4YUGP NEP CHEMISTRY

Programme Outcomes (POs)

The student graduating with the Four-year undergraduate program (4YUGP) NEP Chemistry should be able to acquire,

- Students will be able to understand the basic principles of equipment and instruments used in the chemistry laboratory.
- Students will be able to demonstrate the experimental techniques and methods of their area of specialization in Chemistry.
- Systematic and coherent understanding of the fundamental concepts in Physical Chemistry, Organic Chemistry, Inorganic Chemistry, Analytical Chemistry, and all other related allied chemistry subjects.
- Students will be able to use evidence-based comparative chemistry approaches to explain chemical synthesis and analysis.
- Students will be able to understand the characterization of materials

Disciplinary expertise and proficiency: A graduate student is expected to demonstrate comprehensive knowledge and understanding of theoretical and experimental/applied chemistry in various fields like Pharmaceutical Chemistry, Spectroscopic Technique, Analytical Chemistry, Physical Chemistry, Inorganic Chemistry, Organic Chemistry, Material Chemistry, etc. Additionally, they should be proficient in using advanced instruments and related software for material characterization/chemical analysis and separation technology.
Effective communication skills: The course curriculum includes basic and advanced training to enable graduate students to express themselves through technical writing and oral presentations.
Critical thinker and problem solver: Components within the course curriculum aim to develop critical thinking abilities in graduate students by solving problems/numericals using basic chemistry knowledge and concepts.
Curiosity and investigative mindset: The course curriculum is expected to nurture an inquisitive nature among students through appropriate questioning, planning, and reporting of experimental investigations.
Collaborative contributor:: The curriculum provides opportunities for students to act as team players by contributing in laboratory, field-based situations, and industry settings.
Proficient project management capabilities: The curriculum is designed to equip graduate students with the skills necessary to become proficient project managers, including knowledge about chemistry project management, writing, planning, and understanding ethical standards and regulations related to scientific project operation.
Proficient in digital skills: The curriculum is structured to impart a good working knowledge of understanding and carrying out data analysis, using library search tools, and utilizing chemical simulation software and related computational work.

- **Ethical awareness/reasoning**: A graduate student requires to understand and develop ethical awareness/reasoning, which the course curriculum adequately provides.
- **Lifelong learner**: The course curriculum is designed to inculcate a habit of learning

continuously through use of advanced ICT technique and other available techniques/books/journals for personal academic growth as well as for increasing employability opportunity.

Paper/Course with code	Course Outcomes
Semester-I Chemistry-I	On successful completion, students would have clear understanding of the concepts related to atomic and molecular structure, nuclear charge, chemical bonding, structure, stereochemistry and electronic effect in organic molecules, gaseous state and liquid state of matter . Students will also have hands on experience of soubility, water of crystallization, preparation of molar and normal solution, m.p determination, purification of organic compound by crystallization, experiment on surface tension etc.
Semester-II Chemistry-II	In this chapter. the students are expected to learn the Covalent Bond and Chemical forces, co-ordination chemistry, structure and Isomerism, Reaction Intermediate in Organic Chemistry, Acidity and Basicity in Organic Chemistry, Intensive and extensive variables, isolated, closed and open systems. Cyclic, reversible and irreversible processes. Zeroth law of thermodynamics , Application of first and second law of Thermodynamics. Students will also have hands on experience on Qualitative organic analysis for N, S, halogen and functional group test, Detection of saturation and unsatuaration, identification of functional group, determination of hardness of water, heat capacity by calorimeter, calculation of enthalpy, determination of total hardness of water etc.
Semester-III Chemistry-III	In this course. the students are expected to learn about acid base concept, strength of acid base, Concept of Hybridisation, Valence Bond Theory (VBT), Oxidation and reduction, Concept of aromaticity, hydrocarbons, alkyl and aryl halides, alcohols, phenols, thiols and carbonyl compounds. Students also expected to learn about different properties of solutions and partial molar quantities. Students will also have hands on experience on acid base titration, redox titration, water of crystallization, iron estimation, determination of viscosity etc.
Semester-IV Inorganic Chemistry-I	In this course the students are expected to learn Symmetry elements and Operation, Molecular Point Group, Chemistry of D-block elements, Crystal Field Theory, Ligand Field Theory, Metallurgy, Oxidation and Reduction, Lanthanides and Actinides, Stability of nucleus and radioactive decay processes, Fermi theory, half-lives, auger effect, Mass defect, etc. . Students will also have hands on experience on Qualitative semimicro analysis of mixtures containing 3 anions and 3 cations. Emphasis should be given to the understanding of reactions.

Semester - IV Organic Chemistry-II	In this course students expected to learn about the preparation and application of various organic functional groups like carboxylic acids, amines. Students will also learn heterocyclic chemistry, alkaloids, UV-Visible Spectroscopy and IR Spectroscopy. Students will also have hands on experience on preparation of organic compounds by nitration, bromination, oxidation, reduction etc. Students will also be practically trained with various chromatographic technique like paper chromatography and thin layer chromatography.
Semester-IV Theoretical Chemistry	Students will be exposed to the fundamental aspects of atomic structure through mathematical point of view. The students may be demonstrated the following lab activities using open-source programs such as GAMESS, MacMolPlt, Avogadro, etc or commercial software such as Gaussian, GaussView, etcBuilding and manipulating a small molecular model using a molecular builder such as MacMolPlt, Avogadro, GaussView etc.
Semester-IV Magnetic Resonance Spectroscopy and Analytical Techniques	After completion of this course students expected to learn theory of PMR spectroscopy and interpretation of PMR spectra of simple organic molecules like methanol, ethanol, acetaldehyde, acetic acid and aromatic. Students also learn theory and application of ESR and Mass Spectroscopy. And by using
Semester-V Inorganic Chemistry	In this course the students will learn theories of Coordination Chemistry and Main Group elements. Students will also understand some very important topics such as Definition and classification of organometallic compounds, Metal carbonyls, Zeiese's salt etc. The students are also expected to gain hands on training on Estimation by volumetric method like

	a. Fe(III)- By standard KMnO4 solution b. Fe(III) – By standard K2Cr2O7 solution c. Cu(II) – By Iodometric method etc.
Semeter-V Organic Chemistry	Students will be expected to learn about the formation of Carbon-Carbon bond and Carbon-Heteroatom bond, reactions of active methylene compounds, reactions of enolates, nucleophilic reactions of carbonyl and will learn about carbohydrate chemistry. The students are also expected to gain hands on training on Qualitative Analysis of Carbohydrates, Qualitative analysis of unknown organic compounds and Interpretation of infrared (IR) spectra of simple organic compounds:
Semester-V Reaction Dynamics	After completion of this course the students are expected to understand the application of quantum mechanics in some simple chemical systems such as hydrogen atom or hydrogen like ions. The students will also learn chemical bonding in some simple molecular systems. They will able to understand the basics of various kinds of spectroscopic techniques and photochemistry.
Semester-V Light, Matter Interaction	Students will be able to explain/describe basic principles of different spectroscopic techniques and their importance in chemical/organic analysis. Students will also learn Spectroscopy and its importance in chemistry. Wave-particle duality. Link between spectroscopy and quantum chemistry, Microwave (pure rotational) spectra of diatomic molecules, vibrational spectra, Electronic Spectra etc. Students will also learn about hands on training to calculate the rotational constant, optimum bond length , record the 200-350 nm UV spectra of the given compounds etc.
Semester-VI Inorganic Chemistry	On successful completion students will have the ability to understand the principles of inorganic reaction mechanisms, to analyze substitution reactions complexes, to describe the role and structural features of metal alkyls, metal alkenes, alkynes, allyl, to explain fundamental organometallic reactions, to investigate transition metals' catalytic properties, to Explore the role of essential and trace metals in biology etc and also hands on training on inorganic salt preparation.
Semeter-VI Organic Chemistry	On successful completion students will be have theoretical understanding to comprehend the fundamental principles of photochemistry, to evaluate the occurrence, structure, and classification of terpenes, Analyze pericyclic reactions, to demonstrate a comprehensive understanding of the structure and reactivity of organolithium compounds and hands on training on extraction methods.

Semester-VI Physical Chemistry	At the end of this course students will learn about principles of equilibrium in both homogeneous and heterogeneous systems, analyze ionic equilibria, including the common ion effect, acid-base equilibria, pH calculations etc., can demonstrate proficiency in understanding phase equilibria and can explain the principles of electrochemistry and hands on training on PH metric titration etc.
Semester-VI Industrial Chemistry	Upon completion of this course, students shall be able to demonstrate comprehensive knowledge of industrial gases, Understand the manufacture, applications, analysis methods, and safety considerations for a range of inorganic chemicals, to analyze the production processes and properties of materials used in silicate industries, to explore the manufacture and types of fertilizers, including urea, ammonium nitrate, calcium ammonium nitrate, ammonium phosphates, to gain insight into surface coatings, including the objectives of coating surfaces, to understand the classification of alloys, to gain knowledge of catalysis and its industrial applications, to explore the chemistry of pyrotechnics and propellants and hands on training on Determination of free acidity, estimation of calcium, phosphoric acid etc,