# Program and Course Outcome


## Department of Chemistry

## Morigaon College

## Morigaon - 782105, Assam

# B.Sc. (Honours) Chemistry

## Program Outcomes

**PO-1: Disciplinary knowledge and skill:**

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: Skilled communicator:**

The course curriculum incorporates basics and advanced training in order to make a graduate student capable of expressing the subject through technical writing as well as through oral presentation.

**PO-3: Critical thinker and problem solver:**

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. Students will be able to think and apply evidence based comparative chemistry approach to explain chemical synthesis and analysis.

**PO-4: Sense of inquiry:**

It is expected that the course curriculum will develop an inquisitive characteristics among the students through appropriate questions, planning and reporting experimental investigation.

**PO-5: Team player:**

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

**PO-6: Skilled project manager:**

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-7: Digitally literate:**

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: Ethical awareness:**

A graduate student requires understanding and developing ethical awareness or reasoning which is adequately provided through the course curriculum. Students CO-2: To know how to handle the technical devices for presenting research works. can also create an awareness of the impact of chemistry on the environment, society, and also make development outside the scientific community.

**PO-9: Environmental Awarenes**s:

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-10: Lifelong learner:**

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.

**PO-11: Analytical skill development and job opportunity:**

The course curriculum is designed in such a way that Chemistry graduate students can handle many Chemistry based software, decent instruments and advanced technologies to synthesize, characterize and analyze the chemical compounds very skilfully. Such a wonderful practice in the graduate level will bring a good opportunity to the students for getting job in industries besides academic and administrative works.

# Programme Specific Outcomes

**PSO-1: Core competency:**

The chemistry graduates are expected to gain knowledge of the fundamental concepts of chemistry and applied chemistry through theory and practical. These fundamental concepts would be reflected in the latest understanding of the field to keep continues its progression.

**PSO-2: Communication skills:**

Chemistry graduates are expected to possess minimum standards of communication skills to read and understand documents so that they can solve their problems very methodically, independently and with logical argument. Graduates are expected to build good communication skill so that they can easily share their idea/finding/concepts to others.

**PSO-3: Critical thinking**:

Chemistry graduates are expected to achieve critical thinking ability to design, carry out, record and analyze the results of chemical reactions. They can have that much potential and confidence that they can overcome many difficulties with the help of their sharp scientific knowledge and logical approaches.

**PSO-4: Psychological skills:**

Chemistry graduates are expected to possess basic psychological skills so that they can deal with individuals and students of various socio-cultural, economic and educational levels. Psychological skills are very important for proper mind setting during performing, observing and giving conclusion of a particular reaction. It is also important for self compassion, self-reflection, interpersonal relationships, and emotional management.

**PSO-5: Problem-solving:**

Graduates are expected to be well trained with problem-solving philosophical approaches that are pertinent across the disciplines.

**PSO-6: 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-7: 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-8: Teamwork:**

Graduates are expected to be team players, with productive co-operations involving members from diverse socio-cultural backgrounds.

**PSO-9: Digital Literacy:**

Graduates are expected to be digitally literate for them to enrol and increase their core competency via e-learning resources such as MOOC and other digital tools for lifelong learning.

**PSO-10: 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.

# Program Learning Outcomes in B.Sc. (Honours) Chemistry

The student graduating with the Degree B.Sc. (Honours) Chemistry, should acquire

## 1. **Knowledge and Understanding**:

- The course provides the students with comprehensive understanding of the fundamental concepts of chemistry.
- In depth knowledge of the core subjects-concept, theories, principles and its applications.
- Knowledge about the emerging topics and current developments in Chemistry and• its related field.

## 2. **Laboratory Skills and Techniques:**

- The students gain good practical knowledge and laboratory skills by systematically training them.
- Through methodical instructions the students experience hands-on training of using basic chemical laboratory instruments.
- Basic knowledge about preparation of laboratory reagents, solutions and also protocols for their safe disposal.
- Ability to conduct experiments, analyses of data and interpretation of the results.

## 3. Communication Skills:

- Students develop good communication skills in writing and speaking through vigorous training of recording experiments, viva-voce and presentations.
- Ability to listen and convey effectively the knowledge and information acquired to scientific community and society at large.

## 4. Competency:

- Students develop the ability to think and work independently as well as adaptability to work efficiently in diverse groups.
- A leadership qualities in student develop through its effective contributions in teamwork based projects by designing and execution of the experiments.
- The opportunities for critical thinking, reflective thinking and analytical reasoning also add up the overall development of students.

## 5. Portable Skills:

- Students developed problem-solving skills to solve different types of chemistry-related problems.
- Attitude to be a life-long learner by consistently updating oneself with current knowledge, skills and technologies.
- Basic IT skills and ability to use relevant software’s for making structures, equations and data analysis.

# B.Sc. FYUGP Course Progression

- After 1 Year One can exit just after one-year. In this case, the student will have to complete one extra Vocational / Skill course (Exit Course) of 4 credits and can exit the programme. The student will get a Certificate. The minimum total credit requirements is 44 (and 4 credit extra for the exit Vocational / Skill course).
- After 2 Years One can exit the programme after two-year course as well. In this case, the student will have to complete one extra Vocational / Skill course of 4 credits and can exit the programme. The student will get a Diploma. The minimum total credit requirements is 84 (and 4 credits extra for the exit Vocational / Skill course).
- After 3 Years If a student completes 3 years, s/he can exit the programme. In this case the student will get a Bachelor's Degree. The minimum total credit requirements is 120.
- After 4 Years After completion of 4 years, the student gets either a Bachelor's Degree (Honours) or a Bachelor's Degree (Honours) with Research. The minimum total credit requirements is 160.

# Course outcome in B.Sc. (Honours) Chemistry

# SEMESTER I

## CHEMISTRY – CHE-HC-1016: INORGANIC CHEMISTRY – I

**Learning Outcomes:**

**By the end of the course, the students will be able to:**

- Understand the quantum mechanical model of an atom using Schrodinger equation, the significance of wave function, quantum numbers, electronic configuration, radial and angular distribution curves, shapes of s, p, and d orbitals, and periodicity in atomic radii, ionic radii, ionization enthalpy and electronegativity of elements.
- Suggest the plausible structures and geometries of molecules using Radius Ratio Rules, VSEPR theory and MO diagrams for homo- & hetero-nuclear diatomic molecules.
- Calculate the lattice energy using Born-Landé and Kapustinskii expression.
- Differentiate between metals, semiconductors and insulators based on the Band theory.
- Gain the theoretical understanding of inter-molecular and intra-molecular weak chemical forces and their effect on melting points, boiling points, solubility and energetics of dissolution.

## CHEMISTRY - CHE-HC-1026: PHYSICAL CHEMISTRY – I

**Learning Outcomes:**

**By the end of the course, students will be able to:**

- Gain insight into the physical significance of various properties of gas, liquid and solids and also derive their mathematical expressions.
- Demonstrate understanding of the crystal structure of cubic systems using diffraction pattern.
- Explain the concept of ionization of electrolytes of weak acid and base and hydrolysis of salt.
- Understand various fundamental concepts of pH, buffer solutions, solubility of sparingly soluble salts, acid-base indicators.

# SEMESTER II

## CHEMISTRY – CHE-HC-2016: ORGANIC CHEMISTRY – I

**Learning Objectives**:

**On completion of the course, the student will be able to:**

- Develop a sound understanding of the fundamental concepts of stereochemistry.
- Learning various physical and chemical properties of alkanes, alkenes, alkynes and aromatic hydrocarbons and their general methods of preparation.
- Learn and formulate mechanisms of different organic reaction including Free Radical Substitution, Electrophilic Addition and Electrophilic Aromatic Substitution.

## CHEMISTRY – CHE-HC-2026: PHYSICAL CHEMISTRY - II

**Learning Outcomes:**

**By the end of the course, students will be able to:**

- Understand some important concepts like intensive and extensive properties, state and path functions, reversible and irreversible processes.
- Gain deeper understanding of the three laws of thermodynamics.
- Derive the expressions of w, q, $\Delta U$, $\Delta H$, $\Delta S$, $\Delta G$, $\Delta A$ for ideal gases under different conditions.
- Apply the thermodynamic concepts to evaluate enthalpy of various reactions and understand its dependence on temperature and pressure.
- Explain the concept of chemical potential and partial molar quantities.
- Derive the thermodynamic relations between the colligative properties and understand their applications in everyday life.

# SEMESTER III

## CHEMISTRY – CHE-HC-3016: INORGANIC CHEMISTRY - II

**Learning Outcomes:**

**By the end of the course, the students will be able to:**

- Learn the fundamental principles of metallurgy and methods of extraction and purification of metals.
- Gain knowledge of the basic and practical applications of metals and alloys in various fields and their manufacturing processes.
- Apply the thermodynamic concepts like that of Gibbs energy and entropy to the principles of extraction of metals.
- Understand the periodicity in melting point, atomic and ionic radii, electron gain enthalpy, and ionization enthalpy, electronegativity of s and p block elements.
- Understand oxidation states with reference to elements in unusual and rare oxidation states like carbides and nitrides.
- Understand vital role of sodium, potassium, calcium and magnesium ions in biological systems.

## CHEMISTRY – CHE-HC-3026: ORGANIC CHEMISTRY - II

**Learning Outcomes:**

**On completion of the course, the student will be able to:**

- Understand preparation, properties and reactions of haloalkanes, haloarenes and oxygen containing functional groups.
- Use the synthetic chemistry learnt in this course to do functional group transformations. Propose plausible mechanisms for any relevant reaction.

## CHEMISTRY – CHE-HC-3036: PHYSICAL CHEMISTRY – III

**Learning Outcomes**:

**By the end of the course, students will be able to:**

- Have knowledge of concepts like phase, components and degree of freedom in phase equilibrium.
- Derive Phase rule, Clausius-Clapeyron equation, Gibbs-Duhem-Margules equation, Nernst Distribution law and understand their applications.

- Draw the phase diagram for one- component system (water and sulphur ) and twocomponent system involving eutectic, congruent and incongruent melting points.
- Have better understanding of terms, azeotropes, lever rule, partial miscibility of liquids, CST.
- Differentiate between the working of electrolytic cells and galvanic cells and understand the applications of electrolysis in metallurgy and industry.
- Measure the EMF of an electrochemical cell using Nernst equation and its applications.
- Understand concentration cells with and without transference.• Differentiate between physical adsorption and chemisorption and explain various adsorption isotherms.

# Skill enhancement Courses

## CHE-SE-3034: Basic Analytical Chemistry

**Learning Outcomes:**

**On completion of this course, the students will be able to:**

- A brief fundamental knowledge on concept of sampling, importance of accuracy, precision and sources of error in analytical measurements.
- Methodology for Analysis of Soil, Water and their important parameters.
- Methodology for analysis of Food products, adulterant and preservatives.
- Definition, general introduction on principles of Chromatography, paper ,TLC, Ion exchange etc.
- Analysis of Cosmetics, important components of cosmetics such as deodorants and antiperspirants.

# SEMESTER IV

## CHEMISTRY – CHE-HC-4016: INORGANIC CHEMISTRY - III

**Learning Outcomes**:

**By the end of the course, the students will be able to:**

- Understand the terms, ligand, denticity of ligands, chelate, coordination number and use standard rules to name coordination compounds.
- Discuss the various types of isomerism possible in such compounds and understand the types of isomerism possible in a metal complex.
- Use Valence Bond Theory to predict the structure and magnetic behaviour of metal complexes and understand the terms inner and outer orbital complexes.
- Explain the meaning of the terms $\Delta o$, $\Delta t$, pairing energy, CFSE, high spin and low spin and how CFSE affects thermodynamic properties like lattice enthalpy and hydration enthalpy.
- Explain magnetic properties and colour of complexes on basis of Crystal Field Theory.
- Understand the important properties of transition metals like variable oxidation states, colour, magnetic and catalytic properties and use Latimer diagrams to predict and identify species which are reducing, oxidizing and tend to disproportionate and calculate skip step potentials.
- Understand reaction mechanisms of coordination compounds and differentiate between kinetic and thermodynamic stability.

## CHEMISTRY – CHE-HC-4026: ORGANIC CHEMISTRY - III

**Learning Outcomes:**

**On completion of this course, the students will be able to:**

- Understand thouroughly the chemistry of compounds having nitrogen containing functional groups, heterocyclic, polynuclear hydrocarbons, alkaloids and terpenes which includes various methods for synthesis through application of the synthetic organic chemistry concepts learnt so far.
- Acquainted with important properties, chemical reactions, aromaticity of polynuclear hydrocarbons and heterocyclic compounds, basicity of amines and heterocyclic compounds and their behavior at different pH Elucidate structure of organic compounds with specific examples of terpenes and alkaloids by practical approach.

- Predict the carbon skeleton of amines and heterocyclic compounds via use of Hoffmann's exhaustive methylation and Emde's modification methods.
- Understand the applications of these compounds including their medicinal applications through their reaction chemistry.

## CHEMISTRY – CHE-HC-4036: PHYSICAL CHEMISTRY - IV

**Learning Outcomes:**

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

- Explain the variation of conductance with dilution for weak and strong electrolytes using Arrhenius theory and Debye Huckel Onsager theory.
- Learn the applications of conductance measurements.
- Determine transference number using Hittorf and Moving Boundary methods.
- Explain order, molecularity, rate law and rate of reaction, theories of reaction rates and catalysts; both chemical and enzymatic.
- Derive differential and integrated form of rate expressions up to second order reactions.
- Have deep understanding of the laws of photochemistry and terms, quantum yield, quenching, photostationary states, chemiluminescence.

# Skill enhancement Courses

## CHE-SE-4064: Fuel Chemistry

**Learning Outcomes:**

**On completion of this course, the students will be able to:**

- Review on Energy sources, renewable and non-renewable sources.
- Classification of fuels and their calorific value.
- Descriptive knowledge on Coal and their uses.
- Descriptive knowledge on Petroleum and Petrochemical Industry, different processes , petrochemicals.
- Classification of lubricants, lubricating oil, properties of lubricants.

# SEMESTER V

## CHEMISTRY – CHE-HC-5016: ORGANIC CHEMISTRY - IV

**Learning Outcomes:**

**On completion of this course, the students will be able to:**

- Learn the synthesis, properties and reactions of nucleic acids, amino acids and peptides.
- Demonstrate how structure of biomolecules determines their reactivity and biological functions.
- Gain insight into concepts of heredity through the study of genetic code, replication, transcription and translation.
- Understand the primary, secondary and tertiary structures of proteins and denaturation.
- Demonstrate understanding of metabolic pathways, their inter-relationship, regulation and energy production from biochemical processes.
- Develop a sound understanding of the structure of Pharmaceutical Compounds and understand the importance of different classes of drugs and their applications for treatment of various diseases.

## CHEMISTRY – CHE-HC-5026: PHYSICAL CHEMISTRY - V

**Learning Outcomes:**

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

- Learn about limitations of classical mechanics and solution in terms of quantum mechanics for atomic/molecular systems.
- Develop an understanding of postulates of quantum mechanics, quantum mechanical operators, quantization, probability distribution, uncertainty principle.
- Solve quantum mechanically the various systems like a particle in a box, harmonic oscillator, rigid rotator and hydrogen atom.
- Learn approximate method (Variation Method) and its applications.
- Understand the valence bond and molecular orbital theory to solve H2 molecule.
- Have knowledge of the applications of quantization to spectroscopy.
- Gain insight into the basic principles of rotational, vibrational, electronic, Raman, NMR, ESR spectroscopy to interpret the spectra for structure elucidation.

# Discipline Specific Electives (DSE)

## CHE- HE -5026: Analytical Methods in Chemistry

**Learning Outcomes:**

**On completion of this course, the students will be able to:**

- To understand the qualitative and quantitative aspects of analysis such as sampling, evaluation of analytical data, errors, accuracy, precision etc.
- To skill with theory and practical experience with optical methods of analysis using UV-visible, IR and Atomic adsorption and Emission Spectrophometry.
- To learn experimentally about different types of separation techniques such as Solvent extraction technique and Chromatography technique
- To learn the methods of separation of stereoisomers, calculation of enantiomeric and diastereomeric excess ratios and determination enantiomeric composition by spectral, chemical and chromatographic data analysis.
- To study experimentally how to separate a mixture of monosaccharides, a mixture of dyes and active ingredients of plants, flowers and juices by chromatography method.

## CHE- HE -5066: Instrumental Methods of Chemical Analysis

**Learning Outcomes:**

**On completion of this course, the students will be able to:**

- To study the fundamental laws of spectroscopy and Selection rules, to know the basic principles of Instrumentation for UV-visible spectroscopy and Infra-red spectroscopy and their use for the determination of composition of inorganic complexes, estimation of metal ions in aqueous solution, quantitative analysis of geometrical isomers and keto-enol tautomerism.
- To know the basic concepts of Mass spectrometry, NMR spectroscopy, Electroanalytical methods, Potentiometry and Voltametry.
- To learn experimentally about different types of separation techniques such as Solvent extraction technique and Chromatography technique.

To learn the methods of surface analysis by using X-ray and Electron spectroscopy.

# SEMESTER VI

## CHEMISTRY – CHE-HC-6016: INORGANIC CHEMISTRY - IV

**Learning Outcomes:**

**By the end of the course, the students will be able to:**

**Gain insights into the basic principles of qualitative inorganic analysis.**

- Apply 18-electron rule to account for the stability of metal carbonyls and related species.
- Understand the nature of Zeise's salt and compare its synergic effect with that of carbonyls.
- Identify important structural features of the metal alkyls tetrameric methyl lithium and dimerictrialkyl aluminium and explain the concept of multicenter bonding in these compounds.
- Diagrammatically explain the working of the sodium-potassium pump in organisms and the factors affecting it and describe the active sites and action cycles of the metalloenzymes carbonic anhydrase and carboxypeptidase.
- Understand the sources and consequences of excess and deficiency of trace metals.
- Explain the use of chelating agents in medicine and, specifically, the role of cisplatin in cancer therapy.
- Understand the applications of iron in biological systems with particular reference to haemoglobin, myoglobin, ferritin and transferrin.
- Explain catalysis and describe in detail the mechanism of Wilkinson's catalyst, Zeigler-Natta catalyst and synthetic gasoline manufacture by Fischer-Tropsch process.

## CHEMISTRY – CHE-HC-6026: ORGANIC CHEMISTRY - V

**Learning Outcomes:**

**On completion of this course, the students will be able to:**

- Learn about basic principles of UV, IR and NMR spectroscopic techniques to interpret the spectra to determine structure and stereochemistry of known and unknown compounds.
- Have better knowledge of the chemistry of natural and synthetic polymers including fabrics and rubbers.
- Learn about the chemistry of biodegradable and conducting polymers and assess the need of biodegradable polymers with emphasis on basic principles.
- Understand the theory of colour and constitution as well as the chemistry of dyeing.
- Know applications of various types of dyes including those in foods and textiles.

# Discipline Specific Electives (DSE)

## CHE- HE -6036: Inorganic Materials of Industrial Importance

**Learning Outcomes:**

**On completion of this course, the students will be able to:**

- Helps to understand about the manufacture, properties, compositions, classes and applications of industrially important materials such as ceramics, glasses, cements, fertilizers, surface coating materials and batteries.
- To know about alloys, manufacture of steel, composition and properties of different types of steels.
- To learn about the general principles, properties, classification, industrial use, deactivation and regeneration of catalysis.
- Helps to understand about the preparation and explosive properties of organic and inorganic explosives and the basic idea of rocket propellant.
- To learn how to analyze the composition of cement, composition of percentage of metals in alloy, electroless metallic coatings on ceramic and plastic.
- To know how to determine free acidity in ammonium sulphate fertilizer, estimation of Calcium in Calcium ammonium nitrate fertilizer and phosphoric acid in superphosphate fertilizer.

## CHE- HE -6046: Research Methodology for Chemistry

**Learning Outcomes:**

**On completion of this course, the students will be able to:**

- To know how search various sources for writing literature survey in chemistry research though Print and digital madia.
- To know role of Information Technology and library resources used for literature survey.
- Learning of methods of Scientific Research and writing Scientific Papers, Oral presentation, Poster presentation.
- Learning of Chemical safety and Ethical handling of Chemicals.
- To understand how data analysis and presentation, various analysis methods such as ANOVA etc.
- To understand the various electronic circuits uses in spectrophotometers and electrochemical instruments, elementary aspects of digital electronics.

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# Course Outcomes of Chemistry Generic Elective

## [For students having Honours in subjects other than Chemistry]

## Semester -I

CHE-HG/RC-1016: CHEMISTRY 1

**Learning Outcomes:**

**On completion of this course, the students will be able to:**

- To know in detail about Kinetic Theory of Gases; Liquids and Chemical kinetics
- To learn the basic concept, terms and equations of Atomic Structure; Chemical Periodicity and Acids and Bases
- To learn about the Fundamentals of Organic Chemistry; Stereochemistry; SEM-1 CC-1/GE-1 Types, Mechanism and Examples of Nucleophilic Substitution Reaction and Elimination Reaction
- To learn practically how to do the quantitative estimation of ions in a solution by using iodometric titration, permanganate titration and dichromate titration.
- To learn how to estimation of sodium carbonate and sodium hydrogen carbonate present in a mixture and how to estimate of water of crystallization in Mohr's salt by titrating with KMnO4.
- To study the estimation of oxalic acid by titrating it with KMnO4.

## Semester -II

CHE-HG/RC-2016: CHEMISTRY 2

**Learning Outcomes:**

**On completion of this course, the students will be able to:**

- To understand detail about Chemical thermodynamics, Chemical equilibrium, Solutions, Phase Equilibrium and Solids.
- To learn about synthesis, properties and reactions of Aliphatic Hydrocarbons
- To understand about Error analysis and Computer Aplications
- To know the basic knowledge, types and applications Redox Reactions
- To study the kinetics of acid-catalyzed hydrolysis of methyl acetate and decomposition of H2O2 ( Clock Reaction)

- To determine the viscosity of unknown liquid (glycerol, sugar) with respect to water surface tension of a liquid using Stalagmometer and the solubility of sparingly soluble salt in water
- Preparation of buffer solutions and find the pH of an unknown buffer solution by colour matching method.

# Semester -III

## CHE-HG/RC-3016: CHEMISTRY 3

**Learning Outcomes:**

**On completion of this course, the students will be able to:**

- To learn about Chemical bonding and Molecular structure, Comparative study of p-block elements, Transition Elements and Co-ordination Chemistry
- To know the basic concept, terms, equations and applications of Electrochemistry
- To understand about the synthesis, properties, chemical reactions and mechanisms of Aromatic Hydrocarbons, Organometallic Compounds and Aryl Halides
- To study experimentally the qualitative detection of known and unknown radicals in a mixture

# Semester -IV

## CHE-HG/RC-4016: CHEMISTRY 4

**Learning Outcomes:**

**On completion of this course, the students will be able to:**

- To learn in detail about the preparation, properties, chemical reactions and mechanisms of Alcohol, Phenol, Ethers, Aldehydes, Ketones, Carboxylic acids, Esters, Amides, Amines, Diazonium salts, Amino-acids and Carbohydrates.
- To know in detail about Crystal Field Theory.
- To study the fundamental concepts of Quantum Chemistry and Spectroscopy.
- To learn experimentally the qualitative analysis of single known and unknown solid organic compounds and also the identification of pure solid and liquid organic compounds.

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# B.Sc. FYUGP Chemistry

## Learning outcome:

## Semester-I

### Chemistry I

On successful completion, students would have clear understanding of the concepts related to atomic and molecular structure, chemical bonding, periodicity and states of matter. Students will be able to work in a chemical laboratory following standard safety protocols.

## Semester-II

### Chemistry II

Students shall understand and apply the concepts of chemical bonding, coordination chemistry, acids and bases and the reactive intermediates. They shall also understand the chemistry from a thermodynamic point of view. Students will acquire preliminary training on quantitative analysis, synthesis of coordination compounds, qualitative analysis of organic compounds and measurement of a few basic thermodynamic parameters.

## Semester-III

### Chemistry III

On successful completion of the course students will have significant knowledge of acids/bases as well as an overview of bonding in coordination compounds, principles of redox chemistry, solutions and their properties. Students will also be able to describe and classify organic compounds in terms of their functional groups and reactivity. Further experiments on acid/base and redox titrations will enable the students to consolidate their skills on quantitative analysis. In addition, qualitative analysis of organic compounds having common functional groups will give the students an idea about functional groups and their reactivities. Physical chemistry experiments will introduce the students to physical property measurements and kinetics of chemical reactions.

## Semester –IV

### Inorganic Chemistry-I

On successful completion the students will be able to assign the point groups of molecules, explain bonding in coordination compounds, explain their various properties in terms of CFSE and predict reactivity. Students will have an overview of the metallurgical and nuclear processes as well as the chemistry of *d* and *f*-block elements. Students in general will learn the use of

concepts like solubility product, common ion effect, pH etc. in the analysis of ions. They will also appreciate how a clever design of reactions makes it possible to identify the components in a mixture.

**Organic Chemistry I**

On successful completion students will be able to explain and correlate the structure and reactivity of oxygen and nitrogen containing organic molecules having relevance to bioorganic systems. Students will be able to perform simple organic transformations and purifications following conventional/green pathways.

**Theoretical Chemistry**

Students shall understand the fundamentals of atomic structure and its relation to quantum mechanics. They will be able to formulate the basic structural properties of atoms in terms of mathematical theories. Students shall be able to plot, and program equations related to simple chemical systems using computers. Students shall be solving chemical problems using complex mathematics. This will develop a critical thinking ability to treat simple systems.

**Magnetic Resonance Spectroscopy and Analytical Techniques**

Students shall learn about spectroscopy and how chemical compounds are identified and separated using contemporary methods and instruments.

## Semester –V:

**Inorganic Chemistry II**

Students shall learn about electronic and magnetic properties of coordination complexes. They shall understand the preparation, structure and properties compounds of main group elements and noble gases. Students will also learn about organometallic compounds, comprehend their bonding, stability and reactivity. The laboratory experiments shall enable the learners to separate and estimate individual ions in multicomponent systems.

**Organic Chemistry II**

Students will be able to predict and recognize reactivity of organic molecules by their functional groups, and utilize this understanding for the construction of complex molecules. Learners will be able to qualitatively analyse organic molecules and identify the functional groups by interpreting the IR spectra.

**Reaction Dynamics**

Students shall learn how to mathematically model chemical reactions and evaluate the necessary rates of chemical reactions. They shall also be able to comprehend enzyme action in human physiology. Students hall be able to visualize complex reaction mechanisms via mathematical modeling and develop an analytical thinking ability.

**Light-Matter Interaction**

Students shall learn about the theory of photochemistry, spectroscopy and their application in chemistry. They shall use the knowledge gained from the quantum theories to identify unknown chemical compounds using modern techniques. The experiments performed in the laboratory course shall enable the learners to analyze/estimate various analytes using different techniques.

## Semester-VI:

**Inorganic Chemistry III**

Students shall understand the mechanisms of inorganic reactions and the role of metal ions in biological processes and therapeutic activities. They will be acquainted with the synthesis, structure and reactivity of various organometallic compounds, and their application in organometallic catalysis. Furthermore, the students will understand the importance of organometallic catalysis in the synthesis of industrially important compounds. The laboratory experiments will enable the learners to synthesize metal complexes and double salts and their characterization by various analytical techniques.

**Organic Chemistry III**

Students will be able to recognize and explain the mechanisms of photochemical and pericyclic reactions and apply mechanistic concepts to predict the outcome of synthetic reactions. Students will be introduced to the preparation, structure and reactivity of polyaromatic hydrocarbons and organometallic compounds. Students will develop the skill set to extract important organic components from natural samples, estimate organic compounds and perform photochemical conversion.

**Equilibria and Electrochemistry**

Students shall understand how dynamic equilibrium works in chemical reactions. They shall be introduced to ionics, phases and electrochemical systems.

**Industrial Chemistry**

Students shall acquire knowledge of industrially important chemical processes. They shall know the extraction processes and the chemistry of firecrackers, ceramics, glass and cements.