

**DEPARTMENT OF CHEMISTRY/GOUR MAHAVIDYALAYA**  
**UG – CBCS (HONOURS) CURRICULUM (UNDER GOORBANGA UNIVERSITY)**

**Programme Outcomes (PO):**

**PO1Critical Thinking:** Understanding and Critical Interpretation of theory, facts, figures available in chemical literature.

**PO2Effective Communication:** Use of knowledge of subject and scientific reasoning in problem solving to understand the chemistry in broad area of public interest.

**PO3Social Interaction:** Ability to communicate scientific information and research results in academia, industry and government.

**PO4Ethics:** Use of Chemistry and chemicals for safe handling and key issues for our environments in the field of energy, health and medicine.

**PO5Laboratory skills& Instrumentation:** This needed to design and interprets chemical experiments and instruments. Theoretical understanding of the instruments and their analytical application in diverse field. Data-processing skills, relating to chemical information and data, correct use of units and modes of data presentation.

**PO6Environmental & Sustainability:** Role of chemistry and its application in environmental protection, food & water safety for the benefit of global healthcare.

**PO7Self-directed and lifelong learning:** Acquire the flexible knowledge and problem-solving skills for independent writing and oral communication.

Year	Paper	Courses	Outcomes
SEM-1	ORGANIC CHEMISTRY-I  CEMHT-1	DCT1	<p>Concepts of shapes &amp; hybridisation, of molecules, double bond equivalent, formal charges, resonance, inductive effect, field effect, mesomeric effect, resonance energy, bond polarization and bond polarizability, electromeric effect, steric effect.</p> <p>MO theory, bonding and antibonding interactions, concept of HOMO, LUMO and SOMO; Concepts of aromaticity, antiaromaticity, homoaromaticity; non-aromatic molecules; Frost diagram. Knowledge of VBT and MOT, hybridization on bond properties: bond dissociation energy (BDE) and bond energy; bond distances, bond angles, polarity of molecules and dipole moments; relative stabilities of isomeric hydrocarbons.</p> <p>* Knowledge of ionic, radical and pericyclic reaction mechanism; addition, elimination and substitution reactions type, nature of bond cleavage and bond formation, curly arrow rules in representation of mechanistic steps; reagent type: electrophiles and nucleophiles (elementary idea).</p> <p>Knowledge of ionic, radical, pericyclic, bond cleavage and bond formation.</p> <p>Reaction Mechanism, Reactive intermediates: carbocations, non-classical carbocations, carbanions, carbon radicals, carbenes. Determination of boiling point of organic liquids.</p> <p>Bonding geometries of carbon compounds: Stereochemistry: concept of asymmetry; Fischer, sawhorse, flying wedge and Newman projection formulae and their inter translations. Concept of chirality and symmetry, chirality arising out of stereocenter, concept of prostereoisomerism, conformation, symmetry elements and point groups, D/L and R/S descriptor, optical activity of chiral compounds.</p>
	ORGANIC CHEMISTRY LAB  CEMHP-1	DCP1	<p>Separation of binary mixture of solids based upon solubility, purification of any one of the separated components by crystallization and determination of its melting point.</p> <p>Determination of boiling point of organic liquids.</p>

			Identification of a pure organic solid and liquid compound by chemical test.
	PHYSICAL CHEMISTRY-I  CEMHT-2	DCT2	<p>Fundamental concept of basics physical chemistry, concept of Kinetic Theory and Gaseous state: General treatment of Maxwell's distribution of speed and energy, Concept of Real gases and Viriation equation.</p> <p>Concept of Chemical Thermodynamics including the laws of thermodynamics and the applications of thermodynamics, Thermodynamic relation, general heat capacity relation. It gives the idea of Electrochemistry.</p> <p>Basic concepts of chemical kinetics, different reactions order, temperature dependence of rate constants and Homogeneous catalysis.</p>
	PHYSICAL CHEMISTRY LAB  CEMHP-2	DCP2	<p>Determination of pH of unknown solution(buffer), by colour matching method.</p> <p>Study of kinetics of acid-catalyzed hydrolysis of methyl acetate.</p> <p>Determination of heat of solute ion of oxalic acid from solubility measurement.</p> <p>Study of kinetics of decomposition of H<sub>2</sub>O<sub>2</sub></p> <p>Determination of heat of neutralization of a strong acid by a strong base.</p>
SEM-II	INORGANIC CHEMISTRY-1  CEMHT-3	DCT3	<p>Get idea about the structure of atoms, Pauli's Exclusion Principle, Hund's rules and multiplicity, Aufbau principle, Term symbols of atoms and ions.</p> <p>Idea of modern periodic table, measurement of screening constant, electronegativity, relativistic effect, inert pair effect and group trends.</p> <p>The chemistry of reactivity and relative stability of s ,p &amp; d block elements.</p> <p>Acid-Bases: Idea of various types of acid-base concept, Pauling's rules, leveling effect of solvents, Drago-Wayland Equation, Superacids, HSAB principle, pH, buffer, acid-base neutralisation curves; indicator, choice of indicators.</p> <p>Elementary idea on standard redox reactions, Nernst equation, redox potentials on complex formation, precipitation and change of pH, redox indicators, redox potential diagram and</p>

			their applications and various types of electroanalytical methods. The solubility product and common ion effect.
	INORGANIC CHEMISTRY LAB CEMHP-3	DCP-3	Estimation of carbonate, bicarbonate, hydroxide and free alkali in mixture.  Estimation of Fe(II/III), Cu(II), Mn(II), Cr(III) in a mixture by oxidation - reduction titrations.
	ORGANIC CHEMISTRY-II  CEMHT-4	DCT4	Knowledge of stereo axis, concept of prostereoisomerism, conformational nomenclature and analysis: dihedral, torsion angle, conformation of conjugated systems.  Reaction thermodynamics, Tautomerism, Reaction kinetics, Substitution and Elimination Reactions, Free-radical substitution reaction.
	ORGANIC CHEMISTRY LAB CEMHP-4	DCP4	Organic Preparations, yield percentage calculation.
SEM-III	PHYSICAL CHEMISTRY-II  CEMHT-5	DCT5	Transport processes such as Diffusion and Viscosity.  Conductance measurement, Debye-Huckel theory of ion atmosphere, conductometric titrations, titration number, Walden's rule.  Concept of application of thermodynamics, equilibrium, Le Chatelier's principle and its derivation.  Concept of fundamentals of Quantum mechanics with special emphasis of the concept of operators, commutation of operators with examples such as particle in a box.
	PHYSICAL CHEMISTRY LAB CEMHP-5	DCP5	Experiment dealing with instruments such as conductometer, viscometer etc. Determination of partition coefficient.
	INORGANIC CHEMISTRY-1  CEMHT-6	DCT6	Ionic bond: size effects, radius ratio rule and its application, Packing of ions in crystals. Born-Landé equation, Born-Haber cycle, Solvation energy.  Covalent bond: Polarizing power and polarizability, ionic potential, Fajan's rules, Lewis structures, formal charge. Valence Bond Theory, Bent's rule, Dipole moments, VSEPR theory.

			<p>Idea about MO concept of bonding and MO diagrams of some homonuclear and heteronuclear diatomic molecules, qualitative idea of valence bond and band theories. hydrogen bonding, receptor-guest interactions etc.</p> <p>Radioactivity: idea of Nuclear models: concept of nuclear quantum number, magic numbers. Types of different types of nuclear reactions such as artificial radioactivity, transmutation of elements, fission, fusion and spallation. radio carbon dating, age of rocks and minerals, hazards of radiation.</p>
	<p>INORGANIC CHEMISTRY LAB</p> <p>CEMHP-6</p>	DCP6	<p>Iodo/ Iodimetric Titrations</p> <p>Estimation of metal content in some selective samples.</p>
	<p>ORGANIC CHEMISTRY-III</p> <p>CEMHT-7</p>	DCT7	<p>Chemistry of alkenes and alkynes and the name reactions involved and idea about Electrophilic aromatic substitution, and Nucleophilic aromatic substitution</p> <p>Learning the chemistry of carbonyl compounds in detail and depth including reactions involving exploitation of acidity of a-H of C=O.</p> <p>Chemistry of Organometallics, including Grignard reagents, organolithiums etc.</p>
	<p>ORGANIC CHEMISTRY LAB</p> <p>CEMHP-7</p>	DCP7	<p>learn the techniques of Qualitative Analysis of Single Solid Organic Compounds.</p> <p>Melting point of the given point.</p> <p>Preparation, purification and melting point determination of a crystalline derivative of the given compound.</p>
SEM-IV	<p>PHYSICAL CHEMISTRY-III</p> <p>CEMHT-8</p>	DCT8	<p>Various applications of chemical thermodynamics such as colligative properties and phase equilibria.</p> <p>Knowledge of electrical properties of molecules, electromotive force, dipole moment and polarizability.</p> <p>Concept of Quantum Chemistry including angular momentum, qualitative treatment of hydrogen atom and hydrogen-like ions.</p>

PHYSICAL CHEMISTRY LAB CEMHP-8	DCP8	Experimental techniques such as polarimetry, thermometry with phenol-water system and ph – metry.
INORGANIC CHEMISTRY-III CEMHT-9	DCT9	<p>Concept of general principles of Metallurgy.</p> <p>The chemistry of reactivity and relative stability of s and p block elements and their corresponding compounds.</p> <p>The chemistry of noble gases especially xenon and their compound are known.</p> <p>Isomerism of various types of coordination compounds, Werner's theory of coordination complexes, different types of ligands.</p>
INORGANIC CHEMISTRY LAB CEMHP9	DCP9	<p>Knowledge of Complexometric Titration</p> <p>Different type of Inorganic titration</p>
ORGANIC CHEMISTRY-IV CEMHT-10	DCT10	<p>Chemistry of nitrogen compounds involving preparation and reactions of amines, nitro compounds, alkyl nitriles and isonitriles, diazonium salts etc.</p> <p>Re-arrangements reaction involving migration to electron deficient nitrogen atoms and allied systems</p> <p>Retrosynthetic analysis: disconnections; synthons, strategy of ring synthesis, asymmetric synthesis etc.</p> <p>Organic spectroscopy: basic facts and formula followed by problem solving of structure of organic compounds by the application of the knowledge of UV-VIS, IR and NMR spectroscopy.</p>
ORGANIC CHEMISTRY LAB CEMHP10	DCP10	Knowledge of estimation of amines, aldehydes, alcohol such as glycine, glucose, sucrose, vitamin-C, aromatic amine, phenol, formaldehyde, acetic acid, urea, saponification value of oil/fat/ester.

SEM-V	INORGANIC CHEMISTRY-IV CEMHT-11	DCT11	<p>Explanation of the relative stability of different d-orbital splitting energy levels of different geometry, spectrochemical series, magnetism and colour with the help of crystal field theory.</p> <p>L-S coupling, Orgel diagram and its transition, spectral transition rule and charge transfer spectra.</p> <p>General characteristics and properties of 3d, 4d, and 5d transition elements. Electronic configuration, oxidation states, colour, spectral and magnetic properties of lanthanides and actinides.</p>
	INORGANIC CHEMISTRY LAB CEMHP11	DCP11	Different separation and estimation techniques such as Chromatographic separation, Gravimetric estimation Spectrometric methods.
	ORGANIC CHEMISTRY-V CEMHT-12	DCT12	<p>Chemistry of polynuclear aromatic hydrocarbons and their derivatives, their preparation, conformation and reactivity of heterocyclic compounds.</p> <p>Mechanism, stereochemistry, regioselectivity of pericyclic reactions.</p> <p>Idea of biomolecules like carbohydrates and amino acids, proteins, nucleic acids-their basic chemistry, preparation.</p>
	ORGANIC CHEMISTRY LAB CEMHP12	DCP12	<p>Chromatographic separation techniques.</p> <p>Analysis of organic spectra to solve structural problems of organic compounds.</p>
	ADVANCED PHYSICAL CHEMISTRY CEMHTDSE-1A	DSET1 (Compulsory)	<p>Fundamentals of crystallography and crystal structure.</p> <p>Concept of Statistical Thermodynamics.</p> <p>Learn special selected topics such as specific heat of solids, 3<sup>rd</sup> law of thermodynamics, calculation of entropy, polymers.</p>
	ADVANCED PHYSICAL CHEMISTRY LAB CEMHPDSE-1A	DSEP1	Computer programming based on numerical methods and application in chemistry.
	ANALYTICAL METHODS IN CHEMISTRY	DSET2	Learn qualitative and quantitative aspects of analysis, Optical methods of analysis, electroanalytical methods, different separation

	CEMHTDSE-2A	(Any one)	techniques including chromatography, solvent extraction.
	POLYMER CHEMISTRY CEMHTDSE-2B		Learn functionality and importance of polymeric materials, kinetics of polymerization, nature and structure, crystallization and crystallinity, properties of polymer.
	ANALYTICAL METHODS IN CHEMISTRY LAB CEMHPDSE-2A	DSEP2 (Any one)	Chromatographic separation techniques : monosaccharides mixture by paper chromatography, mixture of dyes by TLC, separation of active ingredients of plants, flowers, juices by TLC.  Learn solvent extractions separation methods.  Determination of COD, BOD using spectrophotometry.
	POLYMER CHEMISTRY CEMHPDSE-2B		Different polymer synthesis.  Polymer characterization.  Polymer analysis.
	IT SKILLS FOR CHEMISTS CEMHSE-1A	SE-1 (Any one)	Knowledge of Mathematical functions and their application in chemistry. Computer programming based on BASIC language, ASCII formats, logical and relative operators, simple programs, statistical analysis, BASIC programs for curve fitting, numerical differentiation and integration. Concept of handling numeric data, numeric modelling.
	BASIC ANALYTICAL CHEMISTRY CEMHSE-1B		Learning strategies of analytical chemistry and its interdisciplinary applicability, complexometry, soil analysis, analysis of water, analysis of food products, analysis of cosmetics.  Estimation of macro nutrients, spectrophotometric determination.
	INORGANIC CHEMISTRY-V CEMHT-13	DCT13	Role and functions of metal ions (specially Na <sup>+</sup> , K <sup>+</sup> , Mg <sup>2+</sup> , Ca <sup>2+</sup> , Fe <sup>3+/2+</sup> , Cu <sup>2+ /+</sup> , and Zn <sup>2+</sup> ), metalloproteins and chelation effect of some metals (Pt, Au) as drugs for different diseases.  It gives the idea of structure and chemistry of several organometallic complexes and catalysts.  Introduction of inorganic reaction mechanisms and its application in complex synthesis.



SEM-VI	INORGANIC CHEMISTRY LAB CEMHP13	DCP13	Identification the compositions (basic and acid radical) of unknown inorganic mixtures by qualitative semimicro analysis.
	PHYSICAL CHEMISTRY-IV CEMHT-14	DCT14	Concept of Molecular spectroscopy such as rotational, vibrational , Raman, nuclear magnetic resonance (NMR) spectroscopy, electron spin resonance (ESR) spectroscopy.  Surface phenomena such as adsorption, surface tension and colloids.  Learning of the concept of Photochemistry and Theory of reaction rate.
	PHYSICAL CHEMISTRY LAB CEMHP-14	DCP14	Experiments involving colorimetry, spectrophotometry and experiments related to surface tension as well as determination of CMC of micelles.
	INSTRUMENTAL METHODS OF CHEMICAL ANALYSIS CEMHTDSE-3A	DSET3 (Any one)	Learning instrumental methods like molecular spectroscopy, Chromatography, Mass spectrometry, potentiometry voltammetry for chemical analysis.  Elementary idea for radiochemical methods.  Basic idea of X-ray analysis and electron spectroscopy.
	INORGANIC MATERIALS OF INDUSTRIAL IMPORTANCE CEMHTDSE-3B		Discussion about the Silicate Industries, Fertilizers, surface coatings on the materials and their application.  Introduction of Solid-state electrolyte, battery, Fuel cells, Solar cell and polymer cell.  Different catalysis and their activity in industrial application and introduction about explosives.  Practical application of the materials
	INSTRUMENTAL METHODS OF CHEMICAL ANALYSIS LAB CEMHPDSE-3A	DSEP3 (Any one)	Study of IR absorption spectra. Determination of Ca, Fe, Cu in food by atomic absorption, steroids, pollutants from wastes, fibre analysis, caffeine in beverages by HPLC. Idea of DNA testing, analysis of mitochondrial DNA.

	INORGANIC MATERIALS OF INDUSTRIAL IMPORTANCE LAB CEMHPDSE-3B		Determination of free acidity in fertilizers, composition of dolomite.  Estimation calcium, phosphoric acid in fertilizer.  Analysis of Fe in cement, Preparation of pigment (ZnO).
	GREEN CHEMISTRY CEMHTDSE-4	DSET4	Introduction to Green Chemistry, Principles of green chemistry and designing a chemical synthesis, examples and future trends.
	GREEN CHEMISTRY CEMHPDSE-4	DSEP4	Preparation and characterization of nanoparticles, biodiesel using safer starting materials. Uses of alternative green solvents, alternative sources of energy.
	PROJECT DSEPROJ-5	DSE-4 (Alternative of 'Green Chemistry')	Dissertation followed by power point presentation.
	PHARMACEUTICAL CHEMISTRY CEMHSE-2A	SE-2 (Any one)	Development and design of drugs, basic retrosynthetic approach, different classification of drugs. Knowledge of aerobic and anaerobic fermentation. Preparation and analysis of aspirin and antacid.
	ANALYTICAL CLINICAL BIOCHEMISTRY CEMHSE-2B		Idea of biomolecules like carbohydrates and amino acids, proteins, nucleic acids-their basic chemistry.  Idea of biochemistry of disease: Composition and functions of blood, composition and estimation of constituents of normal and pathological urine.

Meaning of terms:

DC : Discipline Course

DSE : Discipline Specific Elective Course

SEC : Skill Enhancement Course

PROGRAMME SPECIFIC OUTCOMES (PSO):

PSO1: Upon successful completion of the B.Sc Honours programme students should be able to understand essential facts, concepts, principles and theory relating to chemistry and should apply such knowledge to solve problems.

PSO2: They will acquire communication skills, both oral and written in subject.

PSO3: They acquire the skills of mathematical numerical calculation, error analysis and data representation.

PSO4: They will learn to use computers to solve chemical problems as well as for information retrieval. They will acquire skills in the practical application of theory using computer software and models.

PSO5: Most importantly, they will learn to the techniques of safe handling of hazardous chemicals in the laboratory, monitor reactions, conduct laboratory experiments which are documented in chemical literature, and report the research results in proper format.

Mapping:

PO1 (Critical Thinking)	PO2 (Effective Communication)	PO3 (Social Interaction)	PO4 (Ethics)	PO5 (Laboratory Skill & Instrumentation)	PO6 (Environment & Sustainability)	PO7 (Self directed & lifelong learning)
<u>DCT1</u>	<u>DCT2</u>	<u>DCT1</u>	<u>DCT3</u>	<u>DCP2</u>	<u>DCT1</u>	<u>DCT1</u>
<u>DCT2</u>	<u>DCT5</u>	<u>DCT2</u>	<u>DCT4</u>	<u>DCT3</u>	<u>DCT4</u>	<u>SE1</u>
<u>DCT3</u>	<u>DCT8</u>	<u>DCT3</u>	<u>DSET2</u>	<u>DCT4</u>	<u>DCT7</u>	<u>SE2</u>
<u>DCT4</u>	<u>DSE1</u>	<u>DCT4</u>	<u>DSET3</u>	<u>DCT5</u>	<u>DCT12</u>	
<u>DCT5</u>	<u>DSET4</u>	<u>DCT5</u>	<u>SE2</u>	<u>DCT6</u>	<u>DSET2</u>	
<u>DCT6</u>		<u>DCT6</u>		<u>DCT7</u>	<u>DSET4</u>	
<u>DCT7</u>		<u>DCT7</u>		<u>DCT8</u>	<u>DSE4</u>	
<u>DCT8</u>		<u>DCT8</u>		<u>DCT9</u>		
<u>DCT9</u>		<u>DCT9</u>		<u>DCT10</u>		
<u>DCT10</u>		<u>DCT10</u>		<u>DCT11</u>		
<u>DCT11</u>				<u>DCT12</u>		
<u>DCT12</u>				<u>DSE4</u>		
				<u>SE2</u>		

