Course Outcomes – Program Outcomes (COPO) Mapping

Program Outcomes (PO): B.Sc (H) Chemistry

Undergraduate Curriculum Framework (UGCF)

National Education Policy (NEP)

The Preamble of the Undergraduate Curriculum Framework-2022 underlines the historical perspective, philosophical basis, and contemporary realities of higher education as enshrined in the National Education Policy 2020 and endeavours to synchronize these cornerstones while charting the road ahead for the state of higher education.

ABBREVIATIONS / NOMENCLATURE

Sno.	Nomenclature	Description	Aggregate Courses
1	PO	Program Outcome	PO1, PO2,PO3, PO4, PO5
2	CO	Course Outcome	CO1, CO2, CO3, ……. CO9
3	DSC	Core Courses	DSC1, DSC2, DSC3, …….. DSC12
4	DSE	Discipline Specific Electives	DSE1, DSE2
5	GE	General Electives	GE1 , GE2, GE3, GE4

Program Outcomes (PO): B.Sc(H) Chemistry

UGCF (NEP)

S. No.	Program Outcomes (PO): B.Sc (H) Chemistry	Statements
1.	**PO1**	Knowledge: Students acquire theoretical knowledge and understanding of the fundamental concepts, principles and processes in main branches of chemistry, namely, organic chemistry, inorganic chemistry, physical chemistry, analytical chemistry and biochemistry. In depth understanding is the outcome of transactional effectiveness and treatment of specialized course contents. Width results from the choice of electives that students are offered.
2.	**PO2**	Laboratory Skills: A much valued learning outcome of this programme is the laboratory skills that students develop during the course. Quantitative techniques gained through hands on methods opens choice of joining the industrial laboratory work force early on. The programme also provides ample training in handling basic chemical laboratory instruments and their use in analytical and biochemical determinations. Undergraduates on completion of this programme can cross branches to join analytical, pharmaceutical, material testing and biochemical labs besides standard chemical laboratories.
3.	**PO3**	Communication: Communication is a highly desirable attribute to possess. Opportunities to enhance students' ability to write methodical, logical and precise reports are inherent to the structure of the programme. Techniques that effectively communicate scientific chemical content to large audiences are acquired through oral and poster presentations and regular laboratory report writing.
4	**PO4**	Capacity Enhancement: Modern day scientific environment requires students to possess ability to think independently as well as be able to work productively in groups. This requires some degree of balancing. The chemistry honours programme course is designed to take care of this important aspect of student development through effective teaching learning process.
5	**PO5**	Portable Skills: Besides communication skills, the programme develops a range of portable or transferable skills in students that they can carry with them to their new work environment after completion of chemistry honours programme. These are problem solving, numeracy and mathematical skills- error analysis, units

		and conversions, information retrieval skills, IT skills and organizational skills. These are valued across work environments

Course Outcomes (CO): B.Sc (H) Chemistry

SEMESTER 1: DSC1: ATOMIC STRUCTURE & CHEMICAL BONDING			
Unique Paper Code	**Name of the Paper**	**Course Outcome: CO**	**Statement**
2172011101	Atomic Structure & Chemical Bonding (DSC1: Inorganic Chemistry -I)	CO1	The course enables the students to solve the conceptual questions using the knowledge gained by studying the quantum mechanical model of the atom, 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 electron affinity of elements.
		CO2	The students can draw the plausible structures and geometries of molecules using radius ratio rules, VSEPR theory and MO diagrams (homo- & hetero-nuclear diatomic molecules).
		CO3	The students understand the concept of lattice energy using Born-Landé and Kapustinskii equation.
		CO4	They are able to calibrate the apparatus used in titrimetric analysis and prepare standard solutions for titration
		CO5	They understand the theory and application of various acid-base & redox titrations.
		CO6	They can comprehend the theory of acid-base indicators
DSC2: ORGANIC CHEMISTRY - I			
2172011102	Basic Concepts and Aliphatic Hydrocarbons	CO1	The students understand and explain the electronic displacements and reactive intermediates and their applications in basic concepts.

		CO2	They can formulate the mechanistic route of organic reactions by recalling and correlating the fundamental concepts.
		CO3	They are able to identify and comprehend mechanism for free radical substitution, electrophilic addition, nucleophilic substitution and elimination reactions.
		CO4	They understand the fundamental concepts of stereochemistry.
		CO5	They understand and suitably use the chemistry of hydrocarbons
DSC3: PHYSICAL CHEMISTRY – I			
2172011103	Gaseous and Liquid state	CO1	By the end of this course, the students are able to derive mathematical expressions for different properties of gas and liquid and understand their physical significance.
		CO2	They can apply the concepts of gas equations and liquids while studying other chemistry courses and every-day life.
		CO3	They can handle stalagmometer and Ostwald viscometer properly.
		CO4	They can determine the density of aqueous solutions.
		CO5	They can dilute the given solutions as per required concentrations.
		CO6	They learn data reduction using numerical and graphical methods.
GE-1 (FOR HONOURS): ATOMIC STRUCTURE AND CHEMICAL BONDING			
2174001001	Atomic Structure and Chemical Bonding	CO1	The students are able to solve the conceptual questions using the knowledge gained by studying the quantum mechanical model of the atom, quantum numbers, electronic configuration, radial and angular distribution curves, and shapes of s, p, and d orbitals.
		CO2	Understand the concept of lattice energy and solvation energy.
		CO3	Draw the plausible structures and geometries of molecules using radius ratio rules, VSEPR theory and MO diagrams (homo- & hetero-nuclear diatomic molecules).

COPO MAPPING

	SEMESTER I : COPO MAPPING					
Papers	Program Outcome : PO					
DSC1	Course Outcome: CO	PO1	PO2	PO3	PO4	PO5
	CO1	✓				✓
	CO2					✓
	CO3	✓				
	CO4		✓			
	CO5	✓				
	CO6			✓		
DSC2	CO1	✓				
	CO2	✓				✓
	CO3			✓		
	CO4	✓				
	CO5					✓
DSC3	CO1	✓				
	CO2					✓
	CO3		✓			
	CO4					✓
	CO5		✓			
	CO6	✓				✓
GE1	CO1	✓				
	CO2	✓				
	CO3					✓

SEMESTER 2:

DSC4: CHEMISTRY OF S- AND P-BLOCK ELEMENTS

Unique Paper Code	Name of the Paper	Course Outcome: CO	Statement
2172011201	Chemistry of s- and p- block elements	CO1	The students learn the fundamental principles of metallurgy and understand the importance of recovery of by-products during extraction.

		CO2	They understand applications of thermodynamic concepts like that of Gibbs energy and entropy to the principles of extraction of metals.
		CO3	Learn about the characteristics of s- and p-block elements as well as the synthesis, structure, bonding and uses of their compounds.
		CO4	Understand the concept and use of internal and external redox indicators
		CO5	Comprehend the theory and application of iodometric and iodimetric titrimetric analysis
DSC5: HALOALKANES, ARENES, HALOARENES, ALCOHOLS, PHENOLS, ETHERS AND EPOXIDES			
2172011202	Haloalkanes, Arenes, Haloarenes, Alcohols, Phenols, Ethers and Epoxides	CO1	The students understand reactions of arenes, haloarenes and some oxygen containing functional groups.
		CO2	Understand the concept of protection and deprotection
		CO3	They use the synthetic chemistry learnt in this course to do functional group transformations.
		CO4	They are able to propose plausible mechanisms for the reactions under study..
DSC6: THERMODYNAMICS AND ITS APPLICATIONS			
2172011203	Thermodynamics and its Applications	CO1	The students understand the three laws of thermodynamics, concept of State and Path functions, extensive and intensive properties.
		CO2	They are able to derive the expressions of ΔU, ΔH, ΔS, ΔG, ΔA for an ideal gas under different conditions.
		CO3	They can explain the concept of partial molar properties.
GE-2 (FOR HONOURS): **CHEMICAL KINETICS AND PHOTOCHEMISTRY**			
		CO1	Students understand the concept of rate of a reaction, order and molecularity of a

2174001207	Chemical Kinetics and Photochemistry		reaction, various factors affecting the rate and theories of reaction rates.
		CO2	Students are able to apply the learnt concepts in studying the reaction kinetics of various reactions.
		CO3	Understand the basic concepts of photochemistry, photochemical and photosensitized reactions and their role in biochemical systems.

COPO MAPPING

	SEMESTER II : COPO MAPPING					
Papers	Program Outcome : PO					
	Course Outcome: CO	PO1	PO2	PO3	PO4	PO5
DSC4	CO1	✓				
	CO2	✓				
	CO3	✓				
	CO4	✓				
	CO5		✓			✓
DSC5	CO1	✓				
	CO2	✓				
	CO3			✓	✓	
	CO4					✓
DSC6	CO1	✓				
	CO2	✓				
	CO3			✓		
GE2	CO1	✓				
	CO2					✓
	CO3	✓				

SEMESTER 3:

DSC7: CHEMISTRY OF D- AND F-BLOCK ELEMENTS & QUANTITATIVE INORGANIC ANALYSIS

Unique Paper Code	Name of the Paper	Course Outcome: CO	Statement
2172012301	Chemistry of d- and f- block Elements &	CO1	The course enables students to list the important properties of transition metals, lanthanoids and actinoids.

	Quantitative Inorganic Analysis	CO2	Use Latimer diagrams to predict and identify species which are reducing, oxidizing and tend to disproportionate and calculate skip step potentials.
		CO3	Describe the classification, structure and applications of Inorganic Polymers.
		CO4	List and use the principles of gravimetric analysis for quantitative analysis
DSC8: CARBONYLS, CARBOXYLIC ACIDS, AMINES, NITRO COMPOUNDS, NITRILES, ISONITRILES AND DIAZONIUM SALTS			
2172012302	Carbonyls, Carboxylic acids, Amines, Nitro compounds, Nitriles, Isonitriles and Diazonium salts	CO1	The students can explain the chemistry of oxygen and nitrogen containing compounds.
		CO2	Use the synthetic chemistry learnt in this course to do functional group transformations.
		CO3	Propose plausible mechanisms for the reactions under study.
DSC9: CHEMICAL EQUILIBRIUM, IONIC EQUILIBRIUM, CONDUCTANCE AND SOLID STATE			
2172012303	Chemical equilibrium, Ionic equilibrium, conductance and solid state	CO1	The students will be able to apply the concept of equilibrium to various physical and chemical processes.
		CO2	Derive and express the equilibrium constant for various reactions at equilibrium.
		CO3	Use Le Chatelier's principle to predict the thermodynamic conditions required to get maximum yield of a reaction
		CO4	Apply the concept of equilibrium to various ionic reactions.
		CO5	List different types of electrolytes and their properties related to conductance in aqueous solutions.
		CO6	Use conductance measurements for calculating many properties of the electrolytes.
		CO7	Prepare buffer solutions of appropriate pH.
		CO8	Explain the crystal properties and predict the crystal structures of cubic systems form the XRD.
		CO9	Use the instruments like pH-meter and conductivity meters.

DSE 1 (FOR HONOURS): **INORGANIC MATERIALS OF INDUSTRIAL IMPORTANCE**			
2173012002	Inorganic materials of industrial importance	CO1	The students will be able to state the composition and applications of the different kinds of glass.
		CO2	State the composition of cement and discuss the mechanism of setting of cement.
		CO3	Defend the suitability of fertilizers for different kinds of crops and soil.
		CO4	Explain the process of formulation of paints and the basic principle behind the protection offered by the surface coatings.
		CO5	Describe the principle, working and applications of different batteries.
		CO6	Evaluate the synthesis and properties of nano-dimensional materials, various semiconductor and superconductor oxides.
GE 3 (FOR HONOURS): BASIC CONCEPTS OF ORGANIC CHEMISTRY			
2174001002	Basic Concepts of Organic Chemistry	CO1	The students will be able to understand and explain the differential behavior of organic compounds based on fundamental concepts learnt.
		CO2	Formulate the mechanism of organic reactions by recalling and correlating the fundamental properties of the reactants involved.
		CO3	Learn and identify many organic reaction mechanisms including free radical substitution, electrophilic addition and electrophilic aromatic substitution.
		CO4	Differentiate between various types of organic reactions possible on the basis of reaction conditions.

COPO MAPPING

	SEMESTER III : COPO MAPPING					
Papers	Program Outcome : PO					
	Course Outcome: CO	PO1	PO2	PO3	PO4	PO5
DSC7	CO1	✓				
	CO2					✓
	CO3	✓				
	CO4			✓		
DSC8	CO1	✓				
	CO2					✓
	CO3			✓		
DSC9	CO1					✓
	CO2	✓				
	CO3			✓		
	CO4					✓
	CO5	✓				
	CO6					✓
	CO7		✓			
	CO8			✓		
	CO9		✓			
DSE1	CO1	✓				
	CO2	✓				
	CO3				✓	
	CO4			✓		
	CO5			✓		
	CO6					✓
GE3	CO1	✓				
	CO2				✓	
	CO3	✓			✓	
	CO4				✓	

SEMESTER 4:

DSC10: COORDINATION CHEMISTRY AND REACTION MECHANISM

Unique Paper Code	Name of the Paper	Course Outcome: CO	Statement
2172012401	Coordination Chemistry and	CO1	The students will be able to explain the terms- ligand, denticity of ligands, chelate,

	Reaction Mechanism		coordination number and use standard rules to name coordination compounds.
		CO2	Discuss the various types of isomerism possible in such compounds.
		CO3	Use Valence Bond Theory to predict the structure and magnetic behaviour of metal complexes and understand the terms inner and outer orbital complexes.
		CO4	Explain the meaning of the terms Δo, Δt, pairing energy, CFSE, high spin and low spin complexes and how CFSE affects thermodynamic properties like lattice enthalpy and hydration enthalpy.
		CO5	Explain magnetic properties and colour of complexes on the basis of Crystal Field Theory.
		CO6	Explain the reaction mechanism of coordination compounds and differentiate between kinetic and thermodynamic stability.
DSC11: CARBOHYDRATES, LIPIDS AND HETEROCYCLIC COMPOUNDS			
2172012402	Carbohydrates, Lipids and Heterocyclic Compounds	CO1	The students will be able to describe uses and applications of carbohydrates, lipids and heterocycles.
		CO2	Use the knowledge gained from study of carbohydrates, lipids and heterocycles to propose greener and better synthetic routes.
		CO3	Use the chemistry and biology of carbohydrates, lipids and heterocycles to better serve the mankind.
DSC12: ELECTROCHEMICAL CELLS, CHEMICAL KINETICS AND CATALYSIS			
2172012403	Electrochemical Cells, Chemical Kinetics and Catalysis	CO1	The students will be able to explain the working of electrochemical cells and different types of galvanic cell.
		CO2	Devise a spontaneous galvanic cell using various combinations of half-cells.

		CO3	Understand the concept of concentration cell
		CO4	Use the appropriate galvanic cell to measure pH, calculate thermodynamic parameters and perform potentiometric titrations.
		CO5	Write rate law and derive rate equations for simple and complex reactions and understanding of theories of reaction rates.
		CO6	Understand different types of catalysts and mechanism of enzyme catalysis.
		CO7	Perform potentiometric titrations using appropriate electrodes for quantitative analysis.
		CO8	Set up experiments to study the kinetics of simple reactions.
DSE2 (FOR HONOURS): GREEN CHEMISTRY IN ORGANIC SYNTHESIS			
2173012008	Green Chemistry in Organic Synthesis	CO1	List the twelve principles of green chemistry and build the basic understanding of toxicity, hazard and risk related to chemical substances.
		CO2	Calculate atom economy, E-factor and relate them in all organic synthesis
		CO3	State the uses of catalyst over stoichiometric reagents.
		CO4	Debate and use green solvents, renewable feedstock, and renewable energy sources for carrying out safer chemistry
		CO5	Use green chemistry for problem solving, innovation and finding solutions to environmental problems.
		CO6	Design safer processes, chemicals, and products through understanding of inherently safer design (ISD)
		CO7	Discuss the success stories and use real-world cases to practice green chemistry.
GE 4 (FOR HONOURS): MOLECULES OF LIFE			
2174001206	Molecules of Life	CO1	Learn and demonstrate how the structure of biomolecules determines their chemical properties, reactivity and biological uses.
		CO2	Gain an insight into the mechanism of enzyme action and inhibition.
		CO3	Understand the basic principles of drug-receptor interaction and SAR.

COPO MAPPING

	SEMESTER IV : COPO MAPPING					
Papers	Program Outcome : PO					
	Course Outcome: CO	PO1	PO2	PO3	PO4	PO5
DSC10	CO1	✓				
	CO2	✓				
	CO3				✓	
	CO4	✓				
	CO5					✓
	CO6				✓	
DSC11	CO1	✓				
	CO2				✓	
	CO3				✓	
DSC12	CO1	✓				
	CO2					✓
	CO3	✓				
	CO4				✓	✓
	CO5	✓				
	CO6	✓				
	CO7		✓			
	CO8		✓		✓	
DSE2	CO1	✓				
	CO2					✓
	CO3	✓				
	CO4				✓	
	CO5				✓	✓
	CO6	✓			✓	
	CO7			✓		
GE4	CO1	✓				
	CO2	✓				
	CO3	✓				