | 12  | 12  | 12  | 12  | 12  |
| Weighted percentage of Course Contribution to Pos  | 3.0  | 3.0  | 3.0  | 3.0  | 3.0  |

Level of Correlation between PSO’s and CO’s

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| **Title of the****Course** | **DEPARTMENTAL ELECTIVE-II** |
| **Paper No.** | **ALLIED-II(Industrial Chemistry – II)** |
| **Category** | **Allied** | **Year** | I | **Credits** | 2 | **Course****Code** | **23UICHE25** |
| **Semester** | II |
| **Instructional hours per week** | **Lecture** | **Tutorial** | **Lab Practice** | **Total** |
| 2 | 1 | - | 3 |
| **Prerequisites** | Industrial chemistry I Practical |
| **Objectives of the** | To give insights into chemistry experiments for a beginner  |
| **Course** | 1. To understand the elaborate study of Fuels Introduction.
2. To study the basic concepts and Classification of Coal by Rank.
3. To know about the basic concepts of coking and gaseous fuels.
4. To have a knowledge of Liquid fuels and Refining of Gasoline.
5. To know the details of Residual fuel oils, Power alcohol.
 |
| **Course Outline** | UNIT-I: FUELS AND COMBUSTION:  * 1. Introduction - Classification of Fuels - Calorific Value – Theoretical Calculation of Calorific Value of a Fuel Gross calorific value and net calorific value – Characteristics of a Good Fuel - Solid fuels - Wood.
	2. **Coal** - Classification of Coal by Rank - Selection of Coal - Analysis of Coal and its significance
 |
|  | UNIT-II: **SOLID AND GASEOUS FUELS:**  |
|  | **2.1 Types of coking** - Types of Carbonization of Coal - Role of Sulphur in Coal - Role of Ash in coal.**2.2Gaseous fuels** - Producer Gas - Water Gas - Natural Gas – Oil Gas - Biogas - Components - Composition - preparation – advantages - disadvantages and applications of Coal gas - Gobar gas – LPG |
|  |  |
|  |  |
|  | UNIT-III: **LIQUID FUELS:** **3.1** Petroleum-Cracking - Advantages of catalytic cracking over thermal cracking - Synthetic Petrol. **3.2Refining of Gasoline** – Reforming - Knocking - Octane number of Gasoline - Diesel Engine Fuels - Diesel - Octane number of Diesel Oil - Diesel index.  |
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|  | UNIT-IV: **RESIDUAL FUEL OILS AND ANALYSIS OF FUELS:** |
|  | **4.1** Asphalt - Aviation fuel - advantages -Kerosene as a fuel. **4.2Analysis** and testing of liquid and gaseous fuels - Utilization of fuels - Solar power.  |
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| **UNIT V:** **5.1 Other sources of energy** – Electricity Power - Modern Concept of Fuel - Fuels for  Metallurgy.**5.2Power Alcohol** - Recent Advances In Fuel Technology. Alternative Fuels – Alcohols – Promising Bio fuel: An Alternative Source to Diesel and Gasoline - Control of Pollution in Refineries. |
| Extended Professional Component (is apart of internal componentonly, Not to be included in the external examinationQuestion paper) | Questions related to the above topics, from various competitive examinations UPSC/JAM/TNPSC others to be solved(To be discussed during the Tutorial hours) |
| Skills acquiredFrom this course | Knowledge, Problem solving, Analytical ability, ProfessionalCompetency, Professional Communication and Transferable skills. |
| **Recommended Text** | 1. E. Stocchi: 1990, Industrial Chemistry, Vol-I, Ellis Horwood Ltd; UK 2. J. A. Kent, 1997, Riegelís Handbook of Industrial Chemistry, CBS Publishers, 9th edition, New Delhi. 3. P. C. Jain, M. Jain, Engineering Chemistry, Dhanpat Rai & Sons, 15th edition, New Delhi. 4. A.K.De, Environmental Chemistry, New Age International Pvt; Ltd; 2nd edition,New Delhi.5. S.P. MAHAJAN: Pollution control in process industries, Tata McGraw-Hillpublishing Company Limited, New Delhi.  |
| **Reference Books** | 1. C.k. Varshney: Water Pollution and Management, Wiley Eastern Limited, Chennai.[2. Fundamentals of Industrial Chemistry,2019,Pharmaceuticals, Polymers, and Business,](https://www.amazon.com/dp/1118617568?tag=uuid10-20" \t "_blank)Rachida El Morabet, in [Encyclopedia of Environmental Health,Vol-II (Second Edition)](https://www.sciencedirect.com/referencework/9780444639523/encyclopedia-of-environmental-health),3 [Future industrial coal utilization: forecasts and emerging technological and regulatory issues](https://www.sciencedirect.com/science/article/pii/B9781782421160500049),J.K. Alderman, in [The Coal Handbook: Towards Cleaner Production: Coal Utilisation](https://www.sciencedirect.com/book/9781782421160/the-coal-handbook-towards-cleaner-production), 2013. |
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| **Course Learning Outcomes (for Mapping with Pos and PSOs) On completion of the course the students should be able to****CO1:** Describe the types of Calorific Value of Fuels. The Octane number of fuels.**CO2:** Demonstrate knowledge acquired in solar power.**CO3:** Write down applications of Gaseous fuels.**CO4:** Classify Alternative Fuels based on their function.**CO5:** Describe the advantages of Residual fuel oil. |

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|  | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** |
| **CO1** | S | S | S | S | S | S | S | M | S | M |
| **CO2** | M | S | S | S | M | S | S | M | M | M |
| **CO3** | S | S | S | M | S | S | S | M | S | M |
| **CO4** | S | S | S | S | S | S | S | M | M | M |
| **CO5** | S | M | S | S | S | S | S | M | M | S |

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| --- | --- | --- | --- | --- | --- |
| **CO/PSO** | **PSO1** | **PSO2** | **PSO3** | **PSO4** | **PSO5** |
| **CO1** | 3 | 3 | 3 | 3 | 3 |
| **CO2** | 3 | 3 | 3 | 3 | 3 |
| **CO3** | 3 | 3 | 3 | 3 | 3 |
| **CO4** | 3 | 3 | 3 | 3 | 3 |
| **CO5** | 3 | 3 | 3 | 3 | 3 |
| **Weightage** | 15 | 15 | 15 | 15 | 15 |
| **Weighted percentage of Course Contribution to Pos** | 3.0 | 3.0 | 3.0 | 3.0 | 3.0 |

**Level of Correlation between PSO’s and CO’s**

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| --- | --- |
| **Title of the Course**  | **DEPARTMENTAL ELECTIVE (INDUSTRIAL CHEMISTRY PRACTICAL – II)** |
| **Paper No.**  |  **Allied Practical – II** |
| **Category** | **Allied-Practical** | **Year** | **I** | **Credits** | **1** | **Course Code** | **23UICHP24** |
| **Semester** | **II** |
| **Instructional hours per week** | **Lecture**  | **Tutorial** |  | **Lab Practice** | **Total** |  |
| **-** |  |  | **2** | **2** |
| **Prerequisites** | **Higher Secondary Chemistry Practical** |
| **Objectives of the course** | * To enable the learners to apply the principle in total dissolved solids, and suspended solids in the given water sample.
* To analyze samples with the best utilization of techniques that provides structural information.
* To get in-depth knowledge to determine the acid-neutralizing power of a commercially available antacid tablet.
* To understand the principles of standardizing a solution of the base using the analytical technique known as titration.
* To know about the practical applications of calcium in chalk - Permanganometry and pH .
 |
| **Course Outline**  | 1. Estimation of total dissolved solids in the given water sample (**TDS**) (Only for demonstration)
2. Estimation of total suspended solids in the given water sample (**TS**S) (Only for demonstration) .
3. Determination of total permanent and temporary hardness of water using EDTA.
4. Determination of acetic acid in commercial vinegar using NaOH.
5. Determination of alkali content in antacid tablet using HCl.
6. Estimation of calcium in chalk - Permanganometry.
 |
| **Extended Professional Component (is a part of internal component only, Not to be included in the external examination question paper)**  | Questions related to the above topics, from various competitive examinations UPSC/JAM /TNPSC others to be solved (To be discussed during the Tutorial hours) |
| **Skills Acquired****From this Course** | Knowledge Problem solving, Analytical ability, ProfessionalCompetency, Professional Communication and Transferable skills. |
| **Recommended Text** | 1. J.Bessett et al, **Text Books of Quantitative Chemical Analysis”, 5th edition ELBS, Longmann, UK,1989.**
2. Practical Biochemistry- David Plummer-2005, Tata McGraw-Hills Publishing Company.
3. Vogel’s textbook of chemical analysis
4. . Practical chemistry - A.O. Thomas - Scientific book centre, Cannonade.
5. Practical chemistry - S. Sundaram - 3 Volumes - S. Viswanathan
6. Vogel’s text book of practical organic chemistry – Longman
7. V.V. Eamanujam, inorganic qualitative Analysis.

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| **Reference Books** | 1. P. C. Jain, M. Jain: Engineering Practaical Chemistry, Dhanpat Rai & Sons, Delhi.
2. R. Gopalan, D. Venkappayya, S. Nagarajan: Engineering Chemistry, Vikas Publications, New Delhi.
3. B. K. Sharma: Engineering Chemistry, Goel Publishing House, Meerut.
4. S. C. Bhatia: Chemical Process Industries, Vol. I & II, CBS Publishers, New Delhi.
 |
| **Website and****e-learning source** | https://www.vlab.co.in/broad-area-chemical-sciences [www.epgpathshala.nic.in](http://www.epgpathshala.nic.in/) [www.nptel.ac.in](http://www.nptel.ac.in/)http:/swayam.gov.in |
| **Course Outcomes:** | **Course Outcomes :** On Completion of the Practical the students shouldbe able to**CO1:**  Understand the basic concepts of water pollution. **CO2:** Understand different types of solids in the given water sample.**CO3:** Understand various environmental factors that effect on water**CO4:**  Analyse different type of model to understand antacid tablet**CO5:** Educated in various measurements and monitoring techniques of  analytical titration. |

Scheme of Valuation:

Internal assessment: 25 Marks

External assessment: 75 Marks

Total: 100 Marks

Record: 15 Marks

Procedure: 10 Marks

Error upto

 2 % : 50

 2.1 – 3 % : 40

 3.1 – 4 % : 30

 4.1 – 5 % : 20

 >5 % : 10

For incomplete or wrong calculation deduction 20 % of total marks scored.

For no calculation deduct 40% of total marks scored.

For each arithmetic error deduct I mark.

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| --- | --- | --- | --- | --- | --- |
| **CO/PSO** | **PSO1** | **PSO2** | **PSO3** | **PSO4** | **PSO5** |
| **CO1** | 3 | 3 | 3 | 3 | 3 |
| **CO2** | 3 | 3 | 3 | 3 | 3 |
| **CO3** | 3 | 3 | 3 | 3 | 3 |
| **CO4** | 3 | 3 | 3 | 3 | 3 |
| **CO5** | 3 | 3 | 3 | 3 | 3 |
| **Weightage** | 15 | 15 | 15 | 15 | 15 |
| **Weighted percentage of Course Contribution to PSOs** | 3.0 | 3.0 | 3.0 | 3.0 | 3.0 |

**Level of Correlation between PSO’s and CO’s**

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| --- | --- | --- | --- | --- | --- |
| **CO/PO** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** |
| **CO1** | 3 | 3 | 3 | 3 | 3 |
| **CO2** | 3 | 3 | 3 | 3 | 3 |
| **CO3** | 3 | 3 | 3 | 3 | 3 |
| **CO4** | 3 | 3 | 3 | 3 | 3 |
| **CO5** | 3 | 3 | 3 | 3 | 3 |
| **Weightage** | 15 | 15 | 15 | 15 | 15 |
| **Weighted percentage of Course Contribution to PSOs** | 3.0 | 3.0 | 3.0 | 3.0 | 3.0 |

**Level of Correlation between PO’s and CO’s**

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| --- | --- |
| Title of the Course  | DAIRY CHEMISTRY  |
| Paper No.  | SEC- II  |
| Category  | NME-II | Year  | I  | Credits  | 2  | Course Code  | 23UCHES26 |
| Semester  | II  |
| Instructional hours per week  | Lecture  | Tutorial  | Lab Practice  | Total  |
| 2  | -  | -  | 2  |
| Prerequisites  | Higher secondary chemistry  |
| Objectives of the course  | This course aims at providing an overall view of the * chemistry of milk and milk products
* processing of milk
* preservation and formation of milk products.
 |
| Course Outline  | UNIT I Composition of Milk Milk-definition-general composition of milk- constituents of milk - lipids, proteins, carbohydrates, vitamins and minerals - physical properties of milk - colour, odour, acidity, specific gravity, viscosity and conductivity -Factors affecting the composition of milk - adulterants, preservatives with neutralizer- examples and their detection- estimation of fat, acidity and total solids in milk.  |
| Unit II 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.  |
| UNIT III Major Milk Products Cream - definition - composition - chemistry of creaming process - gravitational and centrifugal methods of separation of cream - estimation of fat in cream. Butter - definition -composition - theory of churning – desi butter - salted butter, estimation of acidity and moisture content in butter. Ghee - major constituents - common adulterants added to ghee and their detection - rancidity - definition - prevention - antioxidants and synergists - natural and synthetic.  |
| UNIT IV Special Milk Standardised milk - definition - merits - reconstituted milk - definition - flow diagram of manufacture - Homogenised milk - flavoured milk - vitaminised milk - toned milk -Incitation milk - Vegetable toned milk - humanized milk - condensed milk - definition, composition and nutritive value.  |
|  | UNIT V Fermented and other Milk Products Fermented milk products – fermentation of milk - definition, conditions, cultured milk - definition of culture - example, conditions - cultured cream, butter milk - Bulgarious milk -acidophilous milk – YoheerIndigeneous products- khoa and chhena definition - Ice cream -definition-percentage composition-types-ingredients-manufacture of ice–cream, stabilizers emulsifiersandtheirrole-milkpowder-definition-needformakingmilkpowderdryingprocess-types of drying.  |

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| Recommended Text  | 1. K. Bagavathi Sundari, Applied Chemistry, MJP Publishers, first edition, 2006.
2. K. S. Rangappa and K.T. Acharya, Indian Dairy Products, Asia Publishing House New Delhi, 1974.

3.Text book of dairy chemistry, M.P. Mathur, D. Datta Roy, P. Dinakar, Indian Council of Agricultural Research, 1 st edition, 2008. 1. A Text book of dairy chemistry, Saurav Singh, Daya Publishing house, 1 st edition,2013.
2. Text book of dairy chemistry, P. L. Choudhary, Bio-Green book publishers, 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, 1980.
4. P.F.Fox and P.L.H. Mcsweeney, Dairy Chemistry and Biochemistry, Springer, Second edition, 2016.
5. Dairy chemistry and biochemistry, P. F. Fox, T. Uniacke-Lowe, P.L.H. McSweeney, J.A. OMahony, Springer, Second edition, 2015.
 |
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Course Learning Outcomes (for Mapping with POs and PSOs)

On completion of the course the students should be able to

CO 1: understand about general composition of milk – constituents and its physical properties. CO 2: acquire knowledge about pasteurization of Milk and various types of pasteurization - Bottle, Batch and HTST Ultra High Temperature Pasteurization.

CO 3: learn about Cream and Butter their composition and how to estimate fat in cream and Ghee

CO 4: explain about Homogenized milk, flavoured milk, vitaminised milk and toned milk. CO 5: have an idea about how to make milk powder and its drying process - types of drying process.



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| --- | --- | --- | --- | --- | --- |
| CO /PO  | PSO1  | PSO2  | PSO3  | PSO4  | PSO5  |
| CO1  | 3  | 3  | 3  | 3  | 3  |
| CO2  | 3  | 3  | 3  | 3  | 3  |
| CO3  | 3  | 3  | 3  | 3  | 3  |
| CO4  | 3  | 3  | 3  | 3  | 3  |
| CO5  | 3  | 3  | 3  | 3  | 3  |
| Weightage  | 15  | 15  | 15  | 15  | 15  |
| Weighted percentage of Course Contribution to Pos  | 3.0  | 3.0  | 3.0  | 3.0  | 3.0  |

 Level of Correlation between PSO’s and CO’s