St. Albert's College (Autonomous)

An initiative of Archdiocese of Verapoly

Affiliated to Mahatma Gandhi University, Kottayam

(Accredited with "A" Grade by NAAC)

Programme Outcomes
Programme Specific Outcomes
Course Outcomes

Department of Chemistry

M. Sc. Chemistry (2016 Admissions Onwards)

Programme Objectives (POs)

The main objectives of this programme include

- Offering opportunity to study Chemistry at an advanced level, covering both the traditional core and modern areas of chemistry.
- Providing opportunities for students to develop and demonstrate advanced knowledge, understanding, practical and research skills.
- Helping students to mould their career
- Providing the opportunity for the students to understand the changing scientific world and to promote the quality of human life considering the preservation of the environment and its other living species.

Programme Specific Outcomes (PSOs)

- Global level competitive research opportunities to pursue PhD in chemistry.
- Pass CSIR-UGC (JRF-NET) and GATE exams to pursue research in top universities/institutes in India.
- Job opportunities at all levels of chemical, pharmaceutical, food products, material and plastic industries.
- Chemistry specific competitive exams conducted by government bodies

Course Outcomes (COs)

SEMESTER – I

Organometallics and Nuclear Chemistry (PCH1CRT01)

After the end of this, the students will be able

- To study the methods of synthesis and the mechanism of selected catalytic organic reactions and also the reactivity of simple organometallic compounds.
- To study the functions of transition metal ions in biological systems.
- To know about the applications of radioactive isotopes.

Structural and Molecular Organic Chemistry (PCH1CRT02)

After the end of this, the students will be able

- To learn and apply the fundamental concepts of organic and photochemical reactions.
- To learn stereochemistry and conformational analysis of organic compounds.

Quantum Chemistry and Group Theory (PCH1CRT03)

By the end of the course, the students are expected to gain knowledge about

- Basic principles and concepts of quantum chemistry
- How operator algebra can be used to solve simple eigenvalue problems
- the time –dependent and time-independent Schrodinger equation for simple molecules
- the interaction of an electron with electromagnetic field
- The role of rotational and spin angular momenta in chemistry
- the different symmetry elements of molecules, the point group it belongs to and its properties,
- construction of character table and construction of SALCs.

Classical and Statistical Thermodynamics (PCH1CRT04)

Upon successful completion students should be able to:

- Acquire knowledge on basics and advanced concepts of classical thermodynamics and able to use them in the evaluation of macroscopic properties
- Able to explicate the phase diagrams of three component systems
- Able to derive Maxwell's law of distribution of velocities
- Understand and differentiate about the three types of velocities of gases
- Study about collision frequency, collision frequency, mean free path etc.
- Understand different transport properties of gases
- Learn law of corresponding states
- Understand statistical mechanics
- Appreciate and learn the role of statistical mechanics in Chemistry
- Differentiate between classical statistics and quantum statistics
- Learn about different types of statistics applied to types of particles present in the system
- Understand about the concept of partition function
- Derive thermodynamic properties using partition function
- Enable the derivation of Sackur-Tetrode equation
- Study about heat capacity of gases and solids
- Differentiate about different theories on molar heat capacities of solids

SEMESTER – II

Coordination Chemistry (PCH2CRT01)

- Enables to know about Structural Aspects and Bonding in coordination complexes.
- Study the Spectral and Magnetic Properties of Metal Complexes.
- Acquire knowledge about the Kinetics, Stereochemistry and Mechanism of Reactions in Metal Complexes.
- Update knowledge about Lanthanoid and Actinoid complexes.

Organic Reaction Mechanisms (PCH2CRT02)

- Understand the involvement of reactive intermediates, their structure and reactivity through various organic reactions.
- Study the orbital interactions in concerted reactions (Woodward Hoffmann rules) and apply knowledge for solving problems.

Chemical Bonding and Computational Chemistry (PCH2CRT03)

At the end of the course, the students are expected to acquire basic knowledge in

- Approximation methods used in solving many electron problems.
- Application of variational method, perturbation method and Hartree Self consistent Field method to solve simple systems.
- Molecular orbital theory and its application in diatomic and polyatomic molecules.
- Using Hückel Molecular orbital method to find out the π-electron energy and wave function of conjugated organic molecules.
- Drawing molecular orbital diagram for π-electron systems.
- Determining the symmetry species of vibrational modes.
- Predicting the IR and Raman activity of molecules.
- Identifying the chances of electronic transitions between different energy levels of molecules.
- Computational methods such as molecular mechanics, semi empirical methods, ab-initio methods and Density Functional Theorem.
- Computer-based calculations using GAMESS / FIREFLY to determine the geometry, energies, vibrational frequencies etc. of chemical compounds and information regarding transition state of chemical reactions.
- Using computational tools in his/her future research career.

Molecular Spectroscopy (PCH2CRT04)

Upon successful completion students should be able to:

- Learn electromagnetic spectrum, its characteristics, doppler broadening and Lamb dip spectrum
- Study origin of spectrum, selection rules and Born – Oppenheimer approximation
- Learn about microwave spectroscopy of diatomic and polyatomic molecules
- Be able to interpret rotational spectra, get information about molecular dimensions
- Study in detail about Morse Potential energy diagram and vibrational spectra
- Understand FTIR spectroscopy
- Study in detail about Raman spectroscopy and its various modifications
- Analyse complementarities of Raman and IR spectroscopy
- Understand electronic transitions of diatomic and polyatomic molecules
- Study mutual exclusion principle
- Write term symbols of diatomic molecules
- Use the Franck-Condon principle to predict the shape of the absorption curve
- Study about different types of lasers and its applications
- Acquire a deeper knowledge about basic principles of NMR spectroscopy and its instrumentation
- Understand ESR Spectroscopy, g-factor, hyperfine interactions in it
- Study Kramers' degeneracy and McConnell equation.
- Understand the theory and important applications of NQR Spectroscopy

SEMESTERS I & II PRACTICALS

Inorganic Chemistry Practical-1 (PCH1CRP01/PCH2CRP01)

- To perform qualitative analytical techniques in inorganic chemistry for identification of ions.
- To perform quantitative Colorimetric estimation of Fe, Cu, Ni, Mn, Cr, NH_4^+, nitrate and phosphate ions.
- To prepare and characterize different types of inorganic complexes.

Organic Chemistry Practical-1 (PCH1CRP02/PCH2CRP02)

- To perform separation and purification of organic compounds and binary mixtures.
- Familiarize with the computational tools to draw the reaction schemes.
- Analyse the spectral data of various organic compounds.

Physical Chemistry Practical-1 (PCH1CRP03/PCH2CRP03)

By the end of this course, students will be able to

- Interpret data from an experiment, including the construction of appropriate graphs and the evaluation of errors.
- Present the results of a practical investigation in a concise manner, and understanding the principle of different phenomena by doing experiments related to Adsorption, Surface tension, Two component and Three component systems.
- Students will get hands on experience on different instruments.
- Plan and apply computer-based calculations using GAMESS / FIREFLY to determine the geometry, energies, vibrational frequencies etc. of chemical compounds.
- Get training on how to use computational tools in his/her future research career.

SEMESTER – III

Structural Inorganic Chemistry (PCH3CRT01)

- Acquire knowledge about the imperfections of solids, electrical and magnetic properties of solids.
- Study the properties of inorganic chains, rings, cages and clusters.
- Updated with knowledge about organometallic polymers and magnetic nanoparticles.

Organic Syntheses (PCH3CRT02)

- Understand the various organic reactions and reagents in organic synthesis.
- To learn the principles of protecting group chemistry.
- Attain a basic knowledge about retrosynthetic approach towards organic synthesis.

Chemical Kinetics, Surface Chemistry and Photochemistry (PCH3CRT03)

- Study and compare different theories of reaction rates
- Evaluate the mechanism involved in chain reactions and unimolecular reactions
- Know different methods of fast reactions
- Analyse mechanism of branching chain reactions
- Identify factors determining reaction rates in solutions
- Know salt effects
- Familiarize acid-base catalytic reactions and the mechanism involved
- Study the mechanism of enzyme catalysis

- Study oscillating chemical reactions
- Understand the basics of surface chemistry and will be able to apply various isotherms in surface catalyzed reactions.
- Acquire knowledge about currently used surface analysis technique and different methods for molecular mass determination of macro molecules in the field of research.
- To learn and apply the fundamental concepts of organic photochemistry.

Spectroscopic Methods in Chemistry (PCH3CRT04)

- Apply the different spectroscopic methods to solve problems based on the data obtained.
- Acquire knowledge about the basic principles and theory of microwave, NMR, IR, Mass and UV- Vis spectroscopy.
- Interpret spectral data for explaining important organic reactions and functional transformations.

SEMESTER – IV

Advanced Inorganic Chemistry (PCH4CRT01)

- Apply group theoretical principles in hybridisation technique of molecules.
- Attain knowledge about the preparation and characteristics of nanomaterials.
- Study about metal organic frame works and types of supramolecules.

Advanced Organic Chemistry (PCH4CRT02)

- Analyse and interpret molecular recognition and supramolecular chemistry.
- Study the basic principles of green chemistry, the method of biosynthesis and biomimetic synthesis.
- Learn the importance of drug design and different categories of polymers.
- Understand the basic principles of research and how to write a scientific report.

Advanced Physical Chemistry (PCH4CRT03)

After the successful completion of the course, the students will be able to:

- Understand different crystal systems, Miller indices and point groups
- Learn different methods of determining crystal structure
- Enable comparison of crystal structures of NaCl and KCl
- Study structure factors.
- Differentiate between different types of liquid crystals
- Know different applications of liquid crystals.

- Recognize the seven crystal systems and their symmetry elements.
- Categorize the crystals into point groups and space groups.
- Define the relationship between diffraction pattern and crystal structure.
- Recall the basic principles of different types of electroanalytical methods.
- Assess potentiometric, polarographic, voltammetric, amperometric and coulometric methods.
- Recognize the applications of electroanalytical techniques in solving the chemical problems quantitatively and qualitatively.
- Evaluate theories of ions in solution.
- Derive Debye-Huckel-Onsager equation.
- Determine ionic strength of solutions.
- Familiarize triple ions and conductance minima.
- Understand electrochemical cells and concentration cells.
- Memorize different theories of electrical double layer.
- Differentiate different types of fuel cells and its applications.
- Apply Overvoltage and its theories, Tafel equation and Butler-Volmer equation.

SEMESTERS III & IV PRACTICALS

Inorganic Chemistry Practical-2 (PCH3CRP01/PCH4CRP01)

- Apply theoretical learning to separate simple binary mixtures of metallic ions in solution.
- Perform alloy analysis and ore analysis.
- Demonstrate application of paper chromatography to separate a mixture of three cations.

Organic Chemistry Practical -2 (PCH3CRP02/PCH4CRP02)

- Conduct preparation involving two step synthetic sequences by chemical methods.
- Capable of applying green alternative methods of organic synthesis.

Physical Chemistry Practical - 2 (PCH3CRP03/PCH4CRP03)

After completing Physical Chemistry Practicals of second year, students will be able to:

- Design and carry out experiments accurately and analyze the results of conducted experiments.
- Understand the rate of reactions, by determining the rate constant of first order and second order reactions.

- Determine unknown concentration of solutions using various methods like conductometry, polarimetry, viscosity, Refractometry and Potentiometric methods.