



B.Sc. I Chemistry
Program Outcomes, Program Specific Outcomes and Course Outcomes

Program Outcomes:

- PO-1:- Students will gain fundamental knowledge of Chemistry which will help them for PG studies and Research.
- PO-2:- Students will be able to know good laboratory practices and lab safety.
- PO-3:- AEDP in Chemistry focus on developing specific, measurable skills and proficiencies that are highly valued by employers.
- PO-4:- The integration of theoretical and practical training provides a well-rounded education, preparing students for the complexities of the modern workplace.
- PO-5:- It can offer strong pathways to employment after graduation.
- PO-6:- Students gain valuable experience in real-world work environments, applying theoretical knowledge in practical settings.

Program Specific Outcomes:

- PSO-1. Students will be able to explain fundamental concepts of Inorganic, Physical, Organic and Analytical Chemistry.
- PSO-2. Students will be able to Identify chemical formulae and solve numerical problems.
- PSO-3. Students will be able to use modern chemical tools, Models, Charts and Equipment.
- PSO-4. Students will be able to prepare and qualify for competitive examinations
- PSO-5. Students will understand good laboratory practices and safety. PSO-6. Students will develop research-oriented skills.

SEMESTER-I, PAPER-I ICH-101- Inorganic Chemistry

Name of the topic	Expected Course outcomes
1. Atomic Structure and Periodicity of Elements.	To learn and understand basic knowledge of inorganic chemistry. To understand size, shape and electronic distribution in shells and sub- shells of an atom.
2. P-block Elements.	To learn and understand the properties and uses of the compounds of Boron, Carbon and Nitrogen from p-block elements
3. Chemical Bonding and Molecular Structure: Ionic Bonding.	To learn different types of bonds and nature of bonding in inorganic compounds. Calculations of different energies associated with ionic bonding.
4. Acids and Bases.	To Understand the role of acids and bases in chemistry. The study is useful in all chemical areas.

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SEMESTER-I, PAPER-II OCH-102- Organic Chemistry

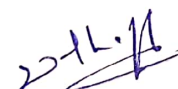
Name of the topic	Expected Course outcomes
1. Fundamentals of Organic Chemistry	The students are expected to understand the fundamentals and basic principles involved in organic chemistry.
2. Stereochemistry	Understanding the spatial arrangement of atoms of organic molecule and types of stereoisomers.
3. Aromaticity	Knowledge of general properties and fundamental reactions of aromatic compounds.
4. Heterocyclic Compounds	To understand the basic knowledge of heterocyclic compounds. To get knowledge of methods to preparation, physical and chemical properties of some heterocyclic compounds with five and six membered heterocycles containing N as the hetero atom (Pyrrole and Pyridine).

Semester II, Paper -III PCH-201-Physical Chemistry

Name of the Topic	Expected Course Outcomes
1. Basic Mathematical Concepts	Learning and coherent understanding of basic concepts and rules of logarithms, graphs, derivative and integrations.
2. Thermodynamics	Knowledge and coherent understanding of basic concepts in thermodynamics will be gained by the student.
3. Chemical Kinetics	Learning and understanding the knowledge about basic concepts in kinetics and first order, second order reactions with characteristics and suitable examples.
4. Physical properties of liquids	Learning and coherent understanding of surface tension, viscosity and refractive index with suitable examples.
5. Electrochemistry	Learning and coherent understanding of basic concepts in electrochemistry, conductors and conductivity cells, measurement of conductance with suitable examples and numerical problems

Semester II, Paper IV ACH-202- Analytical Chemistry

Name of the Topic	Expected Course Outcomes
1. Introduction to Analytical Chemistry	Learning various analytical procedures and importance also sampling, accuracy and precision
2. Fundamentals of Industrial Chemistry and IPR	a. Distinguish between classical and industrial chemistry b. Learning and Understanding basic concepts and concentration terms c. Knowledge of IPR
3. Chromatography	Knowledge of chromatographic separation technique and terms involved in it. Learning paper chromatography and thin layer chromatography.
4. Theory of titrimetric Analysis	Knowledge of various type of titrations, neutralization curves, indicators used in various titrations

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B.Sc. II Chemistry
Program Outcomes, Program Specific Outcomes and Course Outcomes

Program Outcomes:

- PO-1. Students will gain fundamental knowledge of Chemistry which will help them for PG studies and Research.
- PO-2. Students will be able to know good laboratory practices and lab safety.
- PO-3. Students will become proficient in analysing the various observations and chemical phenomena presented to him during the course.
- PO-4. Students will be able to apply the fundamental knowledge to address the cross-cutting issues such as sustainable development.
- PO-5. Students will be able to solve various problems by identifying the essential parts of a problem, formulate strategy for solving the problem, applying appropriate techniques to arrive at a solution, test the precision and accuracy of the solution and interpret the results.
- PO-6. Students will be able to communicate effectively i.e. being able to articulate, comprehend and write effective reports, make effective presentations and documentation and capable of expressing the subject through technical writing as well as through oral presentation.

Program Specific Outcomes:

- PSO-1. Students will be able to explain fundamental concepts of Inorganic, Physical, Organic and Analytical Chemistry.
- PSO-2. Students will be able to Identify chemical formulae and solve numerical problems.
- PSO-3. Students will be able to use modern chemical tools, Models, Charts and Equipment.
- PSO-4. Students will be able to prepare and qualify for competitive examinations.
- PSO-5. Students will understand good laboratory practices and safety.
- PSO-6. Students will develop research-oriented skills.

Semester– III PCH-301: Paper V (PHYSICAL CHEMISTRY)

Name of the Topics	Expected Course Outcomes
Electrolytic Conductivity	Learning and coherent understanding of conductivity and transport number of the aqueous solutions with different applications. Experimental determination of transport number and numerical problems
Thermodynamics	Knowledge and coherent understanding of basic concepts in thermodynamics and concept of Entropy will be gained by the student.

Chemical Kinetics	Learning and understanding the knowledge about basic concepts in kinetics and third order reactions with characteristics, suitable examples and methods for determination of order of reactions and numerical problems.
States of Matter	Learning and coherent understanding of behavior of gases, ideal gas as model system and its extension to real gases. The dependence of physical state on P, V and T. Liquid crystals are essential in all common and research devices, hence they are introduced with suitable examples.
Surface Chemistry	Learning and understanding of theoretical basis of adsorption phenomenon, dynamic nature of surface and its applications.

Semester III, Paper VI ACH-302- Analytical Chemistry

Name of Topic	Expected Course Outcomes
Gravimetric Analysis	Learning and understanding of basic concepts in gravimetric analysis
Colorimetry and Spectrophotometry	Understanding, working and applications of optical methods as an analytical tool.
Soap and Detergents	Knowledge about the chemical nature and cleansing action of soap
Chromatographic Techniques, IPR	Learning and coherent understanding of column and ion exchange chromatography, copyrights and trademarks
Corrosion	Learning and understanding the knowledge about basic concepts in corrosion and mechanism of corrosion

Semester IV ICH-401 Paper-VII Inorganic Chemistry

Name of the Topic	Expected Course Outcomes
1. Co-ordination Chemistry	Learning and understanding basic concepts about coordination complexes.
2. Chemistry of elements of 3d Series elements	Student will be capable of understanding the properties of 3d series elements.
3. Chemical Bonding and Molecular Structure. (VBT and MOT)	Students will understand the formation of molecules on the basis of concept of hybridization and molecular orbital theory.

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4. Inorganic Semi -micro Qualitative Analysis	Students will learn the basic knowledge about the Qualitative analysis of inorganic compounds.
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Semester IV (NEP-2.0) OCH-402 Paper-VIII Organic Chemistry

Name of the topic	Expected Course Outcomes
1. Carboxylic acids and their derivatives.	To impart knowledge about the synthesis, reactivity and applications of carboxylic acids.
2. Amines and Diazonium Salts	Knowledge about classification, preparation and applications of amines and diazonium salts.
3. Carbohydrates	Understanding the classification, configuration and structure of carbohydrates.
4. Carbonyl Compounds Aldehydes and Ketones	Students will be capable of understanding the nomenclature and reactivity of aldehydes and ketones.
5. Stereochemistry	Students will learn the basic knowledge of conformational analysis of some organic compounds.

B.Sc. III Chemistry

Program Outcomes, Program Specific Outcomes and Course Outcomes

Program Outcomes:

PO-1:- Students will gain fundamental knowledge of Chemistry which will help them for PG studies and Research.

PO-2:- Students will be able to know good laboratory practices and lab safety.

PO-3:- Students will become proficient in analyzing the various observations and chemical phenomena presented to him during the course.

PO-4:- Students will be able to apply the fundamental knowledge to address the cross-cutting issues such as sustainable development.

PO-5:- Students will be able to solve various problems by identifying the essential parts of a problem, formulate strategy for solving the problem, applying appropriate techniques to arrive at a solution, test the precision and accuracy of the solution and interpret the results.

PO-6:- Students will be able to communicate effectively i.e. being able to articulate, comprehend and write effective reports, make effective presentations and documentation and capable of expressing the subject through technical writing as well as through oral presentation.

Program Specific Outcomes:

- PSO-1:- Students will be able to explain fundamental concepts of Inorganic, Physical, Organic and Analytical Chemistry.
- PSO-2. Students will be able to Identify chemical formulac and solve numerical problems.
- PSO-3. Students will be able to use modern chemical tools, Models, Charts and Equipment.
- PSO-4. Students will be able to prepare and qualify for competitive examinations.
- PSO-5. Students will understand good laboratory practices and safety.
- PSO-6. Students will develop research-oriented skills.

Program Education Outcomes:

- PEO-1: Students after graduation (Graduates) will possess strong analytical, critical thinking, and problem-solving skills relevant to the field in chemistry and they will be prepared for careers in various sectors, including industry, research, and government, requiring a strong foundation in chemistry.
- PEO-2: Graduates will be able to utilize their chemical knowledge and skills to address societal needs and challenges include areas like environmental sustainability, healthcare, energy solutions, and materials science.
- PEO-3: Graduates will demonstrate a commitment to lifelong learning and professional development, and they will possess strong communication, teamwork, and leadership skills.
- PEO-4: They will be able to apply their chemical knowledge and skills to solve problems and they will be prepared to adapt to the evolving landscape of the chemical sciences.
- PEO-5: Graduates will be equipped to pursue further education, such as an M.Sc. or Ph.D., in chemistry or related disciplines and will be able to work effectively in multidisciplinary and interdisciplinary environments.
- PEO-6 Graduates will be equipped to innovate and develop solutions that benefit society.

SEMESTER V**PCH-501 Paper-IX Physical Chemistry****Course Outcomes:**

- CO1: Students will Learn and understand quantum Chemistry, Heisenberg's uncertainty principle, the concept of energy operators (Hamiltonian), and the Schrödinger wave equation.
- CO2: Students will gain knowledge about rotational, vibrational and Raman spectroscopy
- CO3: Students will Learn and understand photochemical laws, reactions and various photochemical phenomena.
- CO4: Students will gain knowledge of emf measurements, types of electrodes, different types of cells, and various applications of emf measurements.


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ICH-502, Paper No.– X, Inorganic Chemistry

COURSE OUTCOMES (COs):

Students will be able to

CO-1: Learn the properties, geometry, stability and nature of bonding between metal ion and ligand in complexes using Crystal Field Theory and Molecular Orbital Theory.

CO-2: Understand the preparation and applications of the semiconductors and Superconductors in electrical and electronic devices.

CO-3: Study the structure, method of preparation and Applications of Organometallic compounds in various fields. CO-4: Study the synthesis, Classification, types, mechanism, and catalytic applications of different catalysts in industrial fields.

OCHA-503 Organic Chemistry-A Organic Chemistry

Course Outcomes (COs):

Students will be able to explain the

CO1. Fundamental principles of UV-Visible spectroscopy, including electronic transitions, spectral shifts, and the Beer-Lambert Law. Additionally, they will gain the skills to calculate the absorption maximum using the Woodward-Fieser rules and to understand its role in structural elucidation and chemical analysis.

CO2. Use of IR spectroscopy and Hooke's Law to calculate vibrational frequencies and identify vibrational modes in organic molecules. By examining selection rules, electronic effects, and key absorption bands, develop skills to differentiate functional-group and fingerprint regions, aiding in the elucidation of molecular structures and the identification of chemical compounds.

CO3. Use of retrosynthetic analysis, disconnections, and synthons to deconstruct complex organic molecules. Develop proficiency in designing efficient synthetic pathways for target molecules by integrating knowledge of reaction mechanisms and reagents.

CO4. To describe the preparation and strategic use of key oxidizing and reducing reagents in organic transformations. They will explain the mechanisms and synthetic utility of name reactions, enabling them to predict products and design pathways for complex molecular synthesis.

OCHB-503 Organic Chemistry-B

Course Outcomes (COs):

Students will be able to explain the

CO1: Fundamental principles of UV-Visible spectroscopy, including electronic transitions, spectral shifts, and the Beer-Lambert Law. Additionally, they will gain the skills to calculate the absorption maximum using Woodward-Fieser rules and the role in structural elucidation and chemical analysis

CO2: Apply the principles of IR Spectroscopy and Hooke's Law to calculate vibrational frequencies and identify fundamental modes of vibration in organic molecules. By

ICH-502, Paper No.– X, Inorganic Chemistry

COURSE OUTCOMES (COs):

Students will be able to

CO-1: Learn the properties, geometry, stability and nature of bonding between metal ion and ligand in complexes using Crystal Field Theory and Molecular Orbital Theory.

CO-2: Understand the preparation and applications of the semiconductors and Superconductors in electrical and electronic devices.

CO-3: Study the structure, method of preparation and Applications of Organometallic compounds in various fields. CO-4: Study the synthesis, Classification, types, mechanism, and catalytic applications of different catalysts in industrial fields.

OCHA-503 Organic Chemistry-A Organic Chemistry

Course Outcomes (COs):

Students will be able to explain the

CO1. Fundamental principles of UV-Visible spectroscopy, including electronic transitions, spectral shifts, and the Beer-Lambert Law. Additionally, they will gain the skills to calculate the absorption maximum using the Woodward-Fieser rules and to understand its role in structural elucidation and chemical analysis.

CO2. Use of IR spectroscopy and Hooke's Law to calculate vibrational frequencies and identify vibrational modes in organic molecules. By examining selection rules, electronic effects, and key absorption bands, develop skills to differentiate functional-group and fingerprint regions, aiding in the elucidation of molecular structures and the identification of chemical compounds.

CO3. Use of retrosynthetic analysis, disconnections, and synthons to deconstruct complex organic molecules. Develop proficiency in designing efficient synthetic pathways for target molecules by integrating knowledge of reaction mechanisms and reagents.

CO4. To describe the preparation and strategic use of key oxidizing and reducing reagents in organic transformations. They will explain the mechanisms and synthetic utility of name reactions, enabling them to predict products and design pathways for complex molecular synthesis.

OCHB-503 Organic Chemistry-B

Course Outcomes (COs):

Students will be able to explain the

CO1: Fundamental principles of UV-Visible spectroscopy, including electronic transitions, spectral shifts, and the Beer-Lambert Law. Additionally, they will gain the skills to calculate the absorption maximum using Woodward-Fieser rules and the role in structural elucidation and chemical analysis

CO2: Apply the principles of IR Spectroscopy and Hooke's Law to calculate vibrational frequencies and identify fundamental modes of vibration in organic molecules. By

analyzing selection rules, electronic effects, and characteristic absorption bands, they will develop the skills to differentiate between functional group and fingerprint regions to elucidate molecular structures and identify various chemical compounds.

CO3: To classify and describe the occurrence, isolation, and general properties of terpenoids and alkaloids, and apply the isoprene rule to understand their structural frameworks. Furthermore, they will gain proficiency in using analytical evidence and chemical syntheses to determine the structures of natural products such as Citral and Nicotine.

CO4: To classify pesticides and fertilizers by chemical class and explain their mechanisms of action, including contact and systemic modes of action. They will also master integrated pest management (IPM) strategies and the chemical synthesis of key agrochemicals such as Carbaryl and Glyphosate via specific routes, including the Curtius rearrangement.

PRCH-504 Practical Paper in Physical Chemistry-V(a)

Course Outcomes:

After Completion of course students will be able to

CO1: Learn the concept of reaction kinetics

CO2: Learn and understand the concept of Viscosity and its measurement using the Ostwald viscometer

CO3: Gain hands-on experience with a potentiometer, conductometer, pH meter, and refractometer instruments.

CO4: Understand the distribution law and concept of partition coefficient

PRCH-505 Practical Paper in Inorganic Chemistry-V(b)

CO1: Gain the practical skills to perform quantitative analysis

CO2: Perform quantitative analysis of ore and alloy and to determine the percentage of metal and ore using gravimetric analysis method.

CO3: Synthesize and to determine the percentage purity of inorganic compounds and complexes through standard preparation techniques.

CO4: Apply ion exchange chromatography method for separation and estimation of metal ions and inorganic species in complex mixtures.

PRCHA-506 Elective Practical Paper in Organic Chemistry-I

Course Outcomes (COs):

Students will be able

1. To conduct qualitative and quantitative analyses of organic compounds and gain proficiency in techniques such as separating binary mixtures, estimating compounds from samples, and synthesizing organic derivatives.

2. To separate binary organic mixtures into individual components by utilizing differences in solubility and chemical nature (acidic, phenolic, basic, or neutral). Develop skills to identify each component through qualitative analysis, including detection of elements and functional groups and determination of physical constants.

3. To quantify organic compounds using titrimetric methods to measure specific functional groups or compounds. This will help develop skills in calculating and interpreting the purity of organic samples for accurate laboratory analysis.
4. To conduct organic synthesis and purification techniques for specific compounds, while mastering essential lab operations like refluxing, filtration, and recrystallization. Additionally, students will learn to calculate percentage yields and verify product purity through physical constants like melting points.

SEMESTER VI

PCH-601 Paper-XI Physical Chemistry

Course Outcomes:

- CO1: Students will Learn and understand the phase rule, including one component, two-component, and three-component systems phase diagrams, with suitable examples.
- CO2: Students will gain knowledge about Gibbs free energy, Helmholtz energy, Criteria for thermodynamic equilibrium and spontaneity and partial molar quantities
- CO3: Students will Learn and understand Laws of crystallography and the determination of crystal structure by Bragg's method.
- CO4: Students will gain knowledge of potentiometric techniques.

ICH-602, Paper No.– XII, Inorganic Chemistry

COURSE OUTCOMES:

Student will be able to

- CO-1: Learn and focused on the mechanism of the reactions involved in Inorganic complexes of transition metals.
- CO-2: Understand the thermodynamic and kinetic aspects of Metal complexes
- CO-3: Study the characteristics properties of Actinides and generation of nuclear power with the help of nuclear reactions. Also studied role of Radio isotopes in medicinal, industrial and Archaeology fields.
- CO-4: Study the Role of various metals and non-metals useful for our Health.

OCHC-603 Organic Chemistry-C

Course Outcomes (COs):

Students will be able to explain the

1. The fundamental principles of PMR spectroscopy, including nuclear shielding, deshielding, and the role of TMS as a reference standard. They will develop proficiency in interpreting chemical shifts and spin-spin splitting ($n+1$ rule) to solve complex structural problems and determine the molecular frameworks of organic compounds.
2. The fundamental principles of Mass Spectrometry and the formation of various ions by analyzing specific fragmentation patterns, including the McLafferty rearrangement and the Nitrogen rule. They will also develop the skills to interpret mass spectra for the structural identification of organic molecules, such as alkanes, alkenes, and carbonyl compounds, in diverse analytical applications.

3. To describe the mechanisms and stereochemistry of electrophilic addition reactions to carbon-carbon double and triple bonds, including specialized transformations such as hydroboration-oxidation. They will also be able to predict reaction products by applying rules such as Markovnikov and Anti Markovnikov addition, while accounting for carbocation rearrangements and stereochemical outcomes.
4. To classify medicinal agents, define the essential qualities of an ideal drug, and explain the therapeutic applications of specific compounds such as Benzocaine and Chloramphenicol. They will also master the chemical synthesis of key drugs, including Isoniazid and Ethambutol, and evaluate the physiological mechanisms of action of sulfonamide drugs in treating infections.

OCHD-603 Organic Chemistry-D

Course Outcomes (COs):

Students will be able to explain the

CO1: To explain the fundamental principles of PMR spectroscopy, including nuclear shielding, deshielding, and the role of TMS as a reference standard. They will develop proficiency in interpreting chemical shifts and spin-spin splitting ($n+1$ rule) to solve complex structural problems and determine the molecular frameworks of organic compounds.

CO2: To explain the fundamental principles of Mass Spectrometry and the formation of various ions by analyzing specific fragmentation patterns, including the McLafferty rearrangement and the Nitrogen rule. They will also develop the skills to interpret mass spectra for the structural identification of organic molecules, such as alkanes, alkenes, and carbonyl compounds, in diverse analytical applications.

CO3: To classify polymers based on their origin and structure while explaining mechanisms of addition and Ziegler-Natta polymerization. Furthermore, they will gain proficiency in describing the synthesis and applications of commercial resins and conducting organic polymers, such as polyaniline and polypyrrole, for modern industrial and electronic applications.

CO4: To describe the industrial manufacturing process of cane sugar, covering key stages from juice extraction and clarification to crystallization and centrifugation. Additionally, they will identify the economic value of sugar industry by-products and explain the biochemical process of producing ethyl alcohol from molasses through fermentation.

PRCH-604 Practical Paper in Physical Chemistry-VI(a)

Course Outcomes:

After Completion of course, students will be able to

CO1. Learn the concept of activation energy, and effect of salt on rate of reaction

CO2. Understand the adsorption isotherms.

CO3. Gain hands-on experience with a potentiometer, conductometer, pH meter experiments.

CO4. Learn the Beer-Lambert law, concept of dissociation constant



PRCH-605 Practical Paper in Inorganic Chemistry-VI(b)

CO1: Gain knowledge regarding practical applications of chemistry in daily life

CO2: Perform quantitative analysis of ore and alloy and to determine the percentage of metal and ore using gravimetric analysis method.

CO3: Synthesize and to determine the percentage purity of inorganic compounds and complexes through standard preparation techniques.

CO4: Apply ion exchange chromatography method for separation and estimation of metal ions and inorganic species in complex mixtures.

PRCHC-605 Elective Practical Paper in Organic Chemistry-II

Course Outcomes (COs):

Students will be able

1. To conduct qualitative and quantitative analyses of organic compounds and gain proficiency in techniques such as separating binary mixtures, estimating compounds from samples, and synthesizing organic derivatives.

2. To separate binary organic mixtures into individual components by utilizing differences in solubility and chemical nature (acidic, phenolic, basic, or neutral). Develop skills to identify each component through qualitative analysis, including detection of elements and functional groups and determination of physical constants.

3. To quantify organic compounds using titrimetric methods to measure specific functional groups or compounds. This will help develop skills in calculating and interpreting the purity of organic samples for accurate laboratory analysis.

4. To conduct organic synthesis and purification techniques for specific compounds, while mastering essential lab operations like refluxing, filtration, and recrystallization. Additionally, students will learn to calculate percentage yields and verify product purity through physical constants like melting points.


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