M.Sc. Chemistry Course Outcomes Summary Sheet

Course	Paper	Course Outcome 1	Course Outcome 2	Course Outcome 3	Course Outcome 4	Course Outcome 5	Course Outcome 6	Course Outcome 7
M.Sc.(Previous) Chemistry	**(Inorganic Chemistry)I**	Master the foundation of symmetry and group theory for analyzing molecular arrangements and spectroscopic data.	Comprehend VSEPR theory and Walsh diagrams for predicting shapes and stabilities of molecules involving main group elements.	Differentiate between crystal field theory and molecular orbital theory, and apply them to understand metal complex bonding in various geometries.	Interpret electronic spectra and magnetic properties of transition metal complexes using Orgel/Tanabe-Sugano diagrams and spectroscopic methods.	Explain reaction mechanisms of transition metal complexes, including substitution, redox, and electron transfer processes, for predicting reactivity and kinetics.	Utilize principles of nuclear and radiochemistry in understanding radioactive decay, radiation detection, and activation analysis for diverse applications.	Develop critical thinking and problem-solving skills for applying theoretical knowledge to analyze chemical phenomena and interpret experimental data in inorganic chemistry.
M.Sc.(Previous) Chemistry	**(Organic Chemistry)II**	Comprehend principles of delocalized chemical bonding, aromaticity, and their influence on the structure and reactivity of organic molecules.	Master concepts of stereochemistry, including conformational analysis, chirality, and diastereoisomerism, and apply them to predict molecular properties and reactivity.	Explain mechanisms of various organic reactions, including nucleophilic and electrophilic substitution, free radical reactions, and addition reactions, with focus on factors influencing rate and selectivity.	Differentiate and analyze aromatic electrophilic and nucleophilic substitutions, understanding the unique reactivity patterns based on the arenium ion mechanism and electronic effects.	Describe mechanisms of addition reactions to carbon-carbon and carbon-hetero multiple bonds, including hydrogenation, hydroboration, and enolate condensation reactions, focusing on stereochemical control and influencing factors.	Explain principles of elimination reactions (E2, E1, E1cB), pericyclic reactions (concerted, disrotatory, conrotatory, suprafacial, antarafacial), and sigmatropic rearrangements, utilizing frontier orbital theory and Woodward-Hoffmann rules.	Develop problem-solving skills to apply theoretical knowledge of organic reaction mechanisms and stereochemistry to predict product formation, selectivity, and reactivity in complex molecules.
M.Sc.(Previous) Chemistry	**(Physical Chemistry)III**	Master fundamental principles of quantum mechanics, including the Schrodinger equation, model systems, and angular momentum.	Apply approximation methods like variation theory and perturbation theory to analyze the electronic structure of atoms and molecules.	Utilize molecular orbital theory, particularly Huckel theory, to understand bonding, charge distribution, and reactivity in conjugated systems.	Explain concepts of classical thermodynamics, non-ideal systems, and phase transitions, and apply them to chemical equilibria and phase behavior.	Utilize statistical thermodynamics principles, including distribution functions, ensembles, and partition functions, to calculate thermodynamic properties of various systems.	Analyze chemical reaction dynamics using collision theory, activated complex theory, and various kinetic methods, interpreting factors influencing reaction rates and mechanisms.	Understand surface chemistry phenomena like adsorption, micelles, and macromolecules, applying relevant theories and methods for characterization and behavior prediction.
M.Sc.(Previous) Chemistry	**(Spectroscopy)IV**	Comprehend unifying principles of spectroscopy, including electromagnetic radiation interaction with matter, selection rules, and transition probabilities.	Analyze structure and dynamics of molecules using microwave spectroscopy, understanding effects of isotopic substitution and external fields.	Interpret vibrational transitions and spectra obtained through infrared and Raman spectroscopy, applying techniques like normal coordinate analysis and group frequencies.	Explain principles of atomic and molecular electronic spectroscopy, analyzing energy levels, vibronic transitions, and photoelectron spectra for structural elucidation.	Utilize nuclear magnetic resonance spectroscopy (NMR) to probe molecular structure and dynamics, interpreting chemical shifts, coupling constants, and relaxation phenomena.	Apply electron spin resonance spectroscopy (ESR) to understand the electronic structure and magnetic properties of molecules, focusing on hyperfine coupling and spin densities.	Master various diffraction techniques like X-ray, electron, and neutron diffraction for determining the crystalline and molecular structures of materials, including absolute configuration determination.
M.Sc.(Previous) Chemistry	**(Green Chemistry)V**	Master principles and concepts of Green Chemistry, including the twelve principles and their application in designing sustainable chemical processes.	Utilize non-traditional and greener alternative approaches in organic synthesis, such as green reagents, catalysts, and non-conventional energy sources.	. Explain the advantages and applications of microwave-assisted synthesis, particularly for specific organic transformations and heterocyclic ring formation.	Analyze the principles and benefits of ultrasound-assisted and electrochemical green synthesis methods, including examples like sebacic acid and adiponitrile production.	Evaluate environmentally benign alternatives to traditional organic solvents, including ionic liquids, aqueous phases, fluorous solvents, supercritical CO2, and ethyl lactate.	Comprehend the role and mechanisms of green synthesis for nanomaterials, employing techniques like microwave and microbial synthesis for quantum dots and nanoparticles.	Develop problem-solving skills to assess the applicability of Green Chemistry principles and techniques to solve environmental and sustainability challenges in chemical processes.
M.Sc.(Previous) Chemistry	**(Analytical Chemistry)VI**	Apply statistical concepts and chemometrics to evaluate analytical data, assessing accuracy, precision, errors, and drawing valid conclusions.	Design and implement appropriate sampling techniques for various types of samples (gases, fluids, solids, particulates), ensuring representativeness and minimizing variables.	Utilize solvent extraction methods for sample preparation and analyte isolation, understanding the principles, instrumentation, and applications.	Analyze and interpret conductometric and potentiometric measurements for various analytical applications, including titrations, pH determination, and ion-selective electrode measurements.	Explain the principles and applications of coulometry for quantitative analysis, distinguishing between constant current and constant potential methods.	Apply atomic absorption spectroscopy for elemental analysis, understanding the Grotrian diagram, instrumentation, and factors affecting sensitivity and detection limits.	Conduct food analysis to determine major constituents (moisture, ash, protein, fat, fiber, carbohydrates, minerals), identify adulterants and contaminants, and analyze pesticide residues using chromatographic techniques.
M.Sc.(Final) Chemistry	**(Solid, Photo & Spectroscopy)I**	Master principles and applications of UV-vis and IR spectroscopy for analyzing electronic transitions and vibrational frequencies of organic molecules, including carbonyl compounds, conjugated systems, and aromatic compounds.	Utilize Mossbauer spectroscopy and electron microscopy techniques (SEM, TEM, AFM) to investigate the structure, bonding, and oxidation states of transition metal complexes and other materials.	Apply optical rotatory dispersion (ORD) and circular dichroism (CD) methods to determine the absolute configuration of optically active molecules and predict their stereochemical conformations.	Explain principles and applications of NMR spectroscopy, particularly FT-NMR and carbon-13 NMR, for characterizing organic molecules based on chemical shifts, coupling constants, and various two-dimensional techniques.	Utilize mass spectrometry with different ionization techniques (EI, CI, FD, FAB) to analyze organic compounds, interpret fragmentation patterns, and identify molecular structures based on characteristic peaks and rules.	Understand mechanisms of photochemical reactions, including excited state behavior, rate constants, and influence of light intensity, and apply them to study intramolecular and intermolecular reactions of alkenes, carbonyl compounds, and aromatic compounds.	Analyze solid-state reactions, including their kinetics and mechanisms, and explain the relationship between crystal defects (point, line, plane), non-stoichiometry, and electronic properties of materials like metals, insulators, semiconductors, and organic solids.
M.Sc.(Final) Chemistry	**(Bio Inorganic, Bio Organic and Bio Physical Chemistry)II**	Comprehend roles and mechanisms of essential metal ions (Na, K, Mg, Ca, Fe, Cu, Zn, Co, etc.) in various biological systems, including the K+/Na+ pump, oxygen transport through haem proteins, and electron transfer via metalloproteins.	Explain principles and mechanisms of biological nitrogen fixation, both enzymatic (nitrogenase) and chemical approaches, emphasizing the importance of this process for nitrogen availability in ecosystems.	Understand core concepts of bioorganic chemistry, including proximity effects, molecular adaptation, enzyme structure and function, catalytic power, specificity, and regulation mechanisms.	Apply Fischer's lock-and-key and Koshland's induced-fit models to analyze enzyme active sites and their interactions with substrates and inhibitors.	Explain various enzymatic reaction mechanisms, including examples like chymotrypsin, ribonuclease, lysozyme, and carboxypeptidase, focusing on nucleophilic displacements, transfer reactions, and other processes.	Describe structure and functions of key coenzymes (CoA, TPP, PLP, NAD/P, FMN/FAD, etc.) and their involvement in enzymatic reactions catalyzed by these cofactors.	Analyze bioenergetics through standard free energy changes, ATP hydrolysis and synthesis, and apply statistical mechanics principles to understand chain configuration and dimensions of biopolymers like proteins.
M.Sc.(Final) Chemistry	**(Environmental Chemistry)III**	Understand the composition and structure of the atmosphere, including its layers, temperature profiles, heat radiation, and biogeochemical cycles of various elements.	Explain the sources and chemistry of trace atmospheric constituents, such as nitrogen oxides, sulfur dioxide, carbon oxides, and chlorofluorocarbons.	Analyze the mechanisms of tropospheric photochemistry, including the decomposition of NO2, formation of ozone, and reactions of hydroxyl radicals with methane and other organic compounds.	Identify and classify air pollutants, including aerosols, acid rain precursors, and greenhouse gases, and explain their harmful effects on the environment and human health.	Describe the chemistry and consequences of stratospheric ozone depletion, understanding the role of catalytic cycles and the importance of monitoring ozone depletion gases.	Analyze the sources and treatment of water pollution, focusing on redox chemistry, dissolved oxygen, biochemical oxygen demand, and eutrophication.	Explain the toxicity of heavy metals and organic compounds, such as pesticides and polychlorinated biphenyls, and discuss the environmental impacts of soil pollution and major environmental disasters.
M.Sc.(Final) Chemistry	**(Organic Synthesis I)IV**	Master principles, preparation, properties, and applications of various organometallic reagents from Group 1, 2, and Transition Metals in organic synthesis, with detailed mechanistic descriptions.	Explain and apply various oxidation processes to different functional groups using diverse reagents.	Analyze and utilize various reduction techniques for transforming diverse groups, understanding specific methods.	Investigate and comprehend key rearrangements in organic synthesis, focusing on mechanisms and general considerations.	Explore structure, synthesis, and reactivity of metallenes and nonbenzenoid aromatic compounds alongside polycyclic aromatic compounds.	Master the "disconnect approach" in organic synthesis, designing multi-step synthetic routes for complex molecules considering chemoselectivity, protecting groups, and regioselectivity.	Combine knowledge of organometallic reagents, oxidation/reduction, rearrangements, aromatics, and synthetic strategies for total synthesis of diverse organic molecules, choosing the most efficient route and executing multi-step syntheses with precision.
M.Sc.(Final) Chemistry	**(Organic Synthesis II)V**	Master the "disconnect approach" in organic synthesis, prioritizing efficient event order for successful multi-step syntheses.	Apply one-group and two-group C-X disconnection analysis, considering chemoselectivity and protecting groups.	Design and execute syntheses for alkenes via one-group C-C disconnection, incorporating acetylenes and aliphatic nitro compounds.	Plan multi-step organic syntheses using two-group C-C disconnection strategies, leveraging the Diels-Alder reaction and controlling factors in carbonyl condensations.	Analyze and utilize Michael addition and Robinson annelation reactions within two-group C-C disconnection frameworks.	Develop advanced synthetic skills by effectively employing 1,2-, 1,4-, and 1,6-difunctionalised compounds for ring synthesis.	Expand synthetic repertoire by exploring specialized methods like ketenes, pericyclic reactions, and photochemical reactions.
M.Sc.(Final) Chemistry	**(Heterocyclic Chemistry)VI**	Master heterocyclic nomenclature systems for monocyclic, fused, and bridged structures.	Analyze heterocyclic aromaticity using various criteria, classifying and predicting their reactivity and tautomerism.	Understand strain effects in small ring heterocycles and their conformational preferences.	Analyze stereo-electronic effects in heterocyclic systems, including hydrogen bonding and intermolecular interactions.	Develop knowledge of heterocyclic synthesis principles and apply them to design synthetic routes.	Gain expertise in the synthesis and reactions of various three-membered, four-membered, benzo-fused five-membered, and meso-ionic heterocycles.	Comprehensively study six-membered heterocycles with one or more heteroatoms, understanding their synthesis, reactions, and spectral characteristics.
M.Sc.(Final) Chemistry	**(Natural Products)VII**	Master terpenoid and carotenoid chemistry, including their classification, nomenclature, occurrence, isolation, structure determination, isoprene rule, and biosynthesis.	Gain expertise in alkaloid characterization, covering definition, nomenclature, physiological actions, occurrence, isolation, structure elucidation, classification, and role in plants. Understand the structure, stereochemistry, synthesis, and biosynthesis of key alkaloids.	Thoroughly comprehend steroids, including their occurrence, nomenclature, basic skeleton, structure, stereochemistry, isolation, structure determination, and synthesis techniques for prominent steroids like cholesterol, bile acids, sex hormones (androgens, estrogens, progesterone), and aldosterone, along with their biosynthetic pathways.	Analyze the occurrence, nomenclature, structure determination methods, isolation, and synthesis of various plant pigments. Focus on examples like apigenin, luteolin, quercetin, diadzein, cyanidin, and hirsutidin, understanding their flavonoid biosynthetic pathways (acetate and shikimic acid).	Gain in-depth knowledge of porphyrins, especially the structure and synthesis of haemoglobin and chlorophyll.	Understand prostaglandins, including their occurrence, nomenclature, classification, biogenesis, and physiological effects. Analyze Corey's synthesis of PGE1 and PGF2α.	Explore the chemistry of pyrethroids and rotenones, understanding their synthesis and reactivities.

M.Sc. Chemistry Program Summary Sheet			
S.NO.	**Program Outcomes (POs):**	**Program Specific Outcomes (PSOs):**	**Program Educational Objectives (PEOs):**
PO1/PSO1/PEO1	**Strong Foundation in Fundamentals: Possess a deep understanding of core chemical principles and concepts across various branches, including inorganic, organic, analytical, physical, and theoretical chemistry.**	**Higher Education & Research: Prepared for advanced studies in chemistry or related fields (PhD, research positions).**	**Employment in Chemistry: Significant proportion of graduates employed in responsible chemistry-related positions within five years of graduation.**
PO2/PSO2/PEO2	**Problem-Solving and Innovation: Apply chemical knowledge to tackle scientific challenges and develop creative solutions in diverse fields like academia, industry, research, and environmental sectors.**	**Chemical Industry Careers: Equipped for diverse roles in the chemical industry (R&D, quality control, process engineering, materials science).**	**Further Education: Significant proportion of graduates pursuing higher education (PhD, research positions) within five years of graduation.**
PO3/PSO3/PEO3	**Critical Thinking and Problem-Solving: Develop critical thinking skills to analyze complex problems, interpret data, and draw sound conclusions.**	**Scientific & Technological Advancement: Possess skills and knowledge to contribute to research and technological innovations across various fields.**	**Leadership and Contributions: Significant proportion of graduates recognized as leaders in their fields, making impactful contributions to research and technology within ten years of graduation.**
PO4/PSO4/PEO4	**Effective Communication: Communicate scientific concepts and findings effectively both verbally and in writing, catering to diverse audiences.**	**Societal Challenges: Apply chemical expertise to tackle critical issues like environmental pollution, energy sustainability, and healthcare solutions.**	**Societal Impact: Significant proportion of graduates actively engaged in solving critical societal challenges using their chemical expertise within ten years of graduation.**
PO5/PSO5/PEO5	**Ethical and Professional Conduct: Uphold the highest standards of integrity and responsibility in academic and professional endeavors, demonstrating ethical and professional conduct.**	**Teamwork & Collaboration: Develop strong teamwork and collaboration skills for effective contribution in diverse teams and positive work environments.**	**Ethical & Professional Conduct: Significant proportion of graduates recognized for their ethical and professional conduct, serving as role models for future chemists within ten years of graduation.**

Mapping of Course Outcomes of Various Courses of M.Sc. Chemistry Program With Program Outcomes (Pos),Program Specific Outcomes (Psos) & Program Educational Objectives (Peos)

Course Outcome (CO)	POs	PSOs	PEOs	Bloom's Taxonomy Level
M.Sc.Previous INORGANIC CHEMISTRY				
CO1. Master the foundational principles of symmetry and group theory for analyzing molecular arrangements and spectroscopic data.	PO1	PSO1, PSO3	PEO1, PEO2, PEO3	Understand, Analyze (Medium)
CO2. Comprehend the VSEPR theory and Walsh diagrams for predicting shapes and stabilities of molecules involving main group elements.	PO1	PSO1, PSO2, PSO3	PEO1, PEO2, PEO3	Analyze, Apply (Medium)
CO3. Differentiate between crystal field theory and molecular orbital theory, and apply them to understand metal complex bonding in various geometries.	PO1, PO3	PSO1, PSO2, PSO3	PEO1, PEO2, PEO3, PEO4	Analyze, Apply, Evaluate (High)
CO4. Interpret electronic spectra and magnetic properties of transition metal complexes using Orgel/Tanabe-Sugano diagrams and spectroscopic methods.	PO1, PO3	PSO1, PSO2, PSO3	PEO1, PEO2, PEO3, PEO4	Analyze, Evaluate (High)
CO5. Explain reaction mechanisms of transition metal complexes, including substitution, redox, and electron transfer processes, for predicting reactivity and kinetics.	PO1, PO3	PSO1, PSO2, PSO3	PEO1, PEO2, PEO3, PEO4	Analyze, Evaluate (High)
CO6. Utilize the principles of nuclear and radiochemistry in understanding radioactive decay, radiation detection, and activation analysis for diverse applications.	PO1, PO2	PSO1, PSO3, PSO4	PEO1, PEO2, PEO3, PEO4	Apply, Evaluate (Medium-High)
CO7. Develop critical thinking and problem-solving skills for applying theoretical knowledge to analyze chemical phenomena and interpret experimental data in the realm of inorganic chemistry.	PO1, PO2, PO3	PSO1, PSO2, PSO3, PSO4	PEO1, PEO2, PEO3, PEO4, PEO5	Analyze, Evaluate, Create (High)
M.Sc.Previous ORGANIC CHEMISTRY				
CO1. Comprehend the principles of delocalized chemical bonding, aromaticity, and their influence on the structure and reactivity of organic molecules.	PO1	PSO1, PSO3	PEO1, PEO2, PEO3	Understand, Analyze (Medium)
CO2. Master the concepts of stereochemistry, including conformational analysis, chirality, and diastereoisomerism, and apply them to predict molecular properties and reactivity.	PO1	PSO1, PSO2, PSO3	PEO1, PEO2, PEO3	Analyze, Apply (Medium)
CO3. Explain the mechanisms of various organic reactions, including nucleophilic and electrophilic substitution, free radical reactions, and addition reactions, with focus on factors influencing rate and selectivity.	PO1, PO3	PSO1, PSO2, PSO3	PEO1, PEO2, PEO3, PEO4	Analyze, Apply (Medium-High0

CO4. Differentiate and analyze aromatic electrophilic and nucleophilic substitutions, understanding the unique reactivity patterns based on the arenium ion mechanism and electronic effects.	PO1, PO3	PSO1, PSO2, PSO3	PEO1, PEO2, PEO3, PEO4	Analyze, Evaluate (High)
CO5. Describe the mechanisms of addition reactions to carbon-carbon and carbon-hetero multiple bonds, including hydrogenation, hydroboration, and enolate condensation reactions, focusing on stereochemical control and influencing factors.	PO1	PSO1, PSO2, PSO3	PEO1, PEO2, PEO3	Analyze, Apply (Medium-High)
CO6. Explain the principles of elimination reactions (E2, E1, E1cB), pericyclic reactions (concerted, disrotatory, conrotatory, suprafacial, antarafacial), and sigmatropic rearrangements, utilizing frontier orbital theory and Woodward-Hoffmann rules.	PO1, PO3	PSO1, PSO2, PSO3	PEO1, PEO2, PEO3, PEO4	Analyze, Evaluate (High)
CO7. Develop problem-solving skills to apply theoretical knowledge of organic reaction mechanisms and stereochemistry to predict product formation, selectivity, and reactivity in complex molecules.	PO1, PO2, PO3	PSO1, PSO2, PSO3, PSO4	PEO1, PEO2, PEO3, PEO4, PEO5	Analyze, Evaluate, Create (High)
M.Sc.Previous PHYSICAL CHEMISTRY				
CO1. Master the fundamental principles of quantum mechanics, including the Schrodinger equation, model systems, and angular momentum.	PO1, PO3	PSO1, PSO3	PEO1, PEO2, PEO3	Understand, Analyze (High)
CO2. Apply approximation methods such as variation theory and perturbation theory to analyze the electronic structure of atoms and molecules.	PO1, PO3	PSO1, PSO3	PEO1, PEO2, PEO3, PEO4	Apply, Evaluate (High)
CO3. Utilize molecular orbital theory, particularly Huckel theory, to understand bonding, charge distribution, and reactivity in conjugated systems.	PO1, PO3	PSO1, PSO2, PSO3	PEO1, PEO2, PEO3, PEO4	Analyze, Apply, Evaluate (Medium-High)
CO4. Explain the concepts of classical thermodynamics, non-ideal systems, and phase transitions, and apply them to chemical equilibria and phase behavior.	PO1, PO2, PO3	PSO1, PSO2, PSO3, PSO4	PEO1, PEO2, PEO3, PEO4	Analyze, Apply (Medium-High)
CO5. Utilize statistical thermodynamics principles, including distribution functions, ensembles, and partition functions, to calculate thermodynamic properties of various systems.	PO1, PO2, PO3	PSO1, PSO3	PEO1, PEO2, PEO3, PEO4	Apply, Evaluate (High)
CO6. Analyze chemical reaction dynamics using collision theory, activated complex theory, and various kinetic methods, interpreting factors influencing reaction rates and mechanisms.	PO1, PO2, PO3	PSO1, PSO2, PSO3, PSO4	PEO1, PEO2, PEO3, PEO4	Analyze, Evaluate (High)

CO7. Understand surface chemistry phenomena like adsorption, micelles, and macromolecules, applying relevant theories and methods for characterization and behavior prediction.	PO1, PO2	PSO1, PSO2, PSO3	PEO1, PEO2, PEO3, PEO4	Analyze, Apply, Evaluate (Medium-High)
CO8. Explain the principles of electrochemistry, including interfacial thermodynamics, electrode kinetics, and charge transfer, emphasizing their applications in various electrochemical processes.	PO1, PO2	PSO1, PSO2, PSO3	PEO1, PEO2, PEO3, PEO4	Analyze, Apply, Evaluate (Medium-High)
M.Sc.Previous SPECTROSCOPY				
CO1. Comprehend the unifying principles of spectroscopy, including electromagnetic radiation interaction with matter, selection rules, and transition probabilities.	PO1, PO3	PSO1, PSO3	PEO1, PEO2, PEO3	Understand, Analyze (Medium)
CO2. Analyze the structure and dynamics of molecules using microwave spectroscopy, understanding the effects of isotopic substitution and external fields.	PO1, PO3	PSO1, PSO2, PSO3	PEO1, PEO2, PEO3, PEO4	Analyze, Apply (Medium-High)
CO3. Interpret vibrational transitions and spectra obtained through infrared and Raman spectroscopy, applying techniques like normal coordinate analysis and group frequencies.	PO1, PO3	PSO1, PSO2, PSO3	PEO1, PEO2, PEO3, PEO4	Analyze, Apply, Evaluate (Medium-High)
CO4. Explain the principles of atomic and molecular electronic spectroscopy, analyzing energy levels, vibronic transitions, and photoelectron spectra for structural elucidation.	PO1, PO3	PSO1, PSO2, PSO3	PEO1, PEO2, PEO3, PEO4	Analyze, Apply, Evaluate (High)
CO5. Utilize nuclear magnetic resonance spectroscopy (NMR) to probe molecular structure and dynamics, interpreting chemical shifts, coupling constants, and relaxation phenomena.	PO1, PO3	PSO1, PSO2, PSO3	PEO1, PEO2, PEO3, PEO4	Apply, Evaluate (High)
CO6. Apply electron spin resonance spectroscopy (ESR) to understand the electronic structure and magnetic properties of molecules, focusing on hyperfine coupling and spin densities.	PO1, PO3	PSO1, PSO2, PSO3	PEO1, PEO2, PEO3, PEO4	Apply, Evaluate (High)
CO7. Master various diffraction techniques like X-ray, electron, and neutron diffraction for determining the crystalline and molecular structures of materials, including absolute configuration determination.	PO1, PO2, PO3	PSO1, PSO2, PSO3	PEO1, PEO2, PEO3, PEO4	Analyze, Apply, Evaluate (High)
M.Sc.Previous GREEN CHEMISTRY				
CO1. Master the principles and concepts of Green Chemistry, including the twelve principles and their application in designing sustainable chemical processes.	PO1, PO2, PO3	PSO1, PSO2, PSO3, PSO4	PEO1, PEO2, PEO3, PEO4	Understand, Analyze (Medium-High)

CO2. Utilize non-traditional and greener alternative approaches in organic synthesis, such as green reagents, catalysts, and non-conventional energy sources.	PO1, PO2, PO3	PSO1, PSO2, PSO3	PEO1, PEO2, PEO3, PEO4	Apply, Evaluate (Medium-High)
CO3. Explain the advantages and applications of microwave-assisted synthesis, particularly for specific organic transformations and heterocyclic ring formation.	PO1, PO2, PO3	PSO1, PSO2, PSO3	PEO1, PEO2, PEO3, PEO4	Analyze, Apply (Medium)
CO4. Analyze the principles and benefits of ultrasound-assisted and electrochemical green synthesis methods, including examples like sebacic acid and adiponitrile production.	PO1, PO2, PO3	PSO1, PSO2, PSO3	PEO1, PEO2, PEO3, PEO4	Analyze, Apply, Evaluate (Medium-High)
CO5. Evaluate environmentally benign alternatives to traditional organic solvents, including ionic liquids, aqueous phases, fluorous solvents, supercritical CO2, and ethyl lactate.	PO1, PO2, PO3	PSO1, PSO2, PSO3	PEO1, PEO2, PEO3, PEO4	Analyze, Evaluate (Medium-High)
CO6. Comprehend the role and mechanisms of green synthesis for nanomaterials, employing techniques like microwave and microbial synthesis for quantum dots and nanoparticles.	PO1, PO2, PO3	PSO1, PSO2, PSO3	PEO1, PEO2, PEO3, PEO4	Analyze, Understand (Medium-High)
CO7. Develop problem-solving skills to assess the applicability of Green Chemistry principles and techniques to solve environmental and sustainability challenges in chemical processes.	PO1, PO2, PO3	PSO1, PSO2, PSO3, PSO4	PEO1, PEO2, PEO3, PEO4, PEO5	Apply, Evaluate, Create (High)
M.Sc.Previous ANALYTICAL CHEMISTRY				
CO1. Apply statistical concepts and chemometrics to evaluate analytical data, assessing accuracy, precision, errors, and drawing valid conclusions.	PO1, PO3	PSO1, PSO2, PSO3	PEO1, PEO2, PEO3, PEO4	Apply, Analyze, Evaluate (Medium-High)
CO2. Design and implement appropriate sampling techniques for various types of samples (gases, fluids, solids, particulates), ensuring representativeness and minimizing variables.	PO1, PO2, PO3	PSO1, PSO2, PSO3	PEO1, PEO2, PEO3, PEO4	Apply, Analyze (Medium-High)
CO3. Utilize solvent extraction methods for sample preparation and analyte isolation, understanding the principles, instrumentation, and applications.	PO1, PO2	PSO1, PSO2, PSO3	PEO1, PEO2, PEO3	Apply, Analyze (Medium)
CO4. Analyze and interpret conductometric and potentiometric measurements for various analytical applications, including titrations, pH determination, and ion-selective electrode measurements.	PO1, PO2, PO3	PSO1, PSO2, PSO3	PEO1, PEO2, PEO3	Analyze, Apply, Evaluate (Medium-High)
CO5. Explain the principles and applications of coulometry for quantitative analysis, distinguishing between constant current and constant potential methods.	PO1, PO2	PSO1, PSO2, PSO3	PEO1, PEO2, PEO3	Analyze, Understand (Medium)

CO6. Apply atomic absorption spectroscopy for elemental analysis, understanding the Grotrian diagram, instrumentation, and factors affecting sensitivity and detection limits.	PO1, PO2, PO3	PSO1, PSO2, PSO3	PEO1, PEO2, PEO3	Apply, Analyze (Medium-High)
CO7. Conduct food analysis to determine major constituents (moisture, ash, protein, fat, fiber, carbohydrates, minerals), identify adulterants and contaminants, and analyze pesticide residues using chromatographic techniques.	PO1, PO2, PO3	PSO1, PSO2, PSO3	PEO1, PEO2, PEO3, PEO4	Apply, Analyze, Evaluate (High)
M.Sc. Final SOLID STATE, PHOTO & SPECTROSCOPY				
CO1. Master the principles and applications of UV-vis and IR spectroscopy for analyzing electronic transitions and vibrational frequencies of organic molecules, including carbonyl compounds, conjugated systems, and aromatic compounds.	PO1, PO3	PSO1, PSO2, PSO3	PEO1, PEO2, PEO3, PEO4	Analyze, Apply (Medium-High)
CO2. Utilize Mossbauer spectroscopy and electron microscopy techniques (SEM, TEM, AFM) to investigate the structure, bonding, and oxidation states of transition metal complexes and other materials.	PO1, PO2, PO3	PSO1, PSO2, PSO3	PEO1, PEO2, PEO3, PEO4	Apply, Evaluate (High)
CO3. Apply optical rotatory dispersion (ORD) and circular dichroism (CD) methods to determine the absolute configuration of optically active molecules and predict their stereochemical conformations.	PO1, PO3	PSO1, PSO2, PSO3	PEO1, PEO2, PEO3, PEO4	Analyze, Apply, Evaluate (High)
CO4. Explain the principles and applications of NMR spectroscopy, particularly FT-NMR and carbon-13 NMR, for characterizing organic molecules based on chemical shifts, coupling constants, and various two-dimensional techniques.	PO1, PO3	PSO1, PSO2, PSO3	PEO1, PEO2, PEO3, PEO4	Analyze, Apply, Evaluate (High)
CO5. Utilize mass spectrometry with different ionization techniques (EI, CI, FD, FAB) to analyze organic compounds, interpret fragmentation patterns, and identify molecular structures based on characteristic peaks and rules.	PO1, PO3	PSO1, PSO2, PSO3	PEO1, PEO2, PEO3, PEO4	Apply, Analyze, Evaluate (High)
CO6. Understand the mechanisms of photochemical reactions, including excited state behavior, rate constants, and influence of light intensity, and apply them to study intramolecular and intermolecular reactions of alkenes, carbonyl compounds, and aromatic compounds.	PO1, PO3	PSO1, PSO2, PSO3	PEO1, PEO2, PEO3	Analyze, Apply (Medium-High)

CO7. Analyze solid-state reactions, including their kinetics and mechanisms, and explain the relationship between crystal defects (point, line, plane), non-stoichiometry, and electronic properties of materials like metals, insulators, semiconductors, and organic solids.	PO1, PO2, PO3	PSO1, PSO2, PSO3	PEO1, PEO2, PEO3, PEO4	Analyze, Evaluate (High)
M.Sc. Final BIOINORGANIC BIOORGANIC & BIOPHYSICAL CHEMISTRY				
CO1. Comprehend the roles and mechanisms of essential metal ions (Na, K, Mg, Ca, Fe, Cu, Zn, Co, etc.) in various biological systems, including the K+/Na+ pump, oxygen transport through haem proteins, and electron transfer via metalloproteins.	PO1, PO2, PO3	PSO1, PSO2, PSO3, PSO4	PEO1, PEO2, PEO3, PEO4	Understand, Analyze (Medium)
CO2. Explain the principles and mechanisms of biological nitrogen fixation, both enzymatic (nitrogenase) and chemical approaches, emphasizing the importance of this process for nitrogen availability in ecosystems.	PO1, PO2, PO3	PSO1, PSO2, PSO3, PSO4	PEO1, PEO2, PEO3, PEO4	Analyze, Understand (Medium)
CO3. Understand the core concepts of bioorganic chemistry, including proximity effects, molecular adaptation, enzyme structure and function, catalytic power, specificity, and regulation mechanisms.	PO1, PO3	PSO1, PSO2, PSO3	PEO1, PEO2, PEO3	Understand, Analyze (Medium)
CO4. Apply Fischer's lock-and-key and Koshland's induced-fit models to analyze enzyme active sites and their interactions with substrates and inhibitors.	PO1, PO3	PSO1, PSO2, PSO3	PEO1, PEO2, PEO3	Apply, Analyze (Medium)
CO5. Explain various enzymatic reaction mechanisms, including examples like chymotrypsin, ribonuclease, lysozyme, and carboxypeptidase, focusing on nucleophilic displacements, transfer reactions, and other processes.	PO1, PO3	PSO1, PSO2, PSO3	PEO1, PEO2, PEO3	Analyze, Understand (Medium-High)
CO6. Describe the structure and functions of key coenzymes (CoA, TPP, PLP, NAD/P, FMN/FAD, etc.) and their involvement in enzymatic reactions catalyzed by these cofactors.	PO1, PO3	PSO1, PSO2, PSO3	PEO1, PEO2, PEO3	Understand, Analyze (Medium)
CO7. Analyze bioenergetics through standard free energy changes, ATP hydrolysis and synthesis, and apply statistical mechanics principles to understand chain configuration and dimensions of biopolymers like proteins.	PO1, PO2, PO3	PSO1, PSO2, PSO3	PEO1, PEO2, PEO3, PEO4	Analyze, Apply (Medium-High)
M.Sc. Final ENVIRONMENTAL CHEMISTRY				
CO1. Understand the composition and structure of the atmosphere, including its layers, temperature profiles, heat radiation, and biogeochemical cycles of various elements.	PO1, PO2, PO3	PSO1, PSO2, PSO3, PSO4	PEO1, PEO2, PEO3, PEO4	Understand, Analyze (Medium)

CO2. Explain the sources and chemistry of trace atmospheric constituents, such as nitrogen oxides, sulfur dioxide, carbon oxides, and chlorofluorocarbons.	PO1, PO2, PO3	PSO1, PSO2, PSO3, PSO4	PEO1, PEO2, PEO3, PEO4	Analyze, Understand (Medium)
CO3. Analyze the mechanisms of tropospheric photochemistry, including the decomposition of NO2, formation of ozone, and reactions of hydroxyl radicals with methane and other organic compounds.	PO1, PO2, PO3	PSO1, PSO2, PSO3, PSO4	PEO1, PEO2, PEO3, PEO4	Analyze, Apply (Medium-High)
CO4. Identify and classify air pollutants, including aerosols, acid rain precursors, and greenhouse gases, and explain their harmful effects on the environment and human health.	PO1, PO2, PO3	PSO1, PSO2, PSO3, PSO4	PEO1, PEO2, PEO3, PEO4	Analyze, Evaluate (Medium-High)
CO5. Describe the chemistry and consequences of stratospheric ozone depletion, understanding the role of catalytic cycles and the importance of monitoring ozone depletion gases.	PO1, PO2, PO3	PSO1, PSO2, PSO3, PSO4	PEO1, PEO2, PEO3, PEO4	Analyze, Understand (Medium-High)
CO6. Analyze the sources and treatment of water pollution, focusing on redox chemistry, dissolved oxygen, biochemical oxygen demand, and eutrophication.	PO1, PO2, PO3	PSO1, PSO2, PSO3, PSO4	PEO1, PEO2, PEO3, PEO4	Analyze, Apply (Medium-High)
CO7. Explain the toxicity of heavy metals and organic compounds, such as pesticides and polychlorinated biphenyls, and discuss the environmental impacts of soil pollution and major environmental disasters.	PO1, PO2, PO3	PSO1, PSO2, PSO3, PSO4	PEO1, PEO2, PEO3, PEO4	Analyze, Evaluate (High)
M.Sc. Final ORGANIC SYNTHESIS-I				
CO1. Master the principles, preparation, properties, and applications of various organometallic reagents from Group 1, 2, and Transition Metals in organic synthesis, including detailed mechanistic descriptions of their reactions.	PO1, PO2, PO3	PSO1, PSO2, PSO3	PEO1, PEO2, PEO3, PEO4	Analyze, Apply, Understand (High)
CO2. Explain and apply various oxidation processes to different functional groups using diverse reagents, understanding the mechanisms and selectivities involved.	PO1, PO2, PO3	PSO1, PSO2, PSO3	PEO1, PEO2, PEO3, PEO4	Apply, Analyze (High)
CO3. Analyze and utilize various reduction techniques for transforming different functional groups, understanding specific methods and mechanisms with focus on chemoselectivity.	PO1, PO2, PO3	PSO1, PSO2, PSO3	PEO1, PEO2, PEO3, PEO4	Apply, Analyze (High)
CO4. Investigate and comprehend the mechanisms of key rearrangements in organic synthesis, focusing on migratory aptitude, memory effects, and general considerations.	PO1, PO2, PO3	PSO1, PSO2, PSO3	PEO1, PEO2, PEO3, PEO4	Analyze, Evaluate (High)

CO5. Explore the structure, synthesis, and reactivity of metallenes, nonbenzenoid aromatic compounds, and polycyclic aromatic compounds.	PO1, PO2	PSO1, PSO2, PSO3	PEO1, PEO2, PEO3	Understand, Analyze (Medium-High)
CO6. Master the "disconnect approach" in organic synthesis. Design multi-step synthetic routes for complex molecules using synthons, disconnections, functional group interconversions, and efficient event order. Consider chemoselectivity, protecting groups, and regioselectivity while planning your synthetic campaigns.	PO1, PO2, PO3	PSO1, PSO2, PSO3	PEO1, PEO2, PEO3, PEO4	Apply, Create (High)
CO7. Combine your knowledge of organometallic reagents, oxidation/reduction techniques, rearrangements, aromatics, and synthetic strategies to tackle the total synthesis of diverse organic molecules. Analyze the feasibility of different approaches, choose the most efficient route, and execute multi-step syntheses with precision and control.	PO1, PO2, PO3	PSO1, PSO2, PSO3	PEO1, PEO2, PEO3, PEO4	Apply, Evaluate, Create (High)
M.Sc. Final ORGANIC SYNTHESIS-II				
CO1. Master the "disconnect approach" in organic synthesis, identifying synthons, synthetic equivalents, and functional group interconversions, prioritizing efficient event order for successful multi-step syntheses.	PO1, PO2, PO3	PSO1, PSO2, PSO3	PEO1, PEO2, PEO3, PEO4	Apply, Create (High)
CO2. Apply one-group and two-group C-X disconnection analysis to various molecules, considering chemoselectivity, reversal of polarity, and strategic use of protecting groups for alcohols, amines, carbonyls, and carboxyls.	PO1, PO2, PO3	PSO1, PSO2, PSO3	PEO1, PEO2, PEO3, PEO4	Apply, Analyze (High)
CO3. Design and execute syntheses for alkenes via one-group C-C disconnection, utilizing common starting materials like alcohols and carbonyl compounds, while understanding regioselectivity and incorporating acetylenes and aliphatic nitro compounds.	PO1, PO2, PO3	PSO1, PSO2, PSO3	PEO1, PEO2, PEO3, PEO4	Apply, Analyze (High)
CO4. Plan multi-step organic syntheses for complex molecules using two-group C-C disconnection strategies, leveraging the Diels-Alder reaction, 1,3-difunctionalised compounds, a,β-unsaturated carbonyl systems, and controlling factors in carbonyl condensations.	PO1, PO2, PO3	PSO1, PSO2, PSO3	PEO1, PEO2, PEO3, PEO4	Apply, Create (High)

CO5. Analyze and utilize Michael addition and Robinson annelation reactions within two-group C-C disconnection frameworks, building intricate carbon skeletons with precise control and efficiency.	PO1, PO2, PO3	PSO1, PSO2, PSO3	PEO1, PEO2, PEO3, PEO4	Apply, Analyze (High)
CO6. Develop advanced synthetic skills by effectively employing 1,2-, 1,4-, and 1,6-difunctionalised compounds for ring synthesis, particularly saturated heterocycles (3-, 4-, 5-, and 6-membered rings).	PO1, PO2, PO3	PSO1, PSO2, PSO3	PEO1, PEO2, PEO3, PEO4	Apply, Create (High)
CO7. Expand synthetic repertoire by exploring specialized methods like ketenes, pericyclic reactions (e.g., photochemical additions, cycloadditions), and photochemical reactions for accessing diverse and valuable organic products.	PO1, PO2, PO3	PSO1, PSO2, PSO3	PEO1, PEO2, PEO3, PEO4	Analyze, Apply (High)
M.Sc. Final HETEROCYCLIC CHEMISTRY				
CO1. Master the nomenclature of heterocyclic compounds, employing both replacement and systematic (Hantzsch-Widman) systems for monocyclic, fused, and bridged structures.	PO1, PO2	PSO1, PSO2	PEO1, PEO2, PEO3	Understand, Apply (Medium)
CO2. Analyze the aromaticity of heterocycles, applying criteria like bond lengths, ring current, NMR shifts, resonance energy, and diamagnetic susceptibility to classify and predict their reactivity and tautomerism.	PO1, PO2, PO3	PSO1, PSO2, PSO3	PEO1, PEO2, PEO3, PEO4	Apply, Analyze (Medium-High)
CO3. Understand the impact of strain-bond angles and torsional strains in small ring heterocycles, explaining their conformational preferences and the influence of 1,3-diaxial interactions.	PO1, PO2	PSO1, PSO2	PEO1, PEO2, PEO3	Analyze, Understand (Medium)
CO4. Analyze stereo-electronic effects like anomeric and related phenomena, including attractive interactions like hydrogen bonding and intermolecular nucleophilic-electrophilic interactions, in heterocyclic systems.	PO1, PO2, PO3	PSO1, PSO2, PSO3	PEO1, PEO2, PEO3, PEO4	Analyze, Apply (Medium-High)
CO5. Develop knowledge of heterocyclic synthesis principles, including cyclization and cycloaddition reactions, and apply them to design synthetic routes for diverse ring systems.	PO1, PO2, PO3	PSO1, PSO2, PSO3	PEO1, PEO2, PEO3, PEO4	Apply, Create (Medium-High)
CO6. Gain expertise in the synthesis and reactions of various heterocycles, including three-membered and four-membered rings (aziridines, oxiranes, thiiranes, etc.), benzo-fused five-membered rings (benzopyrroles, benzofurans, benzothiophenes), and meso-ionic heterocycles.	PO1, PO2, PO3	PSO1, PSO2, PSO3	PEO1, PEO2, PEO3, PEO4	Analyze, Apply (High)

CO7. Comprehensively study six-membered heterocycles with one or more heteroatoms, including pyrylium/pyridinium salts, pyrones/pyridones, quinolizinium/benzopyrylium salts, coumarins/chromones, diazines/triazines/tetrazines/thiazines, and heterocycles containing P, As, Sb, and B, understanding their synthesis, reactions, and spectral characteristics.	PO1, PO2, PO3	PSO1, PSO2, PSO3	PEO1, PEO2, PEO3, PEO4	Analyze, Understand (High)
M.Sc. Final NATURAL PRODUCTS CHEMISTRY				
CO1. Master terpenoid and carotenoid chemistry, including classification, nomenclature, occurrence, isolation, structure determination, isoprene rule, and biosynthesis. Analyze specific examples like citral, geraniol, menthol, farnesol, etc., in terms of structure, stereochemistry, and synthesis.	PO1, PO2, PO3	PSO1, PSO2, PSO3	PEO1, PEO2, PEO3, PEO4	Analyze, Apply, Understand (Medium-High)
CO2. Gain expertise in alkaloid characterization, covering their definition, nomenclature, physiological actions, occurrence, isolation, structure elucidation, degradation, classification based on nitrogen heterocyclic rings, and role in plants. Understand the structure, stereochemistry, synthesis, and biosynthesis of key alkaloids like ephedrine, coniine, nicotine, etc.	PO1, PO2, PO3	PSO1, PSO2, PSO3	PEO1, PEO2, PEO3, PEO4	Analyze, Understand (High)
CO3. Thoroughly comprehend steroids, including their occurrence, nomenclature, basic skeleton, Diels' hydrocarbon structure, and stereochemistry. Learn isolation, structure determination, and synthesis techniques for prominent steroids like cholesterol, bile acids, sex hormones (androgens, estrogens, progesterone), and aldosterone, along with their biosynthetic pathways.	PO1, PO2, PO3	PSO1, PSO2, PSO3	PEO1, PEO2, PEO3, PEO4	Analyze, Apply, Understand (High)
CO4. Analyze the occurrence, nomenclature, structure determination methods, isolation, and synthesis of various plant pigments. Focus on examples like apigenin, luteolin, quercetin, diadzein, cyanidin, and hirsutidin, understanding their flavonoid biosynthetic pathways (acetate and shikimic acid).	PO1, PO2, PO3	PSO1, PSO2, PSO3	PEO1, PEO2, PEO3, PEO4	Analyze, Apply, Understand (Medium-High)
CO5. Gain in-depth knowledge of porphyrins, especially the structure and synthesis of haemoglobin and chlorophyll.	PO1, PO2	PSO1, PSO2, PSO3	PEO1, PEO2, PEO3	Analyze, Understand (Medium-High)

CO6. Understand prostaglandins, including their occurrence, nomenclature, classification, biogenesis, and physiological effects. Analyze Corey's synthesis of PGE1 and PGF2α.	PO1, PO2, PO3	PSO1, PSO2, PSO3	PEO1, PEO2, PEO3, PEO4	Analyze, Understand (Medium-High)
CO7. Explore the chemistry of pyrethroids and rotenones, understanding their synthesis and reactivities.	PO1, PO2	PSO1, PSO2, PSO3	PEO1, PEO2, PEO3	Analyze, Understand (Medium)