

Program Name: **M. Sc. Chemistry (Analytical)**

### **Program specific Outcomes**

A student completing this program will be able to

**PSO1:** Knowledge: Apply the basic knowledge of inorganic, organic, physical and analytical chemistry, in the various fields of pharmaceutical sciences, environmental sciences, forensic sciences and biochemical analysis

**PSO2:** Laboratory skills: Apply various techniques for the qualitative and quantitative analyses based on instrumental and physico-chemical methods as well as apply the principles of synthetic organic chemistry for organic preparation.

**PSO3:** Environmental concern: Become aware about various kinds of environmental pollution and apply the principles of green chemistry in industrial and laboratory processes

**PSO4:** Employability/future prospects: Develop analytical and problem- solving skills as well as apply good laboratory practices necessary for performing various activities in the industry

**PSO5:** Scientific communication: To develop scientific communication skills, thereby the students are able to express ideas clearly and convincingly, in written and oral forms.

### **Course outcomes for all courses offered by the department:**

<b>Semester</b>	<b>Course code</b>	<b>Course name</b>	<b>Course Outcomes Student completing this course is able to</b>
<b>1</b>	PCH-1851	Inorganic Chemistry-I	1: Apply the approximation methods in quantum theory to solve the Schrodinger wave equation for multielectronic atomic systems such as helium 2: Use molecular symmetry and group theory to simplify problems involving molecular properties 3: Remember the basic laws and mechanisms of magnetochemistry and recognize different magnetic materials 4: Remember the structure and functioning of natural bio-inorganic molecules as well as appraise the role of synthetic coordination compounds in therapy
<b>1</b>	PCH-1852	Organic Chemistry-I	1: Apply the knowledge of basic organic reaction mechanisms to infer various aspects of elimination reaction, nucleophilic reactions and molecular rearrangements 2: Remember the generation and reactivity of reactive intermediates like carbocations, carbanions etc 3: apply the theories of aromaticity to examine molecules and predict their aromatic and antiaromatic character

			4: employ the fundamentals of stereochemistry to predict the configuration of complex chiral molecules and their roles in enantioselective synthesis
1	PCH-1853	Physical Chemistry-I	<p>1: Employ the fundamentals of thermodynamics to examine the third law as well as interpret the changes from ideal to real states for solutions and gases</p> <p>2: use the principles of chemical kinetics to derive the rate equations for complex and fast reactions as well as remember the experimental techniques used to study the kinetics of these reactions</p> <p>3: employ the fundamentals of solid-state chemistry to examine the bonding in solids and interpret phenomenon such as diffusion and electrical conduction and super conduction in solids</p> <p>4: Use the BET adsorption isotherms to calculate surface area, surface tension etc; to understand heat of adsorption and ways of determining it and using this to understand more about micelles</p>
1	PCH-1854	Analytical Chemistry-I	<p>1: identify the sampling technique and calibration method for a given sample/glassware etc. and to learn about validation of analytical methods using different statistical parameters</p> <p>2: Identify, recognize and remember the fundamentals of UV-Vis spectrophotometry and apply them effectively for structural and quantitative analysis of molecules and complexes</p> <p>3: Remember the principle of thermal analysis and recognize the different techniques/instrumentation like DSC, DTA etc for industrial applications</p>
1	PCH-1855L	Inorganic and Organic Chemistry Practicals-I	<p>1: Use the fundamentals of semi-micro qualitative analysis to determine six radicals in an unknown mixture</p> <p>2: Perform green preparation of complexes</p> <p>3: Use the fundamentals of organic synthesis to prepare a variety of organic molecules</p> <p>4: Perform organic estimation of some functional groups</p>
1	PCH-1856L	Physical and Analytical Chemistry Practicals-I	<p>1: Use the conductometer to do acid-base titrations involving mixtures</p> <p>2: Use the potentiometer to determine solubility product and oxidation potentials</p> <p>3: Use the pH meter to do acid-base titrations to determine the assay of a drug and concentration in mixtures</p> <p>4: Perform experiments based on adsorption and kinetics</p>

			<p>5: Perform experiments based on distribution coefficient</p> <p>6: Calibrate glass wares used in an analytical laboratory</p> <p>7: Perform titrations to determine the assay of drugs and other commercial preparations</p> <p>8: Perform water analysis</p>
2	PCH-2851	Inorganic Chemistry II	<p>1: Apply the principles of VSEPR and molecular orbital theory to deduce the properties of conjugated systems, conductors, semi-conductors and insulators</p> <p>2: Use the basics of molecular symmetry and spectroscopy to predict the IR and Raman spectra of molecules</p> <p>3: To recognize the bonding modes in organometallic compounds with various organic ligands</p> <p>4: To remember the reaction mechanisms in coordination compounds</p>
	PCH-2852	Organic Chemistry II	<p>1: To recognize the selectivity and utility of a variety of reagents in organic reactions</p> <p>2: To remember the mechanism and synthetic applications of name reactions</p> <p>3: To apply the fundamental knowledge of heterocycles to elucidate the synthesis, structure and application of polyheteroatomic and benzofused heterocycles</p>
2	PCH-2853	Physical Chemistry II	<p>1: To identify the principles of statistical thermodynamics and hence apply statistical mechanics to molecular problems of chemical thermodynamics</p> <p>2: To identify the various aspects of nuclear chemistry to define its application in energy generation and therapeutics</p> <p>3: use the basic principles of physical chemistry to determine the kinetics, thermodynamics and molecular mass of polymers</p> <p>4: Apply the fundamentals of overvoltage, decomposition potentials and electrochemical polarization to explain the theory and working of polarography</p>
2	PCH-2854	Analytical Chemistry II	<p>1: To use different techniques like liquid-liquid extraction, counter current extraction, digestion and solid phase extraction for sample preparation</p> <p>2: To identify as well as remember the principles and theory of chromatography and to apply them to interpret and use data generated by specialized chromatographic techniques such as GC, HPLC, HPTLC and IEC</p>

			3: To apply the principles of electrochemistry in the quantitative analysis of various ionic solutions using different types of ion selective electrodes
2	PCH-2855L	Inorganic and Organic Chemistry Practicals II	1: To prepare and determine the purity of double and complex salts 2: To perform the colorimetric estimation of some transition metals using complexation 3: To apply the principles of organic spotting to analyse ternary organic mixtures
2	PCH-2856L	Physical and Analytical Chemistry Practicals II	1: Use the conductometer to verify Ostwald's dilution law and Debye-Huckel-Onsager's equation 2: Use the potentiometer to perform acid-base titrations, precipitation titration and redox titrations 3: Use the pH meter to do determine the dissociation constant of a weak acid and the ionization constant of a tribasic acid 4: Perform experiments based on kinetics 5: Perform experiments based on distribution coefficient 6: Perform environmental analysis like determination of DO, COD 7: Perform titrations to determine the assay of drugs and other commercial preparations 8: Perform water and oil analysis
3	PCH-3851	Analytical Spectroscopy - I	1: To apply the fundamentals of various types of spectroscopic techniques like IR, Raman, NMR and x-ray and applications of these techniques to interpret data. 2: To describe the advancement in spectroscopic methods like FT-IR and Fluorescence and can recognize necessity of these techniques in the field of analytical science. 3: To perform quantitative and qualitative measurements of samples by IR.
3	PCH-3852	Electroanalytical Methods	1: To describe and differentiate various techniques based on electro-analytical principle like Voltammetry, Coulometry and polarography. 2: To identify and recognize composition and working of potentiometric, amperometric, conductometric chemical as well as biosensors, and to know applications of field-effect transistors sensors.
3	PCH-3853	Industrial Analytical Chemistry	1: Remember the principle and process control of automated devices as well as the principles and factors affecting flow injection analysis and to know its applications 2: To remember the food regulations and international standards as well as nutritional

			<p>labeling and to perform various compositional analysis of foods, characterization of fats and oils as well as adulteration of milk and milk products.</p> <p>3: To perform the instrumental and titrimetric assays for various drugs, Karl-Fischer titration and to apply it for Moisture/water content determination</p> <p>4: To classify pesticides, fertilizers, soaps and detergents as well as apply the theoretical aspects for their analysis</p>
3	PCH-3854	Forensic Sciences	<p>1: To recognize the function, composition and examination of blood and can explain different test for its confirmatory analysis from forensic evidences.</p> <p>2: To summarize DNA profiling and fingerprint analysis for forensic analysis based on various biochemical procedures.</p> <p>3: To memorize the concept of toxicology in particular related to poisons, drugs and explosive materials and use various analytical methods for their forensic analysis.</p>
3	PCH-3855L	Analytical Instrumental techniques	<p>1: To perform analysis of cations through flame photometry.</p> <p>2: To apply spectrophotometric techniques for quantitative determination of cations and dissociation constants of an indicator</p>
3	PCH-3856L	Industrial applications and titrimetric methods	<p>1: To apply ion-exchange chromatography principle for separation of cations.</p> <p>2: To apply kjeldhal's method for determination of total nitrogen.</p>
4	PCH-4851	Analytical Spectroscopy - II	<p>1: To be able to identify, recognize and compare principle, instrumentations and application of Atomic Absorption Spectroscopy (AAS), inductively coupled plasma atomic emission spectroscopy (ICP-AES), Atomic Fluorescence Spectroscopy (AFS) and implement them effectively for qualitative and quantitative assessment of elements.</p> <p>2: To be able to memorize the theory and principle of mass spectroscopy, various ionization techniques involved and different types of detectors used and to implement the theory to interpret the mass spectra.</p>
4	PCH-4852	Pharmaceutical Chemistry	<p>1: Would have basic infer of clinical biochemistry, and pathobiochemistry of different organs and various organ function tests. Would be able to estimate urea, uric acid, SGPT, SGOT and creatinine in blood serum.</p> <p>2: To discuss and memorize the discovery of new drugs and fundamentals of various steps involved</p>

			<p>in drug development, and to know method development and its validation.</p> <p>3: Recognize the different phases of clinical trials, role of quality control and quality assurance departments in the drug development, and to discuss about International conference on harmonization (ICH) and FDA guidelines.</p> <p>4: To describe various components of bioanalytical methodology, various parameters related to method validation, to discuss incurred sample reanalysis, and USFDA guidelines.</p>
4	PCH-4853	Advanced Analytical Instrumentation	<p>1: Infer and memorize the theory, principle, instrumentation and the applications of various hyphenated techniques like UHPLC, SFC, LC-NMR, LC-MS and ICP-MS.</p> <p>2: To memorize the principle, theories and instrumentation of Scanning Electron Microscopy (SEM), Scanning Tunneling Microscopy (STM) and Atomic Force Microscopy (AFM) and their industrial application</p>
4	PCH-4854	Environmental Chemistry	<p>1: To explain the principles of green chemistry, microwave assisted organic synthesis, and to study in detail the green alternatives for molecular rearrangements, electrophilic aromatic substitution reactions, oxidation- reduction reaction etc</p> <p>2: Able to gain basic information about the pollutants in air, water and soil and to describe its composition, sources, sampling and analysis through various chemical and instrumental methods.</p>
4	PCH-4855L	Industrial and pharmaceutical chemistry	<p>1: to perform various organ function test like bilirubin, SGPT, SGOT, creatinine , uric acid , urea, alkaline phosphatase , phosphorous in blood serum.</p> <p>2: To perform apply principle of Karl-Fisher titration for moisture content determination.</p> <p>3: To perform total organic carbon estimation in soil.</p>
4	PCH-4856L	Dissertation / Industrial Training	<p>1: Apply the theories and concepts learned in real-life world</p> <p>2: Communicate and present the applications, training and experience from the industrial training</p> <p>3: Analyse the observations from the industrial training</p>