

**PROGRAMME OUTCOMES, PROGRAMME SPECIFIC OUTCOMES AND COURSE
OUTCOMES**

DEPARTMENT OF CHEMISTRY
PROGRAM – BSc, CHEMISTRY

PROGRAM OUTCOME

After successful completion of three year degree program in Chemistry a student should be able to-

PO-1. Demonstrate, solve and an understanding of major concepts in all disciplines of chemistry.

PO-2. Solve the problem and also think methodically, independently and draw a logical conclusion.

PO-3. Employ critical thinking and the scientific knowledge to design, carry out, record and analyze the results of chemical reactions.

PO-4. Create an awareness of the impact of chemistry on the environment, society, and development outside the scientific community.

PO-5. Find out the green route for chemical reaction for sustainable development.

PO-6. To inculcate the scientific temperament in the students and outside the scientific community.

PO-7. Use modern techniques, decent equipments and Chemistry softwares.

PROGRAM SPECIFIC OUTCOME

PSO1. Have sound knowledge about the fundamentals and applications of chemical and Scientific theories.

PSO2. Every branch of Science and Technology is related to Chemistry

PSO3. Easily assesses the properties of all elements discovered.

PSO4. Apply appropriate techniques for the qualitative and quantitative analysis of chemicals in laboratories and in industries.

PSO5. Will become familiar with the different branches of chemistry like analytical, organic, inorganic, physical, environmental, polymer and biochemistry

PSO6. Helps in understanding the causes of environmental pollution and can open up new Methods for environmental pollution control.

PSO7. Develops analytical skills and problem solving skills requiring application of chemical principles.

PSO8. Acquires the ability to synthesise, separate and characterize compounds using laboratory and instrumentation techniques.

COURSE OUTCOME

SN	CLASS	PAPER	COURSE OUTCOME
1	BSc I	INORGANIC CHEMISTRY	CO1. Knowledge of atomic structure and periodic properties of elements. CO2. Understand various types of bonding in covalent molecules and ions. CO3. Understand various types of bonding in ionic solids. Programme Specific Outcome and can open up new Methods for environmental pollution control. CO4. Comparative knowledge of s-block elements of periodic table and there compounds. Chemistry of noble gases. CO5. Comparative knowledge of s-block elements of periodic table and there compounds. Chemical principles involve in inorganic chemical analysis.
2	BSc I	ORGANIC CHEMISTRY	CO1. Knowledge of electronic structure, bonding and mechanism of organic reactions. CO2. Knowledge of stereochemistry of organic compounds. CO3. Understand Chemistry of aliphatic and aromatic ring compounds. CO4. Understand Chemistry of alkenes, dienes and alkynes. CO5. Understand Chemistry of arenes and aromaticity.
3	BSc I	PHYSICAL CHEMISTRY	CO1. Understand the idea of mathematical concepts for chemists and basic knowledge of computer. CO2. Knowledge of various types of molecular velocities and their effect on properties. Understand behaviour of ideal gases. CO3. Understand intermolecular forces in liquid state, ideal and non ideal solutions, properties of dilute solutions. CO4. Understand structure, properties and uses of liquid crystals. Colloidal states and its properties and uses. CO5. Understand chemical kinetics rate constant and order of reactions and various theories. Characteristics types and industrial applications of catalysis.
4	BSc I	Practical work	CO1. Analyse qualitatively acid and basic radicals by semi-micro analysis method. CO2. Calibration of thermometers. CO3. Determination of melting point and boiling point of organic compounds. CO3. Mixed melting point determination. CO4 Crystallization CO5. Decolourisation and crystallization using charcoal. CO6. Sublimation.

			<p>CO7. Detection of Nitrogen, Sulphur and Halogens and detection of functional group present in organic compounds.</p> <p>CO8. To determine specific rate of hydrolysis of methyl/ethyl acetate catalysed by hydrogen ion at room temperature.</p> <p>CO9. To study distribution of iodide between water and carbon tetra chloride.</p> <p>CO10. To determine the % composition of a given mixture by viscosity method.</p>
5	BSc II	INORGANIC CHEMISTRY	<p>CO1. Understand chemistry of first transition series elements.</p> <p>CO2. Understand chemistry of second and third transition series elements.</p> <p>CO3. Understand Oxidation and reduction. Coordination compounds.</p> <p>CO4. Understand chemistry of lanthanides and actinides.</p> <p>CO5. Understand Acid and bases and non-aqueous solvents.</p>
6	BSc II	ORGANIC CHEMISTRY	<p>CO1. Understand chemistry of alcohols, phenols and epoxides.</p> <p>CO2. Understand chemistry of aldehydes and Ketons and its uses.</p> <p>CO3. Understand chemistry of carboxylic acid, substituted carboxylic acids and there derivatives.</p> <p>CO4. Understand Chemistry of organic compound of nitrogen.</p> <p>CO5. Understand Chemistry of heterocyclic compounds and amino acids & peptides.</p>
7	BSc II	PHYSICAL CHEMISTRY	<p>CO1. Understand first law of thermodynamics and thermo chemistry.</p> <p>CO2. Understand second law of thermo chemistry, efficiency of a heat engine and concept of entropy.</p> <p>CO3. Understand phase equilibrium, Gibbs rule, and application of phase rule to two component systems and three component systems and Nernst distribution law.</p> <p>CO4. Understand electrolytic conductance, theories of strong electrolytes and migration of ions.</p> <p>CO5. Understand electrochemical cell or galvanic cell, single electrode potential, concentration cell, pH and its determination and corrosion.</p>
8	BSc II	Practical work	<p>CO1. Calibration of fractional weights, pipettes and burettes.</p> <p>CO2. Preparation of standard solutions</p> <p>CO3. Quantitative volumetric estimation of vinegar, antacid tablets, chalk, hardness of water, ferrous & ferric and copper.</p> <p>CO3. Colorimetry: Jobs method and mol ratio method.</p> <p>CO4. Adulteration in food stuffs.</p> <p>CO5. Effluent analysis.</p> <p>CO6. Water analysis.</p> <p>CO7. Solvant extraction- separation and estimation of Mg and Fe.</p> <p>CO8. Ion exchange method; separation and estimation of Mg</p>

			<p>and Zn.</p> <p>CO9. Thin layer chromatography: Determination of Rf value and identification of organic compounds.</p> <p>CO10. Paper chromatography Ascending and circular, Determination of Rf value and identification of organic compounds</p> <p>CO11. Qualitative analysis: identification of an organic compound.</p> <p>CO12. Determination of the transition temperature of given substance by thermometric/ dilatometric method.</p> <p>CO13. To study of a solute on the critical solution temperature of two partially miscible liquids</p> <p>CO14. Construct the phase diagram of two component system by cooling curve method.</p> <p>CO15. Determine the solubility of benzoic acid at different temperature.</p> <p>CO16. Determine the enthalpy of neutralization and ionization.</p>
9	BSc III	INORGANIC CHEMISTRY	<p>CO1. Understand metal ligand bonding in transition metal complexes. Thermodynamics and kinetic aspects of metal complexes.</p> <p>CO2. Understand magnetic properties of transition metal complexes and electronic spectra of complexes.</p> <p>CO3. Understand chemistry of organometallic compounds.</p> <p>CO4. understand bioinorganic chemistry.</p> <p>CO5. Understand hard and soft acids and bases and silicones and phosphazenes.</p>
10	BSc III	ORGANIC CHEMISTRY	<p>CO1. Understand chemistry of organometallic compounds, organosulphur compounds and organic synthesis via enolates.</p> <p>CO2. Understand biomolecules carbohydrates, proteins and nucleic acid.</p> <p>CO3. Understand Chemistry of synthetic polymers and synthetic dyes.</p> <p>CO4. Understand mass spectroscopy, infrared spectroscopy, UVVisible spectroscopy and application of mass, IR, UV-Visible spectroscopy to organic molecules.</p> <p>CO5. Understand NMR spectroscopy and ¹³CMR spectroscopy and magnetic resonance imaging.</p>
11	BSc III	PHYSICAL CHEMISTRY	<p>CO1. Understand Quantum Mechanics black body radiation, DeBroglie's idea of matter waves, Schrödinger time independent wave equation and its applications.</p> <p>CO2. Understand quantum mechanical approach to molecular orbital theory, Orbitals and their characteristics.</p> <p>CO3. Understand Vibrational and Raman spectra.</p> <p>CO4. Understand Third law of thermodynamics, Nernst theorem and its application. Physical property and molecular structure, Magnetic properties.</p>

			CO5. Understand of chemical kinetics rate constant and order of reactions and various theories. Characteristics types and industrial applications of catalysis.
12	BSc III	Practical work	<p>CO1. Synthesis analysis of sodium trioxalato ferrate(III).</p> <p>CO2. Preparation of Ni-DMG.</p> <p>CO3. Preparation of Copper tetra ammine complex.</p> <p>CO3. Preparation of cis- and trans-bioxalato diaqua chromate(III).</p> <p>CO4. Gravimetric analysis of Cu as CuSCN, Ni as Ni(DMG), Ba as BaSO₄ and Fe as Fe₂O₃</p> <p>CO5. Steam distillation: Naphthalene from its suspension in water, Clove oils from clove, Separation of ortho and para-nitrophenols.</p> <p>CO6. Separation of fluorescein and methylene blue by column chromatography.</p> <p>CO7. Separation of leaf pigments from Spinach leave by column chromatography.</p> <p>CO8. Resolution of racemic mixture of (+,-) maleic acid by column chromatography.</p> <p>CO9. Analysis of an organic mixture containing two solid components.</p> <p>CO10 Acetylation of salicylic acid, aniline, glucose and hydroquinone.</p> <p>CO11. Benzoylation of aniline and phenol.</p> <p>CO 12. Preparation of m-dinitrobenzene, p-nitroacetanilide.</p> <p>CO13. Preparation of p-bromoacetanilide, 2,4,6-tribromophenol.</p> <p>CO14. Preparation of methyl orange and methyl red.</p> <p>CO15. Preparation of benzoic acid from toluene.</p> <p>CO16. Preparation of aniline from nitrobenzene, preparation of m-nitro aniline from m-dinitrobenzene.</p> <p>CO17. Determine strength of given acid conductometrically using standard alkali solution.</p> <p>CO18. Study of saponification of ethyl acetate conductometrically.</p> <p>CO19. Determine the specific rotation of a given optically active compound.</p> <p>CO20. Determination of molecular weight of a non-volatile solute by Rast method/ Beckmann freezing point method.</p> <p>CO21. Verify Beer-Lambert law for KMnO₄/ K₂Cr₂O₇ and determination of concentration of the given solution of the solution.</p>

PROGRAM – MSc, CHEMISTRY

PROGRAM OUTCOME

After successful completion of two year degree programme in chemistry a student should be able to-

PO-1. Demonstrate, solve and an understanding of major concepts in all disciplines of Chemistry.

PO-2. Solve the problem and also think methodically, independently and draw a logical conclusion.

PO-3. Create an awareness of the impact of chemistry on the society, and development outside the scientific community.

PO-4. Become professionally trained in the area of Industry, material science, lasers and Nano-Technology.

PO-5. Employ critical thinking and the scientific knowledge to design, carry out, record and analyze the results of Chemistry experiments.

PO-6. To inculcate the scientific temperament in the students and outside the scientific community.

PO-7. Apply modern methods of analysis to chemical systems in a laboratory setting.

PROGRAM SPECIFIC OUTCOME

PSO1 Provide theoretical background and develop practical skills for analysing materials using modern analytical methods and instruments,

PSO2 Inculcate a problem solving approach by coordinating the different branches of chemistry.

PSO3 Becomes professionally skilled for higher studies in research institutions and to work in chemical industries.

PSO4 In-depth knowledge helps to qualify in competitive exams.

COURSE OUTCOME

SN	CLASS	PAPER	COURSE OUTCOME
1	MSc I SEM.	INORGANIC CHEMISTRY	CO1. Understand stereochemistry and bonding in main group compounds. CO2. Understand metal ligand bonding. CO3. Understand electronic spectra of transition metal complexes. CO4. Understand magnetic properties of transition metal complexes.

			CO5. Understand symmetry and matrix representation. CO6. Understand group theory in chemistry.
2	MSc I SEM.	ORGANIC CHEMISTRY	CO1. Understand reaction intermediates. CO2. Understand nature of bonding in organic molecules. CO3. Understand stereochemistry. CO4. Understand reaction mechanism: structure and reactivity. CO5. Understand pericyclic reactions. CO6. Understand molecular rearrangement
3	MSc I SEM.	PHYSICAL CHEMISTRY	CO1. Understand Introduction to exact quantum mechanical results. CO2. Understand approximate methods and angular momentum. CO3. Understand electronic structure of atom. CO4. Understand molecular orbital theory. CO5. Understand chemical dynamics. CO6. Understand surface chemistry. CO7. Understand macromolecules
4	MSc I SEM.	Laboratory Course-I : ORGANIC CHEMISTRY	CO1. Separation, purification and identification of binary organic mixture. CO2. Organic synthesis based on various reactions. CO3. Quantitative estimation of various organic compounds.
5	MSc II SEM.	INORGANIC CHEMISTRY	CO1. Understand metal ligand equilibrium in solution. CO2. Understand reaction mechanism of transition metal complexes. CO3. Understand metal clusters. CO4. Understand metal carbonyls and metal nitrosyls. CO5. Understand isopoly and heteropoly acid and salts.
6	MSc II SEM.	ORGANIC CHEMISTRY	CO1. Understand aliphatic electrophilic substitution. CO2. Understand aliphatic nucleophilic substitution. CO3. Understand aromatic nucleophilic substitution. CO4. Understand free radical reaction. CO5. Understand addition to carbon-carbon multiple bond. CO6. Understand addition to carbon-hetero multiple bonds. CO7. Understand elimination reactions.
7	MSC II SEM.	PHYSICAL CHEMISTRY	CO1. Understand classical thermodynamics. CO2. Understand statistical thermodynamics. CO3. Understand non equilibrium thermodynamics. CO4. Understand electrochemistry. CO5. Understand electro catalysis. CO6. Understand electron diffraction and neutron diffraction.

8	MSc II SEM.	SPECTROSCOPY, DIFFRACTION METHODS & COMPUTER FOR CHEMISTS	<p>CO1. Understand atomic spectroscopy. CO2. Understand molecular spectroscopy. CO3. Understand photo electric spectroscopy. CO4. Understand Nuclear magnetic resonance spectroscopy. CO5. Understand Electron spin resonance spectroscopy. CO6. Understand photo acoustic spectroscopy. CO7. Understand X-ray diffraction. CO8. Understand computer fundamental. CO9. Understand programming in C. CO10. Understand programming in chemistry and use of computer programmes</p>
9	MSc II SEM.	Laboratory Course-I: INORGANIC CHEMISTRY	<p>CO1. Qualitative analysis of mixture containing eight radicals including some less common metal ions. CO2. Quantitative analysis involving two ions in alloys or mixture in solution- one by volumetric and other by gravimetric method. CO3. Quantitative Analysis:-involving two of following in ores, alloys or mixture in solution- one by volumetric and other by gravimetric method Ag, Cu, Fe, Cr, Mn, Ni, Zn, Ca, Mg, Chloride, Sulphate. CO4. Estimation of:- (A) Phosphoric acid in Commercial ortho phosphoric acid. (B) Boric Acid in Borax. (C) Ammonium ion in Ammonium Salt. (D) MnO in pyrolusite (E) Available Chlorine, in bleaching powder. (F) H₂O₂ in commercial sample. CO5. Preparation of selected inorganic compounds and study of their properties by various method including IR, Electronic Spectra, Mossbauer, ESR. Spectra, Magnetic susceptibility etc. (i) V(acac)₂ (ii) cis K[Cr(C₂O₄)₂(H₂O)₂], (iii) [Co(NH₃)₆]Cl₃, trans K[Cr(C₂O₄)₂(H₂O)₂].2H₂O (iv) Na [Cr(NH₃)₂ (SCN)₄] (v) Mn (acac)₃ (vi) K₄ [Fe(C₂O₄)₃] (vii) Prussian Blue, Turnbull's Blue. (viii) [Co (NH₃)₄] [Co(NO₂)₆] (ix) Hg [Co(SCN)₄] (x) [Ni(NH₃)₄]Cl₂, (xi) Ni (DMG)₂, (xii)[Cu(NH₃)₄]SO₄ (xiii) K₃[Cr(C₂O₄)₃].3H₂O</p>

			(xiii) $[\text{Cu}(\text{NH}_3)_4]\text{SO}_4$
10	MSc II SEM.	Laboratory Course-II: PHYSICAL CHEMISTRY	<p>CO1. Verification of Freundlich's Adsorption isotherm.</p> <p>CO2. To study surface tension - concentration relationship for. solutions (Gibbs equation).</p> <p>CO3. Determination of congruent composition and temperature of binary system e.g. diphenylamine - benzophenone system.</p> <p>CO4. Determination of glass transition temperature of given salt e.g. CaCl_2 conductometrically.</p> <p>CO5. To construct the phase diagram for three component system e.g. chloroform, acetic acid and water.</p> <p>CO6. Hydrolysis of an ester/ ionic reactions.</p> <p>CO7. Determination of the velocity constant of hydrolysis of an ester. Determination of effect of (a) change of temperatures, (b) change of concentration of reactants and catalyst and(c) ionic strength of the media on the velocity constant of media.</p> <p>CO8. Determination of the rate constant for the oxidation of iodide ions by hydrogen peroxide.</p> <p>CO9. Determination of the primary salt effect on the kinetics of ionic reaction and Testing of the Bronsted relationship (iodide ions oxidized by persulphate ion).</p> <p>CO10. Determination of solubility of sparingly soluble salt (e.g., PbSO_4, BaSO_4) Conductometrically.</p> <p>CO11. Determination of the strength of strong and weak acids in a given mixture conductometrically.</p> <p>CO12. Determination of dissociation constant of weak electrolyte by conductometer.</p> <p>CO13. .Determination of velocity constant, Order of reaction and energy of activation for Saponification of ethyl acetate by sodium hydroxide.</p> <p>CO14. Determination of the strength of strong and weak acid in a given mixture using pH meter/potentiometer.</p> <p>CO15. Determination of dissociation constant of weak acid by Ph meter.</p> <p>CO16. Determination of concentration of acid in given buffer solution by pH meter.</p> <p>CO17. Determination of strength of halides in a mixture potentiometrically.</p> <p>CO18. Determination of the valency of mercurous ions potentiometrically.</p> <p>CO19. Determination of the strength of strong acid,</p>

			<p>weak acids in a given mixture using a potentiometer/pH meter.</p> <p>CO20. Determination of temperature dependence of EMF of a cell.</p> <p>CO21. Determination of the formation constant of silver- ammonia complex and stoichiometry of the complex potentiometrically.</p> <p>CO22. Determination of activity and activity coefficient of electrolytes.</p> <p>CO23. Determination of thermodynamic constant. ΔG, ΔS and ΔH for the reaction by e.m.f. method. $Zn + H_2SO_4 = ZnSO_4 + H_2$</p> <p>CO24. Determination of the dissociation constant of monobasic / dibasic acid.</p> <p>CO25. Determination of rate constant for hydrolysis/inversion of sugar using a polarimeter. Enzyme kinetic - inversion of sucrose.</p> <p>CO26. Determination of molecular weight of non-volatile and nonelectrolyte/ electrolytes by cryoscopy method and to determine the activity coefficient of an electrolyte.</p> <p>CO27. Determination of the degree of dissociation of weak electrolyte and to study the deviation from ideal behaviour that occurs with a strong electrolyte.</p>
11	MSc III SEM.	APPLICATIONS OF SPECTROSCOPY (COMPULSORY)	<p>CO1. Understand Vibrational spectroscopy.</p> <p>CO2. Understand Electron spin resonance spectroscopy.</p> <p>CO3. Understand Nuclear Magnetic Resonance of Paramagnetic substances in solution</p> <p>CO4. Understand Ultraviolet and Visible Spectroscopy.</p> <p>CO5. Understand Nuclear Magnetic Resonance Spectroscopy.</p> <p>CO6. Understand Carbon-13 NMR Spectroscopy.</p> <p>CO7. Understand mass Spectrometry.</p>
12	MSc III SEM.	CHEMISTRY OF BIO-INORGANIC & BIO.ORGANIC (COMPULSORY)	<p>CO1. Understand Metal ions in Biological Systems.</p> <p>CO2. Understand transport and storage of dioxygen.</p> <p>CO3. Understand introduction of bioorganic chemistry.</p> <p>CO4. Understand enzymes.</p> <p>CO5. Understand kind of reactions catalysed by enzymes.</p> <p>CO6. Understand Co-enzyme chemistry.</p> <p>CO7. Understand enzyme models.</p> <p>CO8. Understand biotechnological application of enzymes.</p>
13	MSc III	ORGANOTRANSITI	CO1. Understand Alkyls and Aryls of Transition

	SEM.	ON METAL CHEMISTRY (Optional for group-A, Inorganic Chemistry)	Metals. CO2. Understand Compounds of transition Metal-Carbon multiple bond. CO3. Transition Metal π -complexes. CO4. Understand Transition Metal Compounds with Bonds to Hydrogen. CO5. Understand Fluxional Organometallic Compounds. CO6. Understand homogeneous catalysis.
14	MSc III SEM.	PHOTOINORGANIC CHEMISTRY (Optional for group-A, Inorganic Chemistry)	CO1. Understand basics of photochemistry. CO2. Understand properties of excited states. CO3. Understand excited states of metal complexes. CO4. Understand ligand field photochemistry. CO5. Understand metal complex sensitizers. CO6. Understand redox reactions by excited metal molecules.
15	MSc IV SEM.	PHOTOCHEMISTRY & SOLID STATE CHEMISTRY (Optional for group A, Inorganic Chemistry)	CO1. Understand photochemistry reaction. CO2. Understand determination of reaction mechanism. CO3. Understand photochemistry of alkenes. CO4. Understand photochemistry of carbonyl compounds. CO5. Understand photochemistry of aromatic compound. CO6. Understand miscellaneous photochemical reactions. CO7. Understand solid state reactions. CO8. Understand crystal defects and non-stoichiometry. CO9. Understand electronic property and band theory.
16	MSc IV SEM.	BIO-PHYSICAL & ENVIRONMENTAL CHEMISTRY (Optional for group-A, Inorganic Chemistry)	CO1. Understand Biological cell and its constituents. CO2. Understand Statistical mechanics in biopolymers. CO3. Understand Biopolymer interactions. CO4. Understand Thermodynamics of biopolymer solutions. CO5. Understand Cell Membrane and Transport of Ion. CO6. Understand Biopolymer and their Molecular Weights. CO7. Understand diffraction method. CO8. Understand Environment. CO9. Understand Hydrosphere. CO10. Understand water quality parameter. CO11. Understand industrial pollution
17	MSc IV SEM.	BIOINORGANIC CHEMISTRY &	CO1. Understand Metal Storage Transport and Biomineralization.

		SUPRAMOLECULAR CHEMISTRY (Optional for group-A, Inorganic Chemistry)	CO2.Understand Metalloenzymes CO3.Understand Peroxidase and cytochrome p-450. Copper enzymes. CO4.Understand Metal-Nucleic Acid Interactions CO5.Understand Metals in Medicine. CO6.Understand Molecular recognition. CO7.Understand Transport processes and carrier designs. Understand supra-molecular chemistry.
18	MSc IV SEM.	ANALYTICAL CHEMISTRY (Optional for group-A, Inorganic Chemistry)	CO1. Understand Introduction, classification and various technique of analytical chemistry. CO2. Understand Error and Evaluation. CO3. Understand Food Analysis. CO4. Understand Analysis of Water Pollution. CO5. Understand Analysis of Soil Fuel. CO6. Understand Fuel analysis.
19	MSc IV SEM.	Laboratory Course-: (SPECIAL CHEMISTRY) PHOTO INORGANIC & ORGANO-TRANSITION CHEMISTRY	CO1. Preparation of selected inorganic compounds and their study by IR, electronic spectra, Mossbauer, ESR, and magnetic susceptibility measurements. Handling of air and moisture sensitive compounds involving vacuum lines. CO2. Kinetics and mechanism of following reactions: i. Substitution reactions in octahedral complexes (acid hydrolysis and base hydrolysis). ii. Redox reaction in octahedral iii. Isomerisation reaction of octahedral. CO3. Extraction of chlorophyll from green leaves of student's choice. Separation of chlorophylls and their electronics spectral study. CO4. Complexation study of Cu (II) ion with biologically important amino acids. CO5. Synthesis of potassium ferrioxalate and determination of the intensity of radiation. ii. Photo-oxidation of oxalic by UO ₂ sensitization. iii. Photodecomposition of HI and Determinant of its quantum yield.