Department of Chemistry

N.C. Autonomous College, Jajpur, Odisha

Programme: UG, Chemistry Honours

Programme Outcomes

Programme	Programme Outcomes
BSc Chemistry Hons.	PO1: Students acquire theoretical knowledge and understanding of the basic concepts, principles and processes in main branches of chemistry which stresses a broad foundation in chemical science with scientific reasoning and temperament. PO2: The student will be equipped with knowledge to solve problems of numerical, synthetic and analytical nature with critical thinking. PO3: The students will develop laboratory skills during the course through different qualitative and quantitative techniques and instrumentations and be a great resource for industry work force.. PO4: Students will acquire the knowledge, techniques and skills to effectively communicate scientific chemical content to large audiences and relate their education with other branches of science PO5: The Chemistry Honours programme is designed to make the students to possess the ability of independent thinking and productivity through effective teaching learning process.

Course outcomes

Semester-I

Atomic Structure, Periodicity of Elements and Chemical Bonding. Fundamental Organic Chemistry

Course outcomes:

1. Solve the conceptual questions using the knowledge gained by studying the quantum mechanical model of the atom.
2. Learn the various atomic properties of atoms and their variations in the periodic table.
3. Gain the idea of different types of bonding and their associated properties.
4. Understand the theory and applications of various acid-base titrations.
5. Understanding the basic concepts of electronic displacement phenomena in organic molecules, various bond breaking processes and types of organic reactions.
6. Fundamental knowledge on symmetry and asymmetry aspect of organic molecules and their spatial arrangements in two-dimension and three-dimension with their stereochemistry.
7. Learning the synthesis, structure and stability of unsaturated hydrocarbons, understanding the concept of aromaticity and chemical reactions of unsaturated hydrocarbons and aromatic hydrocarbons.
8. Knowledge on selection of suitable solvent for purification and separation of organic compounds and detection of various elements present in it.

Semester-II

States of matter, and Ionic equilibrium. Chemical thermodynamics, equilibrium, and Colligative property

Course outcomes:

1. Derive mathematical expressions for different properties of gas and liquid and understand their physical significance.
2. Apply the concepts of gas equations and liquids while studying other chemistry courses and understand the importance of pH in every-day life.
3. Understand different lattice systems and apply working principles of XRD for understanding crystal structure by powder and single crystal method.
4. Handle stalagmometer and Ostwald viscometer properly and determine the density of aqueous solutions. Data reduction, interpretation using numerical and graphical methods.
5. Discuss the laws of thermodynamics and applications to natural phenomena.
6. Acquire a strong foundation of partial molar properties, its variation with temp and pressure for different systems and able to apply on the thermodynamics of simple mixtures.
7. Inculcate firm foundations in the fundamentals and application of chemical equilibrium, and Δ*G* derive the relationship between different equilibrium constants.
8. Understand the basic concept of Solutions of non-volatile solutes, colligative properties. Calculate various thermodynamic properties (Δ*H*neutralization, Δ*H*hydration & Cv) for chemical reactions using calorimeter.

Semester-III

Acids and Bases, Metallurgy, Chemistry of main group elements. Chemistry of halogen, oxygen and sulphur containing organic compounds. Phase equilibrium, Chemical dynamics, catalysis and surface chemistry.

Course outcomes:

1. Know how the various theories of acid and base, and understand the occurrence and purification of metals
2. Learn the different properties of s- and p-block elements
3. Understand the preparation and properties of inorganic polymers.
4. Achieve knowledge on how to standardize, estimate and prepare inorganic compounds/metal ions.
5. Understanding on preparation, properties and reactions of haloalkanes, haloarenes, and organic compounds containing C, H, O and S functional groups.
6. Basic knowledge on various name reactions and their mechanisms involving substitution, addition, elimination and condensation.
7. Knowledge on functional group interconversion and synthetic applications of different organic compounds.
8. Knowledge on various functional group detection in organic compounds and preparation of derivatives of functional groups.
9. Establish the phase rule for one, two component systems, eutectics; and its thermodynamic derivation; fundamentals of physical transformation of pure materials.
10. Interpret chemical kinetics of chemical reactions and its impact on reaction mechanism.
11. Differentiate between homogenous and heterogenous catalysis & Acid Base Catalysis, differentiate between Physical adsorption, chemisorption and various adsorption isotherms.
12. Determine distribution coefficients of solution mixtures, Interpret and use data generated from kinetic studies by graphical and experimental methods.

Semester-IV

Coordination Chemistry, Chemistry of d- and f-block elements, Inorganic Reaction Mechanism and electron transfer reactions. Natural Products, Heterocyclic

Compounds, Nitrogen containing compounds and Polynuclear Hydrocarbons. Conductance, electrochemistry, electrical properties of atoms and molecules.

Course outcomes:

1. Understand the chemistry of coordination compounds, and d- and f-Block elements.
2. Explain magnetic properties and colour of complexes on the basis of Crystal Field Theory.
3. Understanding the fundamental importance of inorganic reaction mechanism and electron transfer reaction
4. Achieved the knowledge of the preparation of inorganic complex, estimation by EDTA method and gravimetric method.
5. Gaining knowledge on preparation, properties and synthetic application of nitrogen containing compounds including diazonium salts.
6. Understanding on isolation and structural elucidation of natural products and heterocyclic compounds and their chemical reactions.
7. Knowledge on structure and properties of fused aromatic compounds.
8. Learning on various procedures of estimation of organic compounds.
9. The text provides an in-depth analysis of the conductance nature of electrolytic solutions, their thermodynamics, Debye-Huckel theory, ionic strength, mean ionic activity coefficient, and the Debye- Huckel limiting law.
10. Explain dynamic electrochemical processes and skill development to analyse it.
11. Understand the dynamic electrochemical processes and skill development to analyse it.
12. Develop skill to solve problems on Electrochemical Cells, electrode potentials, emf & solubility product measurements, potentiometric titrations, pK and pH measurements.

Semester-V

Organic Spectroscopy. Basic quantum chemistry, Molecular & electronic spectroscopy, and photochemistry. Chemistry of Organometallic Compounds. Green Chemistry

Course outcomes:

1. Gaining knowledge on principle of UV-visible and Infrared Spectroscopic techniques.
2. Gaining knowledge on principle of NMR Spectroscopic techniques.
3. Gaining knowledge on principle of Mass Spectrometry techniques.
4. Understanding and interpretation of different spectra of organic molecule.
5. Understand the postulates of quantum mechanics. Construct the Schrödinger wave equations for 1-D box, 3- D box, Rigid rotor, and SHO and able to interpret the solution of Schrödinger equation.
6. Understand LCAO-MO compare with VBT of H2 molecule. Apply the fundamentals of Quantum mechanics to interpret molecular spectroscopy.
7. Calculate quantum yield of photochemical reactions.
8. Interpret the data obtained from graphical methods of Lambert-Beer's law experiments and corelate with UV-Vis spectroscopy.
9. Understand the basic concepts of organometallic compounds pertaining to their synthesis, structure and bonding
10. Understand the mechanistic phenomena of organometallic based catalytic reactions
11. Get knowledge on the versatility of phosphine/NHC ligands, and industrially important metathesis reactions.
12. Understand and explain the basic principles of qualitative inorganic analysis .
13. Discuss about the role of principles of green chemistry.
14. Explain the importance of green synthesis.
15. Interpret the knowledge of prevention of hazardous chemicals in reactions.

16. Evaluate the efficiency of green catalysts & interpret the use of biocatalysts.

Semester-VI

Analytical Methods of Chemistry. Solid and porous materials, and magnetochemistry and power cells. Polymer Chemistry

Course outcomes:

1. Perform calibration and standardization procedures to ensure the accuracy and precision of analytical measurements, adhering to established protocols and standards.
2. Apply a variety of analytical techniques, such as spectroscopy, chromatography electrochemistry, and titrimetry, to quantitatively and qualitatively analyze chemical substances.
3. Collect, analyze, and interpret experimental data accurately using appropriate statistical methods and error analysis techniques.
4. Develop critical thinking and problem-solving skills and Implement quality control and assurance practices, including the use of control charts and validation of analytical methods, to ensure the reliability and reproducibility of analytical results.
5. Learn about the different materials, including theory and methods for the development of new materials with desired properties.
6. Know how pores can influence the properties of materials
7. Demonstrate an increased knowledge and understanding of magnetochemistry with critical thought and achieve the ability to analyze magnetochemical studies and data
8. Explain the principles that underlie the ability of various power cells and develop new idea of constructing power cell.
9. The learners will be able to classify the polymers based on nature, occurance, mode of synthesis, thermal properties etc.

10. To differentiate between methods and mechanism of polymerization process.
11. Calculate molecular weights of polymers and study the applications & properties.
12. The learners will be able to design the monomers for the preparation of polymers of interest, characterize and understand the properties polymers.

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MSc Chemistry Programme Outcomes and Course Outcomes

Programme Outcome:

Programme	Programme Outcomes
MSc Chemistry (2 Years) Postgraduation Degree	**PO1:** The students will acquire the in-depth functional knowledge of the fundamental principles and contemporary practices of chemistry and ability to use them to investigate, explain and predict the new phenomena. **PO2:** Acquire skills to design, execute and document of laboratory experiments at a level suitable to succeed at an entry level position in research, academia, or chemical industry. **PO3:** Develop an awareness of social, economic, environmental and technological implication of chemistry. **PO4:** Find job opportunities in Chemical, pharmaceutical, and other chemistry-based industries; Research & Development in various scientific/academic institutions. **PO5:** Have the ability to disseminate research results orally, and in writing.

Course Outcome

Semester-I

Inorganic Chemistry-I, Organic Chemistry- I, Physical Chemistry –I, Inorganic Chem. Practical-I, Organic Chem. Practical-I, Spectroscopy-I, Computer for Chemist

Course Outcomes:

1. Acquire the knowledge and have the ability to describe the bonding and stereochemistry of different inorganic compounds and ions.
2. Be able understand the concept stability constant, its determination and application in different fields
3. Understand the reactions and mechanism of different types of reactions in coordination compounds and their applications in practical fields.
4. Understand the fundamental aspects of aromaticity, non-aromaticity and antiaromaticity.
5. Feel the structural details of organic compounds and the origin of optical activity of the chiral molecules.
6. Understand the origin of stereoselectivity as far as asymmetric catalysis is concern, and the basic mechanism of substitution reactions in aliphatic compounds.
7. Understanding the underlying concepts and realization of quantum mechanics will be useful in solving problems at realistic atomic and molecular level, in particularly in the field of spectroscopy and analytical chemistry.
8. Understanding thermodynamics requires knowledge of how the microscopic world operates and importance of reversible and irreversible processes.
9. Ability to separate and identify different cations and anion from a mixture of inorganic salts.
10. Understanding the principles of separation and analysis of different ions and their applications in real fields.

11. Learn the techniques of chromatographic separation of mixture of cations and anions.
12. Understand how to detect the presence of different functional groups
13. Demonstrate/apply the techniques involved in organic binary mixture separation
14. Understand how to characterize different functional groups using IR spectroscopy technique.
15. Understand the art of identifying the unknown organic compounds.
16. Understand importance group symmetry and group theory in chemistry, classifying different compounds in to point groups and derive the character tables for various applications.
17. Explain the theory and applications atomic, molecular and microwave spectroscopy
18. Explain the basic principles of photoelectron spectroscopy and its application to chemical analysis.
19. Acquire basic understanding about Computer, computer rogrammes, computer languages, understanding the basic concept associated with C- and C++ Language and program designing, develop different programs.
20. Run and Retrieve results, use of variables, arithmetic assignment operators and conditional operator, and in future student may be able to develop a big program(s)(Software) which may simulate the behaviour of the chemical reaction/processes/events.

Semester-II

Inorganic Chemistry-II, Organic Chemistry- II, Physical Chemistry –II, Inorganic Chem. Practical-II, Organic Chem. Practical-II, Spectroscopy-II, Analytical Chemistry

Course Outcomes:

1. Understand and explain the bonding in coordination and organometallic compounds. Describe the fundamental requirement to interpret the electronic spectra of metal complexes for prediction of their properties.

2. Describe the synthesis, structure and bonding of metal carbonyls, metal nitrosyls, dioxygen, dinitrogen complexes as well as metal clusters.
3. Understand the basic principle of substitution reaction in aromatic compounds along with reaction mechanism.
4. Understand the mechanism of addition reactions of carbon-carbon (C=C C≡C, etc.) multiple bonds and carbon-heteroatom (C=O, C=N, etc.) multiple bonds, and the structure and reactivity of various reactive intermediates.
5. Understand the concept of rate of change associated with chemical
6. reaction, recognizing that the rate of change and how it can be measured.
7. Learning and discussion of surface chemistry certainly enable a student to solve problems associated with catalysis and nanochemistry, as most of the reactions are observed at the interface. It is believed that after going through the course a student will find its utility in chemistry of batteries, fuel cells, solar cells etc.
8. Ensures the students to understand and have hands on experience to preparer inorganic (coordination) compounds in multi steps and acquire knowledge of separation of metals from mixture.
9. Understand the different reactivity pattern of different reagents, and understand how to synthesize different organic compounds.
10. Students will be competent in explaining spectroscopy and solving most of chemical structure analysis.
11. Explain the theoretical basis of different analytical techniques with understanding on operational procedure.
12. Selection of appropriate analytic techniques for analysis of sample and interpretation of analytical results
13. Interference in different analytical techniques and their elimination.

Semester-III

Pericyclic Reactions and Photochemistry, Bio-inorganic and Supramolecular Chemistry, Applied Chemistry practical, Physical Chemistry Practical-I, Applied Spectroscopy-I, Organic Synthesis, Environmental Chemistry

Course Outcomes:

1. Understand the molecular origin of pericyclic reactions, understand the concept of interaction of organic compounds with light and subsequently trigger the reaction, understand the mechanism photochemistry of alkene, carbonyl compounds and aromatic compounds.
2. Understand and acquire knowledge of effect of deficiency and toxicity of metals in both human and plant systems.
3. Describe the structural and functional relationships, mechanisms and importance of metalloenzymes.
4. Understand the fundamentals of supramolecules, supramolecular reactions and catalysis, devises.
5. To perform experiment on preparation of polymers and their basic characterizations.
6. To perform the analysis of different water parameters using classical and instrumental methods.
7. To understand the principles behind the experiment performed in the laboratory.
8. Capable of handling the conductivity meter, pH meter and potentiometer. Also, it gives a real feel of the electrochemistry, such a verification of Debye-Huckel-Onsager equation, neutralisation of weak acids, determination of Ksp of sparingly soluble salt and conductometric titrations, which are taught in theory.
9. The student will get the idea of NMR of biomolecules and the application of shift/contrast reagents, used in MRI studies. Further, students will understand a Mössbauer spectrum, understand the concept of chemical shift, determine oxidation state, electric quadrapole interaction, determines the chemical structure and bonding, hyperfine interactions.
10. Understand the philosophy of synthesis of various natural products, understand the reactivity pattern and underlying reaction mechanism of different oxidizing and reducing reagents, and understand the art of selective protection and deprotection of alcohol, amine, carbonyl and carboxyl groups in organic compounds.

11. The students will able to describe the structure and significance of the spheres of the environment, the important environmental issues and the factors responsible for their cause, understand the significance of environmental science as a subject, explain the chemical nature and interaction of the air, water and soil, apply analytical tools to determine and measure pollutants in various environmental samples, explain environmental pollution issues and the remedies thereof, and understand about green chemistry principles and their applications.

Semester-IV

Bio-organic Chemistry, Organ transition Chemistry, Polymer Chemistry, Solid state Chemistry, Physical Chemistry Practical-II, Project Work, Application of Spectroscopy-II

Course Outcomes:

1. Understand how enzyme catalyzes the reaction with outmost efficiency, acid-base catalysis and covalent catalysis of enzyme, strain and distortion during enzyme catalysis, structure and biological functions of various coenzymes, and the origin of mechanism of enzyme action.
2. Describe the structure and bonding aspects of different organotransition metal compounds and their correlations with the stability and reactivity of such compounds.
3. Identify the different types of organotranstion metal complexes catalyzed reactions and explain mechanistic pathways of different catalytic reactions.
4. Describe the important applications of organometallic homogeneous catalysis in the production of organic chemicals.
5. Understand about the basics of polymer and the differences between crystalline melting temperature and glass transition temperature, as well as the effect of kinetics on both, develop specific skills, competencies, and thought processes sufficient to support further study or work in this field of polymer chemistry, evaluate the effect of

factors such as polymer structure, molecular weight, branching and diluents on crystallinity, and apply knowledge to build up small scale industry for developing endogenous plastic product.

6. Learn the structure, properties and the synthesis of solid materials.
7. More significantly, crystal defects, electronic properties of solid can be easily explained. Also it will enable the student to interpret of crystal structure by X-ray diffraction and neutron diffraction method. After going through the course, it is believed that the student will be self-confident to explain certain optical and magnetic properties of solid-state materials.
8. Understand BeerLambert's law in a better manner also the handling of an instrument will be learnt.
9. Learn the design the experimental set up and perform the experimental as per specific problem selected for project.
10. Gain the knowledge and competency to search literature and write the dissertation.
11. Learn the skill for presentation of the project work.
12. Understand how Ultraviolet and Visible Spectroscopy, Infrared Spectroscopy, Nuclear Magnetic Resonance Spectroscopy and Mass Spectrometry are powerful technique to analyze the structural details of organic compounds, and predict different unknown compound based on UV-Vis, IR, 1HNMR, 13CNMR and mass spectroscopic data.

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