

K.T.S.P.Mandal's
Hutatma Rajguru Mahavidyalaya, Rajgurunagar
Annual Report
Department of chemistry 2024-25

Program Outcomes

PO NO	PO Statement After completing the Bachelor of Science Program, students will be able to-	Knowledge and Skill
PO-1	Gain a thorough knowledge and understanding of concepts and principles in Chemistry and other subjects.	Disciplinary knowledge
PO-2	Communicate the subject knowledge in a clear and simple manner in writing and oral.	Communication skill
PO-3	Identify the given problem and apply, theories/assumptions for solving the same related to real life situations	Critical thinking & problem solving
PO-4	Plan, execute, interpret and report the results of the experiments to investigate.	Research related skill
PO-5	Work effectively and respectfully as a team member in the classroom, laboratory and field-based situations	Co-operation /Teamwork
PO-6	Correlate the ideas, evidences and experiences to analyze and interpret the scientific information with learned scientific reasoning	Scientific reasoning
PO-7	Get sensibly aware with the subject facts that can be applied for the society.	Reflective thinking
PO-8	Apply modern library search tools to locate, retrieve, and evaluate subject-related information.	Information /digitally Literacy
PO-9	Identify the subject resources required for a project and manage different projects.	Self-directed learning
PO-10	Motivate and inspire other colleagues/students in the subject-related activities.	Leadership readiness / Qualities
PO-11	Inculcate continuous learning habit through multiple Techniques	Lifelong readiness /qualities

Program Specific Outcomes

PO NO	PSO Statement	Knowledge and Skill
	After completing the Bachelor of Science in Chemistry, students will be able to-	
PSO-1	Demonstrate comprehensive knowledge and understanding of core principles, theories, and concepts in chemistry.	Disciplinary knowledge
PSO-2	Apply critical thinking skills to analyze complex chemical phenomena, evaluate experimental data, and propose innovative solutions to theoretical and practical problems in chemistry	Critical thinking & problem solving
PSO-3	Utilize resources such as textbooks, scientific literature, online courses, and professional networks to pursue self-directed learning and stay abreast of recent advancements in chemistry.	Self-directed learning
PSO-4	Utilize digital tools, software, and databases effectively for literature research, data analysis, simulation, and visualization in chemistry.	Digitally literacy
PSO-5	Exhibit leadership qualities and interpersonal skills essential for collaboration, teamwork, and effective communication within multidisciplinary research teams and professional environments.	Leadership
PSO-6	Demonstrate readiness for professional practice or further education in chemistry by exhibiting qualities such as adaptability, resilience, professionalism, and a commitment to lifelong learning.	Readiness/qualities

Course Outcomes

CHE-201-MJ-T: Physical Chemistry-I

At the end of the course student will be able to

1. Remember definitions, laws, and formulas related to reaction kinetics, thermodynamics, electrolytic conductance, and phase equilibrium.
2. Understand the rate laws of third-order reactions, thermodynamic concepts like entropy and free energy, ionic conductance, and phase diagrams.
3. Solve numerical problems using the Arrhenius equation, entropy changes, conductance laws, phase rule etc .
4. Compare methods for determining reaction order, thermodynamic processes, and conductance and phase systems.
5. Assess reaction mechanisms, thermodynamic feasibility, and conductance behavior of electrolytes.
6. Summarize the effect of temperature on reaction rate, phase stability, or ion mobility in solution.

CHE-202-MJ-T: Inorganic Chemistry-I

The end of the course, student will be able to

1. Learn key terms and concepts such as types of ligands, isomerism, hybridization, d-orbital shapes, and theories like VBT and CFT.
2. Explain the principles of coordination bonding, types of isomerism, and the structural implications of VBT and CFT in coordination compounds.
3. Apply VBT and CFT to predict geometry, magnetic properties, and hybridization of coordination complexes.
4. Compare types of isomerism and interpret orbital splitting patterns in octahedral, tetrahedral, and square planar complexes.
5. Determine the magnetic moment, ligand field strength and geometry of complexes.
6. Summarize the coordination compounds according to their geometry, spin state, and ligand environment using CFT and VBT concepts.

CHE-203-MJP: Chemistry Practical- III

At the end of the course, student will be able to learn,

1. Know the experimental procedures, formulas, and theoretical principles related to kinetics, thermodynamics, conductance, and coordination chemistry.
2. Understand the principles behind rate laws, enthalpy changes, conductometric titrations, colorimetry, and coordination complex formation.
3. Perform laboratory experiments to determine reaction order, heat changes, cell constants, and synthesize coordination compounds.
4. Analyze the reaction rates, calculate thermodynamic parameters, determine ligand ratios, and analyze chromatographic separations.
5. Evaluate the accuracy of results by comparing with theoretical values, validate Beer's Law, and evaluate coordination complex properties like color and magnetism.
6. Design experiments for synthesis, analysis, and characterization of coordination compounds.

CHE-251-MJ-T: Organic Chemistry-I

At the end of the course, student will be able to learn,

1. Recall basic concepts of acidity, basicity, reaction mechanisms, oxidation, reduction, and stereochemistry.
2. Explain the mechanisms of organic reactions involving halides, oxidizing and reducing agents, and stereochemical outcomes in cyclic systems.
3. Apply knowledge of acidity, basicity, nucleophilic substitution, oxidation, reduction, and stereochemical principles to predict the behavior of organic compounds.
4. Analyze reaction mechanisms, reactivity trends of halogenated hydrocarbons, and stability of substituted cyclohexane conformations.
5. Evaluate the choice of reagents and reaction conditions for achieving specific transformations in organic synthesis.
6. Develop synthetic strategies using organic reactions and stereochemical concepts.

CHE-252-MJ-T: Analytical Chemistry-I

At the end of the course, students will be able to

1. Learn concepts, definitions, and reagents used in volumetric analysis, colorimetry, chromatography, and solvent extraction.
2. Explain the principles of titrations, Beer-Lambert law, chromatographic separation, and solvent extraction mechanisms.
3. Use standard analytical techniques to determine concentrations of substances through titration, colorimetry, chromatography, and extraction.
4. Interpret titration curves, calibration plots, chromatograms, and extraction efficiencies to assess analytical results.
5. Compare the accuracy, precision, and suitability of analytical techniques like redox titrations vs. complexometry or paper chromatography vs. TLC.
6. Perform an analytical procedure of titrimetric, colorimetric, or extraction methods to determine unknown concentrations in a sample.

CHE-253-MJP: Chemistry Practical – IV

At the end of the course, student will be able to

1. Remember the fundamental concepts, reagents, and functional group tests used in organic estimation, preparation, and volumetric analysis.
2. Explain the principles behind organic reactions, separation techniques, and titration methods used in qualitative and quantitative analysis.
3. Perform organic synthesis, separation of binary mixtures, and estimations using volumetric and chromatographic methods in laboratory settings.
4. Differentiate between organic functional groups in mixtures, interpret chromatograms, and analyze titration results to identify and quantify substances.
5. Assess the purity and identity of synthesized or separated compounds using melting point, TLC, and confirmatory tests; validate volumetric results through standardization.
6. Execute multi-step analytical procedures combining organic preparation, separation, and titration.

CHE-221-VSC-T: Industrial Chemistry-I

At the end of the course, student will be able to

1. Remember the definitions, industrial processes, pollution norms, raw materials, and key chemical manufacturing techniques used in large- and small-scale industries.
2. Understand the principles behind unit operations, pollution control technologies, green chemistry approaches, and the roles of industrial and plant chemists.
3. Apply knowledge of industrial processes like distillation, crystallization, and polymerization to real-world chemical production systems
4. Compare unit operations and unit processes, renewable vs. non-renewable resources, and heavy vs. fine chemical manufacturing.
5. Assess the environmental impact of industrial processes by interpreting pollution control standards (CPCB, EPA) and recommending improvements through green chemistry.
6. Design sustainable chemical production workflows that incorporate energy-efficient unit operations and eco-friendly purification methods for fine chemicals.

CHE-271-VSC-P: Industrial Chemistry Practical-I

At the end of the course, student will be able to

1. Learn basic concepts of industrial preparations, qualitative estimations, and pollution control techniques used in chemical laboratories and industries.
2. Explain the principles behind organic synthesis, water hardness estimation, and environmental sampling methods including their industrial significance.
3. Demonstrate the preparation of industrially important compounds like paracetamol and dyes, and perform titrimetric analysis for water and soil quality assessment.
4. Compare experimental results to evaluate chemical purity, water salinity, and environmental parameters using field and lab-based methods.
5. Evaluate the efficiency of pollution indicators, safety protocols, and synthetic routes based on lab outcomes and industrial practices.
6. Design and present a project/report synthesizing learnings from industrial visits and practical's to propose improvements in industrial or environmental chemical practices.

CHE-241-MN-T: Physical and Inorganic Chemistry

At the end of the course, student will be able to

1. Learn key concepts such as the laws of thermodynamics, electrolytic conductance, and definitions related to coordination chemistry.
2. Know thermodynamic processes, conductivity variations, and bonding theories in coordination compounds.
3. Use formulas and concepts to calculate entropy changes, conductance values, and oxidation states in complexes.
4. Differentiate between various chemical processes like isothermal vs. adiabatic expansion, strong vs. weak electrolytes, and inner vs. outer orbital complexes.
5. Examine the effectiveness of theoretical models such as VBT and determine the feasibility of chemical processes based on thermodynamic and conductivity data.
6. To investigate conductance behavior or predict geometry and magnetism in coordination complexes.

CHE-242-MNP: Physical and Inorganic Chemistry Practical

At the end of the course, student will be able to learn,

1. Recall experimental procedures, formulas, and theoretical principles related to kinetics, thermodynamics, conductance, and coordination chemistry.
2. Explain the principles behind rate laws, enthalpy changes, conductometric titrations, colorimetry, and coordination complex formation.
3. Perform laboratory experiments to determine reaction order, heat changes, cell constants, and synthesize coordination compounds.
4. Interpret experimental data to evaluate reaction rates, calculate thermodynamic parameters, determine ligand ratios, and analyze chromatographic separations.
5. Assess accuracy of results by comparing with theoretical values, validate Beer's Law, and evaluate coordination complex properties like color and magnetism.
6. Design and conduct experiments for synthesis, analysis, and characterization of coordination compounds.

CHE-291-MN-T: Organic and Analytical Chemistry

At the end of the course, student will be able to learn,

1. Learn types of halogenated hydrocarbons, definitions, principles, and classification of titrations, chromatography techniques, acid-base theories, and .
2. Understand the theory behind the mechanisms of nucleophilic substitution and elimination, volumetric and chromatographic techniques.
3. Determine the acidity and basicity of organic compounds, prepare and standardize solutions of different concentration.
4. Differentiate between substitution mechanisms (SN1 vs. SN2), including the influence of structural and electronic factors, and types of titrations (e.g., redox vs. complexometric), chromatographic techniques.
5. Investigate the reactivity of halogenated hydrocarbons and suitability of indicators, titration methods, and chromatographic techniques for given analytical tasks.
6. Categorize the organic compounds based on their structure and reactivity, titration or chromatography techniques.

CHE-292-MNP: Organic and Analytical Chemistry Practical

At the end of the course, student will be able to

1. Remember the fundamental concepts, reagents, and functional group tests used in organic estimation, preparation, and volumetric analysis.
2. Explain the principles behind organic reactions, separation techniques, and titration methods used in qualitative and quantitative analysis.
3. Perform organic synthesis, separation of binary mixtures, and estimations using volumetric and chromatographic methods in laboratory settings.
4. Differentiate between organic functional groups in mixtures, interpret chromatograms, and analyze titration results to identify and quantify substances.
5. Assess the purity and identity of synthesized or separated compounds using melting point, TLC, and confirmatory tests; validate volumetric results through standardization.
6. Execute multi-step analytical procedures combining organic preparation, separation, and titration to solve real-world chemistry problems.

OE-201-CHE-T: Chemistry of Cosmetics and Perfumes-I

At the end of the course, student will be able to

1. Remember the classification, ingredients, and historical background of cosmetics and perfumes.
2. Understand the functions and composition of skin and hair care products including cleansers, shampoos, and conditioners.
3. Apply the knowledge of cosmetic ingredients and formulations to identify appropriate products for various skin and hair types.
4. Differentiate between types of cosmetic products such as moisturizers, hair colorants, sunscreens, and understand their ingredient functions.
5. Assess the significance of natural and synthetic ingredients in perfumes and essential oils based on their chemical properties and roles.
6. Design a basic cosmetic formulation, such as a herbal skin cream or a fragrance blend, incorporating suitable ingredients and essential oils.

OE-202-CHE-T: Dairy Chemistry

At the end of the course, student will be able to

1. Remember the composition of milk from various animals and identify key components such as proteins, fats, lactose, vitamins, and minerals.
2. Explain the functional roles of milk constituents in nutrition and dairy product processing such as coagulation and fermentation.
3. Apply knowledge of milk composition to detect adulteration and interpret changes in physicochemical properties like pH, viscosity, and acidity.
4. Differentiate between the types and functions of milk proteins and fats in the preparation of dairy products like cheese, butter, and yogurt.
5. Assess the quality and nutritional value of various dairy products by analyzing their chemical composition and processing methods.
6. Formulate or improve a dairy product (e.g., flavored yogurt or low-fat cheese) based on understanding of milk chemistry and processing techniques

OE-251-CHE-T: Chemistry of Cosmetics and Perfumes-II

At the end of the course, student will be able to

1. Recall key raw materials of herbal origin and classify various herbal cosmetics based on their use and form.
2. Explain the advantages of herbal cosmetics over synthetic products and describe the role of herbal ingredients in skincare, haircare, and oral hygiene.
3. Apply knowledge of herbal ingredients to identify suitable formulations for skin, hair, and dental care applications.
4. Differentiate between various herbal product forms and evaluate the function of individual ingredients in oral and topical formulations.
5. Assess the quality and effectiveness of herbal cosmetics and dental care products using standard evaluation criteria.
6. Design a basic herbal cosmetic or oral hygiene product by selecting appropriate herbal ingredients for specific cosmetic or therapeutic purposes.

OE-252-CHE-T: Agricultural Chemistry

At the end of the course, student will be able to

1. Recall the types, composition, and properties of soil, fertilizers, pesticides, and key terms related to agricultural chemistry.
2. Understand the role of agricultural chemistry in crop nutrition, soil fertility, and pest control.
3. Demonstrate the ability to carry out basic soil tests, fertilizer selection, and pest control techniques in an agricultural setting.
4. Compare the types of fertilizers and pesticides based on composition, use, and environmental impact.
5. Examine the impact of various agricultural inputs like fertilizers and pesticides on crop productivity and environmental safety.
6. Design a sustainable farming plan integrating organic practices, appropriate fertilizers, and pest control strategies.

CHE-201-IKS-T: Ancient Indian Chemistry

At the end of the course, student will be able to

1. Know the Indian Knowledge System and its significance in the protection of traditional knowledge.
2. Understand the need of the Indian Knowledge System (IKS) and significance of the ancient Indian Chemistry.
3. Relate the various concepts of ancient chemistry with the concepts of modern Chemistry.
4. Organize the contributions made by the ancient Indians in the field of Science and related concepts.
5. Evaluate the contribution of Indians in the development of chemistry.
6. Outline the chemistry heritage of ancient India.

SEC-251-CHE-P: Basic Software in Chemistry

At the end of the course, student will be able to

1. Name and draw structures of diverse organic compounds and determine their basic properties.
2. Illustrate key organic reactions (2,4-DNP, aldol, phthalimide) and their mechanisms.
3. Understand the fundamentals of computational chemistry (modeling, optimization, structure-property).
4. Build, analyze, and compare 3D molecular structures using visualization software.
5. Interpret periodic trends and predict chemical behavior using online resources.
6. Perform virtual titrations, solubility and basic thermodynamic calculations using online tools.

CHE-231-FP: Field Project

At the end of the course, student will be able to

1. Learn the fundamental chemistry concepts to real-world environmental and community.
2. Understand the appropriate methodologies for collecting chemical and environmental data through fieldwork.
3. Apply the chemistry concepts to real life problems or environments.
4. Analyse the experimental or observational data to derive meaningful conclusions about local chemical or environmental conditions.
5. Evaluate local problems through a scientific lens and suggest chemistry-based solutions or awareness strategies.
6. Prepare a scientific report and presentations based on their findings

CHE-281-CEP: Community Engagement Project (CEP)

At the end of the course, Student will be able to

1. Identify the chemical aspects of local community issues such as water quality, waste management, or household chemical safety.
2. Understand the societal issues and can provide a scientific solution.
3. Apply chemistry knowledge to promote awareness about safe chemical practices, sustainability, and green alternatives in daily life.
4. Analyse the effectiveness of community engagement activities based on feedback and participation data.
5. Assess the societal issues through the group-based outreach and community interactions.
6. Plan chemistry-related awareness activities such as demonstrations, campaigns, or surveys in schools or local communities

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PSO-5	Exhibit leadership qualities and interpersonal skills essential for collaboration, teamwork, and effective communication within multidisciplinary research teams and professional environments.	Leadership
PSO-6	Demonstrate readiness for professional practice or further education in chemistry by exhibiting qualities such as adaptability, resilience, professionalism, and a commitment to lifelong learning.	Readiness/qualities

Course Outcomes

CHE-101-T: Fundamentals of Chemistry-I

After the completion of this course, student will be able to

CO1: recall the fundamental concepts of the mole concept, atomic structure, organic chemistry, catalysis, and surface chemistry.

CO2: explain the principles of chemical stoichiometry, Hund's rule, Aufbau principle and catalysis.

CO3: utilize the knowledge of the mole concept, atomic structure, factors affecting the reactivity of organic compounds, and surface chemistry.

CO4: apply the principles of the mole concept, atomic structure, organic reactivity, catalysis, and surface chemistry to solve the problems.

CO5: evaluate the solutions based on their concentration, and organic structures based on their reactivity and surface chemistry.

CO6: propose solutions to problems related to organic chemistry reactions, catalysis mechanisms, and atomic structure concepts, and apply them to real-world scenarios.

CHE-102-P: Chemistry Practical -I

After the completion of this course, student will be able to-

CO-1: acquire basic knowledge of experiments of including adsorption, organic qualitative analysis, and inorganic preparations and estimations.

CO-2: utilize theoretical concepts to perform experiments, interpret data, and formulate conclusions.

CO-3: foster critical thinking abilities to assess and enhance the reliability and accuracy of experimental findings.

CO-4: report scientific findings of laboratory experiments.

CO-5: evaluate experimental outcomes to draw insightful conclusions.

CO-6: develop problem-solving skills.

SEC-101-CHE (A)-T Chemistry Laboratory Skills – I

After the completion of this course, student will be able to-

CO1: know the Lab Safety

CO2: demonstrate laboratory apparatus, equipments, reagents and laboratory techniques.

CO3: prepare reagents and solutions of various concentrations.

CO4: explain standard safety guidelines, apparatus, reagents, solvents, solutions and laboratory

techniques.

CO5: prepare solutions of various concentrations

CO6: design safe methods for laboratory techniques.

CHE-151-T: Fundamentals of Chemistry-II

After the completion of this course, student will be able to-

CO1: recall and explain the fundamental principles and concepts from Photochemistry, Chemical Kinetics, Periodicity, Stereochemistry, and Chemical Bonding.

CO2: identify experimental key concepts involved in Photochemistry, Chemical Kinetics, Periodicity, Stereochemistry, and Chemical Bonding.

CO3: draw conclusions about reaction mechanisms, kinetics, periodic trends, stereochemical relationships, and bonding properties.

CO4: apply the principles of Photochemistry, Chemical Kinetics, Periodicity, Stereochemistry,

and Chemical Bonding to solve complex problems and scenarios.

CO5: evaluate the significance of photochemical reactions, kinetic processes, periodicity, bonding theories like VBT and MOT and stereochemical structures.

CO6: propose solutions, and contribute to the advancement of scientific knowledge applications.

SEC-151 CHE (A)-T: Chemistry Laboratory Skills-II

After the completion of this course, student will be able to-

CO1: know the Lab Safety

CO2: demonstrate laboratory apparatus, equipments, reagents and laboratory techniques.

CO3: prepare reagents and solutions of various concentrations.

CO4: explain standard safety guidelines, apparatus, reagents, solvents, solutions and laboratory

techniques.

CO5: justify the filing and record systems.

CO6: create a standard operating procedure for working in a laboratory.