

Department of Chemistry

P.N.G. Govt.P.G.College Ramnagar, Nainital

Programme Outcomes

PO1 Knowledge: Students will demonstrate an understanding of the fundamental principles and concepts of chemistry which include Inorganic, Organic and Physical chemistry along with specific knowledge of spectroscopy, group theory and bio-inorganic, bio-organic and bio-physical in advance courses.

PO2 Theoretical: Analytical- Students will competently apply this knowledge and analyze chemical systems all around by conceptual understanding of the subject in which they identify the essential aspects of a problem, formulate a strategy for solution and communicate their work clearly.

PO3 Computational - Students will use basic computational techniques for modeling chemical systems including those that don't have analytical answers.

PO4 Experimental - Students will systematically explore chemical phenomena by setting up experiments, collecting and analyzing data, and interpreting their results.

B.Sc.-First Year (I & II Semester)

Paper-I(Inorganic Chemistry)

On completion of the course, students are able to:

CO1: Understand the structure of atom, quantum numbers, radial and angular wave functions and probability,

CO2: Understand the Distribution curves, energy diagram, Pauli's exclusion principle. Hund's rule of maximum multiplicity

CO3: Understand the periodic properties.

CO4: Understand the types of chemical bonding

CO5: Understand the types of redox reaction, balancing redox reaction, computation of equivalent weights and concept of Equivalence

CO6: Understand the Molecular orbital theory as applied to diatomic homonuclear/ hetero nuclear inorganic molecules.

CO7: Understand the ionic solid, SCC, BCC, FCC, HCP, and defects in solids.

CO8: Understand the periodic properties and chemical properties of s-block element

CO9: Describe periodic properties and chemical properties of p-block element

CO10: Understand the: General metallurgical processes-concentration ores, calcinations, roasting, smelting, slag & flux. Extraction and refining of Lithium and Beryllium

CO11: Understand the acids and bases concept.

CO12: Understand the coordination chemistry

CO13: Understand the Determination of electrode potential, uses of electrode potential data, reaction feasibility.

CO14: Understand the Chemistry of lanthanides and actinides.

CO15: Understand the Classification and their general characteristics, physical properties of the solvents, reaction in non-

aqueous solvents-liquid

CO16: Understand the corrosion of metal.

CO17: Understand the Thermodynamic and kinetic aspects of coordination compounds. Chemistry of Transition Elements (First, Second and Third Series), and chemical and physical properties of transition metal complexes. Describe Organometallic complexes.

CO18: Understand the Role of metal ions in biology, essential and trace elements in biological systems,

CO19: Understand the Inorganic Polymers of Silicon and Phosphorus. Some Industrially Important Inorganic Materials

B.Sc.-First Year (I & II Semester)

B.Sc. Paper-II (Organic Chemistry)

On completion of the course, students are able to:

CO1: Understand the Structure and bonding of compound

CO2: Understand the Mechanism of organic reaction

CO3: Understand the Stereochemistry of organic compounds

CO1: Understand the Structure and bonding of compound

CO2: Understand the Mechanism of organic reaction

CO3: Understand the Stereochemistry of organic compounds

CO4: Understand the Alkanes, Cycloalkanes, Alkenes, Cycloalkenes,

CO5: Understand the Arenes and Aromaticity

CO6: Explain the Alkyl and Aryl Halides

CO7: Understand the Electromagnetic Spectrum; Absorption, Spectroscopy, NMR Spectroscopy CO8: Understand the Alcohols, Phenols, Ethers and Epoxide, Aldehydes and Ketones Carboxylic Acids and their Derivatives

CO9: Understand the Nitrogen containing Organic Compounds

CO10: Understand the Organic Synthesis via Enolates

CO11: Understand the Organo-metallic Compounds and Organo-sulphur compounds

CO12: Understand the Heterocyclic compounds and Natural Products

CO13: Understand the Carbohydrates Amino Acids, Peptides, Proteins and Nucleic Acids, Fats, Oils and detergents.

CO14: Understand the Synthetic Polymers and Synthetic dyes.

B.Sc.-First Year (I & II Semester)

B.Sc. Paper-III (Physical Chemistry)

On completion of the course, students are able to:

- CO1: Understand the phenomenon, behaviour of gases and know about difference between real and ideal gas and their liquefaction.
- CO2. Understand the Liquid State: Know about the differences between solids, liquid and gases. Elucidate the physical properties like surface tension, viscosity and refractive index of liquids.
- CO3. Understand the Solid State: Define the basic phenomenon of solid state and determine the structure of crystalline solid. Know about the structure determination techniques.
- CO4. Understand the Colloidal State: Describe the classification, preparation and properties of colloids, general application of colloids.
- CO5. Understand the Chemical Kinetics and Catalysis: Explain the required time for reaction completion. The factors like concentration, temperature, pressure, solvent, light and catalyst influencing the rate of reaction. Elucidate the order of reaction and their half-life.
- CO6. Understand the Thermodynamics: Know about thermodynamic reaction and natural process. Understand the law of thermodynamics and their application in explanation of spontaneity in chemical reactions. Thermodynamic study with the help of thermodynamic parameters. Explain about heat of reaction and their calculation methods. Evaluation of absolute entropy from heat capacity data.
- CO7. Understand the Chemical Equilibrium: Equilibrium study with the help of Le Chatelier's principle. Study of equilibrium reactions.
- CO8. Understand the Phase Equilibrium: Know about the meaning of the terms (phase, component and degree of freedom) used in phase rule. Nernst thermodynamic equation applied in phase diagram. Explain phase diagram for two component system.
- CO9. Understand the Electrochemistry: Explain the redox reaction with help of electrochemical series. Know about the conductivity of different electrolyte. Factors affecting the electrical transport - conduction in metals and electrolytic solutions. Understand the type of cell. Define the pH and pK_a, determination of pH using hydrogen, quinhydrone and glass electrodes by potentiometric methods. Elucidate the mechanism of buffer action.
- CO10: Understand the Surface Chemistry: and surface phenomenon of the materials. The adsorption magnitude explain with the help of different isotherm models. Know about Perrin's method for determination of the Avogadro's number.
- CO11: Understand the Elementary Quantum Mechanics: Understand the microscopic properties of atomic constitutional particles. Interpret the wave function with the help of Compton-effect, de Broglie hypothesis, Heisenberg's uncertainty principle, operator concept, Hamiltonian operator, Schrödinger wave equation.
- CO12: Understand the Spectroscopy, electromagnetic radiations. Know about the principles of different spectroscopy: Deduce the importance of Maxwell-Boltzmann distribution law in spectroscopy.
- CO13: Understand the Photochemistry interaction of radiation with matter and differentiate between thermal and photochemical processes. Deduce the different Laws of photochemistry. Utilization of Jablonski diagram in explain different radiative and non-radiative decay. Explain quantum yield. Know about energy transfer processes with simple examples.
- CO14. Understand the Physical Properties and Molecular Structure: Understand optical properties and their relation with chemical constitution and polarization. Understand the dipole moment of different chemical species. Know about structure determination of molecules with the help of dipole moment, induced dipole moment, measurement of dipole moment-temperature method and refractivity method, dipole moment.
- CO15. Understand the Solutions and Colligative Properties Deduce ideal solution, non-ideal solutions, osmosis, elevation of boiling point and depression in freezing point.

B.Sc.-Second Year (III & IV Semester)

Paper-I(Inorganic Chemistry)

On completion of the course, students are able to:

- CO1: Understand the Chemistry of Transition Elements (First Transition Series).
- CO2: Understand the Chemistry of Transition Elements (Second and Third Series)
- CO3: Understand the Acids and Bases
- CO4: Understand the Coordination Chemistry-I:
- CO5: Understand the Paint industry: Constitution, colouring compounds
- CO6: Understand the Oxidation and Reduction
- CO7: Understand the Chemistry of Lanthanides
- CO8: Understand the Chemistry of Actinides
- CO9: Understand the Acids and Bases

B.Sc.-Second Year (III & IV Semester)

Paper-II(Organic Chemistry)

On completion of the course, students are able to:

- CO1: Understand the Electromagnetic Spectrum: Absorption Spectroscopy
- CO2: Understand the Alcohols
- CO3: Understand the Phenols
- CO4: Understand the Ethers and Epoxides
- CO5: Understand the Aldehydes and Ketones
- CO6: Understand the Carboxylic Acids and their Derivatives
- CO7: Understand the Nitrogen Containing Organic Compounds
- CO8: Understand the Organic Synthesis via Enolates

B.Sc.-Second Year (III & IV Semester)

Paper-III(Physical Chemistry)

On completion of the course, students are able to:

- CO1: Understand the Thermodynamics II
- CO2: Understand the Chemical Equilibrium
- CO3: Understand the Phase Equilibrium:
- CO4: Understand the Electrochemistry I & II
- CO5: Understand the Surface Chemistry

B.Sc.- Third Year (V & VI Semester)

Paper-I(Inorganic Chemistry)

On completion of the course, students are able to:

- CO1: Understand the Redox Reactions II

- CO2: Understand the Chemistry of Lanthanides
CO3: Understand the Chemistry of Actinides
CO4: Understand the Non Aqueous Solvents
CO5: Understand the Corrosion of metal
CO6: Understand the Hard and Soft Acid-Base Theory
CO7: Understand the Metal-Ligand bonding in transition metal complexes
CO8: Understand the Magnetic Properties of Transition Metal Complexes
CO9: Understand the Electronic Spectra of Transition Metal Complexes
CO10: Understand the Thermodynamic and Kinetic Aspects of Coordination Compounds.
CO11: Understand the Organometallic chemistry
CO12: Understand the Bioinorganic Chemistry

B.Sc.-Third Year (V & VI Semester)

Paper-II(Organic Chemistry)

On completion of the course, students are able to:

- CO1: Understand the Carboxylic Acids:
CO2. Understand the Carboxylic acid derivatives:
CO3: Understand the Nitrogen Containing Organic Compounds
CO4: Understand the Organic Synthesis via Enolates
CO5: Understand the Spectroscopy
CO6: Understand the Organo-metallic Compounds
CO7: Understand the Organo-sulphur compounds
CO8: Understand the Hetrocyclic compounds
CO9: Understand the Carbohydrates
CO10: Understand the Amino Acids, Peptides, Proteins and Nucleic Acids
CO11: Understand the Fats, Oils and Detergents
CO12: Understand the Synthetic Polymers
CO13: Understand the Synthetic Dyes
CO14: Understand the Natural Products

Third Year (V & VI Semester)

Paper-III(Physical Chemistry)

On completion of the course, students are able to:

- CO1: Understand the Electrochemistry I
CO2. Understand the Electrochemistry II
CO3: Understand the Surface Chemistry
CO4: Understand the Elementary Quantum Mechanics
CO5: Understand the Spectroscopy
CO6: Understand the Rotational spectrum

- Understand the Vibrational spectrum
- CO9: Understand the Electronic spectrum
- CO10: Understand the Photochemistry
- CO11: Understand the Physical Properties and Molecular Structure
- CO12: Understand the Solutions and Colligative Properties
- CO13: Understand the Thermodynamics III

M.Sc.Course Outcomes

Semester-I

Paper I -Inorganic Chemistry:

At the end of this course, students will be able to know

- CO1 Understand the Compounds of Boron, Carbon and Nitrogen with Metals.
- CO2 Understand the Metal-Ligand Equilibria in Solution.
- CO3 Understand the Metal π -Acid Complexes:
- CO4 Understand the Cluster Compounds:
- CO5 Understand Polyoxometalates.
- CO6 Understand Compounds of Boron, Carbon and Nitrogen with Metals.
- CO7 Know the Metal-Ligand Equilibria in Solution.
- CO8 Understand The Metal π -Acid Complexes:
- CO9 To Understand the Cluster Compounds:
- CO10 : Understand Polyoxometalates

Paper-II- Organic Chemistry Semester –

The end of this course, students will be able to know

- CO1 Understand the bonding with delocalisation as well as aromatisation.
- CO2 Understand the 3D structures as well as stereo chemical changes during the chemical reaction.
- CO3 Understand the photochemical and thermal changes during the concerted reaction
- CO4 Understand the nucleophilic displacement reaction in the aliphatic compound
- CO5 Understand the nucleophilic displacement reaction in the aromatic compound
- CO6 Understand the idea about the formation of products with rearranged carbon skeleton

Paper-III- Physical Chemistry-Semester-

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

- CO1 Understand the Laws of thermodynamic and application of thermodynamics laws.
- CO2 To know about general order reactions and application of chemical dynamics.
- CO3 Understand the adsorption, its type and application of adsorption in the formation of charge

idal particles as well as in the decolouration of the various content like sugar

Paper-IV-Group Theory and Instrumentation Chemistry-Semester

The end of this course, students will be able to know

- CO1 Understand the group theory and its application in different field of chemistry
- CO2 Understand the basics of single crystal analysis
- CO3 Understand Separation technique in organic Chemistry
- CO4 Understand the quantitative method to analysis radioactive compound

Paper V-(A)Biology for Chemist(For Mathematics Students)

CO1 Understand the Cell as Unit of Life and Cell Organelles

CO2 Understand the Cell Membrane and Cell Wall

CO3 Understand the Metabolism .

(B)Understand the Mathematics for Chemist(For Biology Students)

CO1 : Understand the Impart knowledge about the Mathematical Functions

CO2 :Understand .Curve Sketching/Graph and Differentiation

SEMESTER-II Inorganic Chemistry(Paper-Ist)

At the end of this course, students will be able to knowledge of General Chemistry and its usages .

CO1:Understand the Metal –Ligand Bonding ,Limitations of crystal field theory, molecular orbital theory, octahedral, tetrahedral and square planar complexes π -bonding and molecular orbital theory

CO2: Understand the Reaction Mechanism of Transition Metals Complexes , Energy profile of a reaction , reactivity of metal complexes , kinetics application of valence bond and crystal field theories

CO3: Understand the Electronic Spectra and Magnetic Properties of Transition Metal Complexes , Spectroscopic ground states correlation , Orgal and Tanabe-Sugano Diagrams for transition metal complexes .

M.Sc Secound Semester- Organic Chemistry— (Paper-II)

CO1; Understand the displacement reaction by the electrophilic as well as related concept

CO2; Understand the displacement reaction by the electrophilic in aromatic systems and related concept

CO3; Understand the free radical reaction with mechanism and factor affecting.

CO4; Understand the types of addition reaction and factor affecting

CO5 ;Understand the addition reaction in carbon-hetroatom multiple bond species

Understand the elimination reaction with related rule

Semester—II - Physical Chemistry- (Paper III)

CO1: Understand the Adsorption , BET equation

CO2: Understand the Debye-Huckel-Onsagar theory , Operators

CO3: Understand the Schrodinger's equation and its application.

CO4: Understand the Gives the idea about types of cell ,their charging and discharging concept

CO5: Understand the some other related concepts Find the probability of electron 1D,2D AND 3D boxes as well as some operators and functions.

Semester—II Paper IV(Spectroscopic Techniques

CO1: Understand the Enormous job opportunities at all level of chemical, phytochemical, pharmaceutical, food products and medical science.

CO2: Understand the Science placements in Research and development in natural product chemistry research

CO3: Understand the Mode of vibrations and group frequencies in IR

CO4: Understand the PQR branches

CO5: Understand the Solvent effect on IR spectra

CO6: Understand the Mossbauer spectra

CO7: Understand the UV visible and Raman Spectra

M.Sc.Semester-III

Paper -I : Solid State Chemistry

Students should know

CO1: Understand the solid state reactions, crystal defects and non-stoichiometry

CO2: Understand the band theory and its importance

CO3: Understand the superconductor with different examples

CO4: Understand the Theory period of one hour per week

1 practical period of week per hour over a semester

Paper –II-Spectroscopic Techniques -

CO1: Understand the Mössbauer Spectroscopy:

CO2: Understand the Ultraviolet and Visible Spectroscopy:

CO3: Understand the Molecular Dissymmetry and Chiroptical Properties:

CO4: Understand the Infrared Spectroscopy

CO5: Understand the Raman Spectroscopy

Paper III: Chemistry of Biological System-

- CO1 Understand the **Bioinorganic Chemistry**: Structure and function of Cell Membrane. Essential and trace metals, role of metal ions in biological processes. Ion Transport through cell membrane. Na^+/K^+ Pump.
- CO2 Understand the **Bioorganic Chemistry**: Introduction and historical perspective, Nomenclature and classification, extraction, purification and uses of enzymes in food drink industry and clinical therapy.
- CO3 Understand the **Biophysical Chemistry**: Forces involved in biopolymer interactions Electrostatic charge and expansion, hydrophobic forces, osmotic pressure, membrane equilibrium. Bioenergetics:.

Paper -IV- Inter disciplinary topics in chemistry

At the end of this course, students will be able to knowledge of General Chemistry and its usages .

- CO1: Understand the Impart knowledge about the Green Chemistry-Basic Principales of green
- CO2: Understand the chemistry and Nanochemistry(History,Defination and scope of nanomaterials)
- CO3: Understand the Data Analysis and Computer.
- CO4: Understand the Environmental Chemistry , Concept and scope , composition of atmosphere , photochemical smog , BoD and COD ,.
- CO5: Understand the Medicinal Chemistry , Primary knowledge of structure activity relationship ,

Photo Chemistry Semester -3 (Paper-V)

At the end of this course, students will be able to knowledge of General Chemistry and its usages

- CO1: Understand the basics ofPhotochemistry
- CO2: Understand the different mechanism of isomerisation and addition reaction alkene and diene
- CO3: Understand the different path of photochemistry ofCarbonylCompounds
- CO4: Understand the photochemistry of AromaticCompounds

M.Sc. -IV- SEMESTER , PAPER-I- (ORGANIC SYNTHESIS)

Students should know

- CO1: Understand the various types of the nucleophilic, addition, substitution as well as rearrangement reactions in the different kind of organic reactions.
- CO2: Understand the reagents involved in the different types of functional interconversions i.e oxidationand reduction reactions.
- CO3: Understand the metellocenes with their formation ,structure and properties. This will also define the benezoid as well as non benezoid aromatic compounds.


- Understand the retrosynthetic route of various chemical reactions.
- CO5: Understand the selective reactions at a particular functionality by protecting the other functionality.
- CO6: Understand the various types of ring synthesis route

M.Sc. -IV- SEMESTER , Paper II Chemistry of Natural Products and Heterocyclic Compounds

At the end of this course, students will be able to knowledge of General Chemistry and its usages. Students should know

- CO1: Understand the Terpenoids and Carotenoids: Classification, nomenclature, occurrence, isolation, general methods of structure determination, isoprene rule. Structure determination,
- CO2: Understand the Alkaloids and Steroids: Definition, nomenclature and physiological action, occurrence, isolation, general methods of structure elucidation, classification, role of alkaloids in plants. Structure, stereochemistry, synthesis and biosynthesis of Morphine and Reserpine .
- CO3: Understand the Prostaglandins/ Pyrethroids and Rotenones: Occurrence, nomenclature, classification, biogenesis and physiological effects. CO4 Understand the Application of Spectroscopic Techniques in Structure Elucidation of Natural Products: Two dimensional NMR spectroscopy- COSY, HETCOR, NOESY, DEPT, INEPT , APT and INADEQUATE techniques
- CO5: Understand the Heterocyclic Chemistry Nomenclature of Heterocycles / Aromatic and Non-aromatic . Systematic nomenclature (Hantzsch-Widman System) for monocyclic, fused and bridged heterocycles. .
- CO6 : Understand the Heterocyclic Synthesis/Small Ring Heterocycles .
- CO7 : Understand the Three membered and four-membered heterocycles-synthesis and reactions of aziridines, oxiranes, thiranes, azetidines , oxetanes and thietanes.
- CO8: Understand the Benzo-Fused Five-membered Heterocycles Synthesis and reactions including medicinal applications of benzopyrroles,
- CO9 Understand the Six-Membered Heterocycles with Two or More Hetero atoms Synthesis and reactions of pyrylium salts and pyrones and their comparison with pyridinium & thiopyrylium salts. Synthesis and reactions of benzopyrylium salts and coumarins.


Principal
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विभागाध्यक्ष : १
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पद. स्नातक स्तर विभाग
प्रबलगर (नैनीताल)