

**P. R. THAKUR GOVT. COLLEGE,
THAKURNAGAR**

Department of Chemistry

**Course outcome of core course and generic
course**

1. Core Course in Chemistry (B.Sc. Honours under CBCS)

Semester	Course code	Course details	Outcome of Course
I	CEMACOR01T	Organic Chemistry-I	Detailed understanding of basic knowledge on bonding in organic molecules and others physical parameters and stability factors. Students will also understand about aromaticity and delocalization. Additionally, concept of reaction mechanism will help students to build up knowledge about pathway of chemical conversion, types of reagents, reaction condition etc. Simultaneously study on reaction intermediates gives idea to find out a possible reaction path for an unknown reaction. Moreover, the stereochemistry part involves the study of the relative spatial arrangement of atoms that form the structure of molecules and their manipulation. The study of stereochemistry focuses on stereoisomers, which by definition have the same molecular formula and sequence of bonded atoms (constitution), but differ in the three-dimensional orientations of their atoms in space.
	CEMACOR01P	Organic Chemistry-I Lab	Students will experience hand on training regarding quantitative separation of organic compounds using several techniques. They will also get training on determination of boiling point with some common organic solvents. It will help to detect proper solvent for a particular reaction in their future. Moreover, they will experience hand on training regarding and skill development for identification of Organic Compounds by Chemical Tests which will help to detect the nature of compounds and their chemical behaviour.
	CEMACOR02T	Physical Chemistry-I	Students will achieve a clear concept on the kinetic theory of gases along with Maxwell speed and energy distribution and the behaviour of real gases. In general temperature-pressure concept, concept of some physical parameters and role of some physical factors viz., temperature, pressure etc. on collisions of gas molecules will be gained. Behaviour of real gases and the extent of their deviation from ideal behaviour is also clearly understood. A detailed understanding of thermodynamics with some important functions. An elaborated discussion of first, second and third law of thermodynamics is made. Chemical kinetics is an important aspect in physical chemistry. Students will get the experience on rate of chemical equation and allied parameters. How temperature and pressure play a significant role on chemical kinetics, will be understood

			clearly. Concept of reaction mechanism will be achieved from the understanding of this aspect.
	CEMACOR02P	Physical Chemistry -I Lab	Students will experience a hands on training on both analytical and instrumentation techniques in carrying out physical experiments. pH determination and determination of heat of neutralization, heat of solution etc. kinetic studies on different reactions are very important areas of learning.
II	CEMACOR03T	Inorganic Chemistry-I	Understanding of different atomic models, and writing electronic configuration and ground state term symbol. Understanding of modern periodic law and periodic properties of elements, different theories of acids and bases, concept of pH, acid-base equilibrium, and neutralization titration. Getting the basic idea about redox reaction, redox potential, factors affecting redox potential, representation of redox potential diagram and basics of solubility product and its application on group separation.
	CEMACOR03P	Inorganic Chemistry-I Lab	Hands on experiences on acid base and redox titrations.
	CEMACOR04T	Organic Chemistry-II	<p>This part offers basic knowledge on stereochemistry and fundamentals of chiral axis, atropisomers, pseudoasymmetry, conformational isomers etc. Also, from this portion students can get a clear idea about stereogenicity of simple as well as complex molecules having axial chirality, potential energy barriers of different conformers, preferred conformation of functional molecules in their ground state.</p> <p>From the reaction kinetics and thermodynamics portion students can acquire thorough background knowledge on reaction thermodynamics (How far?): free energy and equilibrium, enthalpy and entropy as well as Reaction kinetics (How fast?): rate constant and free energy of activation; concept of order and molecularity etc.</p> <p>Concept of organic acids and bases and tautomerism will help the students to build up knowledge about different molecules and their chemical nature.</p> <p>Idea about Substitution and Elimination Reactions may help regarding reaction of organic molecules, several aspects which affect the reaction mode, rate, products etc. This is extremely important to understand various chemical phenomena of organic molecules under different condition and reagents.</p>

	CEMACOR04P	Organic Chemistry-II Lab	From this portion students can acquire thorough background knowledge about qualitative as well as quantitative synthesis of organic molecules. There will be a hand on experience of Yield calculation, Purification, Crystallization and MP detection which may help students to evaluate and characterize the synthesized products with rigorous literature survey
III	CEMACOR05T	Physical Chemistry-II	Transport properties of fluids and related phenomena are also very important areas of learning. Students will understand fluid flow in relation to viscosity and allied parameters. Understanding of conduction in electrochemistry and transport number and also equilibrium in ions. Students will also achieve their knowledge in various aspects of thermodynamics. They will learn partial properties and chemical potential along with application of thermodynamics in chemical reactions and equilibrium. They will also gain the basic concept of quantum mechanics viz., black body radiation, concept of operators, particle in a box, simple harmonic oscillator etc.
	CEMACOR05P	Physical Chemistry-II Lab	Students will experience a training on both analytical and instrumentation techniques in carrying out physical experiments. As a part of analytical experiments, students will determine some physical parameters viz., coefficient of viscosity, partition coefficient etc. They will also be trained on operation of conductometer and will do titration and other experiments using conductometer.
	CEMACOR06T	Inorganic Chemistry-II	Understanding of basics about ionic bonding, covalent bonding, metallic bonding, and different weak chemical forces related to bonding, Factors affecting bonding, shape of molecules and modern concept of covalent bonding, inner structure of atomic nucleus and theories related to its stability, radioactivity and its applications, isotope and its separations and applications, power generation using nuclear reactions.
	CEMACOR06P	Inorganic Chemistry-II Lab	Hands on experiences on some iodo/iodimetric titrations, and estimation of some metal ions in some important alloys/substances.
	CEMACOR07T	Organic Chemistry-III	This part aims to offer basic knowledge on reaction chemistry of alkenes and alkynes. How reagent jugglery causes different fictionalization on simple π -bonds is the main focus of our discussion.

			Moreover, the portion provides most important reactions in synthetic organic chemistry. Such reactions are used for the synthesis of important intermediates that can be used as precursors for the production of pharmaceutical, agrochemical and industrial products. They will also be able to explain the relative reactivity of carbonyl compounds toward various reactions. Moreover, organometallic compounds are widely used both stoichiometrically in research and industrial chemical reactions, as well as in the role of catalysts to increase the rates of such reactions (e.g., as in uses of homogeneous catalysis), where target molecules include polymers, pharmaceuticals, and many other types of practical products.
	CEMACOR07P	Organic Chemistry-III LAb	Students will experience hand on training regarding quantitative separation of organic compounds using several techniques. These classes may help students to develop their skills regarding laboratory experiments of various RNDs and research.
	CEMSSEC001	Basic Analytical Chemistry	Understanding of basics of analytical chemistry, analysis of soil, water, food products and cosmetics. Getting the basics of chromatographic separation technique s mainly thin layer, column and ion exchange.
IV	CEMACOR08T	Physical Chemistry-III	Students will learn the application of thermodynamics in colligative properties, viz., vapour pressure of solution, elevation of boiling point, depression of freezing point and osmotic pressure. They will understand phase rule and various aspects of electrical properties of molecules. They will get the detailed concept of Debye Huckel limiting law along with ionic atmosphere, mean ionic activity coefficients etc. They will also learn the application of quantum mechanics in angular momentum, hydrogen atom and hydrogen like ions etc.
	CEMACOR08P	Physical Chemistry-III Lab	Students will experience a training on determination of solubility product of some sparingly soluble salts. They will achieve hands on experience on experimentation with potentiometer, pH meter. etc. They will do the titration with the help of these equipments and will find out some important physical parameters which are very important in physical chemistry.
	CEMACOR09T	Inorganic Chemistry-III	Understanding of basic principles and methodologies used in extraction, purification of

			elements, chemistry of some s-and p -block elements, idea about noble gases and their compounds particularly based on xenon. Getting basic concept on inorganic polymer and applications of some inorganic polymers. Getting basic idea on coordination compounds, its theory, nomenclature and isomerism.
	CEMACOR09P	Inorganic Chemistry-III Lab	Hands on experiences based on complexometric titration and syntheses of some coordination compounds.
	CEMACOR10T	Organic Chemistry-IV	Detailed understanding of nitrogen compounds including their physical and chemical properties, synthesis, separation, and application in industries. Understanding the type of rearrangements to explain the mechanism for various organic reactions along with evidence and stereochemical features. The logic of organic synthesis will introduce them to the disconnection approach, asymmetric synthesis, and ring synthesis strategy. This knowledge will help them to find out proper pathway to synthesize large organic molecules with proper stereochemistry. Understanding organic spectroscopy will help them to identify or find the structure of unknown organic molecules from their spectroscopic data.
	CEMACOR10P	Organic Chemistry-IV Lab	Hands-on training on quantitative estimation of glycine, glucose, sucrose, vitamin-C, aniline, phenol, formaldehyde, acetic acid, urea, and saponification value of oil/fat/ester.
	CEMSSEC002	Analytical Clinical Chemistry	Understanding the structure, function, and biological importance of various biomolecules like carbohydrates, proteins lipids, lipoproteins, DNA, and RNA. Understanding on biochemistry of diseases by studying various diagnostic approaches by blood and urine analysis. Hands-on training on identification and estimation of carbohydrates, lipids, iodine number in oil, cholesterol, protein and nucleic acids.
V	CEMACOR11T	Inorganic Chemistry-IV	Understanding of different theories of Coordination compounds, and its application on explaining different properties. Understanding of trends in properties of transition elements, lanthanides and actinides.
	CEMACOR11P	Inorganic Chemistry-IV Lab	Hands on experiences on paper chromatographic separations of mixture of ions, gravimetric estimation of some ions, and spectrophotometric determination of 10Dq and λ_{max} values of some complexes.

CEMACOR12T	Organic Chemistry-V	Detailed understanding of structures, stereochemistry, physical and chemical properties, synthesis and reactions of carbocycles, heterocycles, cyclic stereochemistry, pericyclic reactions, carbohydrates and biomolecules
CEMACOR12P	Organic Chemistry-V Lab	Hands-on training on chromatographic separations by paper chromatography, thin layer chromatography, and column chromatographic techniques of a mixture containing amino acids, dyes and sugars.
CEMADSE01T	Advanced Physical Chemistry	Students will learn crystal structure. An elaborated study on crystal lattice, types of solids, Bragg's law, crystal planes etc. will also be learnt. In statistical thermodynamics studies on molecular partition function, Boltzmann distribution, thermodynamic probability will enrich their knowledge in theoretical work in future.
CEMADSE01P	Advanced Physical Chemistry Lab	Students will experience a training on both analytical and instrumentation techniques in carrying out physical experiments. As a part of analytical experiments, students will determine some physical parameters viz., coefficient of viscosity, partition coefficient etc. They will also be trained on operation of conductometer and will do titration and other experiments using conductometer.
CEMADSE02T	Analytical Methods in Chemistry	Learning of computer programming based on numerical methods for root equation, numerical differentiation, numerical integration, matrix operations will make the students expert in computer world.
CEMADSE02P	Analytical Methods in Chemistry Lab	Hands on experiences on separation of different mixtures based on chromatography, solvent extraction, analysis of soil sample, and determination of ion exchange capacity, and spectrophotometric determination of pK_a values of indicator, BOD and COD.
CEMADSE03T	Instrumental Methods of Chemical Analysis	Understanding the role of spectroscopic methods in chemical analysis; principle, instrumentation of IR, UV-Visible and near IR, NMR spectroscopies, chromatography, and their applications; principles of elemental analysis, atomic absorption, emission and fluorescence spectroscopies, potentiometry and voltammetry; basic idea on radiochemical methods of analysis and X-ray analysis and electron spectroscopy.
CEMADSE03P	Instrumental Methods of Chemical Analysis Lab	Hands on experiences about analyses based on IR, UV-Visible, NMR, atomic absorption, emission and

			fluorescence spectroscopies, chromatography, potentiometry and voltammetry.
VI	CEMACOR13T	Inorganic Chemistry-V	Understanding of bioinorganic chemistry, basics of organometallic compounds and their applications, and Reaction mechanism kinetics of different types of inorganic reactions.
	CEMACOR13P	Inorganic Chemistry-V Lab	Hands on experience on qualitative analysis of mixtures containing four radicals.
	CEMACOR14T	Physical Chemistry-IV	Students will learn the spectroscopy of molecules. Different kinds spectroscopy viz., rotational, vibrational, Raman, NMR, ESR etc. are the important area where there is a major scope to learn. They will know the interaction of electromagnetic radiation with molecules and subsequent transition in between energetic states. Hence will try to find out the structure of molecules. They will also learn the detailed about the photochemistry and different photochemical process. The kinetics of some photochemical reactions will also be taught. Surface chemistry is also very important area where a lot of things may be learnt. Students will learn different surface phenomena in respect of solid and liquid. Study of surface tension and surface energy, adsorption of different kinds of molecules onto the surface and properties of colloids will also increase their knowledge.
	CEMACOR14P	Physical Chemistry-IV Lab	Hands on training on the determination of various parameters related to physical properties viz., surface tension, critical micelle concentration (CMC), etc. by analytical methods. They will also use instrument like spectrophotometer to study different photochemical reactions. By this way a concrete knowledge on experimentation will be gained.
	CEMADSE04T	Green Chemistry	Detailed understanding of need, goals, limitations, and principles of Green chemistry. Application and examples of green chemistry in designing a chemical synthesis.
	CEMADSE04P	Green Chemistry Lab	Hands-on training for various green chemistry related issues like the use of safer starting materials, avoiding waste, use of renewable resources, use of enzymes as catalysis, alternative green solvents, and alternative source of energy.
	CEMADSE05T	Inorganic Materials of Industrial Importance	

	CEMADSE05P	Inorganic Materials of Industrial Importance Lab	
	CEMADSE06T	Polymer Chemistry	Polymer Chemistry, polymer science have a major impact in industry. A basic knowledge at the undergraduate level is very essential. Here students will learn polymers, polymerization, different types of polymers and polymerization process along with kinetics of polymerization and various physical and chemical properties. They will know how to produce polymers used by industry and their properties and areas of applications.
	CEMADSE06P	Polymer Chemistry Lab	Hands-on training on preparation of various polymers, viz., polyethylene (PE), poly propylene (PP), polyvinyl chloride (PVC), Nylon, Phenol formaldehyde, urea formaldehyde resin etc. These training is believed to be extremely helpful if the students move for industrial assignments.

2.Generic Course in Chemistry (B.Sc. Generic under CBCS)

Semester	Course code	Course details	Outcome of Course
I	CEMHGEC01T	Inorganic Chemistry-I & Organic Chemistry-I	1. Understanding of extranuclear shell structure of an atom based on different atom model, and writing electronic configuration. Classification of elements based on modern periodic law and understanding of periodic properties. Understanding of different theory of acids and bases and factors affecting their strengths and understanding of different properties based on acids and basic nature of substances. Understanding of elementary idea about redox reaction and its balancing. 2. Detailed understanding of fundamental properties of organic chemistry, basic stereochemistry, reaction mechanism for substitution and elimination reactions, and aliphatic hydrocarbons.
	CEMHGEC01P	Inorganic Chemistry-I Lab & Organic Chemistry-I Lab	1. Hands on experience based on acid-base and redox titrations. 2. Hands-on training on qualitative analysis of solid organic samples.

II	CEMHGEC02T	Physical Chemistry-I & Inorganic Chemistry-II	<p>1. A detailed understanding on the kinetic theory of gases and real gases. Viscosity of gases and subsequent dependence of the same with pressure and temperature. Studies on surface phenomena of liquids and in-depth study of solids and reaction kinetics will add the knowledge of the students.</p> <p>2. Understanding the nature of chemical bonding and its effect on the properties of substances. Understanding of properties of elements of different groups.</p>
	CEMHGEC02P	Physical Chemistry-I Lab & Inorganic Chemistry-II Lab	<p>1. Hands on training of physical experiments like determination of surface tension, viscosity and kinetic study will make the students expert.</p> <p>2. Systemic identification of ions in a given mixture of salts.</p>
III	CEMHGEC03T	Physical Chemistry-II & Organic Chemistry-II	<p>1. A detailed understanding on Chemical energetics, chemical and ionic equilibrium. Studies on chemical thermodynamics and inter relationship of various physical thermodynamic parameters will increase the knowledge.</p> <p>2. Functional group approach for the preparations & reactions to be studied in context to the structures of aromatic hydrocarbons, organometallic compounds, aryl halides, alcohols, phenols, ethers and carbonyl compounds. .</p>
	CEMHGEC03P	Physical Chemistry-II Lab & Organic Chemistry-II Lab	<p>1. Hands on training of physical experiments on calorimeter in order to determination of heat capacity, enthalpy of neutralization. Determination of pH of some unknown solutions.</p> <p>2. Systemic identification of pure solid and liquid organic compounds.</p>
IV	CEMHGEC04T	Physical Chemistry-III & Analytical and	<p>1 Studies on solutions and phase equilibrium along with conductance and electromotive force will expand</p>

		Environmental Chemistry	<p>the level of knowledge which in the long run will be highly beneficial.</p> <p>2. Understanding of basics of gravimetric, volumetric and chromatographic methods of analysis and few estimations based on these principles.</p>
	CEMHGEC04P	Physical Chemistry-III Lab & Analytical and Environmental Chemistry Lab	<p>1. Hands on experiments on conductometry and potentiometry will enable the skill of doing experimental work.</p> <p>2. Hands on experience based on complexometric, redox, and acid-base titrations.</p>