SHYAMPUR SIDDHESWARI MAHAVIDYALAYA

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(Affiliated to University of Calcutta)

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SHYAMPUR SIDDHESWARI MAHAVIDYALAYA
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Four – Year B.Sc. (Honours and Honours with Research) Courses of Studies (Under Curriculum & Credit framework, 2022

University of Calcutta

- Programme Outcome (PO)
- Programme Specific Outcome (PSO)
- Course Outcome (CO)
- CO-PO Mapping
- CO-PSO Mapping

Programme Outcome (PO)

PO 1: Disciplinary knowledge: A graduate student is expected to be capable of demonstrating comprehensive knowledge and understanding both theoretical and practical knowledge in all disciplines of Chemistry. Students can solve their subjective problems very methodically, independently and finally draw a logical conclusion. Further, the student will be capable of applying modern technologies, handling advanced instruments and Chemistry related soft-wares for chemical analysis, characterization of materials and in separation technology.

PO 2: Problem solving: Students will be able to think and apply evidence based comparative chemistry approach to explain chemical synthesis and analysis.

PO 3: Critical thinking: The course curriculum also includes components that can be helpful to graduate students to develop critical thinking and to design, carry out, record and analyze the results of chemical reactions.

PO 4: Research-related skills / Scientific reasoning: Students will demonstrate strong research-related skills by formulating research questions, designing experiments, and employing appropriate methodologies for data collection and analysis. They will exhibit scientific reasoning through critical evaluation of evidence, interpretation of results, and drawing logical conclusions, enabling them to address complex problems and contribute to advancements in their field.

PO 5: Communication Skills: The course curriculum has been designed in such a manner as to enabling a graduate student to become a skilled project manager by acquiring knowledge about chemistry project management, writing, planning, study of ethical standards and rules and regulations pertaining to scientific project operation.

PO 6: Cooperation/Teamwork: The course curriculum has been designed to provide opportunity to act as team player by contributing in laboratory, field based situation and industry.

PO 7: Information/digital literacy: The course curriculum has been so designed to impart a good working knowledge in understanding and carrying out data analysis, use of library search tools, use of chemical simulation software and related computational work.

PO 8: Self-directed learning: Students will demonstrate the ability to independently identify learning needs, set goals, and pursue knowledge using diverse resources. They will reflect on their learning process, adapt strategies as needed, and apply insights to achieve continuous personal and professional growth.

PO 9: Multicultural competence: Students will demonstrate multicultural competence by understanding diverse cultural perspectives, effectively communicating across cultures, and applying inclusive practices in professional settings to promote equity and collaboration.

PO 10: Moral and ethical awareness/reasoning: As an inhabitant of this green planet a Chemistry graduate student should have many social responsibilities. The course curriculum is designed to teach a Chemistry graduate student to follow the green routes for the synthesis of chemical compounds and also find out new greener routes for sustainable development. The course also helps them to understand the causes of environmental pollution and thereby applying environmental friendly policies instead of environmentally hazard ones in every aspect.

PO 11: Leadership readiness/qualities: Students will demonstrate leadership readiness by effectively communicating a vision, motivating teams, and fostering collaboration. They will exhibit critical thinking, problem-solving abilities, and emotional intelligence, enabling them to navigate challenges and drive positive change in diverse environments. This outcome prepares students for impactful leadership roles in their future careers.

PO 12: Lifelong learning: The course curriculum is designed to inculcate a habit of learning continuously through use of advanced ICT technique and other available e-techniques, e-books and e-journals for personal academic growth.

Programme Specific Outcome (PO)

PSO 1: Analytical skill development and job opportunity: Chemistry graduates are expected to possess sufficient knowledge how to synthesize a chemical compound and perform necessary characterization and analysis in support of the formation of the product by using modern analytical tools and advanced technologies. Because of this course curriculum chemistry graduates have lot of opportunity to get job not only in academic and administrative field but also in industry.

PSO 2: Research motivation: Chemistry graduates are expected to be technically well trained with modern devices and Chemistry based software and has powerful knowledge in different disciplines of Chemistry so they can easily involve themselves in theory and laboratory-based research activities.

PSO 3: Social Awareness: As an inhabitant of this green world it is our duty to make our planet clean and suitable for living to all. In this context Chemistry graduates are expected to be more aware about finding green chemical reaction routes for sustainable development. They are expected to maintain good laboratory practices and safety.

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Four – Year Chemistry Major Course Structure

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Course Code: CHEM-H-CC1-1 (Fundamentals of Chemistry - I) (Chemistry Honours, Honours with Research)

Course Outcome (CO): After undergoing the course, the student would be able to

CO1: Demonstrate fundamental knowledge of atomic structure, periodicity, thermodynamics, kinetics, and organic chemistry, including relevant principles.

CO2: Explain shielding, penetration, electronegativity, molecular interactions, stereochemistry, thermodynamic processes, and reaction mechanisms systematically.

CO3: Apply bonding theories, thermodynamic laws, and kinetic principles to solve chemical problems and predict behavior.

CO4: Analyze periodic trends, stereochemical representations, and reaction pathways using scientific reasoning and theoretical understanding.

CO5: Evaluate experimental data from acid-base, redox titrations, and reaction rates to interpret chemical and molecular behavior.

CO6: Perform accurate chemical experiments, including solution preparation and advanced analyses, ensuring procedural accuracy and critical problem-solving.

CO-PO-PSO Mapping:

Course Outcome	Programme Outcome (PO)												Programme Specific Outcome (PSO1)		
	PO 1: Disciplinary knowledge :	PO 2: Problem solving	PO 3: Critical thinking	PO 4.Research-related skills / Scientific reasoning	PO 5: Communication Skills	PO 6: Cooperation/Team work	PO 7: Information/digital literacy:	PO 8: Self-directed learning	PO 9: Multicultural competence	PO 10: Moral and ethical awareness /reasoning	PO 11: Leadership readiness/qualities	PO 12: Lifelong learning	PSO 1: Analytical skill development and job opportunity	PSO 2: Research motivation	PSO 3: Social Awareness
CO1	3	2	2	2	0	0	1	1	0	0	0	2	3	2	1
CO2	3	3	3	2	0	0	1	1	0	0	0	2	3	2	1
CO3	3	3	3	3	0	0	2	2	0	1	0	2	3	3	2
CO4	3	3	3	3	0	0	2	2	0	1	0	2	3	3	2
CO5	3	3	3	3	0	1	2	2	0	1	1	2	3	3	2
CO6	3	3	3	3	1	2	2	3	0	2	2	3	3	3	3
CO:	3.00	2.83	2.83	2.67	1.00	1.50	1.67	1.83	0.00	1.25	1.50	2.17	3.00	2.67	1.83

Course Code: CHEM-H-SEC1-1 (Quantitative Analysis and Basic Laboratory Practices) (Chemistry Honours, Honours with Research)

Course Outcome (CO): After undergoing the course, the student would be able to

CO1: Understand the principles of quantitative analysis, including measurement techniques, methods selection, error analysis, and statistical treatment of data.

CO2: Learn titrimetric methods including acid-base, redox, precipitation, and complexometric titrations, with a focus on applications and calculations.

CO3: Gain knowledge of gravimetric analysis, including theory, precipitation factors, and the use of organic reagents in inorganic analysis.

CO4: Understand water quality analysis, including the determination of impurities, standards, and water treatment technologies for different purposes.

CO5: Apply basic laboratory practices, including calibration of glassware, sampling, weighing, and safety measures in a chemical laboratory setting.

CO6: Demonstrate practical skills in performing titrations, instrument calibration, and analysis of soap alkali content through conductometric and other methods.

CO-PO-PSO Mapping:

Course Outcome	Programme Outcome (PO)												Programme Specific Outcome (PSO1)		
	PO 1: Disciplinary knowledge :	PO 2: Problem solving	PO 3: Critical thinking	PO 4.Research-related skills / Scientific reasoning	PO 5: Communication Skills	PO 6: Cooperation/Team work	PO 7: Information/digital literacy:	PO 8: Self-directed learning	PO 9: Multicultural competence	PO 10: Moral and ethical awareness /reasoning	PO 11: Leadership readiness/qualities	PO 12: Lifelong learning	PSO 1: Analytical skill development and job opportunity	PSO 2: Research motivation	PSO 3: Social Awareness
CO1	3	2	2	3	1	1	2	2	0	1	0	2	3	2	1
CO2	3	3	3	3	1	1	2	2	0	1	0	2	3	2	1
CO3	3	3	3	3	0	0	2	2	0	1	0	2	3	3	2
CO4	3	3	3	3	0	1	2	2	0	2	0	2	3	3	2
CO5	3	3	3	3	1	3	3	3	0	3	1	3	3	3	3
CO6	3	3	3	3	1	3	3	3	0	3	2	3	3	3	3
CO:	3.00	2.83	2.83	3.00	1.00	1.80	2.33	2.33	0.00	1.83	1.50	2.33	3.00	2.67	2.00

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Course Code: CHEM-H-CC2-2 (Fundamentals of Chemistry - II) (Chemistry Honours, Honours with Research)

Course Outcome (CO): After undergoing the course, the student would be able to

CO1: Describe gas behavior, kinetic theory, Maxwell's distribution, collisions, and real gas deviations using van der Waals and virial equations.

CO2: Explain ionic and covalent bonding, lattice energy, hybridizations, VSEPR theory, molecular shapes, and multiple bond characteristics.

CO3: Analyze chirotopicity, stereogenicity, R/S and E/Z descriptors, racemization, resolution, and optical properties of chiral compounds.

CO4: Discuss reactive intermediates, reaction thermodynamics, and kinetics using enthalpy, entropy, activation energy, and Hammond's postulate.

CO5: Illustrate mechanisms of free-radical substitution reactions, halogenation, reactivity-selectivity, and stereochemistry with evidence-based insights.

CO6: Perform quantitative analysis of compounds using titrimetric methods, metal content estimation, and iodimetric techniques for practical applications.

CO-PO-PSO Mapping:

Course Outcome	Programme Outcome (PO)												Programme Specific Outcome (PSO1)		
	PO 1: Disciplinary knowledge :	PO 2: Problem solving	PO 3: Critical thinking	PO 4.Research-related skills / Scientific reasoning	PO 5: Communication Skills	PO 6: Cooperation/Team work	PO 7: Information/digital literacy:	PO 8: Self-directed learning	PO 9: Multicultural competence	PO 10: Moral and ethical awareness /reasoning	PO 11: Leadership readiness/qualities	PO 12: Lifelong learning	PSO 1: Analytical skill development and job opportunity	PSO 2: Research motivation	PSO 3: Social Awareness
CO1	3	3	3	3	1	1	2	2	0	1	0	2	3	2	1
CO2	3	3	3	3	1	1	2	2	0	1	0	2	3	3	2
CO3	3	3	3	3	1	2	2	2	0	1	0	2	3	3	2
CO4	3	3	3	3	0	1	2	2	0	2	0	2	3	3	2
CO5	3	3	3	3	1	1	2	2	0	3	1	3	3	3	2
CO6	3	3	3	3	1	3	3	3	0	3	2	3	3	3	3
CO:	3.00	3.00	3.00	3.00	1.00	1.50	2.17	2.17	0.00	1.83	1.50	2.33	3.00	2.83	2.00

Course Code: CHEM-H-SEC2-2 (AI for Everyone) (Chemistry Honours, Honours with Research)

Course Outcome (CO): After undergoing the course, the student would be able to

CO1: Understand the scope and history of Artificial Intelligence, distinguishing it from human intelligence and exploring its key technologies.

CO2: Gain insights into machine learning techniques including supervised, unsupervised, and reinforcement learning, and understand deep learning and neural networks.

CO3: Learn about Natural Language Processing (NLP) and computer vision, and how these technologies contribute to AI systems.

CO4: Explore real-world applications of AI in fields like healthcare, finance, transportation, customer service, and education.

CO5: Discuss the ethical and social implications of AI, including issues like bias, privacy, job displacement, and social inequality.

CO6: Understand the importance of ethical guidelines, responsible AI practices, and emerging trends in AI, including AI's role in creativity and innovation.

CO-PO-PSO Mapping:

Course Outcome	Programme Outcome (PO)												Programme Specific Outcome (PSO1)		
	PO 1: Disciplinary knowledge :	PO 2: Problem solving	PO 3: Critical thinking	PO 4.Research-related skills / Scientific reasoning	PO 5: Communication Skills	PO 6: Cooperation/Team work	PO 7: Information/digital literacy:	PO 8: Self-directed learning	PO 9: Multicultural competence	PO 10: Moral and ethical awareness /reasoning	PO 11: Leadership readiness/qualities	PO 12: Lifelong learning	PSO 1: Analytical skill development and job opportunity	PSO 2: Research motivation	PSO 3: Social Awareness
CO1	1	1	2	1	2	1	3	1	1	1	1	2	1	1	1
CO2	2	3	2	3	1	1	3	2	0	1	1	2	2	3	1
CO3	1	2	1	3	1	1	3	2	0	1	1	1	2	2	1
CO4	1	2	2	2	2	2	2	2	3	2	2	1	3	3	3
CO5	1	1	1	2	3	1	1	1	3	3	2	1	1	1	3
CO6	1	1	1	2	2	1	1	1	2	3	2	2	1	1	2
CO:	1.17	1.67	1.50	2.17	1.83	1.17	2.17	1.50	2.25	1.83	1.50	1.50	1.67	1.83	1.83

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Course Code: CHEM-H-CC3-3 (Physical Chemistry - I) (Chemistry Honours, Honours with Research)

Course Outcome (CO): After undergoing the course, the student would be able to

CO1: Explain thermodynamic principles, entropy, Gibbs free energy, and spontaneity in systems for chemical and biological processes.

CO2: Analyze systems of variable composition, partial molar properties, chemical potential, fugacity, and activity coefficients.

CO3: Apply thermodynamic laws to chemical equilibrium, equilibrium constants, van't Hoff equations, and solvent extraction processes.

CO4: Describe conductance properties, ion mobility, and Debye-Huckel theory; use conductometric methods for solubility and titration studies.

CO5: Discuss ionic equilibrium concepts, buffer solutions, hydrolysis constants, and pH calculations for strong and weak electrolytes.

CO6: Perform kinetic experiments to determine rate constants for chemical reactions, catalysis, and sugar inversion using polarimetry.

CO-PO-PSO Mapping:

Course Outcome	Programme Outcome (PO)												Programme Specific Outcome (PSO1)		
	PO 1: Disciplinary knowledge :	PO 2: Problem solving	PO 3: Critical thinking	PO 4.Research-related skills / Scientific reasoning	PO 5: Communication Skills	PO 6: Cooperation/Team work	PO 7: Information/digital literacy:	PO 8: Self-directed learning	PO 9: Multicultural competence	PO 10: Moral and ethical awareness /reasoning	PO 11: Leadership readiness/qualities	PO 12: Lifelong learning	PSO 1: Analytical skill development and job opportunity	PSO 2: Research motivation	PSO 3: Social Awareness
CO1	3	2	2	2	1	1	2	1	0	2	1	2	3	2	1
CO2	3	3	2	3	1	1	2	2	0	2	1	2	3	3	1
CO3	3	3	3	3	1	1	2	2	0	2	1	2	3	3	1
CO4	2	2	3	2	1	1	3	1	0	1	1	1	2	2	1
CO5	2	2	2	2	1	1	2	1	0	1	1	1	2	2	1
CO6	2	2	3	3	1	1	2	1	0	1	1	2	3	3	1
CO:	2.50	2.33	2.50	2.50	1.00	1.00	2.17	1.33	0.00	1.50	1.00	1.67	2.67	2.50	1.00

Course Code: CHEM-H-CC4-3 (Organic Chemistry – I) (Chemistry Honours, Honours with Research)

Course Outcome (CO): After undergoing the course, the student would be able to

CO1: Understand electrophilic and nucleophilic aromatic substitution mechanisms, reactions, and Birch reduction of benzenoid aromatics.

CO2: Explain the concepts of organic acids, bases, pKa, and factors influencing acidity, basicity, and tautomerism.

CO3: Describe nucleophilic substitution mechanisms (SN1, SN2, SN2', SN1') and elimination reactions (E1, E2, E1cB).

CO4: Analyze addition reactions to alkenes and alkynes, including regioselectivity, stereoselectivity, and radical addition mechanisms.

CO5: Study the reaction mechanisms and reactivity of alkenes and alkynes, including hydration, hydrogenation, and cyclopropanation.

CO6: Perform practical identification of organic compounds, including solid and liquid samples, through qualitative analysis.

CO-PO-PSO Mapping:

Course Outcome	Programme Outcome (PO)												Programme Specific Outcome (PSO1)		
	PO 1: Disciplinary knowledge :	PO 2: Problem solving	PO 3: Critical thinking	PO 4.Research-related skills / Scientific reasoning	PO 5: Communication Skills	PO 6: Cooperation/Team work	PO 7: Information/digital literacy:	PO 8: Self-directed learning	PO 9: Multicultural competence	PO 10: Moral and ethical awareness /reasoning	PO 11: Leadership readiness/qualities	PO 12: Lifelong learning	PSO 1: Analytical skill development and job opportunity	PSO 2: Research motivation	PSO 3: Social Awareness
CO1	3	3	2	2	1	1	2	1	0	2	1	2	3	2	1
CO2	3	2	2	1	1	1	2	1	0	1	1	2	3	2	1
CO3	3	3	3	2	1	1	2	1	0	1	1	2	3	3	1
CO4	3	3	2	2	1	1	2	1	0	1	1	2	3	3	1
CO5	3	3	2	2	1	1	2	1	0	1	1	2	3	3	1
CO6	2	2	2	3	1	2	3	1	0	1	1	1	3	3	2
CO:	2.83	2.67	2.17	2.00	1.00	1.17	2.17	1.00	0.00	1.17	1.00	1.83	3.00	2.67	1.17

Course Code: CHEM-H-SEC3-3 (CHEMISTRY IN DAILY LIFE) (Chemistry Honours, Honours with Research)

Course Outcome (CO): After undergoing the course, the student would be able to

CO1: Understand the composition, analysis, and adulteration detection of dairy products, beverages, and food additives.

CO2: Apply analytical methods to detect and analyze food preservatives, sweeteners, flavors, and artificial colorants.

CO3: Analyze the classification, sources, deficiency diseases, and structures of key vitamins.

CO4: Evaluate the composition, purity, and rancidity of oils, fats, and tests for adulterants.

CO5: Examine the manufacturing, classification, and applications of soaps, detergents, and their environmental impact.

CO6: Apply knowledge of chemical and renewable energy sources, polymers, and their environmental concerns.

CO-PO-PSO Mapping:

Course Outcome	Programme Outcome (PO)												Programme Specific Outcome (PSO1)		
	PO 1: Disciplinary knowledge :	PO 2: Problem solving	PO 3: Critical thinking	PO 4.Research-related skills / Scientific reasoning	PO 5: Communication Skills	PO 6: Cooperation/Team work	PO 7: Information/digital literacy:	PO 8: Self-directed learning	PO 9: Multicultural competence	PO 10: Moral and ethical awareness /reasoning	PO 11: Leadership readiness/qualities	PO 12: Lifelong learning	PSO 1: Analytical skill development and job opportunity	PSO 2: Research motivation	PSO 3: Social Awareness
CO1	3	3	2	2	2	2	3	1	1	2	1	2	3	2	2
CO2	3	3	3	3	1	2	3	1	0	2	1	2	3	3	2
CO3	3	2	2	2	1	1	2	1	0	1	1	1	2	2	1
CO4	3	3	3	3	1	2	3	1	0	2	1	2	3	3	2
CO5	3	2	2	2	2	2	3	1	1	3	1	1	2	2	3
CO6	3	3	2	2	1	2	3	1	1	3	2	2	3	3	3
CO:	3.00	2.67	2.33	2.33	1.33	1.83	2.83	1.00	1.00	2.17	1.17	1.67	2.67	2.50	2.17

Course Code: CHEM-H-CC5-4 (Inorganic Chemistry – I) (Chemistry Honours, Honours with Research)

Course Outcome (CO): After undergoing the course, the student would be able to

CO1: Understand molecular orbital theory, bond properties, and the bonding of homonuclear and heteronuclear molecules.

CO2: Explain metallic bonding, band theory, semiconductors, insulators, and defects in solids.

CO3: Discuss acid-base concepts, including Arrhenius, Bronsted-Lowry, Lewis, and other theories, and thermodynamic acidity parameters.

CO4: Analyze acid-base equilibria in aqueous solutions, including proton transfer, pH, buffers, and acid-base neutralization curves.

CO5: Learn principles of inorganic qualitative analysis, including cation and anion analysis, solubility products, and separation techniques.

CO6: Perform qualitative semimicro analysis of mixtures containing multiple cations and anions, understanding their reactions and interactions.

CO-PO-PSO Mapping:

Course Outcome	Programme Outcome (PO)												Programme Specific Outcome (PSO1)		
	PO 1: Disciplinary knowledge :	PO 2: Problem solving	PO 3: Critical thinking	PO 4.Research-related skills / Scientific reasoning	PO 5: Communication Skills	PO 6: Cooperation/Team work	PO 7: Information/digital literacy:	PO 8: Self-directed learning	PO 9: Multicultural competence	PO 10: Moral and ethical awareness /reasoning	PO 11: Leadership readiness/qualities	PO 12: Lifelong learning	PSO 1: Analytical skill development and job opportunity	PSO 2: Research motivation	PSO 3: Social Awareness
CO1	3	3	2	2	1	2	3	1	0	2	1	2	3	3	2
CO2	3	3	3	3	1	2	3	1	0	2	1	2	3	3	2
CO3	3	2	3	2	1	1	2	1	0	1	1	1	2	2	1
CO4	2	3	3	2	1	1	2	1	0	1	1	1	2	2	1
CO5	3	2	2	3	2	2	3	1	0	1	1	2	3	3	2
CO6	3	3	2	3	1	3	3	1	0	1	1	2	3	3	2
CO:	2.83	2.67	2.50	2.50	1.17	1.83	2.67	1.00	0.00	1.33	1.00	1.67	2.67	2.67	1.67

Course Code: CHEM-H-CC6-4 (Organic Chemistry – II) (Chemistry Honours, Honours with Research)

Course Outcome (CO): After undergoing the course, the student would be able to

CO1: Understand and apply conformational analysis, prostereoisomerism, chirality, and stereoaxis to various organic compounds.

CO2: Analyze the chemistry of carbonyl compounds, including nucleophilic addition, reactions with enolates, and condensations.

CO3: Explore the exploitation of acidity in α-H of carbonyl compounds, including reactions like aldol, Mannich, and Knoevenagel.

CO4: Examine nucleophilic addition to α,β-unsaturated carbonyl systems and substitution at sp2 carbon in carbonyl derivatives.

CO5: Study the preparation and reactions of organometallic reagents like Grignard reagents, organolithiums, and cuprates.

CO6: Perform qualitative analysis of organic compounds, including detection of elements, functional groups, and solubility tests.

CO-PO-PSO Mapping:

Course Outcome	Programme Outcome (PO)												Programme Specific Outcome (PSO1)		
	PO 1: Disciplinary knowledge :	PO 2: Problem solving	PO 3: Critical thinking	PO 4.Research-related skills / Scientific reasoning	PO 5: Communication Skills	PO 6: Cooperation/Team work	PO 7: Information/digital literacy:	PO 8: Self-directed learning	PO 9: Multicultural competence	PO 10: Moral and ethical awareness /reasoning	PO 11: Leadership readiness/qualities	PO 12: Lifelong learning	PSO 1: Analytical skill development and job opportunity	PSO 2: Research motivation	PSO 3: Social Awareness
CO1	3	3	2	2	1	1	2	1	0	2	1	2	3	3	2
CO2	3	3	3	3	1	1	2	1	0	1	1	2	3	3	2
CO3	3	3	3	2	1	1	2	1	0	2	1	2	3	3	2
CO4	3	3	3	2	1	1	2	1	0	1	1	2	3	3	1
CO5	3	3	3	2	1	1	2	1	0	1	1	2	3	3	2
CO6	3	3	2	3	1	2	3	1	0	1	1	1	3	3	2
CO:	3.00	3.00	2.67	2.33	1.00	1.17	2.17	1.00	0.00	1.33	1.00	1.83	3.00	3.00	1.83

Course Code: CHEM-H-CC7-4 (Physical Chemistry - II) (Chemistry Honours, Honours with Research)

Course Outcome (CO): After undergoing the course, the student would be able to

CO1: Understand and apply concepts of diffusion, viscosity, surface tension, and their dependence on temperature and concentration in liquids.

CO2: Analyse solid-state properties, Bravais lattices, crystal structures, and determine lattice parameters using X-ray diffraction methods.

CO3: Apply thermodynamics to colligative properties, phase equilibria, and phase transitions, including calculations related to boiling point elevation and osmotic pressure.

CO4: Understand and apply the phase rule, phase diagrams, and colligative properties to binary and three-component systems.

CO5: Understand electromotive force, Nernst equation, and use EMF measurements to calculate cell reactions, equilibrium constants, and pH.

CO6: Conduct experiments to measure surface tension, viscosity, and perform conductometric titrations to study kinetics and solution behaviour.

CO-PO-PSO Mapping:

Course Outcome	Programme Outcome (PO)												Programme Specific Outcome (PSO1)		
	PO 1: Disciplinary knowledge :	PO 2: Problem solving	PO 3: Critical thinking	PO 4.Research-related skills / Scientific reasoning	PO 5: Communication Skills	PO 6: Cooperation/Team work	PO 7: Information/digital literacy:	PO 8: Self-directed learning	PO 9: Multicultural competence	PO 10: Moral and ethical awareness /reasoning	PO 11: Leadership readiness/qualities	PO 12: Lifelong learning	PSO 1: Analytical skill development and job opportunity	PSO 2: Research motivation	PSO 3: Social Awareness
CO1	3	3	2	2	1	2	3	1	0	2	1	2	3	3	2
CO2	3	3	3	2	1	2	3	1	0	1	1	2	3	3	2
CO3	3	3	3	3	1	1	2	1	0	1	1	2	3	2	1
CO4	3	3	2	3	1	2	3	1	0	1	1	2	3	2	2
CO5	3	3	2	2	1	2	2	1	0	1	1	1	3	2	1
CO6	3	3	2	3	1	3	3	1	0	1	1	2	3	3	2
CO:	3.00	3.00	2.33	2.50	1.00	2.00	2.67	1.00	0.00	1.17	1.00	1.83	3.00	2.50	1.67

Course Code: CHEM-H-CC8-4 (Inorganic Chemistry – II) (Chemistry Honours, Honours with Research)

Course Outcome (CO): After undergoing the course, the student would be able to

CO1: Understand coordination chemistry fundamentals, including Werner's theory, isomerism, valence bond theory, and crystal field theory of complexes.

CO2: Apply valence bond and crystal field theory to analyze metal-ligand bonding, electronic spectra, and magnetic properties of complexes.

CO3: Explore supramolecular chemistry, including hydrogen bonding and non-covalent interactions such as ion-dipole, van der Waals, and aromatic interactions.

CO4: Understand nuclear stability, nuclear reactions (fission, fusion), and radiocarbon dating in the context of radioactivity.

CO5: Learn redox reactions and balance redox equations using the ion-electron method, Nernst equation, and redox titrations.

CO6: Perform practical estimations of metal ions in mixtures, including Fe^{3+}, Cu^{2+}, Cr^{3+}, and Mn^{2+} using redox reactions.

CO-PO-PSO Mapping:

Course Outcome	Programme Outcome (PO)												Programme Specific Outcome (PSO1)		
	PO 1: Disciplinary knowledge :	PO 2: Problem solving	PO 3: Critical thinking	PO 4.Research-related skills / Scientific reasoning	PO 5: Communication Skills	PO 6: Cooperation/Team work	PO 7: Information/digital literacy:	PO 8: Self-directed learning	PO 9: Multicultural competence	PO 10: Moral and ethical awareness /reasoning	PO 11: Leadership readiness/qualities	PO 12: Lifelong learning	PSO 1: Analytical skill development and job opportunity	PSO 2: Research motivation	PSO 3: Social Awareness
CO1	3	3	2	3	1	2	3	1	0	1	1	2	3	3	2
CO2	3	3	3	3	1	2	3	1	0	1	1	2	3	3	2
CO3	3	3	2	2	1	1	2	1	0	2	1	2	2	2	2
CO4	3	3	2	3	1	1	2	1	0	1	1	2	3	3	1
CO5	3	3	3	2	1	1	2	1	0	1	1	2	3	2	2
CO6	3	3	2	3	1	3	3	1	0	1	1	2	3	3	2
CO:	3.00	3.00	2.33	2.67	1.00	1.67	2.50	1.00	0.00	1.17	1.00	2.00	2.83	2.67	1.83

Course Code: **CHEM-H-CC9-5 (Syllabus yet to be published) (Chemistry Honours, Honours with Research)**

Course Outcome (CO): After undergoing the course, the student would be able to

CO1: Syllabus yet to be published.

CO2: Syllabus yet to be published.

CO3: Syllabus yet to be published.

CO4: Syllabus yet to be published.

CO5: Syllabus yet to be published.

CO6: Syllabus yet to be published.

CO-PO-PSO Mapping:

Course Code: **CHEM-H-CC10-5 (Syllabus yet to be published) (Chemistry Honours, Honours with Research)**

Course Outcome (CO): After undergoing the course, the student would be able to

CO1: Syllabus yet to be published.

CO2: Syllabus yet to be published.

CO3: Syllabus yet to be published.

CO4: Syllabus yet to be published.

CO5: Syllabus yet to be published.

CO6: Syllabus yet to be published.

CO-PO-PSO Mapping:

Course Code: **CHEM-H-CC11-5 (Syllabus yet to be published) (Chemistry Honours, Honours with Research)**

Course Outcome (CO): After undergoing the course, the student would be able to

CO1: Syllabus yet to be published.

CO2: Syllabus yet to be published.

CO3: Syllabus yet to be published.

CO4: Syllabus yet to be published.

CO5: Syllabus yet to be published.

CO6: Syllabus yet to be published.

CO-PO-PSO Mapping:

Course Code: **CHEM-H-CC12-5 (Syllabus yet to be published) (Chemistry Honours, Honours with Research)**

Course Outcome (CO): After undergoing the course, the student would be able to

CO1: Syllabus yet to be published.

CO2: Syllabus yet to be published.

CO3: Syllabus yet to be published.

CO4: Syllabus yet to be published.

CO5: Syllabus yet to be published.

CO6: Syllabus yet to be published.

CO-PO-PSO Mapping:

Course Code: CHEM-H-CC13-6 (Syllabus yet to be published) (Chemistry Honours, Honours with Research)

Course Outcome (CO): After undergoing the course, the student would be able to

CO1: Syllabus yet to be published.

CO2: Syllabus yet to be published.

CO3: Syllabus yet to be published.

CO4: Syllabus yet to be published.

CO5: Syllabus yet to be published.

CO6: Syllabus yet to be published.

CO-PO-PSO Mapping:

Course Code: **CHEM-H-CC14-6 (Syllabus yet to be published) (Chemistry Honours, Honours with Research)**

Course Outcome (CO): After undergoing the course, the student would be able to

CO1: Syllabus yet to be published.

CO2: Syllabus yet to be published.

CO3: Syllabus yet to be published.

CO4: Syllabus yet to be published.

CO5: Syllabus yet to be published.

CO6: Syllabus yet to be published.

CO-PO-PSO Mapping:

Course Code: CHEM-H-CC15-6 (Syllabus yet to be published) (Chemistry Honours, Honours with Research)

Course Outcome (CO): After undergoing the course, the student would be able to

CO1: Syllabus yet to be published.

CO2: Syllabus yet to be published.

CO3: Syllabus yet to be published.

CO4: Syllabus yet to be published.

CO5: Syllabus yet to be published.

CO6: Syllabus yet to be published.

CO-PO-PSO Mapping:

Course Code: **CHEM-H-CC16-7 (Syllabus yet to be published) (Chemistry Honours, Honours with Research)**

Course Outcome (CO): After undergoing the course, the student would be able to

CO1: Syllabus yet to be published.

CO2: Syllabus yet to be published.

CO3: Syllabus yet to be published.

CO4: Syllabus yet to be published.

CO5: Syllabus yet to be published.

CO6: Syllabus yet to be published.

CO-PO-PSO Mapping:

Course Code: **CHEM-H-CC17-7 (Syllabus yet to be published) (Chemistry Honours, Honours with Research)**

Course Outcome (CO): After undergoing the course, the student would be able to

CO1: Syllabus yet to be published.

CO2: Syllabus yet to be published.

CO3: Syllabus yet to be published.

CO4: Syllabus yet to be published.

CO5: Syllabus yet to be published.

CO6: Syllabus yet to be published.

CO-PO-PSO Mapping:

Course Code: **CHEM-H-CC18-7 (Syllabus yet to be published) (Chemistry Honours, Honours with Research)**

Course Outcome (CO): After undergoing the course, the student would be able to

CO1: Syllabus yet to be published.

CO2: Syllabus yet to be published.

CO3: Syllabus yet to be published.

CO4: Syllabus yet to be published.

CO5: Syllabus yet to be published.

CO6: Syllabus yet to be published.

CO-PO-PSO Mapping:

Course Code: **CHEM-H-CC19-7 (Syllabus yet to be published) (Chemistry Honours, Honours with Research)**

Course Outcome (CO): After undergoing the course, the student would be able to

CO1: Syllabus yet to be published.

CO2: Syllabus yet to be published.

CO3: Syllabus yet to be published.

CO4: Syllabus yet to be published.

CO5: Syllabus yet to be published.

CO6: Syllabus yet to be published.

CO-PO-PSO Mapping:

Course Code: **CHEM-H-CC20-7 (Syllabus yet to be published) (Chemistry Honours, Honours with Research)**

Course Outcome (CO): After undergoing the course, the student would be able to

CO1: Syllabus yet to be published.

CO2: Syllabus yet to be published.

CO3: Syllabus yet to be published.

CO4: Syllabus yet to be published.

CO5: Syllabus yet to be published.

CO6: Syllabus yet to be published.

CO-PO-PSO Mapping:

Course Code: **CHEM-H-CC21-8 (Syllabus yet to be published) (Chemistry Honours, Honours with Research)**

Course Outcome (CO): After undergoing the course, the student would be able to

CO1: Syllabus yet to be published.

CO2: Syllabus yet to be published.

CO3: Syllabus yet to be published.

CO4: Syllabus yet to be published.

CO5: Syllabus yet to be published.

CO6: Syllabus yet to be published.

CO-PO-PSO Mapping:

Course Code: **CHEM-H-CC22-8 (Syllabus yet to be published) (Chemistry Honours, Honours with Research)**

Course Outcome (CO): After undergoing the course, the student would be able to

CO1: Syllabus yet to be published.

CO2: Syllabus yet to be published.

CO3: Syllabus yet to be published.

CO4: Syllabus yet to be published.

CO5: Syllabus yet to be published.

CO6: Syllabus yet to be published.

CO-PO-PSO Mapping:

Course Code: **CHEM-H-CC23-8 (Syllabus yet to be published) (Chemistry Honours, Honours with Research)**

Course Outcome (CO): After undergoing the course, the student would be able to

CO1: Syllabus yet to be published.

CO2: Syllabus yet to be published.

CO3: Syllabus yet to be published.

CO4: Syllabus yet to be published.

CO5: Syllabus yet to be published.

CO6: Syllabus yet to be published.

CO-PO-PSO Mapping:

Course Code: CHEM-H-CC24-8 (Syllabus yet to be published) (Chemistry Honours, Honours with Research)

Course Outcome (CO): After undergoing the course, the student would be able to

CO1: Syllabus yet to be published.

CO2: Syllabus yet to be published.

CO3: Syllabus yet to be published.

CO4: Syllabus yet to be published.

CO5: Syllabus yet to be published.

CO6: Syllabus yet to be published.

CO-PO-PSO Mapping:

Course Code: **CHEM-H-CC25-8 (Syllabus yet to be published) (Chemistry Honours, Honours with Research)**

Course Outcome (CO): After undergoing the course, the student would be able to

CO1: Syllabus yet to be published.

CO2: Syllabus yet to be published.

CO3: Syllabus yet to be published.

CO4: Syllabus yet to be published.

CO5: Syllabus yet to be published.

CO6: Syllabus yet to be published.

CO-PO-PSO Mapping:

SHYAMPUR SIDDHESWARI MAHAVIDYALAYA
P.O.- AJODHYA, HOWRAH, WEST BENGAL, PIN- 711312

Chemistry Minor Course Structure

SHYAMPUR SIDDHESWARI MAHAVIDYALAYA

P.O.- AJODHYA, HOWRAH, WEST BENGAL, PIN- 711312

Course Code: CHEM-H-CC1-1 or CHEM-H-CC1-3 (Chemistry MINOR - I)

Course Outcome (CO): After undergoing the course, the student would be able to

CO1: Demonstrate fundamental knowledge of atomic structure, periodicity, thermodynamics, kinetics, and organic chemistry, including relevant principles.

CO2: Explain shielding, penetration, electronegativity, molecular interactions, stereochemistry, thermodynamic processes, and reaction mechanisms systematically.

CO3: Apply bonding theories, thermodynamic laws, and kinetic principles to solve chemical problems and predict behavior.

CO4: Analyze periodic trends, stereochemical representations, and reaction pathways using scientific reasoning and theoretical understanding.

CO5: Evaluate experimental data from acid-base, redox titrations, and reaction rates to interpret chemical and molecular behavior.

CO6: Perform accurate chemical experiments, including solution preparation and advanced analyses, ensuring procedural accuracy and critical problem-solving.

CO-PO-PSO Mapping:

Course Outcome	Programme Outcome (PO)												Programme Specific Outcome (PSO1)		
	PO 1: Disciplinary knowledge :	PO 2: Problem solving	PO 3: Critical thinking	PO 4.Research-related skills / Scientific reasoning	PO 5: Communication Skills	PO 6: Cooperation/Team work	PO 7: Information/digital literacy:	PO 8: Self-directed learning	PO 9: Multicultural competence	PO 10: Moral and ethical awareness /reasoning	PO 11: Leadership readiness/qualities	PO 12: Lifelong learning	PSO 1: Analytical skill development and job opportunity	PSO 2: Research motivation	PSO 3: Social Awareness
CO1	3	2	2	2	0	0	1	1	0	0	0	2	3	2	1
CO2	3	3	3	2	0	0	1	1	0	0	0	2	3	2	1
CO3	3	3	3	3	0	0	2	2	0	1	0	2	3	3	2
CO4	3	3	3	3	0	0	2	2	0	1	0	2	3	3	2
CO5	3	3	3	3	0	1	2	2	0	1	1	2	3	3	2
CO6	3	3	3	3	1	2	2	3	0	2	2	3	3	3	3
CO:	3.00	2.83	2.83	2.67	1.00	1.50	1.67	1.83	0.00	1.25	1.50	2.17	3.00	2.67	1.83

SHYAMPUR SIDDHESWARI MAHAVIDYALAYA

P.O.- AJODHYA, HOWRAH, WEST BENGAL, PIN- 711312

Course Code: CHEM-H-CC2-2 or CHEM-H-CC2-4 (Chemistry MINOR - II)

Course Outcome (CO): After undergoing the course, the student would be able to

CO1: Describe gas behavior, kinetic theory, Maxwell's distribution, collisions, and real gas deviations using van der Waals and virial equations.

CO2: Explain ionic and covalent bonding, lattice energy, hybridizations, VSEPR theory, molecular shapes, and multiple bond characteristics.

CO3: Analyze chirotopicity, stereogenicity, R/S and E/Z descriptors, racemization, resolution, and optical properties of chiral compounds.

CO4: Discuss reactive intermediates, reaction thermodynamics, and kinetics using enthalpy, entropy, activation energy, and Hammond's postulate.

CO5: Illustrate mechanisms of free-radical substitution reactions, halogenation, reactivity-selectivity, and stereochemistry with evidence-based insights.

CO6: Perform quantitative analysis of compounds using titrimetric methods, metal content estimation, and iodimetric techniques for practical applications.

CO-PO-PSO Mapping:

Course Outcome	Programme Outcome (PO)												Programme Specific Outcome (PSO1)		
	PO 1: Disciplinary knowledge :	PO 2: Problem solving	PO 3: Critical thinking	PO 4.Research-related skills / Scientific reasoning	PO 5: Communication Skills	PO 6: Cooperation/Team work	PO 7: Information/digital literacy:	PO 8: Self-directed learning	PO 9: Multicultural competence	PO 10: Moral and ethical awareness /reasoning	PO 11: Leadership readiness/qualities	PO 12: Lifelong learning	PSO 1: Analytical skill development and job opportunity	PSO 2: Research motivation	PSO 3: Social Awareness
CO1	3	3	3	3	1	1	2	2	0	1	0	2	3	2	1
CO2	3	3	3	3	1	1	2	2	0	1	0	2	3	3	2
CO3	3	3	3	3	1	2	2	2	0	1	0	2	3	3	2
CO4	3	3	3	3	0	1	2	2	0	2	0	2	3	3	2
CO5	3	3	3	3	1	1	2	2	0	3	1	3	3	3	2
CO6	3	3	3	3	1	3	3	3	0	3	2	3	3	3	3
CO:	3.00	3.00	3.00	3.00	1.00	1.50	2.17	2.17	0.00	1.83	1.50	2.33	3.00	2.83	2.00

SHYAMPUR SIDDHESWARI MAHAVIDYALAYA

P.O.- AJODHYA, HOWRAH, WEST BENGAL, PIN- 711312

Course Code: CHEM-H-CC4-5 (Chemistry MINOR - III)

Course Outcome (CO): After undergoing the course, the student would be able to

CO1: Understand electrophilic and nucleophilic aromatic substitution mechanisms, reactions, and Birch reduction of benzenoid aromatics.

CO2: Explain the concepts of organic acids, bases, pKa, and factors influencing acidity, basicity, and tautomerism.

CO3: Describe nucleophilic substitution mechanisms (SN1, SN2, SN2', SN1') and elimination reactions (E1, E2, E1cB).

CO4: Analyze addition reactions to alkenes and alkynes, including regioselectivity, stereoselectivity, and radical addition mechanisms.

CO5: Study the reaction mechanisms and reactivity of alkenes and alkynes, including hydration, hydrogenation, and cyclopropanation.

CO6: Perform practical identification of organic compounds, including solid and liquid samples, through qualitative analysis.

CO-PO-PSO Mapping:

Course Outcome	Programme Outcome (PO)												Programme Specific Outcome (PSO1)		
	PO 1: Disciplinary knowledge :	PO 2: Problem solving	PO 3: Critical thinking	PO 4.Research-related skills / Scientific reasoning	PO 5: Communication Skills	PO 6: Cooperation/Team work	PO 7: Information/digital literacy:	PO 8: Self-directed learning	PO 9: Multicultural competence	PO 10: Moral and ethical awareness /reasoning	PO 11: Leadership readiness/qualities	PO 12: Lifelong learning	PSO 1: Analytical skill development and job opportunity	PSO 2: Research motivation	PSO 3: Social Awareness
CO1	3	3	2	2	1	1	2	1	0	2	1	2	3	2	1
CO2	3	2	2	1	1	1	2	1	0	1	1	2	3	2	1
CO3	3	3	3	2	1	1	2	1	0	1	1	2	3	3	1
CO4	3	3	2	2	1	1	2	1	0	1	1	2	3	3	1
CO5	3	3	2	2	1	1	2	1	0	1	1	2	3	3	1
CO6	2	2	2	3	1	2	3	1	0	1	1	1	3	3	2
CO:	2.83	2.67	2.17	2.00	1.00	1.17	2.17	1.00	0.00	1.17	1.00	1.83	3.00	2.67	1.17

SHYAMPUR SIDDHESWARI MAHAVIDYALAYA

P.O.- AJODHYA, HOWRAH, WEST BENGAL, PIN- 711312

Course Code: CHEM-H-CC5-6 (Chemistry MINOR - IV)

Course Outcome (CO): After undergoing the course, the student would be able to

CO1: Understand molecular orbital theory, bond properties, and the bonding of homonuclear and heteronuclear molecules.

CO2: Explain metallic bonding, band theory, semiconductors, insulators, and defects in solids.

CO3: Discuss acid-base concepts, including Arrhenius, Bronsted-Lowry, Lewis, and other theories, and thermodynamic acidity parameters.

CO4: Analyze acid-base equilibria in aqueous solutions, including proton transfer, pH, buffers, and acid-base neutralization curves.

CO5: Learn principles of inorganic qualitative analysis, including cation and anion analysis, solubility products, and separation techniques.

CO6: Perform qualitative semimicro analysis of mixtures containing multiple cations and anions, understanding their reactions and interactions.

CO-PO-PSO Mapping:

Course Outcome	Programme Outcome (PO)												Programme Specific Outcome (PSO1)		
	PO 1: Disciplinary knowledge :	PO 2: Problem solving	PO 3: Critical thinking	PO 4.Research-related skills / Scientific reasoning	PO 5: Communication Skills	PO 6: Cooperation/Team work	PO 7: Information/digital literacy:	PO 8: Self-directed learning	PO 9: Multicultural competence	PO 10: Moral and ethical awareness /reasoning	PO 11: Leadership readiness/qualities	PO 12: Lifelong learning	PSO 1: Analytical skill development and job opportunity	PSO 2: Research motivation	PSO 3: Social Awareness
CO1	3	3	2	2	1	2	3	1	0	2	1	2	3	3	2
CO2	3	3	3	3	1	2	3	1	0	2	1	2	3	3	2
CO3	3	2	3	2	1	1	2	1	0	1	1	1	2	2	1
CO4	2	3	3	2	1	1	2	1	0	1	1	1	2	2	1
CO5	3	2	2	3	2	2	3	1	0	1	1	2	3	3	2
CO6	3	3	2	3	1	3	3	1	0	1	1	2	3	3	2
CO:	2.83	2.67	2.50	2.50	1.17	1.83	2.67	1.00	0.00	1.33	1.00	1.67	2.67	2.67	1.67

SHYAMPUR SIDDHESWARI MAHAVIDYALAYA
P.O.- AJODHYA, HOWRAH, WEST BENGAL, PIN- 711312

Chemistry Interdisciplinary Course Structure

Course Code: CHEM-H-IDC1-1 or CHEM-H-IDC2-2 or CHEM-H-IDC3-3 (Quantitative Analysis and Basic Laboratory Practices)

Course Outcome (CO): After undergoing the course, the student would be able to

CO1: Identify the definitions, classifications, and key concepts in quantitative analysis and measurement techniques.

CO2: Apply statistical methods and regression equations for data analysis and presentation in experiments.

CO3: Perform acid-base, redox, precipitation, and complexometric titrations with precision and accuracy.

CO4: Analyze the quality of water and determine various impurities like pH, alkalinity, hardness, and TDS.

CO5: Evaluate water treatment technologies and their role in disinfection, softening, and effluent treatment.

CO6: Demonstrate laboratory safety practices, calibration of glassware, and preparation of TLC plates for analysis.

CO-PO-PSO Mapping:

Course Outcome	Programme Outcome (PO)												Programme Specific Outcome (PSO1)		
	PO 1: Disciplinary knowledge :	PO 2: Problem solving	PO 3: Critical thinking	PO 4.Research-related skills / Scientific reasoning	PO 5: Communication Skills	PO 6: Cooperation/Team work	PO 7: Information/digital literacy:	PO 8: Self-directed learning	PO 9: Multicultural competence	PO 10: Moral and ethical awareness /reasoning	PO 11: Leadership readiness/qualities	PO 12: Lifelong learning	PSO 1: Analytical skill development and job opportunity	PSO 2: Research motivation	PSO 3: Social Awareness
CO1	3	2	2	3	1	1	2	2	0	1	0	2	3	2	1
CO2	3	3	3	3	1	1	2	2	0	1	0	2	3	2	1
CO3	3	3	3	3	0	0	2	2	0	1	0	2	3	3	2
CO4	3	3	3	3	0	1	2	2	0	2	0	2	3	3	2
CO5	3	3	3	3	1	3	3	3	0	3	1	3	3	3	3
CO6	3	3	3	3	1	3	3	3	0	3	2	3	3	3	3
CO:	3.00	2.83	2.83	3.00	1.00	1.80	2.33	2.33	0.00	1.83	1.50	2.33	3.00	2.67	2.00

SHYAMPUR SIDDHESWARI MAHAVIDYALAYA
P.O.- AJODHYA, HOWRAH, WEST BENGAL, PIN- 711312

Three – Year B.Sc. (Multidisciplinary) Courses of Studies (Under Curriculum & Credit framework, 2022

University of Calcutta

- Programme Outcome (PO)
- Programme Specific Outcome (PSO)
- Course Outcome (CO)
- CO-PO Mapping
- CO-PSO Mapping

Programme Outcome (PO)

PO 1: Disciplinary knowledge: A graduate student is expected to be capable of demonstrating comprehensive knowledge and understanding both theoretical and practical knowledge in all disciplines of Chemistry. Students can solve their subjective problems very methodically, independently and finally draw a logical conclusion. Further, the student will be capable of applying modern technologies, handling advanced instruments and Chemistry related soft-wares for chemical analysis, characterization of materials and in separation technology.

PO 2: Problem solving: Students will be able to think and apply evidence based comparative chemistry approach to explain chemical synthesis and analysis.

PO 3: Critical thinking: The course curriculum also includes components that can be helpful to graduate students to develop critical thinking and to design, carry out, record and analyze the results of chemical reactions.

PO 4: Research-related skills / Scientific reasoning: Students will demonstrate strong research-related skills by formulating research questions, designing experiments, and employing appropriate methodologies for data collection and analysis. They will exhibit scientific reasoning through critical evaluation of evidence, interpretation of results, and drawing logical conclusions, enabling them to address complex problems and contribute to advancements in their field.

PO 5: Communication Skills: The course curriculum has been designed in such a manner as to enabling a graduate student to become a skilled project manager by acquiring knowledge about chemistry project management, writing, planning, study of ethical standards and rules and regulations pertaining to scientific project operation.

PO 6: Cooperation/Teamwork: The course curriculum has been designed to provide opportunity to act as team player by contributing in laboratory, field based situation and industry.

PO 7: Information/digital literacy: The course curriculum has been so designed to impart a good working knowledge in understanding and carrying out data analysis, use of library search tools, use of chemical simulation software and related computational work.

PO 8: Self-directed learning: Students will demonstrate the ability to independently identify learning needs, set goals, and pursue knowledge using diverse resources. They will reflect on their learning process, adapt strategies as needed, and apply insights to achieve continuous personal and professional growth.

PO 9: Multicultural competence: Students will demonstrate multicultural competence by understanding diverse cultural perspectives, effectively communicating across cultures, and applying inclusive practices in professional settings to promote equity and collaboration.

PO 10: Moral and ethical awareness/reasoning: As an inhabitant of this green planet a Chemistry graduate student should have many social responsibilities. The course curriculum is designed to teach a Chemistry graduate student to follow the green routes for the synthesis of chemical compounds and also find out new greener routes for sustainable development. The course also helps them to understand the causes of environmental pollution and thereby applying environmental friendly policies instead of environmentally hazard ones in every aspect.

PO 11: Leadership readiness/qualities: Students will demonstrate leadership readiness by effectively communicating a vision, motivating teams, and fostering collaboration. They will exhibit critical thinking, problem-solving abilities, and emotional intelligence, enabling them to navigate challenges and drive positive change in diverse environments. This outcome prepares students for impactful leadership roles in their future careers.

PO 12: Lifelong learning: The course curriculum is designed to inculcate a habit of learning continuously through use of advanced ICT technique and other available e-techniques, e-books and e-journals for personal academic growth.

Programme Specific Outcome (PO)

PSO 1: Analytical skill development and job opportunity: Chemistry graduates are expected to possess sufficient knowledge how to synthesize a chemical compound and perform necessary characterization and analysis in support of the formation of the product by using modern analytical tools and advanced technologies. Because of this course curriculum chemistry graduates have lot of opportunity to get job not only in academic and administrative field but also in industry.

PSO 2: Research motivation: Chemistry graduates are expected to be technically well trained with modern devices and Chemistry based software and has powerful knowledge in different disciplines of Chemistry so they can easily involve themselves in theory and laboratory-based research activities.

PSO 3: Social Awareness: As an inhabitant of this green world it is our duty to make our planet clean and suitable for living to all. In this context Chemistry graduates are expected to be more aware about finding green chemical reaction routes for sustainable development. They are expected to maintain good laboratory practices and safety.

SHYAMPUR SIDDHESWARI MAHAVIDYALAYA
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Chemistry Course Structure
(CC1 & CC2) and (Minor)
For
Three – year
MULTIDISCIPLINARY Studies

Course Code: CHEM-MD-CC1-1 (Chemistry MDC – I)

OR

CHEM-MD-CC1-3 (Chemistry MDC – I)

Course Outcome (CO): After undergoing the course, the student would be able to

CO1: Demonstrate fundamental knowledge of atomic structure, periodicity, thermodynamics, kinetics, and organic chemistry, including relevant principles.

CO2: Explain shielding, penetration, electronegativity, molecular interactions, stereochemistry, thermodynamic processes, and reaction mechanisms systematically.

CO3: Apply bonding theories, thermodynamic laws, and kinetic principles to solve chemical problems and predict behavior.

CO4: Analyze periodic trends, stereochemical representations, and reaction pathways using scientific reasoning and theoretical understanding.

CO5: Evaluate experimental data from acid-base, redox titrations, and reaction rates to interpret chemical and molecular behavior.

CO6: Perform accurate chemical experiments, including solution preparation and advanced analyses, ensuring procedural accuracy and critical problem-solving.

CO-PO-PSO Mapping:

Course Outcome	Programme Outcome (PO)												Programme Specific Outcome (PSO1)		
	PO 1: Disciplinary knowledge :	PO 2: Problem solving	PO 3: Critical thinking	PO 4.Research-related skills / Scientific reasoning	PO 5: Communication Skills	PO 6: Cooperation/Team work	PO 7: Information/digital literacy:	PO 8: Self-directed learning	PO 9: Multicultural competence	PO 10: Moral and ethical awareness /reasoning	PO 11: Leadership readiness/qualities	PO 12: Lifelong learning	PSO 1: Analytical skill development and job opportunity	PSO 2: Research motivation	PSO 3: Social Awareness
CO1	3	2	2	2	0	0	1	1	0	0	0	2	3	2	1
CO2	3	3	3	2	0	0	1	1	0	0	0	2	3	2	1
CO3	3	3	3	3	0	0	2	2	0	1	0	2	3	3	2
CO4	3	3	3	3	0	0	2	2	0	1	0	2	3	3	2
CO5	3	3	3	3	0	1	2	2	0	1	1	2	3	3	2
CO6	3	3	3	3	1	2	2	3	0	2	2	3	3	3	3
CO:	3.00	2.83	2.83	2.67	1.00	1.50	1.67	1.83	0.00	1.25	1.50	2.17	3.00	2.67	1.83

Course Code: CHEM-MD-CC2-2 (Chemistry MDC – II)

OR

CHEM-MD-CC2-4 (Chemistry MDC – II)

Course Outcome (CO): After undergoing the course, the student would be able to

CO1: Describe gas behavior, kinetic theory, Maxwell's distribution, collisions, and real gas deviations using van der Waals and virial equations.

CO2: Explain ionic and covalent bonding, lattice energy, hybridizations, VSEPR theory, molecular shapes, and multiple bond characteristics.

CO3: Analyze chirotopicity, stereogenicity, R/S and E/Z descriptors, racemization, resolution, and optical properties of chiral compounds.

CO4: Discuss reactive intermediates, reaction thermodynamics, and kinetics using enthalpy, entropy, activation energy, and Hammond's postulate.

CO5: Illustrate mechanisms of free-radical substitution reactions, halogenation, reactivity-selectivity, and stereochemistry with evidence-based insights.

CO6: Perform quantitative analysis of compounds using titrimetric methods, metal content estimation, and iodimetric techniques for practical applications.

CO-PO-PSO Mapping:

Course Outcome	Programme Outcome (PO)												Programme Specific Outcome (PSO1)		
	PO 1: Disciplinary knowledge :	PO 2: Problem solving	PO 3: Critical thinking	PO 4.Research-related skills / Scientific reasoning	PO 5: Communication Skills	PO 6: Cooperation/Team work	PO 7: Information/digital literacy:	PO 8: Self-directed learning	PO 9: Multicultural competence	PO 10: Moral and ethical awareness /reasoning	PO 11: Leadership readiness/qualities	PO 12: Lifelong learning	PSO 1: Analytical skill development and job opportunity	PSO 2: Research motivation	PSO 3: Social Awareness
CO1	3	3	3	3	1	1	2	2	0	1	0	2	3	2	1
CO2	3	3	3	3	1	1	2	2	0	1	0	2	3	3	2
CO3	3	3	3	3	1	2	2	2	0	1	0	2	3	3	2
CO4	3	3	3	3	0	1	2	2	0	2	0	2	3	3	2
CO5	3	3	3	3	1	1	2	2	0	3	1	3	3	3	2
CO6	3	3	3	3	1	3	3	3	0	3	2	3	3	3	3
CO:	3.00	3.00	3.00	3.00	1.00	1.50	2.17	2.17	0.00	1.83	1.50	2.33	3.00	2.83	2.00

Course Code: CHEM-MD-CC3-3 (Chemistry MDC – III)

OR

CHEM-MD-CC3-5 (Chemistry MDC – III)

Course Outcome (CO): After undergoing the course, the student would be able to

CO1: Understand electrophilic and nucleophilic aromatic substitution mechanisms, reactions, and Birch reduction of benzenoid aromatics.

CO2: Explain the concepts of organic acids, bases, pKa, and factors influencing acidity, basicity, and tautomerism.

CO3: Describe nucleophilic substitution mechanisms (SN1, SN2, SN2', SN1') and elimination reactions (E1, E2, E1cB).

CO4: Analyze addition reactions to alkenes and alkynes, including regioselectivity, stereoselectivity, and radical addition mechanisms.

CO5: Study the reaction mechanisms and reactivity of alkenes and alkynes, including hydration, hydrogenation, and cyclopropanation.

CO6: Perform practical identification of organic compounds, including solid and liquid samples, through qualitative analysis.

CO-PO-PSO Mapping:

Course Outcome	Programme Outcome (PO)												Programme Specific Outcome (PSO1)		
	PO 1: Disciplinary knowledge :	PO 2: Problem solving	PO 3: Critical thinking	PO 4.Research-related skills / Scientific reasoning	PO 5: Communication Skills	PO 6: Cooperation/Team work	PO 7: Information/digital literacy:	PO 8: Self-directed learning	PO 9: Multicultural competence	PO 10: Moral and ethical awareness /reasoning	PO 11: Leadership readiness/qualities	PO 12: Lifelong learning	PSO 1: Analytical skill development and job opportunity	PSO 2: Research motivation	PSO 3: Social Awareness
CO1	3	3	2	2	1	1	2	1	0	2	1	2	3	2	1
CO2	3	2	2	1	1	1	2	1	0	1	1	2	3	2	1
CO3	3	3	3	2	1	1	2	1	0	1	1	2	3	3	1
CO4	3	3	2	2	1	1	2	1	0	1	1	2	3	3	1
CO5	3	3	2	2	1	1	2	1	0	1	1	2	3	3	1
CO6	2	2	2	3	1	2	3	1	0	1	1	1	3	3	2
CO:	2.83	2.67	2.17	2.00	1.00	1.17	2.17	1.00	0.00	1.17	1.00	1.83	3.00	2.67	1.17

Course Code: CHEM-MD-CC4-4 (Chemistry MDC – IV)

OR

CHEM-MD-CC4-5 (Chemistry MDC – IV)

Course Outcome (CO): After undergoing the course, the student would be able to

CO1: Understand molecular orbital theory, bond properties, and the bonding of homonuclear and heteronuclear molecules.

CO2: Explain metallic bonding, band theory, semiconductors, insulators, and defects in solids.

CO3: Discuss acid-base concepts, including Arrhenius, Bronsted-Lowry, Lewis, and other theories, and thermodynamic acidity parameters.

CO4: Analyze acid-base equilibria in aqueous solutions, including proton transfer, pH, buffers, and acid-base neutralization curves.

CO5: Learn principles of inorganic qualitative analysis, including cation and anion analysis, solubility products, and separation techniques.

CO6: Perform qualitative semimicro analysis of mixtures containing multiple cations and anions, understanding their reactions and interactions.

CO-PO-PSO Mapping:

Course Outcome	Programme Outcome (PO)												Programme Specific Outcome (PSO1)		
	PO 1: Disciplinary knowledge :	PO 2: Problem solving	PO 3: Critical thinking	PO 4.Research-related skills / Scientific reasoning	PO 5: Communication Skills	PO 6: Cooperation/Team work	PO 7: Information/digital literacy:	PO 8: Self-directed learning	PO 9: Multicultural competence	PO 10: Moral and ethical awareness /reasoning	PO 11: Leadership readiness/qualities	PO 12: Lifelong learning	PSO 1: Analytical skill development and job opportunity	PSO 2: Research motivation	PSO 3: Social Awareness
CO1	3	3	2	2	1	2	3	1	0	2	1	2	3	3	2
CO2	3	3	3	3	1	2	3	1	0	2	1	2	3	3	2
CO3	3	2	3	2	1	1	2	1	0	1	1	1	2	2	1
CO4	2	3	3	2	1	1	2	1	0	1	1	1	2	2	1
CO5	3	2	2	3	2	2	3	1	0	1	1	2	3	3	2
CO6	3	3	2	3	1	3	3	1	0	1	1	2	3	3	2
CO:	2.83	2.67	2.50	2.50	1.17	1.83	2.67	1.00	0.00	1.33	1.00	1.67	2.67	2.67	1.67

Course Code: CHEM-MD-CC5-4 (Chemistry MDC – V)

OR

CHEM-MD-CC5-6 (Chemistry MDC – V)

Course Outcome (CO): After undergoing the course, the student would be able to

CO1: Explain thermodynamic principles, entropy, Gibbs free energy, and spontaneity in systems for chemical and biological processes.

CO2: Analyze systems of variable composition, partial molar properties, chemical potential, fugacity, and activity coefficients.

CO3: Apply thermodynamic laws to chemical equilibrium, equilibrium constants, van't Hoff equations, and solvent extraction processes.

CO4: Describe conductance properties, ion mobility, and Debye-Huckel theory; use conductometric methods for solubility and titration studies.

CO5: Discuss ionic equilibrium concepts, buffer solutions, hydrolysis constants, and pH calculations for strong and weak electrolytes.

CO6: Perform kinetic experiments to determine rate constants for chemical reactions, catalysis, and sugar inversion using polarimetry.

CO-PO-PSO Mapping:

Course Outcome	Programme Outcome (PO)												Programme Specific Outcome (PSO1)		
	PO 1: Disciplinary knowledge :	PO 2: Problem solving	PO 3: Critical thinking	PO 4.Research-related skills / Scientific reasoning	PO 5: Communication Skills	PO 6: Cooperation/Team work	PO 7: Information/digital literacy:	PO 8: Self-directed learning	PO 9: Multicultural competence	PO 10: Moral and ethical awareness /reasoning	PO 11: Leadership readiness/qualities	PO 12: Lifelong learning	PSO 1: Analytical skill development and job opportunity	PSO 2: Research motivation	PSO 3: Social Awareness
CO1	3	2	2	2	1	1	2	1	0	2	1	2	3	2	1
CO2	3	3	2	3	1	1	2	2	0	2	1	2	3	3	1
CO3	3	3	3	3	1	1	2	2	0	2	1	2	3	3	1
CO4	2	2	3	2	1	1	3	1	0	1	1	1	2	2	1
CO5	2	2	2	2	1	1	2	1	0	1	1	1	2	2	1
CO6	2	2	3	3	1	1	2	1	0	1	1	2	3	3	1
CO:	2.50	2.33	2.50	2.50	1.00	1.00	2.17	1.33	0.00	1.50	1.00	1.67	2.67	2.50	1.00

Course Code: CHEM-MD-CC6-5 (Chemistry MDC – VI)

OR

CHEM-MD-CC6-6 (Chemistry MDC – VI)

Course Outcome (CO): After undergoing the course, the student would be able to

CO1: Understand and apply conformational analysis, prostereoisomerism, chirality, and stereoaxis to various organic compounds.

CO2: Analyze the chemistry of carbonyl compounds, including nucleophilic addition, reactions with enolates, and condensations.

CO3: Explore the exploitation of acidity in α-H of carbonyl compounds, including reactions like aldol, Mannich, and Knoevenagel.

CO4: Examine nucleophilic addition to α,β-unsaturated carbonyl systems and substitution at sp2 carbon in carbonyl derivatives.

CO5: Study the preparation and reactions of organometallic reagents like Grignard reagents, organolithiums, and cuprates.

CO6: Perform qualitative analysis of organic compounds, including detection of elements, functional groups, and solubility tests.

CO-PO-PSO Mapping:

Course Outcome	Programme Outcome (PO)												Programme Specific Outcome (PSO1)		
	PO 1: Disciplinary knowledge :	PO 2: Problem solving	PO 3: Critical thinking	PO 4.Research-related skills / Scientific reasoning	PO 5: Communication Skills	PO 6: Cooperation/Team work	PO 7: Information/digital literacy:	PO 8: Self-directed learning	PO 9: Multicultural competence	PO 10: Moral and ethical awareness /reasoning	PO 11: Leadership readiness/qualities	PO 12: Lifelong learning	PSO 1: Analytical skill development and job opportunity	PSO 2: Research motivation	PSO 3: Social Awareness
CO1	3	3	2	2	1	1	2	1	0	2	1	2	3	3	2
CO2	3	3	3	3	1	1	2	1	0	1	1	2	3	3	2
CO3	3	3	3	2	1	1	2	1	0	2	1	2	3	3	2
CO4	3	3	3	2	1	1	2	1	0	1	1	2	3	3	1
CO5	3	3	3	2	1	1	2	1	0	1	1	2	3	3	2
CO6	3	3	2	3	1	2	3	1	0	1	1	1	3	3	2
CO:	3.00	3.00	2.67	2.33	1.00	1.17	2.17	1.00	0.00	1.33	1.00	1.83	3.00	3.00	1.83

Course Code: CHEM-MD-CC7-5 or CHEM-MD-CC7-6 (Chemistry MDC – VII)

Course Outcome (CO): After undergoing the course, the student would be able to

CO1: Understand and apply concepts of diffusion, viscosity, surface tension, and their dependence on temperature and concentration in liquids.

CO2: Analyze solid-state properties, Bravais lattices, crystal structures, and determine lattice parameters using X-ray diffraction methods.

CO3: Apply thermodynamics to colligative properties, phase equilibria, and phase transitions, including calculations related to boiling point elevation and osmotic pressure.

CO4: Understand and apply the phase rule, phase diagrams, and colligative properties to binary and three-component systems.

CO5: Understand electromotive force, Nernst equation, and use EMF measurements to calculate cell reactions, equilibrium constants, and pH.

CO6: Conduct experiments to measure surface tension, viscosity, and perform conductometric titrations to study kinetics and solution behavior.

CO-PO-PSO Mapping:

Course Outcome	Programme Outcome (PO)												Programme Specific Outcome (PSO1)		
	PO 1: Disciplinary knowledge :	PO 2: Problem solving	PO 3: Critical thinking	PO 4.Research-related skills / Scientific reasoning	PO 5: Communication Skills	PO 6: Cooperation/Team work	PO 7: Information/digital literacy:	PO 8: Self-directed learning	PO 9: Multicultural competence	PO 10: Moral and ethical awareness /reasoning	PO 11: Leadership readiness/qualities	PO 12: Lifelong learning	PSO 1: Analytical skill development and job opportunity	PSO 2: Research motivation	PSO 3: Social Awareness
CO1	3	3	2	2	1	2	3	1	0	2	1	2	3	3	2
CO2	3	3	3	2	1	2	3	1	0	1	1	2	3	3	2
CO3	3	3	3	3	1	1	2	1	0	1	1	2	3	2	1
CO4	3	3	2	3	1	2	3	1	0	1	1	2	3	2	2
CO5	3	3	2	2	1	2	2	1	0	1	1	1	3	2	1
CO6	3	3	2	3	1	3	3	1	0	1	1	2	3	3	2
CO:	3.00	3.00	2.33	2.50	1.00	2.00	2.67	1.00	0.00	1.17	1.00	1.83	3.00	2.50	1.67

Course Code: CHEM-MD-CC8-6 (Chemistry MDC – VIII)

Course Outcome (CO): After undergoing the course, the student would be able to

CO1: Understand coordination chemistry fundamentals, including Werner's theory, isomerism, valence bond theory, and crystal field theory of complexes.

CO2: Apply valence bond and crystal field theory to analyze metal-ligand bonding, electronic spectra, and magnetic properties of complexes.

CO3: Explore supramolecular chemistry, including hydrogen bonding and non-covalent interactions such as ion-dipole, van der Waals, and aromatic interactions.

CO4: Understand nuclear stability, nuclear reactions (fission, fusion), and radiocarbon dating in the context of radioactivity.

CO5: Learn redox reactions and balance redox equations using the ion-electron method, Nernst equation, and redox titrations.

CO6: Perform practical estimations of metal ions in mixtures, including Fe^{3+}, Cu^{2+}, Cr^{3+}, and Mn^{2+} using redox reactions.

CO-PO-PSO Mapping:

Course Outcome	Programme Outcome (PO)												Programme Specific Outcome (PSO1)		
	PO 1: Disciplinary knowledge :	PO 2: Problem solving	PO 3: Critical thinking	PO 4.Research-related skills / Scientific reasoning	PO 5: Communication Skills	PO 6: Cooperation/Team work	PO 7: Information/digital literacy:	PO 8: Self-directed learning	PO 9: Multicultural competence	PO 10: Moral and ethical awareness /reasoning	PO 11: Leadership readiness/qualities	PO 12: Lifelong learning	PSO 1: Analytical skill development and job opportunity	PSO 2: Research motivation	PSO 3: Social Awareness
CO1	3	3	2	3	1	2	3	1	0	1	1	2	3	3	2
CO2	3	3	3	3	1	2	3	1	0	1	1	2	3	3	2
CO3	3	3	2	2	1	1	2	1	0	2	1	2	2	2	2
CO4	3	3	2	3	1	1	2	1	0	1	1	2	3	3	1
CO5	3	3	3	2	1	1	2	1	0	1	1	2	3	2	2
CO6	3	3	2	3	1	3	3	1	0	1	1	2	3	3	2
CO:	3.00	3.00	2.33	2.67	1.00	1.67	2.50	1.00	0.00	1.17	1.00	2.00	2.83	2.67	1.83

SHYAMPUR SIDDHESWARI MAHAVIDYALAYA
P.O.- AJODHYA, HOWRAH, WEST BENGAL, PIN- 711312

SKILL ENHANCEMENT COURSE
CHEMISTRY

For

Three – year
MULTIDISCIPLINARY Studies

Course Code: CHEM-MD-SEC (CHEMISTRY IN DAILY LIFE)

Course Outcome (CO): After undergoing the course, the student would be able to

CO1: Identify and describe the composition, analysis, and adulteration detection methods for dairy products, beverages, and food additives.

CO2: Apply analytical techniques to estimate fat content, minerals, and contaminants in milk, butter, coffee, and beverages.

CO3: Analyze the structure, sources, deficiency diseases, and functions of essential vitamins for health and nutrition.

CO4: Evaluate the purity, rancidity, and adulteration of edible oils, fats, and soaps for quality control.

CO5: Explain the principles and applications of renewable energy sources, including solar energy, fuel cells, and storage.

CO6: Design and conduct experiments to determine properties like iodine number, saponification value, and methyl alcohol content.

CO-PO-PSO Mapping:

Course Outcome	Programme Outcome (PO)												Programme Specific Outcome (PSO1)		
	PO 1: Disciplinary knowledge :	PO 2: Problem solving	PO 3: Critical thinking	PO 4.Research-related skills / Scientific reasoning	PO 5: Communication Skills	PO 6: Cooperation/Team work	PO 7: Information/digital literacy:	PO 8: Self-directed learning	PO 9: Multicultural competence	PO 10: Moral and ethical awareness /reasoning	PO 11: Leadership readiness/qualities	PO 12: Lifelong learning	PSO 1: Analytical skill development and job opportunity	PSO 2: Research motivation	PSO 3: Social Awareness
CO1	3	3	2	2	2	2	3	1	1	2	1	2	3	2	2
CO2	3	3	3	3	1	2	3	1	0	2	1	2	3	3	2
CO3	3	2	2	2	1	1	2	1	0	1	1	1	2	2	1
CO4	3	3	3	3	1	2	3	1	0	2	1	2	3	3	2
CO5	3	2	2	2	2	2	3	1	1	3	1	1	2	2	3
CO6	3	3	2	2	1	2	3	1	1	3	2	2	3	3	3
CO:	3.00	2.67	2.33	2.33	1.33	1.83	2.83	1.00	1.00	2.17	1.17	1.67	2.67	2.50	2.17

SHYAMPUR SIDDHESWARI MAHAVIDYALAYA
P.O.- AJODHYA, HOWRAH, WEST BENGAL, PIN- 711312

INTERDISCIPLINARY COURSE IN CHEMISTRY

For

Three – year MULTIDISCIPLINARY Studies

SHYAMPUR SIDDHESWARI MAHAVIDYALAYA

P.O.- AJODHYA, HOWRAH, WEST BENGAL, PIN- 711312

Course Code: CHEM-MD-IDC (CHEMISTRY IN DAILY LIFE)

Course Outcome (CO): After undergoing the course, the student would be able to

CO1: Identify and describe the composition, analysis, and adulteration detection methods for dairy products, beverages, and food additives.

CO2: Apply analytical techniques to estimate fat content, minerals, and contaminants in milk, butter, coffee, and beverages.

CO3: Analyze the structure, sources, deficiency diseases, and functions of essential vitamins for health and nutrition.

CO4: Evaluate the purity, rancidity, and adulteration of edible oils, fats, and soaps for quality control.

CO5: Explain the principles and applications of renewable energy sources, including solar energy, fuel cells, and storage.

CO6: Design and conduct experiments to determine properties like iodine number, saponification value, and methyl alcohol content.

CO-PO-PSO Mapping:

Course Outcome	Programme Outcome (PO)												Programme Specific Outcome (PSO1)		
	PO 1: Disciplinary knowledge :	PO 2: Problem solving	PO 3: Critical thinking	PO 4.Research-related skills / Scientific reasoning	PO 5: Communication Skills	PO 6: Cooperation/Team work	PO 7: Information/digital literacy:	PO 8: Self-directed learning	PO 9: Multicultural competence	PO 10: Moral and ethical awareness /reasoning	PO 11: Leadership readiness/qualities	PO 12: Lifelong learning	PSO 1: Analytical skill development and job opportunity	PSO 2: Research motivation	PSO 3: Social Awareness
CO1	3	3	2	2	2	2	3	1	1	2	1	2	3	2	2
CO2	3	3	3	3	1	2	3	1	0	2	1	2	3	3	2
CO3	3	2	2	2	1	1	2	1	0	1	1	1	2	2	1
CO4	3	3	3	3	1	2	3	1	0	2	1	2	3	3	2
CO5	3	2	2	2	2	2	3	1	1	3	1	1	2	2	3
CO6	3	3	2	2	1	2	3	1	1	3	2	2	3	3	3
CO:	3.00	2.67	2.33	2.33	1.33	1.83	2.83	1.00	1.00	2.17	1.17	1.67	2.67	2.50	2.17

Shyampur Siddheswari Mahavidyalaya
Ajodhya, Shyampur, Howrah, Pin-711312. West Bengal

Chemistry Honours Syllabus under CBCS (2018)

University of Calcutta

3 Years B.Sc. Honours Programme

- Programme Outcome (PO)
- Programme Specific Outcome (PSO)
- Course Outcome (CO)
- CO-PO Mapping
- CO-PSO Mapping

- # Programme Outcome (PO)

PO 1: Disciplinary knowledge: A graduate student is expected to be capable of demonstrating comprehensive knowledge and understanding both theoretical and practical knowledge in all disciplines of Chemistry. Students can solve their subjective problems very methodically, independently and finally draw a logical conclusion. Further, the student will be capable of applying modern technologies, handling advanced instruments and Chemistry related soft-wares for chemical analysis, characterization of materials and in separation technology.

PO 2: Problem solving: Students will be able to think and apply evidence based comparative chemistry approach to explain chemical synthesis and analysis.

PO 3: Critical thinking: The course curriculum also includes components that can be helpful to graduate students to develop critical thinking and to design, carry out, record and analyze the results of chemical reactions.

PO 4: Research-related skills / Scientific reasoning: Students will demonstrate strong research-related skills by formulating research questions, designing experiments, and employing appropriate methodologies for data collection and analysis. They will exhibit scientific reasoning through critical evaluation of evidence, interpretation of results, and drawing logical conclusions, enabling them to address complex problems and contribute to advancements in their field.

PO 5: Communication Skills: The course curriculum has been designed in such a manner as to enabling a graduate student to become a skilled project manager by acquiring knowledge about chemistry project management, writing, planning, study of ethical standards and rules and regulations pertaining to scientific project operation.

PO 6: Cooperation/Teamwork: The course curriculum has been designed to provide opportunity to act as team player by contributing in laboratory, field based situation and industry.

PO 7: Information/digital literacy: The course curriculum has been so designed to impart a good working knowledge in understanding and carrying out data analysis, use of library search tools, use of chemical simulation software and related computational work.

PO 8: Self-directed learning: Students will demonstrate the ability to independently identify learning needs, set goals, and pursue knowledge using diverse resources. They will reflect on their learning process, adapt strategies as needed, and apply insights to achieve continuous personal and professional growth.

PO 9: Multicultural competence: Students will demonstrate multicultural competence by understanding diverse cultural perspectives, effectively communicating across cultures, and applying inclusive practices in professional settings to promote equity and collaboration.

PO 10: Moral and ethical awareness/reasoning: As an inhabitant of this green planet a Chemistry graduate student should have many social responsibilities. The course curriculum is designed to teach a Chemistry graduate student to follow the green routes for the synthesis of chemical compounds and also find out new greener routes for sustainable development. The course also helps them to understand the causes of environmental pollution and thereby applying environmental friendly policies instead of environmentally hazard ones in every aspect.

PO 11: Leadership readiness/qualities: Students will demonstrate leadership readiness by effectively communicating a vision, motivating teams, and fostering collaboration. They will exhibit critical thinking, problem-solving abilities, and emotional intelligence, enabling them to navigate challenges and drive positive change in diverse environments. This outcome prepares students for impactful leadership roles in their future careers.

PO 12: Lifelong learning: The course curriculum is designed to inculcate a habit of learning continuously through use of advanced ICT technique and other available e-techniques, e-books and e-journals for personal academic growth.

- ## Programme Specific Outcome (PSO)

PSO 1: Analytical skill development and job opportunity: Chemistry graduates are expected to possess sufficient knowledge how to synthesize a chemical compound and perform necessary characterization and analysis in support of the formation of the product by using modern analytical tools and advanced technologies. Because of this course curriculum chemistry graduates have lot of opportunity to get job not only in academic and administrative field but also in industry.

PSO 2: Research motivation: Chemistry graduates are expected to be technically well trained with modern devices and Chemistry based software and has powerful knowledge in different disciplines of Chemistry so they can easily involve themselves in theory and laboratory-based research activities.

PSO 3: Social Awareness: As an inhabitant of this green world it is our duty to make our planet clean and suitable for living to all. In this context Chemistry graduates are expected to be more aware about finding green chemical reaction routes for sustainable development. They are expected to maintain good laboratory practices and safety.

Course Code: CEMA-CC-1-1 (Inorganic Chemistry 1 and Organic Chemistry 1A)

Course Outcome: After undergoing the course, the student would be able to

CO-1: Define key concepts related to the extra-nuclear structure of atoms, quantum numbers, hybridization, and bonding theories, including resonance and molecular orbital theory.

CO-2: Describe various acid-base concepts (Arrhenius, Bronsted-Lowry, Lewis) and explain their applications in determining the strength and behavior of acids and bases. Additionally, explain how physical properties of organic compounds relate to their structures, including the effects of hybridization and electronic displacements.

CO-3: Utilize the ion-electron method to balance redox reactions and apply the Nernst equation to calculate standard redox potentials. Demonstrate knowledge by predicting the outcome of various organic reactions, classifying them as addition, elimination, or substitution reactions.

CO-4: Analyze solubility effects (common ion effect) and their applications to precipitation and separation processes of metallic ions. Examine the stability of isomeric hydrocarbons using thermodynamic data, discussing how these factors relate to molecular structure.

CO-5: Evaluate electroanalytical methods such as potentiometric and conductometric titrations to determine equivalence points and pKa values. Compare different reaction mechanisms (ionic, radical, pericyclic) to assess their relevance and effectiveness in specific organic reactions.

CO-6: Design a laboratory experiment to investigate acid-base equilibria, including the selection of appropriate indicators and the interpretation of results. Develop a proposal for a project involving the separation and purification of organic compounds from a binary mixture, outlining methodology and expected results based on principles of solubility and crystallization.

CO-PO-PSO Mapping:

Course Outcome	Programme Outcome (PO)												Programme Specific Outcome (PSO1)		
	PO 1: Disciplinary knowledge :	PO 2: Problem solving	PO 3: Critical thinking	PO 4.Research-related skills / Scientific reasoning	PO 5: Communication Skills	PO 6: Cooperation/Teamwork	PO 7: Information/digital literacy:	PO 8: Self-directed learning	PO 9: Multicultural competence	PO 10: Moral and ethical awareness/reasoning	PO 11: Leadership readiness/qualities	PO 12: Lifelong learning	PSO 1: Analytical skill development and job opportunity	PSO 2: Research motivation	PSO 3: Social Awareness
CO1	3	2	2	1	0	0	1	0	0	0	0	1	3	2	0
CO2	3	3	2	1	0	0	1	0	0	0	0	1	3	2	1
CO3	3	3	3	2	0	0	2	0	0	0	0	1	3	3	1
CO4	3	2	3	2	0	0	2	0	0	0	0	1	3	3	1
CO5	3	3	3	3	0	0	2	0	0	0	0	1	3	3	1
CO6	3	3	3	3	2	2	2	1	0	0	0	1	3	3	1
CO:	3.00	2.67	2.67	2.00	2.00	2.00	1.67	1.00	0.00	0.00	0.00	1.00	3.00	2.67	1.00

Course Code: CEMA-CC-1-2 (Physical Chemistry 1 and Organic Chemistry 1B)

Course Outcome: After undergoing the course, the student would be able to

CO-1: Identify key concepts and definitions related to the kinetic theory of gases, chemical kinetics, stereochemistry, and reactive intermediates in organic chemistry.

CO-2: Explain the principles of gas behavior, the significance of rate laws, and the implications of molecular chirality and stereoisomerism in organic compounds.

CO-3: Utilize experimental techniques to measure the kinetics of reactions, assess viscosity, and determine the boiling points of organic compounds, demonstrating practical laboratory skills.

CO-4: Distinguish between ideal and real gases using the van der Waals equation, and interpret kinetic data to determine the order of reactions and identify the mechanism of catalysis.

CO-5: Critically assess the outcomes of experiments related to gas behavior, reaction rates, and stereochemical analysis, discussing the reliability and limitations of experimental methods.

CO-6: Design and propose novel experimental setups to investigate new aspects of gas behavior or reaction mechanisms in organic chemistry, demonstrating innovative thinking and application of theoretical knowledge.

CO-PO-PSO Mapping:

Course Outcome	Programme Outcome (PO)												Programme Specific Outcome (PSO1)		
	PO 1: Disciplinary knowledge :	PO 2: Problem solving	PO 3: Critical thinking	PO 4.Research-related skills / Scientific reasoning	PO 5: Communication Skills	PO 6: Cooperation/Teamwork	PO 7: Information/digital literacy:	PO 8: Self-directed learning	PO 9: Multicultural competence	PO 10: Moral and ethical awareness/reasoning	PO 11: Leadership readiness/qualities	PO 12: Lifelong learning	PSO 1: Analytical skill development and job opportunity	PSO 2: Research motivation	PSO 3: Social Awareness
CO1	3	2	1	1	0	0	0	0	0	1	0	1	3	2	1
CO2	3	3	2	2	0	0	0	1	0	1	0	1	3	3	2
CO3	3	3	3	3	0	1	0	0	0	1	0	1	3	3	1
CO4	3	2	3	2	0	0	0	0	0	1	0	1	3	3	1
CO5	3	3	3	3	1	0	0	0	0	1	0	1	3	3	2
CO6	3	3	3	3	1	0	1	1	0	2	1	1	3	3	2
CO:	3.00	2.67	2.50	2.33	1.00	1.00	1.00	1.00	0.00	1.17	1.00	1.00	3.00	2.83	1.50

Course Code: CEMA-CC-2-3 (Organic Chemistry 2)

Course Outcome: After undergoing the course, the student would be able to

CO-1: Find key terms and concepts related to stereochemistry, reaction mechanisms, thermodynamics, and reaction kinetics in organic chemistry.

CO-2: Explain the principles of chirality, conformational analysis, and the relationship between structure and reactivity in substitution and elimination reactions.

CO-3: Conduct laboratory experiments to perform organic reactions, analyze yields, and purify products through crystallization or sublimation, demonstrating practical skills in organic chemistry.

CO-4: Differentiate between various reaction mechanisms (S_N1, S_N2, E1, E2) and interpret thermodynamic and kinetic data to predict the outcomes of chemical reactions.

CO-5: Critically assess the efficiency of organic reactions and purification methods, calculating percentage yields and discussing the implications of experimental results in the context of reaction conditions.

CO-6: Design a laboratory project that incorporates multiple organic synthesis reactions, utilizing knowledge of reaction mechanisms and conditions to propose innovative approaches to product formation and purification.

CO-PO-PSO Mapping:

Course Outcome	Programme Outcome (PO)												Programme Specific Outcome (PSO1)		
	PO 1: Disciplinary knowledge :	PO 2: Problem solving	PO 3: Critical thinking	PO 4.Research-related skills / Scientific reasoning	PO 5: Communication Skills	PO 6: Cooperation/Teamwork	PO 7: Information/digital literacy:	PO 8: Self-directed learning	PO 9: Multicultural competence	PO 10: Moral and ethical awareness/reasoning	PO 11: Leadership readiness/qualities	PO 12: Lifelong learning	PSO 1: Analytical skill development and job opportunity	PSO 2: Research motivation	PSO 3: Social Awareness
CO1	3	2	1	1	0	0	0	0	0	0	0	1	3	2	1
CO2	3	3	2	2	0	0	1	1	0	0	0	1	3	3	1
CO3	3	3	3	3	0	2	1	1	0	0	0	1	3	3	2
CO4	3	3	3	3	0	1	1	1	0	0	0	1	3	3	1
CO5	3	3	3	3	0	1	1	1	0	0	0	1	3	3	1
CO6	3	3	3	3	2	3	1	2	0	2	2	2	3	3	2
CO:	3.00	2.83	2.50	2.50	2.00	1.75	1.00	1.20	0.00	2.00	2.00	1.17	3.00	2.83	1.33

Course Code: CEMA-CC-2-4 (Inorganic Chemistry 2)

Course Outcome: After undergoing the course, the student would be able to

CO-1: Identify and define key concepts in chemical bonding, including ionic and covalent bonds, molecular orbital theory, and nuclear stability.

CO-2: Explain the principles underlying ionic and covalent bonding, including concepts such as lattice energy, hybridization, molecular orbital theory, and the characteristics of weak chemical forces.

CO-3: Perform iodometric titrations to estimate the concentration of Vitamin C, arsenite, antimony, and available chlorine in various samples, demonstrating practical skills in quantitative analysis.

CO-4: Analyze molecular orbital diagrams and interpret bond properties, such as bond order and bond length, for diatomic molecules and molecular species.

CO-5: Assess the stability and reactivity of isotopes through nuclear reactions, including fission and fusion, and evaluate the implications for nuclear energy and radioactivity in practical applications.

CO-6: Design a laboratory experiment that investigates the properties of a chosen compound, utilizing techniques for estimation of metal content and analyzing the results in the context of chemical bonding theories.

CO-PO-PSO Mapping:

Course Outcome	Programme Outcome (PO)												Programme Specific Outcome (PSO1)		
	PO 1: Disciplinary knowledge :	PO 2: Problem solving	PO 3: Critical thinking	PO 4.Research-related skills / Scientific reasoning	PO 5: Communication Skills	PO 6: Cooperation/Teamwork	PO 7: Information/digital literacy:	PO 8: Self-directed learning	PO 9: Multicultural competence	PO 10: Moral and ethical awareness/reasoning	PO 11: Leadership readiness/qualities	PO 12: Lifelong learning	PSO 1: Analytical skill development and job opportunity	PSO 2: Research motivation	PSO 3: Social Awareness
CO1	3	2	2	1	0	0	0	1	0	0	0	1	3	2	0
CO2	3	3	2	2	0	0	0	1	0	0	0	1	3	3	0
CO3	3	3	3	3	0	1	0	0	0	0	0	1	3	3	1
CO4	3	2	3	2	0	0	0	0	0	0	0	1	3	3	0
CO5	3	3	3	3	0	0	0	1	0	1	0	1	3	3	1
CO6	3	3	3	3	1	1	0	1	0	0	0	1	3	3	1
CO:	3.00	2.67	2.67	2.33	1.00	1.00	0.00	1.00	0.00	1.00	0.00	1.00	3.00	2.83	1.00

Course Code: CEMA-CC-3-5 (Physical Chemistry 2)

Course Outcome: After undergoing the course, the student would be able to

CO-1: Define the fundamental laws of thermodynamics, definitions of thermodynamic parameters, principles of electrochemistry, and key equations such as the Gibbs-Helmholtz and Nernst equations.

CO-2: Explain the concepts of entropy, enthalpy, free energy, chemical potential, and their interdependence. Understand the physical interpretation of various thermodynamic principles, electrochemical laws, and ionic equilibria.

CO-3: Use the first and second laws of thermodynamics to solve problems related to work, heat, and internal energy changes in chemical systems under different conditions. Apply the Nernst equation to calculate EMF and determine reaction spontaneity in electrochemical cells.

CO-4: Analyze the effects of temperature, pressure, and concentration changes on equilibrium using Le Chatelier's principle and thermodynamic relations. Interpret the role of activity coefficients and fugacity in systems of variable composition.

CO-5: Assess the applicability and limitations of the van der Waals equation for real gases. Evaluate the impact of ionic strength and conductance on reaction behavior, and predict the feasibility of reactions using EMF values and thermodynamic criteria.

CO-6: Design experiments to measure conductivity, determine reaction enthalpies, or investigate the efficiency of buffer systems. Develop new approaches to optimize chemical equilibria and propose novel applications of electrochemical principles in real-world scenarios.

CO-PO-PSO Mapping:

Course Outcome	Programme Outcome (PO)												Programme Specific Outcome (PSO1)		
	PO 1: Disciplinary knowledge :	PO 2: Problem solving	PO 3: Critical thinking	PO 4.Research-related skills / Scientific reasoning	PO 5: Communication Skills	PO 6: Cooperation/Teamwork	PO 7: Information/digital literacy:	PO 8: Self-directed learning	PO 9: Multicultural competence	PO 10: Moral and ethical awareness/reasoning	PO 11: Leadership readiness/qualities	PO 12: Lifelong learning	PSO 1: Analytical skill development and job opportunity	PSO 2: Research motivation	PSO 3: Social Awareness
CO1	3	2	1	1	0	0	0	0	0	0	0	1	3	2	0
CO2	3	3	2	2	0	0	0	1	0	0	0	1	3	3	0
CO3	3	3	3	3	0	0	0	0	0	0	0	1	3	3	0
CO4	3	2	3	2	0	0	0	0	0	0	0	1	3	3	0
CO5	3	3	3	3	0	0	0	0	0	0	0	1	3	3	0
CO6	3	3	3	3	0	0	0	0	0	0	0	1	3	3	0
CO:	3.00	2.67	2.50	2.33	0.00	0.00	0.00	1.00	0.00	0.00	0.00	1.00	3.00	2.83	0.00

Course Code: CEMA-CC-3-6 (Inorganic Chemistry 3)

Course Outcome: After undergoing the course, the student would be able to

CO-1: List the periodic properties of elements, fundamental concepts of s- and p-block chemistry, properties of noble gases, and key aspects of coordination chemistry, such as Werner's theory and ligand classification.

CO-2: Explain periodic trends (e.g., ionization energy, electronegativity, and atomic radii) using effective nuclear charge, screening effects, and Slater's rules. Understand the structure, bonding, and reactivity of s- and p-block compounds, noble gas compounds, and various types of inorganic polymers.

CO-3: Use VSEPR theory, Valence Bond Theory, and Molecular Orbital Theory to predict the geometry and bonding of coordination complexes and noble gas compounds. Apply Slater's rules to estimate effective nuclear charge and predict periodic trends for various elements.

CO-4: Analyze the stability and reactivity of s- and p-block compounds based on periodic trends, oxidation states, and diagonal relationships. Compare different types of inorganic polymers and their structural properties to those of organic polymers.

CO-5: Evaluate the influence of the lanthanide contraction and the inert pair effect on the properties of transition metals and heavy elements. Assess the bonding and stereoisomerism in coordination complexes and predict their potential applications based on structural properties.

CO-6: Design new coordination complexes using different ligand types and predict their isomeric forms and stability. Propose new synthetic pathways for inorganic polymers like siloxanes and phosphazenes, or suggest novel applications for noble gas compounds in various chemical processes.

CO-PO-PSO Mapping:

Course Outcome	Programme Outcome (PO)												Programme Specific Outcome (PSO1)		
	PO 1: Disciplinary knowledge :	PO 2: Problem solving	PO 3: Critical thinking	PO 4.Research-related skills / Scientific reasoning	PO 5: Communication Skills	PO 6: Cooperation/Teamwork	PO 7: Information/digital literacy:	PO 8: Self-directed learning	PO 9: Multicultural competence	PO 10: Moral and ethical awareness/reasoning	PO 11: Leadership readiness/qualities	PO 12: Lifelong learning	PSO 1: Analytical skill development and job opportunity	PSO 2: Research motivation	PSO 3: Social Awareness
CO1	3	2	1	1	0	0	0	0	0	0	0	1	3	2	0
CO2	3	3	2	2	0	0	0	1	0	0	0	1	3	3	0
CO3	3	3	2	2	0	0	0	1	0	0	0	1	3	3	0
CO4	3	2	3	2	0	0	0	0	0	0	0	1	3	3	0
CO5	3	3	3	3	0	0	0	0	0	0	0	1	3	3	0
CO6	3	3	3	3	0	0	0	0	0	0	0	1	3	3	0
CO:	3.00	2.67	2.33	2.17	0.00	0.00	0.00	1.00	0.00	0.00	0.00	1.00	3.00	2.83	0.00

Course Code: CEMA-CC-3-7 (Organic Chemistry 3)

Course Outcome: After undergoing the course, the student would be able to

CO-1: Relate the fundamental mechanisms and characteristics of chemical reactions involving alkenes, alkynes, and aromatic compounds, including Markovnikov and anti-Markovnikov additions, aromatic substitutions, and nucleophilic additions to carbonyl groups.

CO-2: Explain the regioselectivity and stereoselectivity of addition reactions to unsaturated systems (alkenes, alkynes, and conjugated dienes), as well as the principles underlying electrophilic and nucleophilic aromatic substitutions.

CO-3: Implement the knowledge of reaction mechanisms to predict products in chemical reactions, including the use of reagents like Grignard reagents, organolithiums, and Gilman cuprates in forming C–C bonds, as well as in laboratory estimations of organic compounds (e.g., glucose, sucrose, and acetic acid).

CO-4: Differentiate between various reaction pathways (such as substitution vs. elimination and nucleophilic vs. electrophilic addition) by examining reaction intermediates and stereochemical outcomes, supported by mechanistic evidence and reactivity principles.

CO-5: Assess the role of substituents and reaction conditions (temperature, solvent, catalysts) in determining the selectivity and yield of synthetic organic reactions, such as aldol condensations, Michael additions, and aromatic substitution patterns.

CO-6: Design synthetic strategies for complex organic molecules by integrating multiple reaction mechanisms, such as combining aldol condensation, Michael addition, and conjugate addition for ring-forming reactions, and developing purification methods for organic compounds based on physical properties.

CO-PO-PSO Mapping:

Course Outcome	Programme Outcome (PO)												Programme Specific Outcome (PSO1)		
	PO 1: Disciplinary knowledge :	PO 2: Problem solving	PO 3: Critical thinking	PO 4.Research-related skills / Scientific reasoning	PO 5: Communication Skills	PO 6: Cooperation/Teamwork	PO 7: Information/digital literacy:	PO 8: Self-directed learning	PO 9: Multicultural competence	PO 10: Moral and ethical awareness/reasoning	PO 11: Leadership readiness/qualities	PO 12: Lifelong learning	PSO 1: Analytical skill development and job opportunity	PSO 2: Research motivation	PSO 3: Social Awareness
CO1	3	2	2	1	0	0	1	1	0	0	0	1	3	2	0
CO2	3	3	2	2	0	0	1	1	0	0	0	1	3	3	0
CO3	3	2	3	2	0	0	1	1	0	0	0	1	3	3	0
CO4	3	2	3	3	0	0	1	1	0	0	0	1	3	2	0
CO5	3	3	3	3	0	0	1	1	0	0	0	1	3	3	0
CO6	3	3	3	3	0	0	1	1	0	0	0	1	3	3	0
CO:	3.00	2.50	2.67	2.33	0.00	0.00	1.00	1.00	0.00	0.00	0.00	1.00	3.00	2.67	0.00

Course Code: CEMA-CC-4-8 (Organic Chemistry 4)

Course Outcome: After undergoing the course, the student would be able to

CO-1: Identify and describe the fundamental concepts and mechanisms for reactions involving nitrogen compounds, rearrangements, and synthetic strategies in organic chemistry, as well as the basic principles of UV, IR, and NMR spectroscopy.

CO-2: Explain the stereochemical features and evidence for rearrangement reactions, the role of retrosynthetic analysis in organic synthesis, and the spectral characteristics of organic molecules in UV, IR, and NMR spectra.

CO-3: Use knowledge of reaction mechanisms and synthetic strategies to predict the outcome of chemical reactions involving diazonium salts, aromatic rearrangements, and the use of synthetic equivalents for C–C bond formation.

CO-4: Differentiate between various rearrangement reactions (e.g., Wagner-Meerwein vs. Hofmann rearrangement), and analyze spectral data (UV, IR, and NMR) to determine the structure of simple organic molecules.

CO-5: Assess the stability and reactivity of intermediates in nitrogen compound reactions and rearrangements, and evaluate synthetic pathways based on stereoselectivity and regioselectivity considerations.

CO-6: Design multistep synthetic routes for complex organic molecules using retrosynthetic analysis, considering strategies such as protection-deprotection and asymmetric synthesis, and develop purification methods for synthesized compounds.

CO-PO-PSO Mapping:

Course Outcome	Programme Outcome (PO)												Programme Specific Outcome (PSO1)		
	PO 1: Disciplinary knowledge :	PO 2: Problem solving	PO 3: Critical thinking	PO 4.Research-related skills / Scientific reasoning	PO 5: Communication Skills	PO 6: Cooperation/Teamwork	PO 7: Information/digital literacy:	PO 8: Self-directed learning	PO 9: Multicultural competence	PO 10: Moral and ethical awareness/reasoning	PO 11: Leadership readiness/qualities	PO 12: Lifelong learning	PSO 1: Analytical skill development and job opportunity	PSO 2: Research motivation	PSO 3: Social Awareness
CO1	3	2	2	1	0	0	1	1	0	0	0	1	3	2	0
CO2	3	3	2	2	0	0	1	1	0	0	0	1	3	3	0
CO3	2	2	3	2	0	0	1	1	0	0	0	1	3	3	0
CO4	3	2	2	3	0	0	1	1	0	0	0	1	3	2	0
CO5	3	3	3	3	0	0	1	1	0	0	0	1	3	3	0
CO6	3	3	3	3	0	0	1	1	0	0	0	1	3	3	0
CO:	2.83	2.50	2.50	2.33	0.00	0.00	1.00	1.00	0.00	0.00	0.00	1.00	3.00	2.67	0.00

Course Code: CEMA-CC-4-9 (Physical Chemistry 3)

Course Outcome: After undergoing the course, the student would be able to

CO-1: Define key concepts and laws related to colligative properties, phase equilibrium, quantum mechanics, and crystal structure, including Raoult's law, Clapeyron and Clausius-Clapeyron equations, Bragg's law, and the Schrodinger equation.

CO-2: Explain the principles of ideal and non-ideal solutions, phase diagrams, and the Ehrenfest classification of phase transitions. Describe the fundamentals of quantum mechanics, including wave-particle duality, the uncertainty principle, and the behavior of particles in a box.

CO-3: Apply thermodynamic relationships, such as Raoult's law and Clausius-Clapeyron equation, to solve problems involving colligative properties and phase transitions. Use the Schrodinger equation to model quantum mechanical systems like a particle in a box.

CO-4: Analyze phase diagrams, binary and ternary solutions, and solid-liquid equilibrium to predict system behavior under various conditions. Evaluate quantum mechanical operators, eigenfunctions, and the behavior of systems at different quantum states.

CO-5: Assess the structural properties of crystals using Bravais lattices, Miller indices, and the results from powder diffraction methods. Evaluate the significance of thermal properties such as specific heat (Dulong-Petit, Einstein, and Debye theories) in solids.

CO-6: Design and perform experiments to study colligative properties, phase diagrams, and partition coefficients. Propose solutions to practical problems involving the thermodynamic behavior of solutions, phase transitions, and quantum mechanical systems.

CO-PO-PSO Mapping:

Course Outcome	Programme Outcome (PO)												Programme Specific Outcome (PSO1)		
	PO 1: Disciplinary knowledge :	PO 2: Problem solving	PO 3: Critical thinking	PO 4.Research-related skills / Scientific reasoning	PO 5: Communication Skills	PO 6: Cooperation/Teamwork	PO 7: Information/digital literacy:	PO 8: Self-directed learning	PO 9: Multicultural competence	PO 10: Moral and ethical awareness/reasoning	PO 11: Leadership readiness/qualities	PO 12: Lifelong learning	PSO 1: Analytical skill development and job opportunity	PSO 2: Research motivation	PSO 3: Social Awareness
CO1	3	2	3	1	0	0	1	0	0	0	0	1	3	2	1
CO2	3	3	3	2	0	0	1	1	0	0	0	1	3	3	2
CO3	3	3	3	3	0	0	1	1	0	0	0	1	3	3	2
CO4	3	3	3	3	0	0	1	1	0	0	0	1	3	3	2
CO5	3	3	3	3	0	0	1	1	0	0	0	1	3	3	2
CO6	3	3	3	3	1	1	2	2	0	1	1	1	3	3	3
CO:	3.00	2.83	3.00	2.50	1.00	1.00	1.17	1.20	0.00	1.00	1.00	1.00	3.00	2.83	2.00

Course Code: CEMA-CC-4-10 (Inorganic Chemistry 4)

Course Outcome: After undergoing the course, the student would be able to

CO-1: Identify and describe the key principles of Crystal Field Theory, molecular orbital theory, and reaction kinetics for coordination compounds, including terminologies such as CFSE, OSSE, trans effect, and Racah parameters.

CO-2: Explain the magnetic and optical properties of transition metal complexes using crystal field splitting and electron configuration. Describe the concepts of d-d transitions, L-S coupling, and the spectrochemical series in predicting complex properties.

CO-3: Use Crystal Field Theory and MO Theory to predict the stability, geometry, and electronic configurations of various coordination complexes. Apply the concept of trans effect to determine substitution patterns in square planar complexes.

CO-4: Analyze the comparative chemical properties of 3d, 4d, and 5d transition elements and f-block elements, including trends in oxidation states, redox properties, and magnetic behavior. Evaluate how ligand field effects influence the reaction rates and mechanisms in both square planar and octahedral complexes.

CO-5: Assess the thermodynamic and kinetic stability of coordination complexes and propose the most likely mechanisms for ligand substitution reactions in different geometries. Evaluate the role of Jahn-Teller distortions and its effect on the properties of transition metal ions.

CO-6: Design new coordination compounds using various ligand types, predict their electronic and magnetic properties, and suggest their potential applications in catalysis or material science. Propose synthetic strategies for the separation of lanthanides using ion-exchange methods and evaluate their efficiency.

CO-PO-PSO Mapping:

Course Outcome	Programme Outcome (PO)												Programme Specific Outcome (PSO1)		
	PO 1: Disciplinary knowledge :	PO 2: Problem solving	PO 3: Critical thinking	PO 4.Research-related skills / Scientific reasoning	PO 5: Communication Skills	PO 6: Cooperation/Team work	PO 7: Information/digital literacy:	PO 8: Self-directed learning	PO 9: Multicultural competence	PO 10: Moral and ethical awareness/reasoning	PO 11: Leadership readiness/qualities	PO 12: Lifelong learning	PSO 1: Analytical skill development and job opportunity	PSO 2: Research motivation	PSO 3: Social Awareness
CO1	3	2	2	1	0	0	1	1	0	0	0	1	3	1	0
CO2	3	2	2	2	0	0	2	1	0	0	0	2	3	2	0
CO3	3	3	3	2	1	0	1	1	0	0	0	2	3	3	0
CO4	3	3	3	3	1	0	1	2	0	0	0	2	3	3	0
CO5	3	3	3	3	1	0	2	2	0	0	0	2	3	3	0
CO6	3	3	3	3	2	0	3	3	0	0	0	3	3	3	0
CO:	3.00	2.67	2.67	2.33	1.25	0.00	1.67	1.67	0.00	0.00	0.00	2.00	3.00	2.50	0.00

Course Code: CEMA-CC-5-11 (Physical Chemistry 4)

Course Outcome: After undergoing the course, the student would be able to

CO-1: Tell the fundamental concepts of quantum mechanics, such as Schrödinger's equation, angular momentum, and the basics of statistical thermodynamics, including partition functions and the Boltzmann distribution.

CO-2: Explain the solutions to the Schrödinger equation for different systems (simple harmonic oscillator, rigid rotator, hydrogen atom) and their physical significance. Understand the concept of macrostates, microstates, and their relation to entropy and equilibrium configuration in statistical thermodynamics.

CO-3: Use the Born-Oppenheimer approximation and the LCAO-MO approach to describe the bonding in simple molecules like H_2^+ and H_2. Apply the variation theorem to estimate the ground-state energy of simple quantum systems like the particle-in-a-box.

CO-4: Analyze the differences between the Valence Bond (VB) and Molecular Orbital (MO) theories in explaining molecular bonding. Assess the role of angular momentum in determining the behavior of atomic and molecular systems using commutation relations.

CO-5: Evaluate the limitations of the Schrödinger equation in multi-electron systems and justify the use of approximation methods. Compare different numerical methods, such as the Newton-Raphson method and Simpson's rule, for solving mathematical problems in quantum chemistry and thermodynamics.

CO-6: Design and develop computational models to solve complex quantum mechanical equations using numerical integration and differentiation techniques. Construct theoretical frameworks for understanding the statistical behavior of molecular systems under different thermodynamic conditions.

CO-PO-PSO Mapping:

Course Outcome	Programme Outcome (PO)												Programme Specific Outcome (PSO1)		
	PO 1: Disciplinary knowledge :	PO 2: Problem solving	PO 3: Critical thinking	PO 4.Research-related skills / Scientific reasoning	PO 5: Communication Skills	PO 6: Cooperation/Teamwork	PO 7: Information/digital literacy:	PO 8: Self-directed learning	PO 9: Multicultural competence	PO 10: Moral and ethical awareness/reasoning	PO 11: Leadership readiness/qualities	PO 12: Lifelong learning	PSO 1: Analytical skill development and job opportunity	PSO 2: Research motivation	PSO 3: Social Awareness
CO1	3	2	2	1	0	0	1	1	0	0	0	1	3	1	0
CO2	3	2	2	2	0	0	2	1	0	0	0	2	3	2	0
CO3	3	3	3	2	1	0	1	1	0	0	0	2	3	3	0
CO4	3	3	3	3	1	0	2	2	0	0	0	2	3	3	0
CO5	3	3	3	3	1	0	2	2	0	0	0	2	3	3	0
CO6	3	3	3	3	2	0	3	3	0	0	0	3	3	3	0
CO:	3.00	2.67	2.67	2.33	1.25	0.00	1.83	1.67	0.00	0.00	0.00	2.00	3.00	2.50	0.00

Course Code: CEMA-CC-5-12 (Organic Chemistry 5)

Course Outcome: After undergoing the course, the student would be able to

CO-1: Identify and describe the structures, synthetic methods, and reaction mechanisms of various carbocyclic and heterocyclic compounds, such as naphthalene, furan, pyrrole, and pyridine, as well as the basic configurations and properties of carbohydrates, amino acids, and nucleic acids.

CO-2: Explain the chemical properties, orientation effects, and stereochemical outcomes of reactions involving polynuclear aromatic hydrocarbons and heterocycles. Understand the stereoelectronic requirements and conformational aspects of cyclic stereochemistry

CO-3: Utilize the knowledge of synthetic strategies and reaction mechanisms to predict the reactivity and outcomes of carbocyclic and heterocyclic systems, including the synthesis and reactivity patterns of pyridine, indole, quinoline, and isoquinoline derivatives.

CO-4: Compare and contrast the reactivity, orientation, and regioselectivity in the electrophilic and nucleophilic substitutions of aromatic and heteroaromatic systems. Analyze the stereochemical implications of conformational changes in cyclic systems and predict the outcomes of pericyclic reactions.

CO-5: Assess the stability and reactivity of various intermediates in heterocyclic and carbocyclic chemistry and evaluate synthetic routes based on regio- and stereoselectivity considerations for the synthesis of biologically active compounds such as amino acids, peptides, and nucleic acids.

CO-6: Design multistep synthetic routes for complex carbocyclic and heterocyclic compounds using retrosynthetic analysis. Develop strategies for stereoselective and regioselective synthesis in cyclic systems, and propose synthetic routes for biomolecules such as oligosaccharides and peptides.

CO-PO-PSO Mapping:

Course Outcome	Programme Outcome (PO)												Programme Specific Outcome (PSO1)		
	PO 1: Disciplinary knowledge :	PO 2: Problem solving	PO 3: Critical thinking	PO 4.Research-related skills / Scientific reasoning	PO 5: Communication Skills	PO 6: Cooperation/Teamwork	PO 7: Information/digital literacy:	PO 8: Self-directed learning	PO 9: Multicultural competence	PO 10: Moral and ethical awareness/reasoning	PO 11: Leadership readiness/qualities	PO 12: Lifelong learning	PSO 1: Analytical skill development and job opportunity	PSO 2: Research motivation	PSO 3: Social Awareness
CO1	3	2	2	1	0	0	1	1	0	0	0	1	3	1	0
CO2	3	2	2	2	0	0	2	1	0	0	0	2	3	2	0
CO3	3	3	3	2	1	0	1	1	0	0	0	2	3	3	0
CO4	3	3	3	3	1	0	1	2	0	0	0	2	3	3	0
CO5	3	3	3	3	1	0	2	2	0	0	0	2	3	3	0
CO6	3	3	3	3	2	0	3	3	0	0	0	3	3	3	0
CO:	3.00	2.67	2.67	2.33	1.25	0.00	1.67	1.67	0.00	0.00	0.00	2.00	3.00	2.50	0.00

Course Code: CEMA-CC-6-13 (Inorganic Chemistry 5)

Course Outcome: After undergoing the course, the student would be able to

CO-1: Identify key principles of qualitative analysis for cations and anions, including the concepts of solubility products and the common ion effect. Recognize the classification and roles of essential and trace elements in biological systems, and recall the basic definitions and classifications of organometallic compounds.

CO-2: Explain the significance of interfering anions in qualitative analysis and the procedures for their removal. Describe the biochemical roles of metal ions such as Fe, Cu, Zn, and Ca in biological processes, including oxygen transport and enzymatic reactions. Understand the application of the 18-electron rule to predict the stability of organometallic complexes and the concept of synergic bonding.

CO-3: Use solubility principles to predict the separation of cations into analytical groups in qualitative analysis. Apply the knowledge of metal-ligand interactions to explain the structure and reactivity of biomolecules such as hemoglobin and myoglobin. Illustrate the preparation methods and chemical behavior of organometallic compounds like metal carbonyls and ferrocene.

CO-4: Analyze the impact of toxic metal ions on biological systems and propose chelation therapies for metal poisoning. Assess the effectiveness of group reagents in the separation of metal ions in qualitative analysis. Compare different catalytic mechanisms used by organometallic complexes in industrial processes such as hydrogenation, hydroformylation, and olefin polymerization.

CO-5: Evaluate the efficiency of various group separation techniques in qualitative analysis and suggest improvements for removing interfering anions. Critically assess the role of different metal ions in enzymatic catalysis and metal ion transport across membranes. Judge the suitability of different organometallic catalysts for specific industrial reactions based on their structure and electronic configuration.

CO-6: Design experimental procedures for the separation and identification of complex cations and anions in an unknown mixture. Construct models to demonstrate the role of metal ions in biological systems and propose novel organometallic compounds with potential catalytic applications in green chemistry and industrial processes.

CO-PO-PSO Mapping:

Course Outcome	Programme Outcome (PO)												Programme Specific Outcome (PSO1)		
	PO 1: Disciplinary knowledge :	PO 2: Problem solving	PO 3: Critical thinking	PO 4.Research-related skills / Scientific reasoning	PO 5: Communication Skills	PO 6: Cooperation/Teamwork	PO 7: Information/digital literacy:	PO 8: Self-directed learning	PO 9: Multicultural competence	PO 10: Moral and ethical awareness/reasoning	PO 11: Leadership readiness/qualities	PO 12: Lifelong learning	PSO 1: Analytical skill development and job opportunity	PSO 2: Research motivation	PSO 3: Social Awareness
CO1	3	1	1	1	0	0	1	1	0	0	0	1	3	1	0
CO2	3	2	2	2	0	0	1	1	0	0	0	1	3	2	0
CO3	3	3	2	2	1	0	2	2	0	0	0	2	3	2	0
CO4	3	3	3	3	1	0	2	2	0	0	0	2	3	3	0
CO5	3	3	3	3	1	0	2	2	0	0	0	2	3	3	0
CO6	3	3	3	3	2	0	3	3	0	0	0	3	3	3	0
CO:	3.00	2.50	2.33	2.33	1.25	0.00	1.83	1.83	0.00	0.00	0.00	1.83	3.00	2.33	0.00

Course Code: CEMA-CC-6-14 (Physical Chemistry 5)

Course Outcome: After undergoing the course, the student would be able to

CO-1: Identify and describe key concepts related to the interaction of electromagnetic radiation with molecules, including various types of spectra (rotation, vibration, electronic, and Raman spectra). Identify fundamental laws of photochemistry, such as Lambert-Beer's law and Stark-Einstein law, and the main characteristics of adsorption isotherms.

CO-2: Explain the principles of rotation and vibrational spectroscopy, including selection rules, intensity variations, and molecular vibrations. Describe the basic mechanisms of fluorescence and phosphorescence and differentiate between physical and chemical adsorption, along with their respective isotherms.

CO-3: Apply spectroscopic techniques to determine molecular parameters such as bond lengths, force constants, and dissociation energies in diatomic and triatomic molecules. Utilize Lambert-Beer's law to calculate absorption coefficients and quantum yields in photochemical reactions.

CO-4: Analyze spectral data from rotational and vibrational spectroscopy to derive molecular properties and interpret Jablonski diagrams for excited-state processes. Examine the relationship between surface phenomena and their effects on adsorption, including the impact of temperature on surface tension.

CO-5: Evaluate the effectiveness of different spectroscopic techniques in studying molecular interactions and excited-state dynamics. Assess the impact of collision theory and transition state theory on the understanding of reaction rates in photochemical processes.

CO-6: Design experiments to investigate molecular vibrations using vibrational spectroscopy, and propose a method to analyze photochemical reaction rates under varying conditions. Construct models to illustrate the mechanisms of adsorption and the stability of colloids in different environments.

CO-PO-PSO Mapping:

Course Outcome	Programme Outcome (PO)												Programme Specific Outcome (PSO1)		
	PO 1: Disciplinary knowledge :	PO 2: Problem solving	PO 3: Critical thinking	PO 4.Research-related skills / Scientific reasoning	PO 5: Communication Skills	PO 6: Cooperation/Team work	PO 7: Information/digital literacy:	PO 8: Self-directed learning	PO 9: Multicultural competence	PO 10: Moral and ethical awareness/reasoning	PO 11: Leadership readiness/qualities	PO 12: Lifelong learning	PSO 1: Analytical skill development and job opportunity	PSO 2: Research motivation	PSO 3: Social Awareness
CO1	3	1	1	1	0	0	1	1	0	0	0	1	3	1	0
CO2	3	2	2	2	0	0	1	1	0	0	0	1	3	2	0
CO3	3	3	2	2	1	0	2	2	0	0	0	2	3	2	0
CO4	3	3	3	3	1	0	2	2	0	0	0	2	3	3	0
CO5	3	3	3	3	1	0	2	2	0	0	0	2	3	3	0
CO6	3	3	3	3	2	0	3	3	0	0	0	3	3	3	0
CO:	3.00	2.50	2.33	2.33	1.25	0.00	1.83	1.83	0.00	0.00	0.00	1.83	3.00	2.33	0.00

Course Code: CEMA-DSE-A-1: (MOLECULAR MODELLING AND DRUG DESIGN)

Course Outcome: After undergoing the course, the student would be able to

CO-1: Tell the fundamental concepts in molecular modeling, including potential energy surfaces, coordinate systems, and molecular graphics. Identify various force fields used in molecular mechanics, such as bond stretching, angle bending, and types of non-bonded interactions (electrostatic and van der Waals interactions).

CO-2: Explain the significance of energy minimization methods and their role in exploring potential energy surfaces. Describe the principles behind molecular dynamics simulations and the Monte Carlo simulation method, including their applications in studying molecular systems.

CO-3: Apply force field models to simulate liquid water and perform energy minimization techniques to explore molecular configurations. Utilize molecular dynamics simulations to analyze the behavior of simple molecular models under different thermodynamic conditions.

CO-4: Analyze simulation results to assess the stability of molecular structures, estimating errors and interpreting thermodynamic properties. Examine the efficacy of different structure prediction methods, such as comparative modeling and threading, in predicting protein structures.

CO-5: Evaluate the accuracy and reliability of molecular dynamics and Monte Carlo simulation methods in predicting molecular behavior and interactions. Assess the outcomes of structure-based drug design approaches, including QSAR and molecular docking, in relation to their potential effectiveness.

CO-6: Design a computational experiment to predict protein structures using comparative modeling techniques and propose a strategy for de novo ligand design based on molecular docking studies. Construct models that demonstrate the effects of temperature and pressure on molecular dynamics simulations.

CO-PO-PSO Mapping:

Course Outcome	Programme Outcome (PO)												Programme Specific Outcome (PSO1)		
	PO 1: Disciplinary knowledge :	PO 2: Problem solving	PO 3: Critical thinking	PO 4.Research-related skills / Scientific reasoning	PO 5: Communication Skills	PO 6: Cooperation/Teamwork	PO 7: Information/digital literacy:	PO 8: Self-directed learning	PO 9: Multicultural competence	PO 10: Moral and ethical awareness/reasoning	PO 11: Leadership readiness/qualities	PO 12: Lifelong learning	PSO 1: Analytical skill development and job opportunity	PSO 2: Research motivation	PSO 3: Social Awareness
CO1	3	1	1	1	0	0	1	1	0	0	0	1	3	1	0
CO2	3	2	2	2	0	0	1	1	0	0	0	1	3	2	0
CO3	3	3	2	2	1	0	2	2	0	0	0	2	3	2	0
CO4	3	3	3	3	1	0	2	2	0	0	0	2	3	3	0
CO5	3	3	3	3	1	0	2	2	0	0	0	2	3	3	0
CO6	3	3	3	3	2	0	3	3	0	0	0	3	3	3	0
CO:	3.00	2.50	2.33	2.33	1.25	0.00	1.83	1.83	0.00	0.00	0.00	1.83	3.00	2.33	0.00

Course Code: CEMA-DSE-A-2: (APPLICATIONS OF COMPUTERS IN CHEMISTRY)

Course Outcome: After undergoing the course, the student would be able to

CO-1: Identify and describe the basic elements of the FORTRAN language, including keywords, commands, and the use of logical and relational operators. Identify essential features of spreadsheet software, including formatting and basic functions in MS Excel.

CO-2: Explain the concepts of array variables, iteration, and the differences between functions and subroutines in FORTRAN. Describe how to create and format spreadsheets in Excel, including entering data, creating charts, and performing simple calculations.

CO-3: Apply FORTRAN programming techniques to solve numerical problems, such as matrix addition and multiplication. Use Excel to create spreadsheets for data entry and analysis, and employ the SOLVER and Goal Seek functions to solve simultaneous equations related to chemical equilibrium problems.

CO-4: Analyze pH metric titration curves through numerical modeling using Excel functions. Evaluate data sets for trends and relationships using statistical methods, such as regression analysis and curve fitting.

CO-5: Evaluate the accuracy and precision of data sets by applying concepts of Gaussian distribution and errors in measurement. Assess the statistical significance of experimental results using the T test and F test in Excel, determining the validity of the data.

CO-6: Design a comprehensive project utilizing FORTRAN to write a program for solving complex numerical problems, incorporating functions and subroutines. Develop a detailed statistical analysis report using Excel that includes descriptive statistics, error analysis, and significance testing of the results.

CO-PO-PSO Mapping:

Course Outcome	Programme Outcome (PO)												Programme Specific Outcome (PSO1)		
	PO 1: Disciplinary knowledge :	PO 2: Problem solving	PO 3: Critical thinking	PO 4.Research-related skills / Scientific reasoning	PO 5: Communication Skills	PO 6: Cooperation/Teamwork	PO 7: Information/digital literacy:	PO 8: Self-directed learning	PO 9: Multicultural competence	PO 10: Moral and ethical awareness/reasoning	PO 11: Leadership readiness/qualities	PO 12: Lifelong learning	PSO 1: Analytical skill development and job opportunity	PSO 2: Research motivation	PSO 3: Social Awareness
CO1	3	2	1	1	1	0	2	1	0	1	0	1	2	1	1
CO2	3	2	2	1	1	0	2	1	0	1	0	1	2	2	1
CO3	3	3	2	2	1	1	2	2	0	1	0	2	3	2	2
CO4	3	3	3	3	1	1	2	2	0	1	0	2	3	3	2
CO5	3	3	3	3	1	1	2	2	0	1	0	2	3	3	2
CO6	3	3	3	3	2	2	3	3	0	1	2	3	3	3	2
CO:	3.00	2.67	2.33	2.17	1.17	1.25	2.17	1.83	0.00	1.00	2.00	1.83	2.67	2.33	1.67

Course Code: CEMA-DSE-A-3: (GREEN CHEMISTRY AND CHEMISTRY OF NATURAL PRODUCTS)

Course Outcome: After undergoing the course, the student would be able to

CO-1: Define green chemistry and list its goals and principles. Recall examples of green synthesis and natural compounds like alkaloids and terpenes, including their structures and physiological actions.

CO-2: Explain the importance of green chemistry in reducing waste and toxicity in chemical processes. Discuss the twelve principles of green chemistry and how they apply to designing chemical syntheses, including concepts like atom economy and green solvents.

CO-3: Apply the principles of green chemistry to design a green synthesis for a specific compound, incorporating waste reduction and toxicity minimization strategies. Conduct calculations for atom economy in various reactions, such as rearrangements, substitutions, and eliminations.

CO-4: Analyze various examples of green reactions, comparing their traditional synthetic routes with their green alternatives, such as microwave-assisted and ultrasound-assisted reactions. Assess the advantages and limitations of different green solvents and energy sources in chemical reactions.

CO-5: Evaluate the impact of green chemistry on sustainable development and future trends, including biomimetic and multifunctional reagents. Critically assess the medicinal importance of various alkaloids and terpenes, discussing their structures, isolation methods, and physiological actions.

CO-6: Design an experimental project focused on synthesizing a selected alkaloid or terpene using green chemistry principles. Propose innovative approaches to enhance the sustainability of the synthesis, such as utilizing alternative energy sources or developing a solventless process.

CO-PO-PSO Mapping:

Course Outcome	Programme Outcome (PO)												Programme Specific Outcome (PSO1)		
	PO 1: Disciplinary knowledge :	PO 2: Problem solving	PO 3: Critical thinking	PO 4.Research-related skills / Scientific reasoning	PO 5: Communication Skills	PO 6: Cooperation/Teamwork	PO 7: Information/digital literacy:	PO 8: Self-directed learning	PO 9: Multicultural competence	PO 10: Moral and ethical awareness/reasoning	PO 11: Leadership readiness/qualities	PO 12: Lifelong learning	PSO 1: Analytical skill development and job opportunity	PSO 2: Research motivation	PSO 3: Social Awareness
CO1	3	2	1	1	1	0	1	1	1	3	0	2	3	2	3
CO2	3	2	2	1	1	0	1	2	1	3	0	2	3	3	3
CO3	3	3	2	2	2	1	2	3	1	3	1	2	3	3	3
CO4	3	3	3	3	2	1	2	3	1	3	1	2	3	3	3
CO5	3	3	3	3	2	1	2	3	1	3	1	2	3	3	3
CO6	3	3	3	3	3	2	3	3	1	3	3	3	3	3	3
CO:	3.00	2.67	2.33	2.17	1.83	1.25	1.83	2.50	1.00	3.00	1.50	2.17	3.00	2.83	3.00

Course Code: CEMA-DSE-A-4: (ANALYTICAL METHODS IN CHEMISTRY)

Course Outcome: After undergoing the course, the student would be able to

CO-1: Identify the fundamental laws of spectroscopy, including Beer-Lambert's law, and recall the basic principles and instrumentation of UV-Visible, IR, atomic absorption, and emission spectrometry. List the various separation techniques, including chromatography and solvent extraction.

CO-2: Explain the interaction of radiation with matter and the significance of selection rules in spectroscopy. Discuss the principles of thermal analysis, electroanalytical methods, and the mechanisms involved in solvent extraction and chromatography.

CO-3: Apply the principles of UV-Visible and IR spectrometry to perform quantitative analysis of metal ions and geometrical isomers in various samples. Utilize chromatographic techniques for the separation and analysis of organic and inorganic compounds, and calculate enantiomeric excess using optical rotation measurements.

CO-4: Analyze spectroscopic data to interpret the structure of compounds and evaluate the effects of isotope substitution in IR spectra. Compare the efficiency and mechanisms of different separation techniques, including solvent extraction and chromatography, to determine the best method for specific applications.

CO-5: Evaluate the strengths and limitations of various instrumental methods of analysis, including atomic absorption and emission spectrometry. Critically assess the role of computer technology in enhancing the accuracy and efficiency of these analytical techniques.

CO-6: Design an analytical experiment that incorporates multiple methods of analysis, such as spectrometry and chromatography, to investigate a specific chemical problem. Propose a comprehensive approach to optimize the extraction and separation of a target analyte from complex matrices, ensuring the reliability and reproducibility of results.

CO-PO-PSO Mapping:

Course Outcome	Programme Outcome (PO)												Programme Specific Outcome (PSO1)		
	PO 1: Disciplinary knowledge :	PO 2: Problem solving	PO 3: Critical thinking	PO 4.Research-related skills / Scientific reasoning	PO 5: Communication Skills	PO 6: Cooperation/Team work	PO 7: Information/digital literacy:	PO 8: Self-directed learning	PO 9: Multicultural competence	PO 10: Moral and ethical awareness/reasoning	PO 11: Leadership readiness/qualities	PO 12: Lifelong learning	PSO 1: Analytical skill development and job opportunity	PSO 2: Research motivation	PSO 3: Social Awareness
CO1	3	2	1	1	1	1	2	1	0	1	0	1	3	1	1
CO2	3	2	2	2	1	1	2	1	0	1	0	1	2	2	1
CO3	3	3	2	3	1	1	3	2	0	1	1	2	3	3	2
CO4	3	3	3	3	1	1	2	2	0	2	1	2	3	3	2
CO5	3	3	3	3	2	1	2	2	0	2	1	2	3	3	3
CO6	3	3	3	3	3	2	3	3	1	3	3	3	3	3	3
CO:	3.00	2.67	2.33	2.50	1.50	1.17	2.33	1.83	1.00	1.67	1.50	1.83	2.83	2.50	2.00

Course Code: CEMA-DSE-B-1: (INORGANIC MATERIALS OF INDUSTRIALIMPORTANCE)

Course Outcome: After undergoing the course, the student would be able to

CO-1: Identify and describe key concepts related to glass types, ceramics, cement, and fertilizers, including their classifications and manufacturing processes. Identify different types of batteries, alloys, and catalysts, along with their characteristics and applications.

CO-2: Explain the properties of various types of glass (e.g., soda-lime glass, borosilicate glass) and ceramics, as well as the role of different ingredients in cement manufacturing. Describe the objectives of surface coatings, including the formulation and composition of paints and pigments.

CO-3: Apply knowledge of fertilizer manufacturing processes to analyze the production of urea and ammonium nitrate. Demonstrate the ability to evaluate battery components and characteristics, particularly in primary and secondary batteries, including lead-acid and lithium batteries.

CO-4: Analyze the classification and properties of alloys, including ferrous and non-ferrous alloys. Examine the manufacturing processes involved in steel production, such as decarbonization and desulfurization, and evaluate their impact on the properties of the final product.

CO-5: Evaluate the effectiveness of various catalysts in homogeneous and heterogeneous catalysis, including their industrial applications. Assess the implications of catalyst deactivation and regeneration processes on catalytic efficiency and sustainability.

CO-6: Design a project that investigates the preparation and explosive properties of chemical explosives, such as lead azide and RDX. Propose a comprehensive analysis of surface coatings that incorporates innovative approaches to improve performance and environmental sustainability.

CO-PO-PSO Mapping:

Course Outcome	Programme Outcome (PO)												Programme Specific Outcome (PSO1)		
	PO 1: Disciplinary knowledge :	PO 2: Problem solving	PO 3: Critical thinking	PO 4.Research-related skills / Scientific reasoning	PO 5: Communication Skills	PO 6: Cooperation/Teamwork	PO 7: Information/digital literacy:	PO 8: Self-directed learning	PO 9: Multicultural competence	PO 10: Moral and ethical awareness/reasoning	PO 11: Leadership readiness/qualities	PO 12: Lifelong learning	PSO 1: Analytical skill development and job opportunity	PSO 2: Research motivation	PSO 3: Social Awareness
CO1	3	2	2	1	1	1	2	1	0	1	0	1	3	2	1
CO2	3	2	2	1	1	1	2	1	0	1	0	1	2	2	1
CO3	3	3	3	3	1	1	3	2	0	2	1	2	3	3	2
CO4	3	3	3	3	1	1	2	2	0	2	1	2	3	2	2
CO5	3	3	3	3	2	1	2	2	0	2	1	2	3	3	3
CO6	3	3	3	3	3	3	3	3	1	3	3	3	3	3	3
CO:	3.00	2.67	2.67	2.33	1.50	1.33	2.33	1.83	1.00	1.83	1.50	1.83	2.83	2.50	2.00

Course Code: CEMA-DSE-B-2: (NOVEL INORGANIC SOLIDS)

Course Outcome: After undergoing the course, the student would be able to

CO-1: Describe the various synthesis methods for inorganic solids, including heat and beat methods, co-precipitation, sol-gel methods, and hydrothermal methods. Identify key categories of nanomaterials and engineering materials used in mechanical construction.

CO-2: Explain the principles and applications of solid electrolytes, inorganic pigments, and molecular materials. Describe the characteristics and advantages of composite materials and specialty polymers, as well as their role in modern engineering applications.

CO-3: Apply knowledge of nanostructures to prepare gold and silver metallic nanoparticles and understand their applications. Demonstrate the ability to analyze the composition and mechanical characteristics of various engineering materials, such as cast irons and alloy steels.

CO-4: Analyze the limitations of conventional engineering materials and the advantages of composite materials in overcoming these limitations. Examine the different matrix materials and reinforcements used in composites, assessing their impact on mechanical properties.

CO-5: Evaluate the properties and performance of specialty polymers, particularly conducting polymers, in various applications. Assess the environmental effects on composite materials and the implications for their long-term use in engineering applications.

CO-6: Design a research project that explores innovative methods for synthesizing nanomaterials and their potential applications in bio-inorganic systems. Propose a new composite material that addresses specific limitations of conventional materials and detail its potential applications in mechanical construction.

CO-PO-PSO Mapping:

Course Outcome	Programme Outcome (PO)												Programme Specific Outcome (PSO1)		
	PO 1: Disciplinary knowledge :	PO 2: Problem solving	PO 3: Critical thinking	PO 4.Research-related skills / Scientific reasoning	PO 5: Communication Skills	PO 6: Cooperation/Teamwork	PO 7: Information/digital literacy:	PO 8: Self-directed learning	PO 9: Multicultural competence	PO 10: Moral and ethical awareness/reasoning	PO 11: Leadership readiness/qualities	PO 12: Lifelong learning	PSO 1: Analytical skill development and job opportunity	PSO 2: Research motivation	PSO 3: Social Awareness
CO1	3	2	2	1	1	1	2	1	0	1	0	1	3	2	1
CO2	3	3	2	2	1	1	2	2	0	1	0	1	3	3	2
CO3	3	3	3	3	1	1	3	2	0	2	1	2	3	3	2
CO4	3	3	3	3	2	1	3	2	0	2	1	2	3	3	3
CO5	3	3	3	3	2	1	3	2	0	2	2	2	3	3	3
CO6	3	3	3	3	3	2	3	3	1	3	3	3	3	3	3
CO:	3.00	2.83	2.67	2.50	1.67	1.17	2.67	2.00	1.00	1.83	1.75	1.83	3.00	2.83	2.33

Course Code: CEMA-DSE-B-3 (POLYMER CHEMISTRY)

Course Outcome: After undergoing the course, the student would be able to

CO-1: Identify and recall the different classifications of polymers, polymer nomenclature, and key terms related to polymer chemistry, including functionality, polymerization processes, and types of polymerizations (e.g., step growth and chain growth).

CO-2: Explain the importance of functionality in synthetic polymer formation and the relationship between functionality, extent of reaction, and degree of polymerization. Discuss the concepts of crystallization, crystallinity, and their significance in determining the properties of polymers.

CO-3: Utilize methods for determining the molecular weight of polymers, including end group analysis, viscometry, light scattering, and osmotic pressure techniques. Apply the Flory-Huggins theory to evaluate polymer solubility and assess the thermodynamics of polymer solutions.

CO-4: Analyze the structure-property relationships in polymers and evaluate the effects of various factors on properties such as glass transition temperature (Tg) and crystallinity. Compare the physical, thermal, flow, and mechanical properties of different types of polymers.

CO-5: Critically evaluate the preparation, structure, properties, and applications of specific polymers, such as polyolefins, poly(vinyl chloride), and conducting polymers. Assess the significance of polydispersity index and molecular weight distribution in the context of polymer performance.

CO-6: Design a synthetic route for a polymer based on desired properties and applications, considering factors such as functionality, polymerization methods, and structural characteristics. Propose a methodology for testing the properties of the synthesized polymer, including mechanical and thermal analyses.

CO-PO-PSO Mapping:

Course Outcome	Programme Outcome (PO)												Programme Specific Outcome (PSO1)		
	PO 1: Disciplinary knowledge :	PO 2: Problem solving	PO 3: Critical thinking	PO 4.Research-related skills / Scientific reasoning	PO 5: Communication Skills	PO 6: Cooperation/Teamwork	PO 7: Information/digital literacy:	PO 8: Self-directed learning	PO 9: Multicultural competence	PO 10: Moral and ethical awareness/reasoning	PO 11: Leadership readiness/qualities	PO 12: Lifelong learning	PSO 1: Analytical skill development and job opportunity	PSO 2: Research motivation	PSO 3: Social Awareness
CO1	3	2	2	1	1	1	2	1	0	1	0	1	3	2	1
CO2	3	3	2	2	1	1	2	2	0	1	0	1	3	3	2
CO3	3	3	3	3	1	1	3	2	0	2	1	2	3	3	2
CO4	3	3	3	3	2	1	3	2	0	2	1	2	3	3	3
CO5	3	3	3	3	2	1	3	2	0	2	2	2	3	3	3
CO6	3	3	3	3	3	2	3	3	1	3	3	3	3	3	3
CO:	3.00	2.83	2.67	2.50	1.67	1.17	2.67	2.00	1.00	1.83	1.75	1.83	3.00	2.83	2.33

Course Code: CEMA-DSE-B-4 (Dissertation)

Course Outcome: After undergoing the course, the student would be able to

CO-1: Aa

CO-2: Aa

CO-3: Aa

CO-4: Aa

CO-5: Aa

CO-6: Aa

CO-PO-PSO Mapping:

Course Code: CEMA-SEC-1 (Mathematics and Statistics for Chemists)

Course Outcome: After undergoing the course, the student would be able to

CO-1: Relate key mathematical concepts including functions, limits, derivatives, and integral calculus. Identify fundamental statistical terms such as permutations, combinations, probability, and descriptive statistics.

CO-2: Explain the physical significance of differentiation and integration in the context of chemistry. Describe the importance of statistical measures such as accuracy, precision, and normal distribution in analytical chemistry.

CO-3: Apply differentiation techniques to solve problems related to maxima and minima in chemical contexts. Utilize integration to calculate areas and volumes relevant to chemical applications, such as determining concentrations and reaction yields.

CO-4: Analyze analytical data by evaluating errors and applying statistical tests, including F, Q, and t tests. Interpret results of probability distributions and assess confidence intervals to draw conclusions about experimental data.

CO-5: Evaluate data using qualitative and quantitative statistical methods. Critically assess the results of analysis of variance (ANOVA), correlation, and regression analyses to determine the relationships between variables in chemical experiments.

CO-6: Design experiments that incorporate statistical methods for data analysis, including the use of regression techniques for fitting linear and polynomial equations. Formulate a plan for presenting analytical data effectively using descriptive statistics and visual representations.

CO-PO-PSO Mapping:

Course Outcome	Programme Outcome (PO)												Programme Specific Outcome (PSO1)		
	PO 1: Disciplinary knowledge :	PO 2: Problem solving	PO 3: Critical thinking	PO 4.Research-related skills / Scientific reasoning	PO 5: Communication Skills	PO 6: Cooperation/Teamwork	PO 7: Information/digital literacy:	PO 8: Self-directed learning	PO 9: Multicultural competence	PO 10: Moral and ethical awareness/reasoning	PO 11: Leadership readiness/qualities	PO 12: Lifelong learning	PSO 1: Analytical skill development and job opportunity	PSO 2: Research motivation	PSO 3: Social Awareness
CO1	3	2	1	1	1	0	2	1	0	1	0	1	3	2	2
CO2	3	3	2	2	1	1	2	2	0	1	0	1	3	3	2
CO3	3	3	3	2	1	1	3	2	0	1	1	2	3	3	2
CO4	3	3	3	3	2	1	3	2	0	2	1	2	3	3	3
CO5	3	3	3	3	2	1	3	2	0	2	2	2	3	3	3
CO6	3	3	3	3	3	2	3	3	1	3	3	3	3	3	3
CO:	3.00	2.83	2.50	2.33	1.67	1.20	2.67	2.00	1.00	1.67	1.75	1.83	3.00	2.83	2.50

Course Code: CEMA-SEC-2 (ANALYTICAL CLINICAL BIOCHEMISTRY)

Course Outcome: After undergoing the course, the student would be able to

CO-1: Define fundamental concepts of carbohydrates, proteins, lipids, and nucleic acids, including their classifications, structures, and biological importance. Identify key metabolic pathways, such as glycolysis and the Krebs cycle.

CO-2: Explain the processes of metabolism and energy production in cells, particularly the role of ATP. Describe the structure and function of enzymes, including the significance of coenzymes, cofactors, and enzyme inhibitors in biochemical reactions.

CO-3: Apply knowledge of biochemical pathways to analyze and interpret data related to metabolic disorders, such as diabetes or anemia. Utilize techniques for the isolation and characterization of polysaccharides and proteins in laboratory settings.

CO-4: Analyze the biochemical composition of blood and urine samples to diagnose diseases. Interpret laboratory results for blood sugar, urea, creatinine, cholesterol, and bilirubin levels, recognizing their clinical significance.

CO-5: Evaluate the role of lipoproteins and steroid hormones in the human body, assessing their implications in health and disease. Critically assess the methodologies used in blood and urine analysis for diagnosing clinical conditions.

CO-6: Design experiments or clinical protocols for the analysis of biological samples, including appropriate methods for sample collection, preservation, and biochemical assays. Propose potential treatments or interventions based on biochemical findings in the context of disease management.

CO-PO-PSO Mapping:

Course Outcome	Programme Outcome (PO)												Programme Specific Outcome (PSO1)		
	PO 1: Disciplinary knowledge :	PO 2: Problem solving	PO 3: Critical thinking	PO 4.Research-related skills / Scientific reasoning	PO 5: Communication Skills	PO 6: Cooperation/Teamwork	PO 7: Information/digital literacy:	PO 8: Self-directed learning	PO 9: Multicultural competence	PO 10: Moral and ethical awareness/reasoning	PO 11: Leadership readiness/qualities	PO 12: Lifelong learning	PSO 1: Analytical skill development and job opportunity	PSO 2: Research motivation	PSO 3: Social Awareness
CO1	3	2	1	1	1	0	2	1	0	2	0	1	3	2	2
CO2	3	3	2	2	1	1	2	2	0	2	0	1	3	3	2
CO3	3	3	3	2	1	1	3	2	0	2	1	2	3	3	2
CO4	3	3	3	3	2	1	3	2	0	3	1	2	3	3	3
CO5	3	3	3	3	2	1	3	2	1	3	2	2	3	3	3
CO6	3	3	3	3	3	2	3	3	1	3	3	3	3	3	3
CO:	3.00	2.83	2.50	2.33	1.67	1.20	2.67	2.00	1.00	2.50	1.75	1.83	3.00	2.83	2.50

Course Code: CEMA-SEC-3 (PHARMACEUTICALS CHEMISTRY)

Course Outcome: After undergoing the course, the student would be able to

CO-1: Identify and describe fundamental concepts related to drug discovery, design, and development, including the basic principles of retrosynthetic analysis and classifications of pharmaceuticals.

CO-2: Explain the mechanisms of action and therapeutic uses of various classes of drugs, including analgesics, antibiotics, antiviral agents, and central nervous system agents. Describe the processes involved in fermentation and its role in drug production.

CO-3: Apply retrosynthetic analysis techniques to propose synthetic pathways for representative drugs such as aspirin, chloramphenicol, and acyclovir. Use knowledge of fermentation processes to outline methods for the production of antibiotics and vitamins.

CO-4: Analyze the structural features and chemical properties of selected drugs and their relevance to pharmacological activity. Examine the fermentation process and evaluate its efficiency in the production of pharmaceuticals like penicillin and citric acid.

CO-5: Evaluate the effectiveness and safety profiles of different drug classes, comparing their mechanisms of action, side effects, and therapeutic applications. Critically assess the advantages and limitations of fermentation methods in pharmaceutical manufacturing.

CO-6: Design a research proposal for the development of a new drug, including the rationale for its therapeutic target, proposed synthesis, and potential fermentation methods for production. Formulate a strategy for optimizing fermentation conditions for improved yield of pharmaceutical compounds.

CO-PO-PSO Mapping:

Course Outcome	Programme Outcome (PO)												Programme Specific Outcome (PSO1)		
	PO 1: Disciplinary knowledge :	PO 2: Problem solving	PO 3: Critical thinking	PO 4.Research-related skills / Scientific reasoning	PO 5: Communication Skills	PO 6: Cooperation/Teamwork	PO 7: Information/digital literacy:	PO 8: Self-directed learning	PO 9: Multicultural competence	PO 10: Moral and ethical awareness/reasoning	PO 11: Leadership readiness/qualities	PO 12: Lifelong learning	PSO 1: Analytical skill development and job opportunity	PSO 2: Research motivation	PSO 3: Social Awareness
CO1	3	2	1	1	1	0	2	0	0	2	0	1	3	2	2
CO2	3	3	2	2	1	1	2	1	1	2	1	2	3	3	3
CO3	3	3	3	2	2	1	3	2	0	2	0	2	3	3	2
CO4	3	3	3	3	2	0	3	1	1	2	1	2	3	3	3
CO5	3	3	3	3	3	1	3	2	2	3	2	2	3	3	3
CO6	3	3	2	3	3	2	3	2	3	3	3	3	3	3	3
CO:	3.00	2.83	2.33	2.33	2.00	1.25	2.67	1.60	1.75	2.33	1.75	2.00	3.00	2.83	2.67

Course Code: CEMA-SEC-4 (PESTICIDE CHEMISTRY)

Course Outcome: After undergoing the course, the student would be able to

CO-1: Define key concepts related to pesticide chemistry, including the classification of pesticides, their natural and synthetic origins, and the structure-activity relationship (SAR) of various pesticide classes.

CO-2: Explain the benefits and adverse effects of pesticide use, as well as the changing concepts of pesticide application in agricultural and environmental contexts. Describe the synthesis and technical manufacture of representative pesticides, including organochlorines, organophosphates, carbamates, quinones, and anilides.

CO-3: Apply knowledge of pesticide formulations to calculate acidity and alkalinity in given samples according to Bureau of Indian Standards (BIS) specifications. Utilize principles of synthesis to prepare simple organophosphates, phosphonates, and thiophosphates in a laboratory setting.

CO-4: Analyze the structure-activity relationships of various pesticides to predict their efficacy and potential side effects. Examine the environmental and health implications of pesticide use, considering both benefits and drawbacks.

CO-5: Evaluate the effectiveness and safety of different pesticide classes based on their chemical properties, modes of action, and environmental impact. Critically assess the regulatory frameworks governing pesticide use and the implications of their changing concepts.

CO-6: Design a project or proposal to develop a new pesticide formulation, considering factors such as efficacy, environmental impact, and safety. Formulate a comprehensive plan for testing its effectiveness against target pests while adhering to relevant regulatory guidelines.

CO-PO-PSO Mapping:

Course Outcome	Programme Outcome (PO)												Programme Specific Outcome (PSO1)		
	PO 1: Disciplinary knowledge :	PO 2: Problem solving	PO 3: Critical thinking	PO 4.Research-related skills / Scientific reasoning	PO 5: Communication Skills	PO 6: Cooperation/Team work	PO 7: Information/digital literacy:	PO 8: Self-directed learning	PO 9: Multicultural competence	PO 10: Moral and ethical awarenes s/reasoning	PO 11: Leadership readiness/qualities	PO 12: Lifelong learning	PSO 1: Analytical skill development and job opportunity	PSO 2: Research motivation	PSO 3: Social Awareness
CO1	3	2	1	1	1	0	2	0	0	2	0	1	3	2	2
CO2	3	3	2	2	1	1	2	1	1	3	1	2	3	3	3
CO3	3	3	2	2	1	1	3	2	0	2	0	2	3	3	2
CO4	3	3	3	3	2	0	3	1	1	3	1	2	3	3	3
CO5	3	3	3	3	3	1	3	2	2	3	2	2	3	3	3
CO6	3	3	2	3	3	2	3	2	2	3	3	3	3	3	3
CO:	3.00	2.83	2.17	2.33	1.83	1.25	2.67	1.60	1.50	2.67	1.75	2.00	3.00	2.83	2.67

Shyampur Siddheswari Mahavidyalaya
Ajodhya, Shyampur, Howrah, Pin-711312. West Bengal

Chemistry General Syllabus under CBCS (2018)

University of Calcutta

3 Years B.Sc. General Programme

- Programme Outcome (PO)
- Programme Specific Outcome (PSO)
- Course Outcome (CO)
- CO-PO Mapping
- CO-PSO Mapping

- ## Programme Outcome (PO)

PO 1: Disciplinary knowledge: A graduate student is expected to be capable of demonstrating comprehensive knowledge and understanding both theoretical and practical knowledge in all disciplines of Chemistry. Students can solve their subjective problems very methodically, independently and finally draw a logical conclusion. Further, the student will be capable of applying modern technologies, handling advanced instruments and Chemistry related soft-wares for chemical analysis, characterization of materials and in separation technology.

PO 2: Problem solving (Ap): Students will be able to think and apply evidence based comparative chemistry approach to explain chemical synthesis and analysis.

PO 3: Critical thinking (An): The course curriculum also includes components that can be helpful to graduate students to develop critical thinking and to design, carry out, record and analyze the results of chemical reactions.

PO 4: Research-related skills / Scientific reasoning: Students will demonstrate strong research-related skills by formulating research questions, designing experiments, and employing appropriate methodologies for data collection and analysis. They will exhibit scientific reasoning through critical evaluation of evidence, interpretation of results, and drawing logical conclusions, enabling them to address complex problems and contribute to advancements in their field.

PO 5: Communication Skills (U/A): The course curriculum has been designed in such a manner as to enabling a graduate student to become a skilled project manager by acquiring knowledge about chemistry project management, writing, planning, study of ethical standards and rules and regulations pertaining to scientific project operation.

PO 6: Cooperation/Teamwork: The course curriculum has been designed to provide opportunity to act as team player by contributing in laboratory, field based situation and industry.

PO 7: Information/digital literacy: The course curriculum has been so designed to impart a good working knowledge in understanding and carrying out data analysis, use of library search tools, use of chemical simulation software and related computational work.

PO 8: Self-directed learning: Students will demonstrate the ability to independently identify learning needs, set goals, and pursue knowledge using diverse resources. They will reflect on their learning process, adapt strategies as needed, and apply insights to achieve continuous personal and professional growth.

PO 9: Multicultural competence: Students will demonstrate multicultural competence by understanding diverse cultural perspectives, effectively communicating across cultures, and applying inclusive practices in professional settings to promote equity and collaboration.

PO 10: Moral and ethical awareness/reasoning: As an inhabitant of this green planet a Chemistry graduate student should have many social responsibilities. The course curriculum is designed to teach a Chemistry graduate student to follow the green routes for the synthesis of chemical compounds and also find out new greener routes for sustainable development. The course also helps them to understand the causes of environmental pollution and thereby applying environmental friendly policies instead of environmentally hazard ones in every aspect.

PO 11: Leadership readiness/qualities: Students will demonstrate leadership readiness by effectively communicating a vision, motivating teams, and fostering collaboration. They will exhibit critical thinking, problem-solving abilities, and emotional intelligence, enabling them to navigate challenges and drive positive change in diverse environments. This outcome prepares students for impactful leadership roles in their future careers.

PO 12: Lifelong learning: The course curriculum is designed to inculcate a habit of learning continuously through use of advanced ICT technique and other available e-techniques, e-books and e-journals for personal academic growth.

- ## Programme Specific Outcome (PSO)

PSO 1: Analytical skill development and job opportunity: Chemistry graduates are expected to possess sufficient knowledge how to synthesize a chemical compound and perform necessary characterization and analysis in support of the formation of the product by using modern analytical tools and advanced technologies. Because of this course curriculum chemistry graduates have lot of opportunity to get job not only in academic and administrative field but also in industry.

PSO 2: Research motivation: Chemistry graduates are expected to be technically well trained with modern devices and Chemistry based software and has powerful knowledge in different disciplines of Chemistry so they can easily involve themselves in theory and laboratory-based research activities.

PSO 3: Social Awareness: As an inhabitant of this green world it is our duty to make our planet clean and suitable for living to all. In this context Chemistry graduates are expected to be more aware about finding green chemical reaction routes for sustainable development. They are expected to maintain good laboratory practices and safety.

Course Code: CEMG-CC1/GE1

Course Outcome: After undergoing the course, the student would be able to

CO-1: Tell the fundamental concepts in physical chemistry, including the kinetic theory of gases, properties of liquids, chemical kinetics, atomic structure, periodicity, and organic chemistry principles.

CO-2: Compare the behavior of ideal and real gases, including concepts like mean free path, Maxwell's distribution, and van der Waals equation. Describe the principles of surface tension and viscosity, the significance of Arrhenius equation in chemical kinetics, and the key aspects of atomic structure and chemical periodicity.

CO-3: Apply knowledge of reaction rates to determine the order of reactions using various methods, such as half-life and differential methods. Conduct practical laboratory experiments to estimate concentrations and properties of various chemical substances, utilizing techniques such as titration and volumetric analysis.

CO-4: Categorize data from kinetic experiments to deduce rate laws and mechanisms of reactions. Compare and contrast the properties of acids and bases based on different concepts, such as Brönsted-Lowry, Lewis, and HSAB theory. Examine the stereochemical aspects of organic compounds and interpret their implications in chemical reactions.

CO-5: Determine the effectiveness of different nucleophilic substitution and elimination mechanisms in organic reactions. Assess the reliability of experimental data collected during practicals and make informed conclusions based on statistical analysis of results.

CO-6: Build an experimental procedure to investigate the effects of temperature on the viscosity of a liquid or surface tension, considering safety and accuracy. Propose a hypothesis related to chemical kinetics that can be tested in a laboratory setting, including a rationale for the chosen methods and expected outcomes.

CO-PO-PSO Mapping:

Course Outcome	Programme Outcome (PO)												Programme Specific Outcome (PSO1)		
	PO 1: Disciplinary knowledge :	PO 2: Problem solving	PO 3: Critical thinking	PO 4.Research-related skills / Scientific reasoning	PO 5: Communication Skills	PO 6: Cooperation/Team work	PO 7: Information/digital literacy:	PO 8: Self-directed learning	PO 9: Multicultural competence	PO 10: Moral and ethical awareness/reasoning	PO 11: Leadership readiness/qualities	PO 12: Lifelong learning	PSO 1: Analytical skill development and job opportunity	PSO 2: Research motivation	PSO 3: Social Awareness
CO1	3	2	1	2	1	0	0	1	0	1	1	1	2	1	1
CO2	3	2	1	2	1	0	0	1	0	1	1	1	2	1	1
CO3	2	3	2	3	1	0	1	1	0	2	1	1	3	2	1
CO4	2	3	2	3	1	0	1	1	0	2	1	1	3	2	1
CO5	2	2	2	2	1	0	0	1	0	2	1	1	3	2	1
CO6	2	2	2	3	1	0	1	1	0	2	1	1	3	2	1
CO:	2.33	2.33	1.67	2.50	1.00	0.00	1.00	1.00	0.00	1.67	1.00	1.00	2.67	1.67	1.00

Course Code: CEMG-CC2/GE2

Course Outcome: After undergoing the course, the student would be able to

CO-1: Define fundamental principles of chemical thermodynamics, equilibrium, solutions, phase equilibria, and redox reactions. Identify key concepts related to aliphatic hydrocarbons and error analysis.

CO-2: Illustrate the laws of thermodynamics, the concept of entropy, and the criteria for chemical equilibrium. Describe the behavior of ideal and non-ideal solutions, phase diagrams, and the characteristics of various types of hydrocarbons.

CO-3: Make use of thermodynamic principles to calculate changes in internal energy, enthalpy, and entropy for various processes. Conduct laboratory experiments to determine kinetic parameters, solubility, and surface tension, as well as to prepare and analyze buffer solutions.

CO-4: Examine the effects of external parameters on chemical equilibria and predict shifts according to Le Chatelier's principle. Evaluate experimental data for accuracy and precision, and assess the significance of systematic and random errors in quantitative analysis.

CO-5: Determine the effectiveness of different methods for preparing and analyzing hydrocarbons. Assess the influence of factors such as pH, complex formation, and ionic strength on redox potentials and the feasibility of redox titrations.

CO-6: Construct an experimental procedure to investigate the impact of temperature or concentration on the rate of a chemical reaction or the solubility of a sparingly soluble salt. Propose a research question related to phase equilibria or thermodynamic properties that can be tested in the laboratory, including the rationale and expected outcomes.

CO-PO-PSO Mapping:

Course Outcome	Programme Outcome (PO)												Programme Specific Outcome (PSO1)		
	PO 1: Disciplinary knowledge :	PO 2: Problem solving	PO 3: Critical thinking	PO 4.Research-related skills / Scientific reasoning	PO 5: Communication Skills	PO 6: Cooperation/Teamwork	PO 7: Information/digital literacy:	PO 8: Self-directed learning	PO 9: Multicultural competence	PO 10: Moral and ethical awareness/reasoning	PO 11: Leadership readiness/qualities	PO 12: Lifelong learning	PSO 1: Analytical skill development and job opportunity	PSO 2: Research motivation	PSO 3: Social Awareness
CO1	3	1	1	0	0	0	2	1	0	1	0	1	2	1	2
CO2	3	2	2	0	0	0	1	0	0	1	0	1	2	2	1
CO3	3	2	3	2	0	0	2	1	0	1	0	1	3	3	2
CO4	3	3	3	2	0	0	2	1	0	1	0	1	3	3	2
CO5	3	3	2	2	0	0	2	0	0	1	0	1	3	3	3
CO6	3	3	3	3	1	1	3	2	0	2	1	2	3	3	3
CO:	3.00	2.33	2.33	2.25	1.00	1.00	2.00	1.25	0.00	1.17	1.00	1.17	2.67	2.50	2.17

Course Code: CEMG-CC3/GE3

Course Outcome: After undergoing the course, the student would be able to

CO-1: Find key concepts and definitions related to chemical bonding, molecular structure, coordination chemistry, ionic equilibria, and electrochemistry. Identify the characteristics of aromatic hydrocarbons and organometallic compounds.

CO-2: Classify the principles of ionic and covalent bonding, including the Born-Haber cycle and Fajan's rules. Describe the trends in properties of p-block and transition elements and the significance of coordination compounds.

CO-3: Apply the concepts of electrochemistry to calculate cell potentials using the Nernst equation. Conduct qualitative analysis of mixtures to identify cation and anion radicals through systematic procedures.

CO-4: Analyze the electronic configurations and oxidation states of transition elements and lanthanoids, comparing their properties and complex formation abilities. Assess the stability of ionic compounds through lattice energy calculations and solubility product principles.

CO-5: Evaluate the effectiveness of various methods for synthesizing aromatic hydrocarbons and organometallic compounds. Assess the impact of factors such as concentration and temperature on ionic equilibria and electrochemical processes.

CO-6: Design an experimental procedure to investigate the effect of different ligands on the stability and reactivity of coordination complexes. Propose a research question regarding the synthesis or properties of organometallic compounds and outline the methodology to be employed.

CO-PO-PSO Mapping:

Course Outcome	Programme Outcome (PO)												Programme Specific Outcome (PSO1)		
	PO 1: Disciplinary knowledge :	PO 2: Problem solving	PO 3: Critical thinking	PO 4.Research-related skills / Scientific reasoning	PO 5: Communication Skills	PO 6: Cooperation/Teamwork	PO 7: Information/digital literacy:	PO 8: Self-directed learning	PO 9: Multicultural competence	PO 10: Moral and ethical awareness/reasoning	PO 11: Leadership readiness/qualities	PO 12: Lifelong learning	PSO 1: Analytical skill development and job opportunity	PSO 2: Research motivation	PSO 3: Social Awareness
CO1	3	1	1	0	0	0	2	1	0	1	0	1	2	1	2
CO2	3	2	2	0	0	0	1	0	0	1	0	1	2	2	1
CO3	3	2	3	2	0	0	2	1	0	1	0	1	3	3	2
CO4	3	3	3	2	0	0	2	1	0	1	0	1	3	3	2
CO5	3	3	2	2	0	0	2	0	0	1	0	1	3	3	3
CO6	3	3	3	3	1	1	3	2	0	2	1	2	3	3	3
CO:	3.00	2.33	2.33	2.25	1.00	1.00	2.00	1.25	0.00	1.17	1.00	1.17	2.67	2.50	2.17

Course Code: CEMG-CC4/GE4

Course Outcome: After undergoing the course, the student would be able to

CO-1: Identify and recall the different classes of organic compounds studied in this course, including alcohols, phenols, ethers, aldehydes, ketones, carboxylic acids, amines, and amino acids. Recognize key reactions and mechanisms associated with these functional groups.

CO-2: Explain the principles of crystal field theory and its application to the stability of coordination complexes. Describe the classification of carbohydrates and amino acids, emphasizing their properties and reactions.

CO-3: Apply the techniques of qualitative analysis to identify functional groups in organic compounds. Utilize knowledge of organic synthesis to propose appropriate methods for preparing specific alcohols, aldehydes, or carboxylic acids.

CO-4: Analyze reaction mechanisms for various organic reactions, including aldol condensation, Claisen rearrangement, and diazo coupling. Evaluate the impact of structural differences on the acidity and basicity of organic compounds.

CO-5: Evaluate the significance of different synthesis methods for alcohols, phenols, and ethers in industrial and laboratory contexts. Assess the role of spectroscopy in identifying molecular structures and the relationships between quantum mechanics and spectroscopic techniques.

CO-6: Design an experimental protocol for the synthesis of a selected organic compound, outlining the reaction conditions and mechanisms involved. Propose a research project investigating the reactivity of a specific class of organic compounds, including the methods for analysis and characterization

CO-PO-PSO Mapping:

Course Outcome	Programme Outcome (PO)												Programme Specific Outcome (PSO1)		
	PO 1: Disciplinary knowledge :	PO 2: Problem solving	PO 3: Critical thinking	PO 4.Research-related skills / Scientific reasoning	PO 5: Communication Skills	PO 6: Cooperation/Teamwork	PO 7: Information/digital literacy:	PO 8: Self-directed learning	PO 9: Multicultural competence	PO 10: Moral and ethical awareness/reasoning	PO 11: Leadership readiness/qualities	PO 12: Lifelong learning	PSO 1: Analytical skill development and job opportunity	PSO 2: Research motivation	PSO 3: Social Awareness
CO1	3	2	1	0	0	0	1	0	0	0	0	1	2	1	1
CO2	3	2	2	0	0	0	1	0	0	1	0	1	2	2	1
CO3	3	3	2	1	0	0	2	1	0	1	0	1	3	3	2
CO4	3	3	3	1	0	0	2	1	0	1	0	1	3	3	2
CO5	3	2	3	2	0	0	2	1	0	1	0	1	3	3	2
CO6	3	3	3	3	1	1	3	2	0	2	1	3	3	3	3
CO:	3.00	2.50	2.33	1.75	1.00	1.00	1.83	1.25	0.00	1.20	1.00	1.33	2.67	2.50	1.83

Course Code: CEMG-DSE-A-1

Course Outcome: After undergoing the course, the student would be able to

CO-1: Identify and define key concepts related to novel inorganic solids, including synthesis methods (such as sol-gel and hydrothermal), types of inorganic solids, and the classification of nanomaterials.

CO-2: Explain the significance of inorganic solids in technology, including solid electrolytes, inorganic pigments, and the role of molecular materials and fullerides in various applications.

CO-3: Apply different synthesis methods to prepare novel inorganic solids, such as nanoparticles and hydrogels, demonstrating practical skills in laboratory techniques for characterizing these materials.

CO-4: Analyze the mechanical and fabrication characteristics of various engineering materials, comparing the properties and applications of metals, composites, and specialty polymers in mechanical construction.

CO-5: Evaluate the advantages and limitations of conventional engineering materials versus composite materials, discussing the role of the matrix in composites and assessing their environmental effects.

CO-6: Design an experimental protocol for synthesizing a specific type of nanomaterial or composite, detailing the preparation methods, expected properties, and potential applications in real-world scenarios.

CO-PO-PSO Mapping:

Course Outcome	Programme Outcome (PO)												Programme Specific Outcome (PSO1)		
	PO 1: Disciplinary knowledge :	PO 2: Problem solving	PO 3: Critical thinking	PO 4.Research-related skills / Scientific reasoning	PO 5: Communication Skills	PO 6: Cooperation/Teamwork	PO 7: Information/digital literacy:	PO 8: Self-directed learning	PO 9: Multicultural competence	PO 10: Moral and ethical awareness/reasoning	PO 11: Leadership readiness/qualities	PO 12: Lifelong learning	PSO 1: Analytical skill development and job opportunity	PSO 2: Research motivation	PSO 3: Social Awareness
CO1	3	2	2	1	0	0	2	1	0	1	0	2	3	2	1
CO2	3	2	2	1	0	0	2	1	0	1	0	2	3	2	1
CO3	3	3	2	2	0	0	3	1	0	1	0	2	3	3	2
CO4	3	3	3	2	0	0	2	1	0	1	0	2	3	3	2
CO5	3	2	3	2	0	0	2	1	0	2	0	2	3	3	3
CO6	3	3	3	3	1	1	3	2	0	2	1	3	3	3	3
CO:	3.00	2.50	2.50	1.83	1.00	1.00	2.33	1.17	0.00	1.33	1.00	2.17	3.00	2.67	2.00

Course Code: CEMG-DSE-A-2

Course Outcome: After undergoing the course, the student would be able to

CO-1: Identify and define key concepts related to inorganic materials, including the types of silicate glasses, classifications of cements and fertilizers, and various types of alloys.

CO-2: Explain the manufacturing processes and properties of industrially significant inorganic materials such as glass, ceramics, cements, and fertilizers, highlighting their applications in various industries.

CO-3: Apply laboratory techniques to determine the composition and properties of fertilizers, analyze the components of alloys, and perform assessments of surface coatings in practical experiments.

CO-4: Analyze the advantages and limitations of different types of coatings and paints, comparing their formulations and properties in relation to their intended applications.

CO-5: Evaluate the effectiveness of different battery technologies (primary and secondary) and their components, discussing their roles in energy storage and applications in various devices.

CO-6: Design a project to synthesize and test a specific surface coating or alloy, detailing the preparation methods, expected properties, and potential industrial applications of the developed material.

CO-PO-PSO Mapping:

Course Outcom	Programme Outcome (PO)												Programme Specific Outcome (PSO1)		
	PO 1: Disciplinary knowledge:	PO 2: Problem solving	PO 3: Critical thinking	PO 4.Research-related skills / Scientific reasoning	PO 5: Communication Skills	PO 6: Cooperation/Team work	PO 7: Information/digital literacy:	PO 8: Self-directed learning	PO 9: Multicultural competence	PO 10: Moral and ethical awareness/ reasoning	PO 11: Leadership readiness /qualities	PO 12: Lifelong learning	PSO 1: Analytical skill development and job opportunity	PSO 2: Research motivation	PSO 3: Social Awareness
CO1	2	1	0	1	1	1	2	1	2	2	0	1	1	0	1
CO2	2	0	1	1	0	0	2	0	0	0	0	1	1	0	0
CO3	3	2	0	0	0	1	2	0	2	2	0	1	1	1	1
CO4	2	0	0	0	0	0	1	0	0	0	0	1	0	0	1
CO5	1	0	0	1	0	0	0	1	0	0	0	0	0	0	0
CO6	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CO:	1.83	1.50	1.00	1.00	1.00	1.00	1.75	1.00	2.00	2.00	0.00	1.00	1.00	1.00	1.00

Course Code: CEMG-DSE-B-1

Course Outcome: After undergoing the course, the student would be able to

CO-1: Define the twelve principles of Green Chemistry, including the goals and limitations of Green Chemistry practices.

CO-2: Explain the significance of Green Chemistry in sustainable development and its application in designing chemical syntheses that minimize waste and hazardous byproducts.

CO-3: Implement Green Chemistry principles in laboratory experiments, including the preparation of biodiesel from waste cooking oil and the synthesis of compounds through microwave-assisted and ultrasound-assisted reactions.

CO-4: Analyze various Green Chemistry techniques and their impact on reducing environmental hazards, comparing traditional methods with green approaches in organic synthesis.

CO-5: Evaluate the effectiveness of alternative energy sources and catalytic methods in chemical reactions, assessing their contributions to the principles of Green Chemistry.

CO-6: Design a synthetic pathway for a target molecule using Green Chemistry principles, detailing the steps involved, the choice of reagents, and the methods for minimizing waste and toxicity.

CO-PO-PSO Mapping:

Course Outcome	Programme Outcome (PO)												Programme Specific Outcome (PSO1)		
	PO 1: Disciplinary knowledge :	PO 2: Problem solving	PO 3: Critical thinking	PO 4.Research-related skills / Scientific reasoning	PO 5: Communication Skills	PO 6: Cooperation/Teamwork	PO 7: Information/digital literacy:	PO 8: Self-directed learning	PO 9: Multicultural competence	PO 10: Moral and ethical awareness/reasoning	PO 11: Leadership readiness/qualities	PO 12: Lifelong learning	PSO 1: Analytical skill development and job opportunity	PSO 2: Research motivation	PSO 3: Social Awareness
CO1	3	1	1	1	0	0	1	1	0	3	0	2	2	1	3
CO2	3	2	2	2	0	0	1	1	0	3	1	2	2	1	3
CO3	3	3	3	3	0	0	3	2	0	3	0	3	3	3	3
CO4	3	3	3	3	0	0	2	2	0	3	0	3	3	3	3
CO5	3	2	3	2	0	0	2	2	0	3	0	3	3	3	3
CO6	3	3	3	3	1	0	3	2	0	3	1	3	3	3	3
CO:	3.00	2.33	2.50	2.33	1.00	0.00	2.00	1.67	0.00	3.00	1.00	2.67	2.67	2.33	3.00

Course Code: CEMG-DSE-B-2

Course Outcome: After undergoing the course, the student would be able to

CO-1: Define the fundamental principles and instrumentation of various analytical techniques, including UV-Visible spectrometry, infrared spectrometry, flame atomic absorption, and emission spectrometry.

CO-2: Explain the underlying principles of separation techniques such as chromatography and solvent extraction, including the mechanisms involved and their applications in qualitative and quantitative analysis.

CO-3: Use analytical methods to conduct experiments, such as determining pH levels in soil, estimating calcium and magnesium concentrations, and separating and identifying components in mixtures through chromatography.

CO-4: Analyze data obtained from spectrophotometric measurements to determine pKa values, chemical oxygen demand (COD), and biological oxygen demand (BOD), and interpret results in the context of environmental and chemical assessments.

CO-5: Evaluate the efficiency and effectiveness of different analytical techniques in measuring trace metal ions in water samples, comparing their sensitivity, accuracy, and applicability to real-world scenarios.

CO-6: Design an experimental protocol for a given analytical problem that incorporates appropriate techniques (e.g., chromatography, spectrophotometry), demonstrating an understanding of the principles involved and the potential sources of error

CO-PO-PSO Mapping:

Course Outcome	Programme Outcome (PO)												Programme Specific Outcome (PSO1)		
	PO 1: Disciplinary knowledge :	PO 2: Problem solving	PO 3: Critical thinking	PO 4.Research-related skills / Scientific reasoning	PO 5: Communication Skills	PO 6: Cooperation/Teamwork	PO 7: Information/digital literacy:	PO 8: Self-directed learning	PO 9: Multicultural competence	PO 10: Moral and ethical awareness/reasoning	PO 11: Leadership readiness/qualities	PO 12: Lifelong learning	PSO 1: Analytical skill development and job opportunity	PSO 2: Research motivation	PSO 3: Social Awareness
CO1	3	2	1	0	0	0	1	1	0	0	1	1	1	0	1
CO2	3	2	1	0	0	0	1	1	1	0	1	1	1	0	0
CO3	3	2	2	0	0	1	1	1	1	0	1	1	0	1	0
CO4	2	2	2	2	1	1	0	1	1	1	0	2	0	0	1
CO5	2	2	2	0	0	0	1	0	0	1	0	1	0	0	0
CO6	2	2	0	2	0	0	1	0	0	0	0	1	0	0	0
CO:	2.50	2.00	1.60	2.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.17	1.00	1.00	1.00

Course Code: CEMG-SEC-1

Course Outcome: After undergoing the course, the student would be able to

CO-1: Define key concepts in analytical chemistry, including accuracy, precision, significant figures, and the composition of soil and water.

CO-2: Describe the principles and techniques of various analytical methods, including complexometric titrations, chromatography, and ion-exchange methods, as well as their applications in the analysis of soil, water, food products, and cosmetics.

CO-3: Perform practical analyses, such as determining the pH of soil and water samples, estimating calcium and magnesium ions through complexometric titration, and identifying food adulterants using chromatographic techniques.

CO-4: Analyze data obtained from experimental results to evaluate the quality of soil and water samples, assess nutritional values in food products, and identify contaminants in cosmetics, demonstrating the ability to interpret findings in a real-world context.

CO-5: Critically evaluate the efficiency and reliability of various analytical techniques used for determining the composition of soil, water, and food products, including the assessment of potential sources of error and the significance of proper sampling methods.

CO-6: Design and propose a comprehensive analytical study on a selected topic, such as the analysis of arson accelerants or gasoline, incorporating appropriate methodologies, instrumentation, and safety considerations while addressing the significance of the study in the context of environmental or health-related issues.

CO-PO-PSO Mapping:

Course Outcome	Programme Outcome (PO)												Programme Specific Outcome (PSO1)		
	PO 1: Disciplinary knowledge :	PO 2: Problem solving	PO 3: Critical thinking	PO 4.Research-related skills / Scientific reasoning	PO 5: Communication Skills	PO 6: Cooperation/Teamwork	PO 7: Information/digital literacy:	PO 8: Self-directed learning	PO 9: Multicultural competence	PO 10: Moral and ethical awareness/reasoning	PO 11: Leadership readiness/qualities	PO 12: Lifelong learning	PSO 1: Analytical skill development and job opportunity	PSO 2: Research motivation	PSO 3: Social Awareness
CO1	3	1	1	1	0	0	2	1	0	0	0	2	2	1	1
CO2	3	2	2	2	1	0	2	1	0	0	0	2	2	2	2
CO3	3	3	3	3	1	0	3	2	0	0	1	3	3	3	3
CO4	3	3	3	3	1	0	3	2	0	0	0	3	3	3	3
CO5	3	2	3	2	1	0	3	2	0	1	0	3	3	3	3
CO6	3	3	3	3	2	0	3	3	0	1	2	3	3	3	3
CO:	3.00	2.33	2.50	2.33	1.20	0.00	2.67	1.83	0.00	1.00	1.50	2.67	2.67	2.50	2.50

Course Code: CEMG-SEC-2

Course Outcome: After undergoing the course, the student would be able to

CO-1: Identify and describe the fundamental concepts of biochemistry, including the biological importance of carbohydrates, proteins, lipids, and nucleic acids, as well as key metabolic pathways such as glycolysis, the Krebs cycle, and processes like replication and transcription.

CO-2: Explain the structures and functions of carbohydrates, proteins, lipids, and nucleic acids, including the classification of these biomolecules and their roles in biological processes, such as energy metabolism and genetic information transfer.

CO-3: Perform laboratory techniques for the isolation and characterization of polysaccharides and proteins, including enzyme assays to evaluate enzyme activity, and interpret results to understand metabolic pathways and enzyme function.

CO-4: Analyze biochemical data from blood and urine tests, interpreting results related to health conditions such as anemia and metabolic disorders. Use these analyses to assess the biochemical basis of diseases and the physiological significance of various biomolecules.

CO-5: Critically evaluate the roles of enzymes as biocatalysts in biochemical reactions, including their mechanisms of action, the effects of inhibitors, and their significance in green chemistry and industrial applications.

CO-6: Design a project or experiment that investigates a specific biochemical process, such as the effects of enzyme inhibitors on metabolic pathways or the impact of diet on blood composition. Propose hypotheses, methods, and expected outcomes, emphasizing the relevance of biochemistry in health and disease.

CO-PO-PSO Mapping:

Course Outcome	Programme Outcome (PO)												Programme Specific Outcome (PSO1)		
	PO 1: Disciplinary knowledge :	PO 2: Problem solving	PO 3: Critical thinking	PO 4.Research-related skills / Scientific reasoning	PO 5: Communication Skills	PO 6: Cooperation/Teamwork	PO 7: Information/digital literacy:	PO 8: Self-directed learning	PO 9: Multicultural competence	PO 10: Moral and ethical awareness/reasoning	PO 11: Leadership readiness/qualities	PO 12: Lifelong learning	PSO 1: Analytical skill development and job opportunity	PSO 2: Research motivation	PSO 3: Social Awareness
CO1	3	1	1	2	0	0	1	0	0	0	0	0	0	1	1
CO2	2	1	1	2	0	0	1	0	0	0	0	0	1	1	0
CO3	2	2	1	2	0	0	2	0	0	0	0	0	1	1	1
CO4	3	1	2	2	0	0	1	1	0	0	0	1	0	0	1
CO5	3	1	2	2	0	0	1	1	1	0	0	1	1	0	0
CO6	3	1	1	0	0	1	1	0	0	0	0	1	0	0	0
CO:	2.67	1.17	1.33	2.00	0.00	1.00	1.17	1.00	1.00	0.00	0.00	1.00	1.00	1.00	1.00

Course Code: CEMG-SEC-3

Course Outcome: After undergoing the course, the student would be able to

CO-1: Identify and describe the key concepts of drug discovery, design, and development processes, including fundamental terminologies and principles of retrosynthetic analysis.

CO-2: Explain the mechanisms of action and therapeutic uses of representative drug classes, including analgesics, antipyretics, anti-inflammatory agents, antibiotics, antiviral agents, central nervous system agents, cardiovascular agents, and drugs related to HIV/AIDS.

CO-3: Demonstrate the ability to utilize retrosynthetic analysis in the synthesis of various pharmaceutical compounds, showcasing the basic steps involved in the design and development of drugs from precursors.

CO-4: Analyze fermentation processes for the production of key pharmaceutical compounds, including ethyl alcohol, citric acid, and various antibiotics. Evaluate the differences between aerobic and anaerobic fermentation methods and their applications in drug manufacturing.

CO-5: Critically assess the efficacy and safety profiles of specific drugs, discussing their benefits and potential side effects, as well as the regulatory considerations involved in bringing new pharmaceuticals to market.

CO-6: Design a research proposal or experimental plan focused on the synthesis of a specific drug or the fermentation process for producing a pharmaceutical compound. Outline objectives, methods, expected outcomes, and potential implications for drug development

CO-PO-PSO Mapping:

Course Outcome	Programme Outcome (PO)												Programme Specific Outcome (PSO1)		
	PO 1: Disciplinary knowledge :	PO 2: Problem solving	PO 3: Critical thinking	PO 4.Research-related skills / Scientific reasoning	PO 5: Communication Skills	PO 6: Cooperation/Teamwork	PO 7: Information/digital literacy:	PO 8: Self-directed learning	PO 9: Multicultural competence	PO 10: Moral and ethical awareness/reasoning	PO 11: Leadership readiness/qualities	PO 12: Lifelong learning	PSO 1: Analytical skill development and job opportunity	PSO 2: Research motivation	PSO 3: Social Awareness
CO1	3	2	2	2	1	0	1	3	0	2	0	2	2	2	1
CO2	3	2	2	2	1	0	1	1	0	1	0	2	2	2	2
CO3	3	3	3	3	0	1	2	2	0	1	1	3	3	3	3
CO4	3	3	3	3	0	1	2	2	0	1	0	3	3	3	3
CO5	3	2	2	2	1	0	1	2	0	3	0	2	3	2	3
CO6	3	3	3	3	2	0	3	3	0	2	3	3	3	3	3
CO:	3.00	2.50	2.50	2.50	1.25	1.00	1.67	2.17	0.00	1.67	2.00	2.50	2.67	2.50	2.50

Course Code: CEMG-SEC-4

Course Outcome: After undergoing the course, the student would be able to

CO-1: Define key terms and concepts related to pesticides, including their classification into natural and synthetic types, as well as the structural characteristics and functional groups of representative pesticide classes.

CO-2: Explain the benefits and adverse effects of using pesticides in agriculture and other industries, discussing their impact on human health, non-target organisms, and the environment, as well as the evolution of pesticide use and regulation.

CO-3: Illustrate the concepts of structure-activity relationships (SAR) in the context of pesticide design and efficacy, demonstrating how molecular structure influences the biological activity of representative pesticides.

CO-4: Analyze the synthesis and technical manufacture of various pesticides, including Organochlorines (DDT, Gammexene), Organophosphates (Malathion, Parathion), Carbamates (Carbofuran, Carbaryl), Quinones (Chloranil), and Anilides (Alachlor, Butachlor). Discuss the chemical reactions involved and the rationale behind the choice of synthetic pathways.

CO-5: Evaluate the changing concepts surrounding pesticide use, including integrated pest management (IPM) strategies, the transition towards more sustainable and eco-friendly alternatives, and the implications for public health and environmental policy.

CO-6: Propose a research project or case study that investigates the effectiveness and safety of a specific pesticide from the listed classes. Outline the objectives, methodology, anticipated results, and potential recommendations for future pesticide use or regulation.

CO-PO-PSO Mapping:

Course Outcome	Programme Outcome (PO)												Programme Specific Outcome (PSO1)		
	PO 1: Disciplinary knowledge :	PO 2: Problem solving	PO 3: Critical thinking	PO 4.Research-related skills / Scientific reasoning	PO 5: Communication Skills	PO 6: Cooperation/Team work	PO 7: Information/digital literacy:	PO 8: Self-directed learning	PO 9: Multicultural competence	PO 10: Moral and ethical awareness/reasoning	PO 11: Leadership readiness/qualities	PO 12: Lifelong learning	PSO 1: Analytical skill development and job opportunity	PSO 2: Research motivation	PSO 3: Social Awareness
CO1	3	2	0	1	0	0	2	2	0	0	0	3	1	0	0
CO2	3	2	0	2	0	2	2	2	0	2	3	2	0	1	0
CO3	3	2	0	2	0	0	2	0	1	2	0	2	0	1	1
CO4	1	2	2	1	0	0	0	0	2	0	0	1	0	0	1
CO5	2	2	2	2	0	1	0	0	2	0	0	2	1	1	0
CO6	3	2	1	1	0	0	0	0	2	0	0	2	0	0	0
CO:	2.50	2.00	1.67	1.50	0.00	1.50	2.00	2.00	1.75	2.00	3.00	2.00	1.00	1.00	1.00