



॥ विद्या विनयेन शोभते ॥

Janardan Bhagat Shikshan Prasarak Sanstha's

**CHANGU KANA THAKUR**

**ARTS, COMMERCE AND SCIENCE COLLEGE, NEW PANVEL  
(AUTONOMOUS)**

Re-accredited 'A+' Grade by NAAC (3<sup>rd</sup> Cycle - CGPA 3.61)

'College with Potential for Excellence' Status Awarded by UGC

'Best College Award' by University of Mumbai

## Department: Chemistry

### B.Sc. (Chemistry)

PSOs	
PSO1	The students will have sound understanding of fundamental and application-based principles and theories in Physical, Inorganic, Organic and Analytical Chemistry
PSO2	Students will learn various techniques to perform scientific experiments as well as accurately record and analyse the results of such experiments
PSO3	Student will learn the usage of analytical instruments, select, and apply appropriate techniques and resources for the analysis
PSO4	Extensive laboratory and classroom work will skill the students with in problem solving, critical thinking and analytical reasoning as applied to scientific problems.
PSO5	Students will be acquainted with new areas in both chemistry and allied fields of science and technology
PSO6	Students will understand the applications and impact of the chemistry in societal, and environmental contexts, and demonstrate its knowledge and need for sustainable development
PSO7	Students will learn to apply ethical practices such as limited and safe use of hazardous chemicals, responsibility toward environmental and health safety
PSO8	solving, critical thinking and analytical reasoning as applied to scientific problems
PSO9	Students will be able to work in team and thus get prepared as a perfect professional chemist with respect to knowledge, responsibility and teamwork

COs		
Semester I		
Course (Paper) Name and No.- <b>General Chemistry – I</b>		
CO1	Recall thermodynamics terms, the first law of thermodynamics and terms like normality, and molarity.	
CO2	Solve the Numerical problems based on the Concentration of solutions	
CO3	Classify the elements according to electronic configuration and explain details of periodic trends and atomic structure.	
CO 4	Explain the name, bonding, structure and bond fission of organic compounds.	
Course (Paper) Name and No.- <b>General Chemistry – II</b>		
CO 1	Explain enantiomer, optical activity, diastereomers, projection formulas, and isomerism.	
CO 2	Outline the metallic and non-metallic nature, oxidation states, electronegativity, Anomalous behavior and allotropy of main group elements.	
CO 3	Explain the reactivity of group 1 and group 2 elements and the effects of Oxides of carbon, sulphur and nitrogen on the environment.	
CO 4	Define surface tension, Viscosity, Refractive index of Liquid, and order of reaction.	
Course (Paper) Name and No.- <b>Chemistry Practical</b>		
CO 1	Find the exact concentrations of the solutions and enthalpy of dissolution.	
CO 2	Apply chemical kinetics law to calculate the rate constant of the reaction.	
CO 3	Find the normality of the acids and bases and the purity of the samples gravimetrically.	
CO 4	Apply Thin Layer Chromatography (TLC) , Distillation, Recrystallization, and sublimation methods for separation of mixtures.	
Course (Paper) Name and No-- <b>Chemistry in Ancient India (IKS)</b>		
CO 1	Explain the ancient Indian Science and Technology.	
CO 2	Apply the knowledge of Rasayan Shastra used during the ancient period and Charaka Samhita.	
CO 3	Tell the history of Metals and Metallurgy in Ancient India.	
CO 4	Explain the knowledge of extraction and smelting of metals in ancient India.	

Course (Paper) Name and No- <b>Chemistry in Everyday Life-I (Open elective)</b>		
CO1	Students understand the role of chemistry in everyday life.	
CO2	Analyze the connection between chemistry and nutrition and life.	
CO3	Describe the impact of <b>chemistry</b> in areas of <b>human</b> activity.	
CO 4	Find the various chemicals used in daily human life.	
Course (Paper) Name and No- <b>Techniques in Environmental Analysis-I (SEC)</b>		
CO1	Categorize the various parameters for determining the water quality such as alkalinity, hardness, total dissolved solids etc.	
CO2	Apply knowledge of basic water chemistry to solve problems associated with water/ waste-water treatment and water quality.	
CO3	Understand various water treatment processes.	
CO4	Apply the basic practical knowledge for a sample of water analyses.	
Course (Paper) Name and No -- <b>Practical in Techniques in Environmental Analysis-I (SEC)</b>		
CO1	Find the $p^H$ , Acidity, and Alkalinity of the given water samples.	
CO2	Analyze the solid pollutant present in the water samples.	
CO3	Determine the total hardness and purity of the given water samples.	
Course (Paper) Name and No-- <b>Good Laboratory Practices-I (VSC)</b>		
CO1	Apply practical skills in science courses with an understanding of laboratory practices	
CO2	Understand the different aspects and laboratory techniques in Chemistry	
CO3	Make use of safety measures while working in the laboratory.	

<b>Semester II</b>		
Course (Paper) Name and No-- <b>General Chemistry – III</b>		
CO 1	Explain deviations from ideal gas laws , the Joule-Thomson effect and nanotechnology with the experimental setup.	
CO 2	Define the equilibrium constant, the Le-Chatelier Principle and the second law of thermodynamics.	
CO 3	Discuss basic terms of co-ordination chemistry, qualitative analysis and acid-base theories	
CO 4	Identify the products of reactions of alkanes, alkenes and alkynes.	
Course (Paper) Name and No-- <b>General Chemistry – IV</b>		
CO 1	Identify the shapes of molecules with and without lone pair of electrons and the oxidation number of elements to balance the redox equations.	
CO 2	Explain the Law of crystallography, the Different types of interaction of electromagnetic radiation with matter, the Degree of ionization and the Henderson equation for acidic and basic buffers.	
CO 3	Classify between aromatic, anti-aromatic, and non-aromatic compounds	
CO 4	Write the mechanism of the Electrophilic aromatic substitution reaction.	
Course (Paper) Name and No-- <b>Chemistry Practical</b>		
CO 1	Apply chemical kinetics law to calculate the rate constant of reaction.	
CO 2	Make use of a colorimeter and pH meter.	
CO 3	Identify organic compounds containing C,H (O) N, S, X elements.	
CO 4	Identify cations and anions from the given mixture of compounds and the percentage of metal present in the sample by titration.	
Course (Paper) Name and No-- <b>Chemistry in Everyday Life-II (Open elective)</b>		
CO1	Know the various compounds used in the everyday life.	
CO2	Analyse the role of chemistry in the different compounds utilised in the daily life.	
CO3	Understand the importance of chemistry in the everyday life	

Course (Paper) Name and No-- <b>Techniques in Environmental Analysis-II (SEC)</b>		
CO1	Understanding the sources and causes of soil pollution.	
CO2	Study the soil pollution to understand the various health impacts.	
CO3	List the various control measures of soil pollution.	
CO4	Determine the quality of soil of the surrounding.	
Course (Paper) Name and No-- <b>Practical in Techniques in Environmental Analysis-II</b>		
CO1	Identify the quality of soil of the surroundings.	
CO2	Develop the environmental control plan for the environmental pollution problem.	
CO3	Classify the various samples of soil according to their purity.	
CO4	Discover the various components of soil.	
Course (Paper) Name and No-- <b>Fundamentals of Chemistry (Minor)</b>		
CO1	Explain the study of chemical equilibrium	
CO2	Explain the basics of acids and bases.	
CO3	Understand the fundamentals of chemistry.	
Course (Paper) Name and No-- <b>Practical's in Minor Chemistry-I (Minor)</b>		
CO1	Prepare solutions of different Molarity/Normality.	
CO2	Determine the quality of the substance.	
CO3	Perform the estimation of fruit juices, shampoos, etc.	
CO4	Separate the mixtures by Chromatography.	

<b>Semester III</b>		
Course (Paper) Name and No.- <b>General Chemistry-I</b>		
CO1	Illustrate the equation of Gibbs free energy, Chemical potential, Transport number and degree of Ionization.	
CO2	Explain different types of ionic crystals and hybridizations.	
CO3	Construct the molecular orbital diagram of homonuclear diatomic molecules.	
CO4	Compare the different properties, reactions and reactivity of alkyl/aryl/halides/organometallic compounds/alcohol, Phenol and epoxide	

<b>Course (Paper) Name and No.- General Chemistry -II</b>		
CO1	Explain complex chemical reactions, Collision and activated complex theory, the effect of temperature on Arrhenius equation, and the thermodynamics of ideal solutions.	
CO2	Summarize the chemistry of Boron, Silicon and Germanium compounds.	
CO3	Recall the facts and basic concepts like distillation of solution, Haber process and role of active methylene compounds.	
CO4	Construct the names and methods of preparation of carbonyl group compounds.	
<b>Course (Paper) Name and No.- Paper-III (Analytical Chemistry)</b>		
CO1	Classify analytical methods and errors in analysis.	
CO2	Outline the methods of calibration of tools used and preparations for titrimetric analysis.	
CO3	Explain the principles of titrimetric analysis and UV-Visible spectroscopy.	
CO4	Apply statistical methods to treat the analytical data.	
<b>Course (Paper) Name and No.- Practical</b>		
CO1	Determination of various constants such as solubility products, dissociation constant, rate constant based on physical principles.	
CO2	Identify the ions in inorganic salts.	
CO3	Demonstrate the effectiveness of crystallization as a separation technique.	
CO4	Infer the obtained results effectively presentation	
<b>Semester IV</b>		
<b>Course (Paper) Name and No.- General Chemistry -I</b>		
CO1	Explain thermodynamics properties, equilibrium constant and different types of electrodes.	
CO2	Illustrate Gibb's Phase rule and phase diagram of one and two component system with examples.	
CO3	List the properties of transition metal compounds and different types of isomers in coordination compounds.	
CO4	Compare properties, acidity, preparations, reactions, nucleophilicity of acyl substituents of carboxylic acid and stereochemistry.	
<b>Course (Paper) Name and No.- General Chemistry -II</b>		
CO1	Explain law of crystallography, types of crystal, Interplanar distance in lattice, types of catalysis, Mechanisms and Kinetics of catalyst.	
CO2	explain the concept of hydration of cations and anions with respect to effect of charge and radius.	
CO3	Identify the hazardous effect of air pollutant like sulphuric acid, nitric acid and phosphoric acid	
CO4	Outline the synthesis, reaction of amines and heterocyclic compounds like Furan, Pyrrole, Thiophene.	

Course (Paper) Name and No.- <b>Paper-III (Analytical Chemistry)</b>		
CO1	Classify various separation methods based on their principles.	
CO2	Discuss the principles, construction and working of instrumental techniques based on the electrochemical properties of the analytes.	
CO3	Describe chemical methods of analysis and their suitable parameters.	
CO4	Apply the analytical methods to determine the physico chemical of environmental analysis.	
Course (Paper) Name and No.- <b>Practical</b>		
CO1	Find emf, amount of acid, acid strength potentiometrically.	
CO2	Compare the strength of HCl and H <sub>2</sub> SO <sub>4</sub> by kinetically.	
CO3	Calculate the amount from given sample by conductometrically and gravimetrically.	
CO4	Analyze qualitatively bifunctional organic compounds.	
Semester V		
Course (Paper) Name and No.- <b>Physical Chemistry I</b>		
CO1	Memorize the concept of dipole moment, polar and non- polar molecules, examples of colligative properties, basic terms of radioactivity and Surface tension.	
CO2	Differentiate Rotational Spectroscopy and Vibrational Spectroscopy Raman Spectroscopy, Freundlich Adsorption Isotherm and Langmuir Adsorption Isotherm	
CO3	Explain first and second law of photochemistry Raoult's law, Clapeyron equation, van't Hoff Factor.	
CO4	Apply spectroscopic data for solving different numerical, lattice space information for determination structure of unit cell and Carbon Dating Method.	

Course (Paper) Name and No.- <b>Inorganic Chemistry, Paper- II</b>		
CO1	Explain the concept of Superconductivity, types of super conductors and its applications, imperfections in solids and their effect on properties, chemistry of inner transition elements, extraction and applications, chemistry of non-aqueous solvents	
CO2	Explain electrical properties of conductors, insulators and semiconductors on the basis of Band theory. Explain Inorganic Polymers, Chemistry of interhalogens and Pseudo halogens.	
CO3	Assign the point group for given molecules using basic concepts of molecular symmetry and construct molecular orbital diagrams for heteronuclear diatomic molecules and polyatomic species.	
CO4	Determine packing density of different types of cubic unit cells	
Course (Paper) Name and No.- <b>Practical I (Physical and Inorganic Chemistry)</b>		
CO1	Handle and Understand principles of different instruments like Colorimetry, Potentiometry, Conductometry.	
CO2	Determine molecular weight of any high polymer polyvinyl alcohols by viscosity measurement.	
CO3	Interpret the order of reaction graphically from given experimental data and to calculate the specific rate constant.	
CO4	Develop the practical skills for preparation of different inorganic metal complexes	
CO5	Examine the percentage purity of the inorganic compounds qualitatively and quantitatively and impurity identification.	
Course (Paper) Name and No.- <b>Organic Chemistry, Paper-III</b>		
CO1	Explain the rate of the excited molecule in photochemistry and systematic study of photochemical reactions.	
CO2	Apply the concepts in writing and predicting the mechanism of organic reactions.	
CO3	Examine the spectral data of UV-Visible, IR, NMR and Mass spectroscopy for structure elucidation of organic compounds.	
CO4	Construct the structures of carbohydrates and its inter-conversion, describe the structures of proteins, nucleic acids and its components.	



<b>Course (Paper) Name and No.- Analytical Chemistry Paper IV</b>		
CO1	Define, and explain the concepts of quality control, quality assurance, grades of chemicals, concentrations and importance of sampling at a basic level.	
CO2	Explain the theoretical principals of titrations and apply them for end point detection and selection of suitable indicators	
CO3	Apply the Nernst law to the solvent extraction and describe the principles and processes of solvent extraction and solid phase extraction.	
CO4	Describe the role of analytical instruments in science and allied fields and explain the principles, instrumentation, working of Spectroscopic techniques.	
<b>Course (Paper) Name and No.- Organic and Analytical Chemistry Practical II</b>		
CO 1	Demonstrate the skills in quantitative analysis of the real samples such as cosmetics, environmental samples, fertilizers etc., apply appropriate methods to obtain experimental data and interpret it.	
CO2	Use instrumental techniques for the estimation of various samples, and practice calibration of instruments and preparation of standards and references.	
CO3	Identify the chemical type of components present in binary mixture of solid-solid mixture and unknown organic compound by micro-scale technique.	
CO4	Apply skills in the separation and qualitative analysis of organic compounds of solid-solid mixtures by microscale technique.	
<b>Course (Paper) Name and N: Drugs and Dyes Paper-V</b>		
CO1	Define the routes of administration, methods of ingestion, tolerance, withdrawal and interactions of these drugs with other psychoactive and non-psychoactive drugs.	
CO2	Explain details about the pharmacodynamics agents used for the treatment of different diseases side effects and synthesis.	
CO3	Classify the dyes based on applications and dyeing methods.	
CO4	Make use of Unit processes required for the synthesis of dyes intermediates.	

Course (Paper) Name and No: <b>Drugs and Dyes Paper-V</b>		
CO1	Synthesis of simple drugs i.e aspirin	
CO2	Estimation of Ibuprofen.	
CO3	Determination of iron from given drug sample.	
CO4	Project on cotton dyeing.	
<b>Semester VI</b>		
Course (Paper) Name and No.- <b>Physical Chemistry I</b>		
CO1	Recall the concept Ionic Strength, activity and activity Coefficient, examples of different polymers, and concept of nanomaterial and nanotechnology	
CO2	Differentiate between Concentration cell and chemical cell natural and artificial polymers.	
CO3	Understand cell representation rules to representation of cells phase rule to determine degree of freedom	
CO4	Apply co-precipitation method for synthesis of new nanomaterials in laboratory	
Course (Paper) Name and No.- <b>Inorganic Chemistry, Paper- II</b>		
CO1	Demonstrate the knowledge of organometallic chemistry, and metallurgy.	
CO2	Explain importance of nanomaterials, Chemical methods of synthesis of nanomaterials and forms of nanomaterials	
CO3	Construct molecular orbital diagram of different coordination compounds, Analyse the electronic spectra of complexes.	
CO4	Measure Crystal field stabilization energy (CFSE) for octahedral complexes using basic concepts of Crystal Field Theory.	
Course (Paper) Name and No.- <b>Practical I (Physical and Inorganic Chemistry)</b>		
CO1	Determine molecular weight by Rast method and order of reaction by fractional change method and Explain the adsorption phenomenon and the validity of adsorption isotherm.	
CO2	Demonstrate practical skills based on instruments such as conductometry, pH meter, potentiometry.	
CO3	Develop the practical skills for preparation of different inorganic metal complexes	
CO4	Examine the percentage purity of the inorganic compounds qualitatively and quantitatively and impurity identification.	

<b>Course (Paper) Name and No.- Organic Chemistry, Paper-III</b>		
CO1	Explain stereoselectivity, stereospecificity, mechanism and stereochemistry of substitution, elimination and addition and rearrangement reactions.	
CO2	Predict the synthons and functional group transformation and classify the selectivity of reagents and catalyst in organic synthesis.	
CO3	Describe the structures of proteins, nucleic acids and its components.	
CO4	Interpret the analytical and chemical evidence for structure elucidation of natural products.	
<b>Course (Paper) Name and No.- Analytical Chemistry Paper IV</b>		
CO1	Explain the fundamentals and working of electroanalytical techniques such as polarography and amperometry.	
CO2	Discuss the basics of chromatography, contrast and describe underlying principle, instrumentation and working of advanced separation methods such as GC, HPLC and HPTLC	
CO3	Explain the principles of thermal and radioanalytical methods and study of thermal decomposition of materials.	
CO4	Apply analytical techniques for the analysis of cosmetics and food and describe food preservation and processing techniques.	
<b>Course (Paper) Name and No.- Organic and Analytical Chemistry Practical II</b>		
CO1	Demonstrate the analytical skills required for detection, identification, separation and analysis of food samples, environmental samples, pharmaceuticals etc.	
CO2	Conduct, analyze and interpret results of a chemical analysis and communicate effectively in written reports and other formats	
CO3	Demonstrate the separation of the liquid-liquid and solid-liquid mixtures by fractional distillation.	
CO4	Plan organic synthesis with calculations, stoichiometry, aspects of synthesis and predictions of spectral data in IR and NMR of the reactant and product.	
<b>Course (Paper) Name and No: Drugs and Dyes Paper-V</b>		
CO1	Explain details about the chemotherapeutic agents used for the treatment of different diseases side effects and synthesis.	
CO2	Explain drug discovery design and development and drug metabolism and application of nanoparticles in medicinal chemistry.	
CO3	Classify the dyes based on the Chemical Constitution and preparations	
CO4	Explain the non-textile uses and health and Environmental Hazards of the dyes.	

Course (Paper) Name and No: <b>Drugs and Dyes Practical, Paper-V</b>		
CO1	Synthesize, Crystallization Physical constant, able to understand process of purification.	
CO2	Determination of Calcium from given Calcium tablet.	
CO3	Examine monograph.	
CO4	Apply the TLC technique for the separation of the mixture of dyes.	



॥ विद्या विनयेन शोभते ॥

Janardan Bhagat Shikshan Prasarak Sanstha's

**CHANGU KANA THAKUR**

**ARTS, COMMERCE AND SCIENCE COLLEGE, NEW PANVEL  
(AUTONOMOUS)**

Re-accredited 'A+' Grade by NAAC (3<sup>rd</sup> Cycle - CGPA 3.61)

'College with Potential for Excellence' Status Awarded by UGC

'Best College Award' by University of Mumbai

## **M.Sc. (Organic Chemistry)**

<b>PSOs</b>	
PSO1	Develop analytical thinking and apply the same for understanding principles, proposing mechanism and logical conclusions.
PSO2	Comprehensive understanding of the interdisciplinary nature of Chemistry and emerging trends in Chemistry.
PSO3	Enormous employment opportunities at Research and Development as well as synthetic division of chemical, pharmaceutical, dyestuff and food industries.
PSO4	Competency in design and planning of synthesis and carry out with Good Laboratory Practices.
PSO5	Access, search and use of chemical literature and acquiring necessary skills to succeed in research and advance studies.
PSO6	Research opportunities to pursue Ph.D. programme.
PSO7	Competency in handling instruments and interpretation of spectral data for structure determination of organic compounds

COs		
Semester I		
Course (Paper) Name and No.- <b>Organic Chemistry paper-III</b>		
CO1	Understand the types of addition reaction and their applications.	
CO2	Summarize the various aspects of aromaticity, aliphatic and aromatic nucleophilic substitution reactions with their mechanism and examples.	
CO3	Apply the concept of Configurational descriptors (R,S nomenclature) to chiral centers in Organic compounds	
CO4	Predict the mechanism, selectivity, importance and applications of oxidizing and reducing agent.	
Course (Paper) Name and No.- <b>Organic Chemistry Practical</b>		
CO1	Plan preparation of organic compounds	
CO2	Demonstrate the skill of purification of organic compounds by recrystallization and sublimation methods.	
CO3	Apply the thin layer chromatography technique to check the purity of the synthesized product.	
CO4	Can Sketch the structure of organic compounds using software Chem Biodraw.	
Course (Paper) Name and No.- <b>Analytical Chemistry</b>		
CO1	Explain the concept of data domain, performance characteristics of an instrument/method, total quality management, quality standards for laboratories, quality audits and quality reviews.	
CO2	Discover the applications of UV-Visible spectroscopy, IR spectroscopy, Differential scanning calorimetry.	
CO3	Identify the need of automation in chemical analysis, safety measures in laboratory, need of accreditation of laboratories and GLP.	
CO4	Interpret the data based on calculations and statistical tests.	
Course (Paper) Name and No.- <b>Analytical Chemistry Practical</b>		
CO1	Demonstrate the titration skills for the analysis of samples of a diverse variety	
CO2	Apply the statistical methods for data analysis	
CO3	Analyze the measured data based on Chemical principles	
CO4	Measure the characteristics of ion exchange resins	
Course (Paper) Name and No.- <b>Inorganic Chemistry, Paper-1</b>		
CO1	Explain theories of bonding, hybridization, resonance concept, MOT for diatomic species of first transition Series, Polyatomic species and Higher boranes, carboranes, metalloboranes and metallocarboranes, metal carbonyls and halide clusters.	
CO2	Explain The concept of band theory, Fermi level, K-Space and Brillouin Zones. Structures of Compounds of the type: AB, AB <sub>2</sub> etc. and Preparative methods of inorganic solids & nano materials.	
CO3	Construct Group Multiplication Tables, Character tables using concept of Molecular Symmetry and Group Theory.	
CO4	Determine electronic parameters such as $\Delta$ , B, C, Nephelauxetic ratio, formation constants of metal complexes and Characterize coordination compounds using techniques like thermal studies, Conductivity measurements, electronic spectral and magnetic measurements, IR, NMR and ESR spectroscopic	

<b>Course (Paper) Name and No.- Inorganic Chemistry Practical</b>		
CO1	Prepare various inorganic complexes such as Bis-(tetramethylammonium) tetrachlorocuprate (II) (Me <sub>4</sub> N) <sub>2</sub> [CuCl <sub>4</sub> ], Tetramminemonocarbanato Cobalt (III) Nitrate, Bis (ethylenediammine) Copper (II) Sulphate, Hydroniumdichlorobis(dimethylglyoximate) etc.	
CO2	Determine the electrolytic nature of inorganic compounds	
CO3	Apply Slope intercept method for determination of equilibrium constants for Fe <sup>+3</sup> /SCN <sup>-</sup> system.	
CO4	Analyze the inorganic complex for percentage of metal and ligand.	
<b>Course (Paper) Name and No.- Physical Chemistry (Electives-I)</b>		
CO1	Prove Maxwell relations and its significance and applications to ideal gases, Joule Thomson experiment, Joule Thomson coefficient and inversion temperature. Apply Third law of Thermodynamics to find out absolute entropy	
CO2	Make use of quantum mechanics for Particle waves and Schrödinger wave equation, wave functions, properties of wave functions, Normalization of wave functions, orthogonality of wave functions. Particle in a one, two- and three-dimensional box	
<b>Course (Paper) Name and No.- Physical Chemistry (Electives-II)</b>		
CO1	Define, understand basic terms of Chemical Dynamics i.e. rate constant, order of reaction, molecularity of reaction also compare Composite Reactions and Polymerization reactions	
CO2	Make use of Colloids and Surface Phenomena in daily applications	
<b>Course (Paper) Name and No.- Physical Chemistry Practical</b>		
CO1	Know the principles of different instruments like Potentiometry, Conductometry, pH Metry.	
CO2	Determine the heat of solution of sparingly soluble acid and identify the reaction between acetone and iodine.	
<b>Course (Paper) Name and No.- Research Methodology</b>		
CO1	Explain the importance of different types of print and digital resources for gap analysis and data collection.	
CO2	Design/propose methodologies preferably with green and safe approach to conduct research	
CO3	Analyze scientific data by statistical and graphical methods.	
CO4	Apply skills of chemical safety & ethical handling of chemicals	
<b>Semester II</b>		
<b>Course (Paper) Name and No.- Organic Chemistry</b>		
CO1	Explain the Generation of carbanion, enolate, and enamine with their alkylation & acylation reaction and name reactions with their mechanism.	
CO2	Illustrate mechanism, stereochemistry, applications and importance of name reactions and rearrangements.	
CO3	Explain the role of reagents in organic synthesis and understand the elimination reactions.	
CO4	Interpret the structure of organic compounds using combined of spectral techniques.	
<b>Course (Paper) Name and No.- Organic Chemistry Practical</b>		
CO1	Identify the chemical type of components present in a binary mixture of an organic compound.	
CO2	Apply skills in the separation and qualitative analysis of organic compounds of binary mixtures by microscale technique.	

CO3	Make use of crystallization, sublimation and distillation for purification of the organic compounds.	
CO4	Demonstrate the practical aspects in the preparation of the organic compounds' derivatives.	
<b>Course (Paper) Name and No.- Analytical Chemistry</b>		
CO1	Translate the theoretical principles of advanced separation techniques, spectroscopic techniques, radioanalytical techniques, electroanalytical techniques into applications.	
CO2	Explain the working principles of surface analytical techniques such as SEM, STM, TEM, ESCA, Auger spectroscopy and ICP-AES	
CO3	Compare the different ion sources and mass analyzers in mass spectroscopy	
CO4	Determine the electrical quantities such as charge, current, potential using Electroanalytical methods	
<b>Course (Paper) Name and No.- Analytical Chemistry Practical</b>		
CO1	Demonstrate the operational skills on the selected instruments and retrieve information	
CO2	Develop a sense of time management, safe use of chemicals and environmental safety	
<b>Course (Paper) Name and No.- Inorganic Chemistry</b>		
CO1	Recall Organometallic Chemistry of Transition metals, Eighteen and sixteen electron rules, Preparation and property's structure and bonding of the Organometallic compounds	
CO2	Explain Photochemical Reactions, Ligand substitution reactions of: Octahedral complexes, Square planar complexes, trans-effect, its theories and applications. Redox reactions: inner and outer sphere mechanisms, stereochemistry of substitution reactions of octahedral complexes	
CO3	Explain Bioinorganic Chemistry related to biological oxygen carriers; hemoglobin, hemerythrin and hemocyanin- structure of metal active center and differences in mechanism of oxygen binding, Copper containing enzymes, Nitrogen fixation Metal ion transport and storage, Medicinal applications of cis-platin and related compounds.	
CO4	Discuss the implication of toxic metallic species radioactive materials on environment and biological system using case studies.	
<b>Course (Paper) Name and No.- Inorganic Chemistry Practical</b>		
CO1	Analyse ores and alloys using volumetric and gravimetric analysis.	
CO2	Estimate percentage of metals in the ore and alloy.	
CO3	Apply the potentiometric method for redox titrations of Fe, Cu etc.	
<b>Course (Paper) Name and No.- Physical Chemistry (Electives-I)</b>		
CO1	Explain Bioenergetics, Real solutions and Fugacity of real gases also show graphical representations of BET isotherms	
CO2	Prove expressions for the total wave function for 1s, 2s, 2p and 3d orbitals of hydrogen and application of the Schrödinger equation to two electron system	
<b>Course (Paper) Name and No.- Physical Chemistry (Electives-II)</b>		
CO1	Explain terms involved in Chemical Kinetics and Molecular Reaction Dynamics. Elementary Reactions in Solution, Kinetics of reactions catalysed by enzymes -Michaelis-Menten analysis, Lineweaver-Burk and Eadie Analyses, Inhibition of Enzyme action.	
CO2	Apply Photochemistry to solve NET, SET GATE Problems.	



<b>Course (Paper) Name and No.- Physical Chemistry Practical</b>		
CO1	Know principles of different instruments like Potentiometry, Conductometry, pH Metry and colorimeter.	
CO2	Make use of graphical representation to identify Shape of Orbitals.	
<b>Course (Paper) Name and No.- On Job Training</b>		
CO1	Practical Skill Development: Trainees will acquire hands-on experience and proficiency in relevant industry tools, techniques, and processes, effectively applying theoretical knowledge to real-world tasks.	
CO2	Problem-Solving Abilities: Trainees will develop critical thinking and problem-solving skills by addressing practical challenges and troubleshooting issues encountered in the work environment.	
CO3	Professional Competency: Trainees will demonstrate enhanced job readiness and professional competency, including adherence to industry standards, effective communication, and teamwork	
CO4	Industry Knowledge: Trainees will gain a deeper understanding of industry practices, workflows, and organizational culture, improving their ability to navigate and contribute effectively within their field.	
CO5	Performance Improvement: Trainees will improve their performance and productivity by integrating feedback and learning from experienced professionals, leading to better job performance and career growth.	
<b>Semester III</b>		
<b>Course (Paper) Name and No.- Theoretical Organic Chemistry-I, Paper I</b>		
CO1	Explain the structure, generation, stability and reactions of organic reactive intermediates and importance of neighbouring group participation, role of FMOs.	
CO2	Apply the principles of photochemistry to carbonyl compounds, olefins, arenes and radical reactions.	
CO3	Identify pericyclic reactions and describe cycloaddition reactions, electrocyclic reactions and sigmatropic rearrangements	
CO4	Analyze conformation of medium size ring, fused ring, bridge ring, steroids and reactivity of addition, elimination, rearrangement and reduction with stereoselective and stereospecific reactions.	
<b>Course (Paper) Name and No.- Synthetic Organic Chemistry –I, Paper II</b>		
CO1	Summarize generation, stability, structure, stereochemical aspects of free radicals, its characteristic reactions and use in organic synthesis.	
CO2	Explain preparation of organometallic compound, its applications, mechanism and regiochemistry of reactions involving metals/non-metals in organic synthesis.	
CO3	Compare between enamines and enolates, methods of preparation, applications with stereochemical aspects in synthetic reactions	
CO4	Predict the products of name reactions, domino reactions, click reactions, multicomponent reactions and describe the mechanisms showing how the products are formed	
<b>Course (Paper) Name and No.- Natural products Heterocyclic chemistry and Spectroscopy-I, Paper III</b>		
CO1	Explain the occurrence, structural features, and biological importance and multistep synthesis of natural products.	
CO2	Draw conclusion based on evidence for structure elucidation and synthesis of natural products.	
CO3	Construct the names of heterocyclic compounds by IUPAC nomenclature and explain synthesis and reactivity of heterocyclic compounds	

CO4	Interpret the data for the structure elucidation of organic compounds based on UV, IR, <sup>1</sup> H-NMR and <sup>13</sup> C-NMR.	
<b>Course (Paper) Name and No.- Medicinal, Biogenesis and Green Chemistry, Paper IV</b>		
CO1	Demonstrate the knowledge of the twelve principles of green chemistry which they can practice to a range of workplace for a safer less toxic and healthier environment.	
CO2	Explain the basic terms used in medicinal chemistry, the pharmacokinetics of drug, drug structure activity relationship, physical chemical parameters of drugs and procedures in drug design.	
CO3	Apply skills required for drug design, development of modern methods of synthesis required for employment in the pharmaceutical industries.	
CO4	Build the Biogenesis and biosynthesis of natural products by acetate pathway, shikimate pathway and mevalonate it pathway.	
<b>Course (Paper) Name and No.- Bioorganic Chemistry, Paper IV</b>		
CO1	Summarize amino acids, peptides, proteins and nucleic acids and chemical synthesis of oligonucleotides.	
CO2	Explain importance of enzymatic reactions and factors affecting enzyme kinetics.	
CO3	Relate the importance of enzymes in the synthesis of organic compound.	
CO4	Explain biological importance and metabolism of carbohydrates and lipids.	
<b>Course (Paper) Name and No.- Ternary Mixture (Practical)</b>		
CO1	Identify the chemical type of components present the in ternary mixture of organic compounds.	
CO2	Apply skills in detection, identification and separation of organic compounds of ternary mixtures by microscale technique.	
<b>Course (Paper) Name and No.- Identification of organic compounds (Practical)</b>		
CO1	Identify the chemical type of components present the in ternary mixture of organic compounds.	
CO2	Demonstrate the practical aspects in the preparation of the organic compounds and their derivatives	
<b>Course (Paper) Name and No.- Single step preparation (Practical)</b>		
CO1	Demonstrate the skills in organic preparations required for pursuing a career in the pharmaceutical, chemical industry, research etc.	
CO2	Make use of column chromatography, crystallization steam and vacuum distillation for purification of the organic compounds	
CO3	Identify the prepared organic compounds by Thin Layer Chromatography	
<b>Semester IV</b>		
<b>Course (Paper) Name and No.- Theoretical Organic Chemistry-II, Paper I</b>		
CO1	Explain the principles of molecular association and organization, host- guest interaction, structure and properties of crown ether, cryptands, cyclophanes, rotaxanes, cyclodextrines, molecular self-assembly and Supramolecular polymers	
CO2	Explain principles, methods of asymmetric synthesis and use of chiral auxiliaries in asymmetric synthesis	
CO3	Apply the linear free energy relationship for determination of organic reaction mechanism using Hammett equation and Taft equation.	

CO4	Determine the enantiomer and diastereomer composition by different methods, asymmetric transformation, molecular dissymmetry and chiroptical properties and explain the ORD and CD curves, Cotton effects, octane rule and its applications.	
Course (Paper) Name and No.- <b>Synthetic Organic Chemistry –II, Paper II</b>		
CO1	Explain the concepts of retrosynthesis, protecting groups, synthetic planning and selective transformations in organic synthesis.	
CO2	Apply disconnection approach, FGI, FGA, FGR and recognize starting compounds in designing organic synthesis of target molecules.	
CO3	Summarize electro-organic chemistry and use of organocatalyst, Lewis acid, crown ethers, cryptands, micelles etc. in selected methods of organic synthesis.	
CO4	Predict the products of organic synthesis in which transition and rare earth metals are used.	
Course (Paper) Name and No.- <b>Natural products Heterocyclic chemistry and Spectroscopy-II, Paper III</b>		
CO1	Explain occurrence, classification, structural and stereochemical features of steroids, insect pheromones, insecticides, vitamins and their biological role in life related processes.	
CO2	Plan the synthesis of biologically important steroids, vitamins, antibiotics, insecticides.	
CO3	Apply fundamentals of heterocyclic reactivity and synthesis skills required for heterocyclic compounds in research and industry and explain the names of heterocyclic compounds by IUPAC nomenclature and replacement nomenclature.	
CO4	Interpret the data for the structure elucidation of organic compounds based on UV, IR, <sup>1</sup> H-NMR, <sup>13</sup> C-NMR two dimensional spectroscopic techniques, COSY and HETCOR spectra, NOE and NOESY, INEPT, APT and INADEQUATE techniques.	
Course (Paper) Name and No.- <b>Intellectual Property Rights &amp; Cheminformatics, Paper IV</b>		
CO1	Define various terminologies related to IPR	
CO2	Explain the role of law in the violation of IPR	
CO3	Summarise the various models of cheminformatics.	
CO4	Apply the knowledge of cheminformatics to predict the properties of compounds, structures and drug designing.	
Course (Paper) Name and No.- <b>Research Methodology, Paper IV</b>		
CO1	Explain the importance of different types of print and digital resources for gap analysis and data collection.	
CO2	Design/propose methodologies preferably with green and safe approach to conduct research	
CO3	Analyze scientific data by statistical and graphical methods.	
CO4	Apply skills of chemical safety & ethical handling of chemicals	
Course (Paper) Name and No.- <b>Two step preparation (Practical)</b>		
CO1	Plan the synthesis of organic compounds.	
CO2	Make use of thin layer chromatography and physical constant to know the purity of organic compounds	
CO3	Apply principles of purification techniques such as recrystallization and distillation for purification of organic compounds.	
CO4	Compare spectral data of reactant and product and explain mechanism of reactions and MSDS of chemicals.	

Course (Paper) Name and No.- <b>Spectral identification &amp;Project or Internship</b>		
CO1	Interpret spectral data like FT-IR, <sup>13</sup> C NMR, <sup>1</sup> HNMR, UV-Visible spectrum and Mass spectrum for structure elucidation of organic compound	
CO2	Analyze the print and digital resources critically to formulate the researchproblem, argue and justify the statements	
CO3	Apply the existing methodologies or develop a new methodology to address the research problem	
CO4	Interpret the results and structures it to communicate via dissertation, andoral presentation by following ethical guidelines	



॥ विद्या विनयेन शोभते ॥

Janardan Bhagat Shikshan Prasarak Sanstha's  
**CHANGU KANA THAKUR**

**ARTS, COMMERCE AND SCIENCE COLLEGE, NEW PANVEL  
(AUTONOMOUS)**

Re-accredited 'A+' Grade by NAAC (3<sup>rd</sup> Cycle - CGPA 3.61)  
'College with Potential for Excellence' Status Awarded by UGC  
'Best College Award' by University of Mumbai

## **M.Sc. (Analytical Chemistry)**

<b>PSOs</b>	
PSO1	Students will have a strong foundation in the fundamentals and application of various theoretical concepts in Analytical, Inorganic, Organic and Physical Chemistry
PSO2	Students will learn advanced characterization techniques by gaining the knowledge of spectroscopy, chromatography, electroanalytical methods, hyphenated techniques and chemistry of synthetic and natural products
PSO3	Student will learn the usage of analytical instruments, select, and apply appropriate techniques and resources for the analysis
PSO4	Students will demonstrate their laboratory skills in qualitative, quantitative, separation and advanced instrumental methods
PSO5	Students will identify the need of IPR by integrating the knowledge of total quality management, GLP and GMP
PSO6	Research ability will be developed as the students get skilled to problem solving, critical thinking and analytical reasoning as applied to scientific problems
PSO7	The ability to communicate scientific information in written, oral and electronic formats will be developed among students
PSO8	Students will be able to learn application of various softwares for interpretation and representation of results.

<b>COS</b>		
<b>Semester I</b>		
Course (Paper) Name and No.- <b>Physical Chemistry I</b>		
CO1	Prove Maxwell relations and its significance and applications to ideal gases, Joule Thomson experiment, Joule Thomson coefficient and inversion temperature. Apply Third law of Thermodynamics to find out absolute entropy	
CO2	Make use of quantum mechanics for Particle waves and Schrödinger wave equation, wave functions, properties of wave functions, Normalization of wave functions, orthogonality of wave functions. Particle in a one, two- and three-dimensional box	
CO3	Define, understand basic terms of Chemical Dynamics i.e. rate constant, order of reaction, molecularity of reaction also compare Composite Reactions and Polymerization reactions	
CO4	Make use of Colloids and Surface Phenomena in daily applications	
Course (Paper) Name and No.- <b>Analytical Chemistry PSC1AC1</b>		
CO1	Explain the concept of data domain, performance characteristics of an instrument/method, total quality management, quality standards for laboratories, quality audits and quality reviews.	
CO2	Discover the applications of UV-Visible spectroscopy, IR spectroscopy, Differential scanning calorimetry.	
CO3	Identify the need of automation in chemical analysis, safety measures in laboratory, need of accreditation of laboratories and GLP.	
CO4	Interpret the data based on calculations and statistical tests.	
Course (Paper) Name and No.- <b>Analytical Chemistry Practical</b>		
CO1	Demonstrate the titration skills for the analysis of samples of a diverse variety	
CO2	Apply the statistical methods for data analysis	
CO3	Analyze the measured data based on Chemical principles	
CO4	Measure the characteristics of ion exchange resins	
Course (Paper) Name and No.- <b>Organic Chemistry paper-III</b>		
CO1	Understand the types of addition reaction and their applications	
CO2	Summarize the various aspects of aromaticity, aliphatic, and aromatic nucleophilic substitution reactions with their mechanism and examples.	
CO3	Apply the concept of Configurational descriptors (R,S nomenclature) to chiral centres in Organic compounds	
CO4	Predict the mechanism, selectivity, importance and applications of oxidizing and reducing agent	
Course (Paper) Name and No.- <b>Organic Chemistry Practical</b>		
CO1	Plan preparation of organic compounds	
CO2	Demonstrate the skill of purification of organic compounds by recrystallization and sublimation methods.	
CO3	Apply the thin layer chromatography technique to check the purity of the synthesized product.	
CO4	Can Sketch the structure of organic compounds using software Chem Biodraw.	

<b>Course (Paper) Name and No.- Physical Chemistry Practical</b>		
CO1	Know the principles of different instruments like Potentiometry, Conductometry, pH Metry.	
CO2	Determine the heat of solution of sparingly soluble acid and identify the reaction between acetone and iodine.	
<b>Course (Paper) Name and No.- Inorganic Chemistry (Elective-I)</b>		
CO1	Explain theories of bonding, hybridization, resonance concept, MOT for diatomic species of first transition Series, Polyatomic species and Higher boranes, carboranes, metalloboranes and metallocarboranes, metal carbonyls and halide clusters.	
CO2	Explain The concept of band theory, Fermi level, K-Space and Brillouin Zones. Structures of Compounds of the type: AB, AB <sub>2</sub> etc. and Preparative methods of inorganic solids & nano materials	
<b>Course (Paper) Name and No.- Inorganic Chemistry (Elective-II)</b>		
CO1	Construct Group Multiplication Tables, Character tables using concept of Molecular Symmetry and Group Theory.	
CO2	Determine electronic parameters such as $\Delta$ , B, C, Nephelauxetic ratio, formation constants of metal complexes and Characterize coordination compounds using techniques like thermal studies, Conductivity measurements, electronic spectral and magnetic measurements, IR, NMR and ESR spectroscopic.	

Course (Paper) Name and No.- <b>Inorganic Chemistry Practical's</b>		
CO1	Prepare various inorganic complexes such as Bis-(tetramethylammonium) tetrachloroCuprate (II) (Me <sub>4</sub> N) <sub>2</sub> [CuCl <sub>4</sub> ], Tetramminemonocarbanato Cobalt (III) Nitrate, Bis (ethylenediammine) Copper (II) Sulphate, Hydroniumdichlorobis(dimethylglyoximato) etc.	
CO2	Determine the electrolytic nature of inorganic compounds	
CO3	Apply Slope intercept method for determination of equilibrium constants for Fe <sup>+3</sup> / SCN <sup>-</sup> system.	
CO4	Analyze the inorganic complex for percentage of metal and ligand.	
Course (Paper) Name and No.- <b>Research Methodology</b>		
CO1	Explain the importance of different types of print and digital resources for gap analysis and data collection.	
CO2	Design/propose methodologies preferably with green and safe approach to conduct research	
CO3	Analyze scientific data by statistical and graphical methods.	
CO4	Apply skills of chemical safety & ethical handling of chemicals	
<b>Semester II</b>		
Course (Paper) Name and No.- <b>Physical Chemistry I</b>		
CO1	Explain Bioenergetics, Real solutions and Fugacity of real gases also show graphical representations of BET isotherms	
CO2	Prove expressions for the total wave function for 1s, 2s, 2p and 3d orbitals of hydrogen and application of the Schrödinger equation to two electron system	
CO3	Explain terms involved in Chemical Kinetics and Molecular Reaction Dynamics. Elementary Reactions in Solution, Kinetics of reactions catalysed by enzymes -Michaelis-Menten analysis, Lineweaver-Burk and Eadie Analyses, Inhibition of Enzyme action.	
CO4	Apply Photochemistry to solve NET, SET GATE Problems.	
Course (Paper) Name and No.- <b>Physical Chemistry Practical</b>		
CO1	Know principles of different instruments like Potentiometry, Conductometry, pH Metry and colorimeter.	
CO2	Make use of graphical representation to identify Shape of Orbitals.	
Course (Paper) Name and No.- <b>Analytical Chemistry</b>		
CO1	Translate the theoretical principles of advanced separation techniques, spectroscopic techniques, radioanalytical techniques, electroanalytical techniques into applications.	
CO2	Explain the working principles of surface analytical techniques such as SEM, STM, TEM, ESCA, Auger spectroscopy and ICP-AES	
CO3	Compare the different ion sources and mass analyzers in mass spectroscopy	
CO4	Determine the electrical quantities such as charge, current, potential using Electroanalytical methods	
Course (Paper) Name and No.- <b>Analytical Chemistry Practical</b>		
CO1	Demonstrate the operational skills on the selected instruments and retrieve information	
CO2	Develop a sense of time management, safe use of chemicals and environmental safety	



Course (Paper) Name and No.- <b>Organic Chemistry</b>		
CO1	Explain the Generation of carbanion, enolate, and enamine with their alkylation & acylation reaction and name reactions with their mechanism.	
CO2	Illustrate mechanism, stereochemistry, applications and importance of name reactions and rearrangements	
CO3	Explain the role of reagents in organic synthesis and understand the basics of elimination reactions.	
CO4	Interpret the structure of organic compounds using combined of spectral techniques.	
Course (Paper) Name and No.- <b>Organic Chemistry Practical</b>		
CO1	Identify the chemical type of components present in a binary mixture of an organic compound.	
CO2	Apply skills in the separation and qualitative analysis of organic compounds of binary mixtures by microscale technique.	
CO3	Make use of crystallization, sublimation and distillation for purification of the organic compounds.	
CO4	Demonstrate the practical aspects in the preparation of the organic compound's derivatives.	
Course (Paper) Name and No.- <b>Inorganic Chemistry (Elective-I)</b>		
CO1	Recall Organometallic Chemistry of Transition metals, Eighteen and sixteen electron rules, Preparation and property's structure and bonding of the Organometallic compounds	
CO2	Explain Photochemical Reactions, Ligand substitution reactions of: Octahedral complexes, Square planar complexes, trans-effect, its theories and applications. Redox reactions: inner and outer sphere mechanisms, stereochemistry of substitution reactions of octahedral complexes	
Course (Paper) Name and No.- <b>Inorganic Chemistry (Elective-II)</b>		
CO1	Measure the physical property of the samples and relate it with quantity	
CO2	Construct the graphs based on the measurements and calculations	
Course (Paper) Name and No.- <b>Inorganic Chemistry Practicals</b>		
CO1	Analyse ores and alloys using volumetric and gravimetric analysis.	
CO2	Estimate percentage of metals in the ore and alloy	
CO3	Apply the potentiometric method for redox titrations of Fe, Cu etc.	
Course (Paper) Name and No.- <b>On Job Training</b>		
CO1	Practical Skill Development: Trainees will acquire hands-on experience and proficiency in relevant industry tools, techniques, and processes, effectively applying theoretical knowledge to real-world tasks.	
CO2	Problem-Solving Abilities: Trainees will develop critical thinking and problem-solving skills by addressing practical challenges and troubleshooting issues encountered in the work environment.	
CO3	Professional Competency: Trainees will demonstrate enhanced job readiness and professional competency, including adherence to industry standards, effective communication, and teamwork	
CO4	Industry Knowledge: Trainees will gain a deeper understanding of industry practices, workflows, and organizational culture, improving their ability to navigate and contribute effectively within their field.	
CO5	Performance Improvement: Trainees will improve their performance and productivity by integrating feedback and learning from experienced professionals, leading to better job performance and career growth.	

<b>Semester III</b>		
<b>Course (Paper) Name and No.- Quality in Analytical Chemistry (Paper-I)</b>		
CO1	Students will understand importance of GLP and their regulations.	
CO2	Students will understand theoretical aspects of sampling, pre-treatment and method validation	
CO3	Students will learn the laboratory accreditation, its benefits and importance of ICH guidelines.	
CO4	Student will get knowledge of how to measure uncertainty in measurements, dealing with signal to noise ratio and legislator aspects of pharmaceutical industries.	
<b>Course (Paper) Name and No.: Practical's (Paper-I)</b>		
CO1	Students will learn the analysis of quality of various types of samples using instrumental methods of analysis.	
CO2	Students will learn graphical representation of the data.	
<b>Course (Paper) Name and No. Advanced Instrumental Technique (Paper-II)</b>		
CO1	Student will help to understand the theoretical concepts of surface analytical techniques.	
CO2	Student will understand advanced spectroscopic techniques used for characterization of matter.	
CO3	Students will get detailed insights of advanced electroanalytical techniques.	
CO4	Student will find applications of chemiluminescence, ORD-CD, Photoacoustic spectroscopy in analytical chemistry.	
<b>Course (Paper) Name and No. Practical's (Paper-II)</b>		
CO1	Students will learn the various advanced analytical techniques for analysis of different samples.	
CO2	Students will get knowledge of quality control methods and understand the importance of accuracy.	
<b>Course (Paper) Name and No. Bioanalytical Chemistry and Food Analysis (Paper-III)</b>		
CO1	Student will learn bioanalytical techniques of analysis.	
CO2	Student will understand the importance of Immunoassays and its applications.	
CO3	Student will get general idea about food processing, food preservation and determination of food contaminant etc.	
CO4	Student will understand technique use in food packaging and food analysis.	
<b>Course (Paper) Name and No. Practicals (Paper-III)</b>		
CO1	Students will perform practical based upon food analysis.	
CO2	Students will understand data acquisition and analysis.	
<b>Course (Paper) Name and No.: Elective paper E1 Environmental and Certain Industrially Important Materials (Paper-IV)</b>		
CO1	Student will learn different aspects of Chemistry of atmosphere and environmental legislation.	
CO2	Student will understand the quality and requirement of potable water and bore well water.	
CO3	Student will study the details of sources and hazardous of soil pollutant and monitoring of air pollution.	
CO4	Student will do the detail study of control of pollution through Green Chemistry.	

<b>Course (Paper) Name and No. Elective paper E2 Pharmaceutical and Organic Analysis (Paper-IV) PSC3POA</b>		
CO1	Student will get general idea regarding the pharmaceutical analysis and quality control methods of pharmaceutical industry.	
CO2	Student will know the details of drug analysis on the basis of functional groups and other factors.	
CO3	Student will understand the applications of analytical chemistry in forensic science.	
CO4	Student will learn the various aspects of cosmetic industry and analysis of different types of cosmetics.	
<b>Course (Paper) Name and No. Practical's (Paper-IV)</b>		
CO1	Students will perform the practical based on estimations of drugs by non-aqueous Titration.	
CO2	Students will perform the practical based on the analysis of water sample.	
<b>Semester IV</b>		
<b>Course (Paper) Name and No. Quality in Analytical Chemistry (Paper-I)</b>		
CO1	Students will get detailed insights of modern chromatographic techniques for separation of mixture on the basis of charge, size, and affinity of composition.	
CO2	Student will learn details of various separation processes.	
CO3	Student will study the separation, analysis and standardization of herbal based products.	
CO4	Student will understand the concept of electrophoresis in analysis and basics of nanotechnology.	
<b>Course (Paper) Name and No. Practical's (Paper-I)</b>		
CO1	Student will understand the use of various instrumental methods for the analysis of different samples.	
<b>Course (Paper) Name and No. Advanced Instrumental Technique (Paper-II)</b>		
CO1	Student will do the detail study of principle, instrumentation and applications of NMR spectroscopy.	
CO2	Student will understand the detail concept of mass spectroscopy and Raman spectroscopy.	
CO3	Student will learn principle and interfacing of radio analytical techniques and hyphenated thermal methods	
CO4	Student will know the detail concept of hyphenated techniques including GC-MS, GCIR, LC-MS, and HPLC-MS et	
<b>Course (Paper) Name and No. Practical's (Paper-II)</b>		
CO1	Student will able to do Interpretation of data using various advanced techniques.	
CO2	Student will able to do Interpretation of spectra of NMR, Mass, IR, UV visible.	
<b>Course (Paper) Name and No. Selected Topics in Analytical Chemistry (Paper-III)</b>		
CO1	Student will learn the different aspects of effluent treatment	
CO2	Student will understand steps involved in solid waste management.	
CO3	Student will get an idea about classifications and applications of plastics, polymer, paints and pigments and their environmental impact.	
CO4	Student will study metallurgical analysis.	

Course (Paper) Name and No. <b>Practical's (Paper-III)</b>		
CO1	Students will learn quantitative estimation of various types of metallurgical samples.	
Course (Paper) Name and No. <b>Intellectual Property (Paper-IV)</b>		
CO1	Student will learn about details intellectual property.	
CO2	Student will get knowledge of intellectual property rights (IPR).	
CO3	Student will understand concepts in cheminformatics.	
CO4	Student will learn about industrial designing and traits in it.	
Course (Paper) Name and No. <b>Research Methodology (Paper-IV)</b>		
CO1	Student will learn every aspect of publication of research paper such as terms associated with journals, referencing and library resources.	
CO2	Student will get conversant with the methods of data analysis and various software's employed for it.	
CO3	Student will get knowledge of actual writing scientific papers.	
CO4	Student will get information of the safety and ethical handling of chemicals.	
Course (Paper) Name and No. <b>Practicals (Paper-IV)</b>		
CO1	Student will actually get involved in research work.	
CO2	Student will understand the analysis of data generated by their research work.	
CO3	Student will learn how to present research work	