



Mahatma Gandhi Vidyamandir's  
**Arts, Commerce &  
Science College,  
Malegaon City.**

# CHEMISTRY

PO-PSO-CO

### **Programme Outcomes**

- PO1. B.Sc. Chemistry curriculum is so designed to provide the students a comprehensive understanding about the fundamentals of chemistry covering all the principles and perspectives.
- PO2. The branches of Chemistry such as Organic Chemistry, Inorganic Chemistry, Physical Chemistry and Analytical Chemistry expose the diversified aspects of chemistry where the students experience a broader outlook of the subject.
- PO3. The syllabi of the B.Sc. Chemistry course are discretely classified to give stepwise advancement of the subject knowledge right through the three years of the term.
- PO4. The practical exercises done in the laboratories impart the students the knowledge about various chemical reagents and reactions. Thereby, developing their skills of handling the corrosive, poisonous, explosive and carcinogenic chemicals making themselves employable in any kind of chemical industries. They are also trained about the adverse effects of the obnoxious chemicals and the first aid treatment.

### **Programme Specific Outcomes (Physical Chemistry)**

- PSO1. The students will understand the existence of matter in the universe as solids, liquids, and gases which are composed of molecules, atoms and sub atomic particles.
- PSO2. Students will introduce core area of physical chemistry, based around the themes of systems, states and processes. Topics covered are quantum mechanics and structure, chemical thermodynamics, phase changes, and chemical kinetics.
- PSO3. The laboratory component provides training in a range of theoretical and applied physical chemistry techniques which are relevant to both industrial and research settings.
- PSO4. Enormous job opportunities at all level of chemical, pharmaceutical, food products life oriented material industries.
- PSO5. All theoretical concepts are implemented in Physical Chemistry.
- PSO6. Students solve problems in Physical Chemistry by using appropriate methodologies
- PSO7. Contribute to team and group work for scientific investigation and reporting.

### **Program Specific Outcomes (Inorganic Chemistry)**

- PSO1. Students will learn to estimate inorganic salt mixtures and organic compounds both qualitatively and quantitatively using the classical methods of analysis in practical classes.

### **Program Specific Outcomes (Organic Chemistry)**

- PSO1. Students will grasp the mechanisms of different types of reactions both organic and inorganic and will try to predict the products of unknown reactions.
- PSO2. Students will learn to synthesize the chemical compounds by maneuvering the addition of reagents under optimum reaction conditions.
- PSO3. Students interpret concept of aromaticity and its properties.

### **Program Specific Outcomes (Analytical Chemistry)**

- PSO1. Know and express the Qualitative and Quantitative analysis.
- PSO2. Understand the fundamentals of analytical chemistry and steps of a characteristic analysis.
- PSO3. Expresses the role of analytical chemistry in science.
- PSO4. Estimates kinds of errors in chemical analysis & evaluates the effects of systematic errors on analytical results.

PSO5. Compare of the experimental mean with true value and two experimental means, determine the detection limits.

PSO6. Interpret the statistical tests also sources of random errors and effects of random errors on analytical results.

#### **Program Specific Outcomes (Industrial Chemistry)**

PSO1. All theoretical concepts are implemented in practical which make a student industry ready.

PSO2. Content of the course prepare a student for self-entrepreneurship.

PSO3. The syllabi of the course is a good platform for higher level course in industries. .

PSO4. The course is designed to support automation and digitization in all walks of life.

PSO5. Ability to apply the knowledge gained during the course of the program from Mathematics, Basic Computing, Basic Sciences and Social Sciences in general and all computer science courses in particular

PSO6. To identify, formulate and solve problems faced in industries and/or during research work with due consideration for the public health and safety, in the context of cultural, societal, and environmental situations.

#### **Program Specific Outcomes (Biochemistry)**

PSO1. Understand the principles of various fields of chemistry and biology (organic chemistry, analytical chemistry, biochemistry, genetics, metabolism, and molecular biology)

PSO2. Be able to work with others demonstrating leadership and collaborative skills

PSO3. Apply modern instrumentation theory and practice to biochemical problems

PSO4. Present the results, conclusions, and relevance of scientific experiments to a specific audience

PSO5. Develop as independent thinkers who are responsible for their own learning

#### **Program Specific Outcomes (Medicinal Chemistry)**

PSO1. Know basics of medicinal chemistry, biophysical properties and overview of basic concepts of traditional systems of medicine.

PSO2. Over view of the overall process of drug discovery, and the role played by medicinal chemistry in this process.

PSO3. Understand biological activity parameters and importance of stereochemistry of drugs and receptors.

PSO4. Knowledge of mechanism of action of drugs belonging to the classes of infectious and non-infectious diseases.

PSO5. Enhancement of practical skills in synthesis, purification and analysis by project work.

#### **Program Specific Outcomes (Environmental Chemistry)**

PSO1. Know the importance and conservation of environment, biogeochemical cycles.

PSO2. Know Hydrosphere and Water Pollution, Water resources, Hydrological Cycle, Organic and inorganic pollutant, Water quality parameters and Analytical Techniques in water Analysis

#### **Program Specific Outcomes (Soil and Agriculture Chemistry)**

PSO1. Know the different components and properties of soil.

PSO2. Classification of soil on the basis of pH, different plant nutrients required for plants and their functions, role of various fertilizers and manures required for plant growth.

PSO3. Identify the problematic soil and recommend method for their reclamation.

PSO4. Know the various methods and their techniques in analysis of soil.

PSO5. Know importance of manures as compared to chemical fertilizers, various techniques to protect the plants.

PSO6. Have the knowledge of various pesticides, insecticides, fungicides and herbicides.

### **Program Specific Outcomes (Cosmetics and Perfumes Chemistry)**

PSO1. Chemistry of Cosmetics and Perfumes

PSO2. Chemistry of Perfumes and fragrances

### **Course Outcomes**

CO1. To acquaint the students with the developments in Prose and poetry.

CO2. To enable the students to evaluate, analyses, appreciate prose and poetry.

## **F.Y. B.Sc.**

### **Physical Chemistry**

CO1. Apply thermodynamic principles to physical and chemical processes also applications of it.

CO2. Relate Chemical equilibrium with free energy gas equilibrium – equilibrium constant, Vant Hoff's equation and its application.

CO3. Understand concept of ionisation processes, common ion effect, solubility product, buffer solutions and pH scales.

### **Organic Chemistry**

CO1. Understand the fundamental principles and recent developments in subject area.

CO2. Be inspired and develop interest towards chemistry as the main subject.

CO3. Familiar with the current and recent development in Chemistry and research and development in chemistry.

### **Chemistry Practical**

CO1. Aware the importance of chemical safety and lab safety while performing experiments in laboratory.

CO2. Understand the determination of thermochemical parameters and related concepts.

CO3. Understand the technique of pH measurements.

CO4. Prepare the buffer solutions.

CO5. Analyse the elements of organic compounds.

CO6. Understand chromatographic techniques for separation of constituents of mixtures.

### **Inorganic Chemistry**

CO1. Understand theories and principles applied to atomic structure, quantum mechanics and related important Schrodinger equation with radial and angular wave functions.

CO2. Understand the properties in details regarding effective, atomic and ionic size, crystal and covalent radii, ionisation energies, electro negativity and it's scale.

CO3. Understand attainment of stable electronic configurations, various types of chemical bonds, lattice and solvation energy, Born – Haber cycle its application Fajan's rule, dipole moment and percentage ionic character, hybridization, VSEPR theory, geometry of compounds.

### **Analytical Chemistry**

- CO1. Understand analytical chemistry, perspective of analytical chemistry, analytical problems.
- CO2. Understand various methods of expressing concentrations with their units and their methods of calculation which will be helpful for preparation of solution, relation between molecular formula and empirical formula, stoichiometric calculations, equilibrium concentration and percent concentrations unit, distinction between mass and weight.
- CO3. Understand the determination of type, characteristic tests and classifications, reactions of different functional groups with elements detection and purification of organic compounds.
- CO4. Understand basics of chromatography and types of chromatography, theoretical background for paper and thin layer chromatography.
- CO5. Understand measurement of pH, electrodes for measurement of pH, application of pH meter.

### **Chemistry Practical**

- CO1. Understand Inorganic Estimations using volumetric analysis.
- CO2. Understand Synthesis of inorganic compounds.
- CO3. Understand Analysis of commercial products.
- CO4. Purify organic compounds.
- CO5. Understand preparation and mechanism of reaction mechanisms.

## **S.Y. B.Sc.**

### **Physical and Analytical Chemistry**

- CO1. Understand concept of kinetic rate laws, derive the rate of reaction of different order of reaction with example also determine order of reaction using Integrated rate equation, graphical, half-life and differential methods. Explain and derive Arrhenius equation with energy of activation, collision theory and transition state theory of bimolecular reaction
- CO2. Define and discuss adsorption, physisorption and chemisorption, different factors Influencing adsorption, explain adsorption isotherms of Freundlich, Langmuir and BET theory
- CO3. Define and explain accuracy and precision also analyse the methods of expressing errors in quantitative analysis.
- CO4. Explain and define different terms in volumetric analysis also explain pH range of colour changes, construct acid – base titration and , complexometric titration, precipitation titration and redox titration curves.

### **Inorganic and Organic Chemistry**

- CO1. After studying the M. O. T students able to define terms related to M. O. T, explain LCAO principle, draw MO energy level diagram for homo and hetero diatomic molecules and determine bond order and magnetic property of molecules and explain stability of molecules.
- CO2. Different terms related to the Co-ordination Chemistry, explain Werner's theory of coordination compounds and can be able to differentiate between primary and secondary valency, correlate coordination number and structure of complex ion. IUPAC nomenclature to coordination compound.
- CO3. Identify and draw the structure of aromatic hydrocarbons and synthesis of aromatic hydrocarbons and mechanism of reactions involved with important reactions, correlate reagent and reactions.
- CO4. Identify and draw the structures of alkyl and aryl halides from their names or from structure name can be assigned. Also discuss the synthesis of them, mechanism of nucleophilic substitution reactions and importance of alkyl or aryl halide, also correlate reagent and reactions.

CO5. Identify and draw the structures of alcohols and phenols from their names or structure, synthesis of them also mechanism of various reactions with correlation of reagent, give synthesis of expected alcohols or phenols.

### **Practical Chemistry III**

CO1. Communicate effectively in both written and oral forms, keep a laboratory notebook and record careful observations and elicit the conclusions what they have learned.

CO2. Interpret and analyse data collected in laboratory, create graphs, compare quantitative data and draw conclusions about data obtained

CO3. Think critically, abstractly and logically, work with variety of technologies such as computer, data acquisition equipment, microscopes, digital devices, media, the Internet for scientific information and knowledge.

CO4. Exhibit social and ethical responsibility, perform productivity in the workforce and demonstrate the ability to learn independently

### **Physical and Analytical Chemistry**

CO1. Understand the terms in phase equilibria, types of equilibrium, derive phase rule of one component system such as water, carbon dioxide and sulphur system

CO2. Define and differentiate ideal and non-ideal solutions, and interpret V. P and T composition diagram, discuss azeotropes, lever rule, Henry's law and its applications, also explain UCST and LCST, distribution law, apply solvent extraction to separate the components of mixture.

CO3. Explain and define terms of conductometry, Kohlrausch's law and its applications, conductometric titrations and application of analysis to real problem in analytical laboratory.

CO4. Define and explain terms of colorimetry, derive Beer's law of absorptivity and apply colorimetric methods of analysis to real problem in analytical laboratory.

CO5. Get information regarding column chromatography and related terms and application for separation of substances.

### **Inorganic and Organic Chemistry**

CO1. Know isomerism in coordination complexes with different types of isomerism.

CO2. Apply VBT to explain bonding in coordination compound of different geometries, explain inner and outer orbital complexes.

CO3. Explain CFT for different types of complexes with strong field and weak field ligand approach, also explains the magnetic properties and origin of coordination complex, stabilisation energy and spectrochemical series, Jahn Teller effects in Cu(II) Oh complexes.

CO4. Draw and explain synthesis and structures of aldehyde ketone with mechanism, correlate reagent and reactions of them.

CO5. Draw and explain synthesis of carboxylic acids and their derivatives with mechanism. Also correlate reagent and reactions of carboxylic acid and their derivatives.

CO6. Identify, draw and synthesis carboxylic amines with mechanism and correlate reagent and reaction of carboxylic amines, also synthesis diazonium salt from amines.

CO7. Understand stereochemistry of cyclohexane draw different conformations and convert them into another confirmation, also explain stability w. r. t P. E.

### **Practical Chemistry**

- CO1. Demonstrate the ability to learn independently, give independent projects with proper reasoning of their work, report their results confidently.
- CO2. Gain awareness of their role in the global community, connect to other occupations and careers on the basis of their choice of interest.
- CO3. Verify theoretical principles experimentally by interpreting their data's and explain practical output by correlation with theory.
- CO4. Perform organic and Inorganic synthesis by suitable methods
- CO5. Set up the apparatus, prepare the solutions for the designed experiments.
- CO6. Perform the quantitative chemical analysis of substances.
- CO7. Perform productively in the workforce, utilise the body, the mind and the heart for both spatial and analytical reasoning for excellent preparation.

### **T.Y. B.Sc.**

#### **Physical Chemistry I**

- CO1. Know historical of development of quantum mechanics in chemistry, differences between classical and quantum mechanics, wave functions.
- CO2. Understand the operators, solving Schrodinger equation for 1D, 2D and 3D model
- CO3. Physical interpretation of the  $\psi$  and  $\psi^2$  and sketching the wave function, Applications to conjugated systems, zero-point energy. etc
- CO4. Understand the terms and meanings used in Investigation of Molecular Structure
- CO5. Determination of molecular structure by different methods.
- CO6. Study of different Molecular spectra such as Rotational, Vibrational, Raman, Raleigh spectra
- CO7. Know the difference between thermal and photochemical processes, photochemical laws: Grothus-Draper, Stark-Einstein law.
- CO8. Determination of quantum yield also factors affecting on it
- CO9. Study Photochemical reactions: photosynthesis, photolysis, photocatalysis and photosensitization and various phenomenon: fluorescence, phosphorescence etc.
- CO10. Solving the problems on each topic.

#### **Analytical Chemistry I**

- CO1. Explain different principles involved in the gravimetry, spectrophotometry, parameters in instrumental analysis, qualitative analysis.
- CO2. Perform quantitative calculations depending upon equations student has studied in the theory. Furthermore, student should able to solve problems on the basis of theory.
- CO3: Design analytical procedure for given sample.

#### **Physical Chemistry Practical I**

- CO1. To determine the specific refractivity and molecular refractivity of given liquids.
- CO2: To estimate Fe <sup>3+</sup> & Co by thiocyanate and R-nitroso salt method respectively by Colorimetric Estimations.
- CO3. To determine simultaneously Cu<sup>2+</sup> and Ni<sup>2+</sup> by Colorimetry /Spectrophotometry.
- CO4. Conductometric titration of weak acid and strong acid with strong alkali.
- CO5. To determine velocity constant, equivalent conductance at infinite dilution of strong electrolytes, relative strength of monochloro acetic acid and acetic acid Conductometrically.
- CO6. To determine molecular weight of high polymer by using solutions of different concentrations.

### **Inorganic Chemistry I**

CO1. Explain electroneutrality principle and different types of pi bonding.

CO2. To able to explain Charge Transfer Spectra.

CO3. To able to explain Nephelauxetic effect towards covalent bonding.

### **Industrial Chemistry I**

CO1. Meaning of the terms involved.

CO2. They should also know the physico-chemical principals involved in manufacturing process.

CO3. To manufacture of cane juice extraction by various methods.

### **Inorganic Chemistry Practical I**

CO1. To estimate Fe, Ba, Ni as  $\text{Fe}_2\text{O}_3$ ,  $\text{BaSO}_4$  & Ni-DMG gravimetrically.

CO2. Preparation of inorganic complexes and spot tests for metal ions and ligands

CO3. Inorganic Qualitative Analysis of at least 5 mixtures containing borate and phosphate.

### **Organic Chemistry I**

CO1. To understand the reactions and mechanisms.

CO2. Synthetic applications ethyl acetoacetate and malonic ester.

CO3. To write the mechanism of some named rearrangement reactions and their applications.

### **Chemistry of Biomolecules**

CO1. The student will understanding of Cell types, Difference between a bacterial cell, Plant cell and animal cell. Biological composition and organization of cell membrane, structure and function of various cell organelles of plant and animal cell. Concepts of biomolecules, Bonds that link monomeric units to form macromolecules.

CO2. The student know the classes of enzymes with subclasses and examples. Enzyme specificity, Equations of enzyme kinetics  $K_m$  and its significance, features of various types of enzyme inhibitions, industrial applications of enzymes.

CO3. The student will understand the structure and types of amino acids. Reactions of amino acids. Properties of amino acids. Peptide bond formation. Types of proteins. Structural features in proteins. Effect of pH on structure of amino acid, Determination of N and C terminus of peptide chain.

### **Organic Chemistry Practical I**

CO1. To separate, purify and analyse binary water insoluble mixture.

CO2. To understand the techniques involving drying and recrystallization by various method.

CO3. Do and understand stoichiometric calculations and relate them to green process metrics.

### **Skills Enhancing Course I**

#### **Introduction to Medicinal Chemistry**

CO1. The basics of medicinal chemistry, biophysical properties, overview of basic concepts of traditional systems of medicine.

CO2. To Enhancement of practical skills in synthesis, purification and analysis.

CO3. To over view of the overall process of drug discovery, and the role played by medicinal chemistry in this process.

## **Skills Enhancing Course-II**

### **Environmental Chemistry**

CO1: Students should know Organic and inorganic pollutants.

CO2: Students should know importance and conservation of environment.

CO3: Students should know Organic and inorganic pollutants.

### **Physical Chemistry II**

CO1. Study of Electrochemical cells, Daniel cell, conventions used to represent electrochemical cells, thermodynamic conditions: reversible and irreversible

CO2. Study of Weston standard cell, primary and secondary reference electrodes, Construction representation, working and limitation,

CO3. Nernst Equation for theoretical determination of EMF. Applications of emf measurements.

CO4. Study of primary and secondary batteries and their applications.

CO5. Study of fuel cells, comparison of it with batteries

CO6. Study of 14 Bravais lattices, space group, seven crystal systems.

CO7. Understand Methods of Crystal structure analysis: The Laue method and Bragg's method

CO8. Derivation of Bragg's equation, Determination of crystal structure of NaCl by Bragg's method,

CO9. Know Radioactivity, types and properties of radiations: alpha, beta and gamma also the the detection and measurement of Radioactivity: Cloud chamber, Ionization Chamber, G. M counter, Scintillation counter etc.

CO10. Understand Types of radioactive decay:  $\alpha$ -Decay,  $\beta$ -Decay and  $\gamma$ -Decay, Group Displacement Law, Radioactive Disintegration Series.

CO11. Understand the kinetics of Radioactive Decay, Half-life, average life and units of radioactivity. Energy released in nuclear reaction: Einstein's equation, Mass Defect, Nuclear Binding Energy, Application of radioisotopes as a tracer: Chemical investigation- Esterification, Friedel -Craft reaction and structure determination w.r.t  $\text{PCl}_5$ , Age determination use of tritium and  $\text{C}^{14}$  dating.

CO12. Solve the problems based on all topics

### **Physical Chemistry III**

CO1. Understand meaning of the terms-Solution, electrolytes, nonelectrolytes and colligative properties, lowering and elevation of B.P. of solvent in solution, Landsberger's method, freezing point depression, Beckmann's method Osmosis and Osmotic pressure, Berkeley and Hartley method,

CO2. Application of colligative properties to determine molecular weight of nonelectrolyte, abnormal molecular weight, relation between Van't Hoff's factor and degree of dissociation of electrolyte by colligative property.

CO3. Understand factors affecting on solid state reactions, rate laws for reactions in solid state, electronic structure and macroscopic properties.

CO4. Know cohesive energy in ionic crystals, electronic structure of solids, conductors and insulators, Ionic crystals, semiconductors, cohesive energy in metals, cohesive energy of ionic crystals based on Coulomb's law and Born Haber Cycle

CO5. Understand correspondence between energy levels in the atom and energy bands in solid as band structure in solids – Na, Ca and diamond, conductors and insulators – Its correlation with extent of energy in energy bands

- CO6. Understand the phenomena of photoconductivity, semiconductors – Role of impurity in transformation of insulator into semiconductor, and its temperature dependent conductivity.
- CO7. Know History of polymers, classification of polymers, Chemical bonding & Molecular forces in Polymer
- CO8. To determine the molecular weight of polymers, practical significance of polymer molecular weights.
- CO9. To determine the Results of kinetics studies. Rate laws for reactions in solid state.
- CO10. Numericals based on all topics

### **Physical Chemistry Practical II**

- CO1. Potentiometry-To determine the PKa value of given monobasic weak acid, formal redox potential of Fe<sup>2+</sup>/ Fe<sup>3+</sup> system potentiometrically, amount of NaCl in the given solution by potentiometric titration against silver nitrate.
- CO2. To prepare standard 0.2 M Na<sub>2</sub>HPO<sub>4</sub> and 0.1 M Citric acid solution, hence prepare four different buffer solutions using them. Determine the pH value of these and unknown
- CO3. To determine the amount of NaCl in the given solution by potentiometric titration against silver nitrate.
- CO4. To determine the solubility product and solubility of AgCl potentiometrically using chemical cell.
- CO5. pH metry - To determine the degree of hydrolysis of aniline hydrochloride.  
To determine the dissociation constant of oxalic acid by pH-metric titration with strong base. To determination of Pka of given weak acid by pH metry titration with strong base
- CO6. Colligative properties - To determine the molecular weight of solute by depression in freezing point method Or To study the association of Benzoic acid in benzene by Beckmann Method.  
Determine the molecular weight of given electrolyte and non-electrolyte by
- CO7. Turbidometry- Determination of SO<sub>4</sub><sup>2-</sup> and Cl by turbidimetric method (turbidimetric titration or to determine the molecular weight of a given polymer by turbidometry
- CO8. Table work - Analysis of crystal structure from X-ray diffraction spectra of any two compounds (Calculation d, lattice constant, crystal volume and density, and assigning planes to peaks using JCPDS data)

### **Inorganic Chemistry II**

- CO1. To understand the polymers of Si, B, Si and P.
- CO2. A student should Know the metalloproteins of iron.
- CO3. A student should be able to know the types of Inorganic polymers.

### **Inorganic Chemistry III**

- CO1. A student should be able to know toxic chemical in the environment.
- CO2. Student should be able to Know about carbon nanotube and its application. CO3. Students will also come to know different properties of acids and bases.

### **Organic Chemistry II**

- CO1. Understanding the identity, purity, and percent yield of products and to summarize.
- CO2. Understanding of: how to calculate limiting reagent, theoretical yield, and percent yield. CO3. Understanding of how to dispose of chemicals in a safe and responsible manner

### **Organic Chemistry III**

CO1. Understanding how to characterize products by physical and spectroscopic means including MP, IR, NMR, GC, and MS.

CO2. Understanding how to use the scientific method to create, test, and evaluate a hypothesis

CO3. Understanding of the general reactivity of functional groups and mechanism

### **Organic Chemistry Practical II**

CO1. To Identify the functional group or groups present in a compound.

CO2. Practical knowledge of handling chemicals.

CO3. To Determine the molecular weight of given tribasic acids.

### **Skill Enhancing Course III**

#### **Chemistry of Soil and Agrochemicals**

CO1. Understood various components of soil and soil properties and their impact on plant growth, classification of the soil.

CO2. Explores the problems and potentials of soil and decide the most appropriate treatment for land use.

CO3. Useful in making decisions on nutrient dose, choice of fertilizers and method of application etc.

CO4. Got experience on advanced analytical and instrumentation methods in the estimation of soil.

CO5. Understood various Nutrient management concepts and Nutrient use efficiencies of major and micronutrients and enhancement techniques.

CO6. Understand chemistry of pesticide.

### **Skill Enhancing Course-IV**

#### **Chemistry of Cosmetics and Perfumes**

CO1. Students will know common natural raw materials, especially the basic functional group

CO2. Chemical composition, preparation and uses of some cosmetics

CO3. Know Chemistry of Cosmetics Perfumes and fragrances

CO4. Rules and regulations for cosmetic industry, Chemical composition, preparation and uses of some cosmetics