

Rayat Shikshan Sanstha's  
**Annasaheb Awate Arts, Commerce & Hutatma Babu Genu Science College, Manchar**

DEPARTMENT OF CHEMISTRY

**Course Outcomes**

**F.Y.B.Sc. (Chemistry)**

Sr. No.	Class	Course	Course Outcomes
1	F. Y. Semester I	CH-101 : Physical Chemistry	<ol style="list-style-type: none"> <li>1. The students are expected to understand the fundamentals, principles, and recent developments in the thermodynamics.</li> <li>2. It is expected to inspire and boost interest of the students towards chemistry as the main subject.</li> <li>3. To familiarize with current and recent developments in Chemistry.</li> <li>4. To create foundation for research and development in Chemistry.</li> </ol>
		CH-102:Organic chemistry	<ol style="list-style-type: none"> <li>1. The student are expected to understand the fundamentals, principles and recent development in the subject area</li> <li>2. It is expected to inspire and boost interest of student toward chemistry as the main subject</li> <li>3. To familiarize with current and recent development in chemistry</li> <li>4. To create foundation for research and development in chemistry.</li> </ol>
		CH-103 : Chemistry Practical –I	<ol style="list-style-type: none"> <li>1. Importance of chemical safety and Lab safety while performing experiments in laboratory</li> <li>2. Determination of thermochemical parameters and related concepts</li> <li>3. Techniques of pH measurements</li> <li>4. Preparation of buffer solutions</li> </ol>
	F. Y. Semester II	CH-201: Inorganic Chemistry	<ol style="list-style-type: none"> <li>1. Various theories and principles applied to reveal atomic structure.</li> <li>2. Discuss electronic configuration of an atom and anomalous electronic configurations.</li> <li>3. Explain characteristics of ionic bond, types of ions, energy consideration in ionic bonding, lattice and solvation energy and their importance in the context of stability and solubility of ionic compounds</li> </ol>
		CH-202: Analytical Chemistry	<ol style="list-style-type: none"> <li>1. Students will know about basics of analytical chemistry, some techniques of analysis and able to do calculations essential for analysis.</li> </ol>
		CH- 203: Chemistry Practical –II	<ol style="list-style-type: none"> <li>1. Inorganic Estimations using volumetric analysis</li> <li>2. Synthesis of Inorganic compounds</li> <li>3. Analysis of commercial products</li> <li>4. Purification of organic compounds</li> </ol>
2	S. Y. Semester I	CH -301: Physical and Analytical Chemistry	<ol style="list-style-type: none"> <li>1. Define / Explain concept of kinetics, terms used, rate laws, molecularity, order.</li> <li>2. Discuss factors influencing adsorption, its characteristics, differentiates types as physisorption and Chemisorption, Classification of Adsorption Isotherms, to derive isotherms.</li> </ol>

			<ol style="list-style-type: none"> <li>Define, explain and compare meaning of accuracy and precision.</li> <li>2. Perform calculations involved in volumetric analysis.</li> </ol>
		CH-302: Inorganic and Organic Chemistry	<ol style="list-style-type: none"> <li>Define terms related to molecular orbital theory (AO, MO, sigma bond, pi bond, bond order, magnetic property of molecules, etc).</li> <li>Explain Werner's theory of coordination compounds. Differentiate between primary and secondary valency. Correlate coordination number and structure of complex ion.</li> <li>Identify and draw the structures aromatic hydrocarbons from their names or from structure name can be assigned.</li> </ol>
		CH-303: Practical Chemistry-III	<ol style="list-style-type: none"> <li>Verify theoretical principles experimentally.</li> <li>Interpret the experimental data on the basis of theoretical principles.</li> <li>Correlate theory to experiments. Understand/verify theoretical principles by experiment observations; explain practical output / data with the help of theory.</li> </ol>
S. Y. Semester II		CH-401: Physical and Analytical Chemistry	<ol style="list-style-type: none"> <li>Discuss meaning of phase, component and degree of freedom .</li> <li>Discuss / explain thermodynamic aspects of Ideal solutions-Gibbs free energy change, Volume change, Enthalpy change and entropy change of mixing of Ideal solution.</li> <li>Explain / discuss conductometric titrations .</li> <li>Explain / define different terms in Colorimetry such as radiant power, transmittance, absorbance, molar, Lamberts Law, Beer's Law, molar absorptivity</li> </ol>
		CH-402 : Inorganic and Organic Chemistry	<ol style="list-style-type: none"> <li>Isomerism in coordination complexes 2. Explain different types of isomerism in coordination complexes.</li> <li>Apply principles of VBT to explain bonding in coordination compound of different geometries. 2. Correlate no of unpaired electrons and orbitals used for bonding. 2. Identify / explain / discuss inner and outer orbital complexes. 4. Explain / discuss limitation of VBT.</li> <li>Explain principle of CFT. 2. Apply crystal field theory to different type of complexes (Td, Oh, Sq, Pl complexes) 3. Explain: i) strong field and weak field ligand approach in Oh complexes ii) Magnetic properties of coordination compounds on the basis of weak and strong ligand field ligand concept. iii) Origin of colour of coordination complex. 4. Calculate field stabilization energy and magnetic moment for various complexes.</li> <li>Identify and draw the structures aldehydes and ketones from their names or from structure name can be assigned. 2. Explain / discuss synthesis of aldehydes and ketones. 3. Write / discuss the mechanism reactions aldehydes and ketones. 4. Explain /Discuss important reactions of aldehydes and ketones.</li> <li>Identify and draw the structures carboxylic acids and their derivatives from their names or from structure name can be assigned. 2. Explain / discuss synthesis of carboxylic acids</li> </ol>

			<p>and their derivatives. 3. Write / discuss the mechanism reactions carboxylic acids and their derivatives.</p> <p>6. Identify and draw the structures amines from their names or from structure name can be assigned. 2. Explain / discuss synthesis of carboxylic amines. 3. Write / discuss the mechanism reactions carboxylic amines.</p>
		CH-403: Practical Chemistry-IV	<p>1. Understand systematic methods of identification of substance by chemical methods.</p> <p>2. Write balanced equation for all the chemical reactions performed in the laboratory.</p> <p>3. Perform organic and inorganic synthesis and able to follow the progress of the chemical reaction.</p>
3	T. Y. Semester I	CH-501	<p>1. Difference between thermal and photochemical processes.</p> <p>2. photochemical laws: Grothus - Draper law, Stark-Einstein law</p> <p>3. Quantum yield and reasons for high and low quantum yield</p> <p>4. Dipole moment and its experimental determination by temperature variation method.</p> <p>5. Electromagnetic spectrum, Nature of wave and its characteristics such as wavelength, wave number, frequency and velocity, Energy level diagram</p>
		CH-502: Analytical Chemistry- I	<p>1. Define basic terms in gravimetry, spectrophotometry, qualitative analysis and parameters in instrumental analysis. Such as: Gravimetry, precipitation, solubility product, ionic product, common ion effect, precipitating agent, washing of ppt., drying and ignition of ppt., linearity range, detection limit, precision, accuracy, Sensitivity, Selectivity, Robustness and Ruggedness, electromagnetic radiations, spectrophotometry, Beers law, absorbance, transmittance, molar absorptivity, monochromator, wavelength of maximum absorbance.</p> <p>2. Explain different principles involved in the gravimetry, spectrophotometry, parameters in instrumental analysis, qualitative analysis.</p>
		CH-503: Physical Chemistry Practical - I	<p>1. To determine the specific refractivity's of the given liquids A and B and their mixture and hence determine the percentage composition their mixture C.</p> <p>2. To titrate <math>\text{Cu}^{2+}</math> ions with EDTA photometrically.</p>
		CH-504: Inorganic Chemistry - I	<p>1. Explain electroneutrality principle and different types of pi bonding.</p> <p>2. To understand about inert and labile complexes and stability of complexes in aqueous solutions</p> <p>3. To know trends in periodic properties of these elements w.r.t. size of atom and ions, reactivity, catalytic activity, oxidation state, complex formation ability, color, magnetic properties, non-stoichiometry, density, melting point, boiling point.</p>
		CH-505 Industrial Chemistry	<p>1) The students are expected to learn; Importance of chemical industry, Meaning of the terms involved, Comparison between batch and continuous process ,Knowledge of various industrial aspects.</p> <p>2) The students are expected to learn, Concept of basic chemicals, Their uses and manufacturing process, They should also know the physico-chemical principals involved in manufacturing process. 3) The students are expected to learn.</p>

		<p>3) Sugar Industry: The students are expected to learn Importance of sugar industry, Manufacture of direct iii. Consumption (plantation white) sugar with flow diagram. Cane juice extraction by various methods, Clarification by processes like carbonation, vi. Sulphitation, Phosphatation, etc. Concentration of juice by using multiple effect evaporator system, Crystallization of sucrose by using vacuum pan by processes like carbonation, Sulphitation, vii. Phosphatation, etc. Concentration of juice by using multiple effect evaporator system, Crystallization of sucrose by using vacuum pan.</p> <p>Fermentation Industry- The students are expected to learn Importance, Basic requirement of fermentation process, Manufacturing of ethyl alcohol by using molasses and fruit juice.</p> <p>4) The students are expected to learn, Different types of soap products, Chemistry of soap, Raw materials required for soap manufacture, Meaning of the term's Surfactants, Types of surfactants, Raw materials for detergents, Detergent builders, additives, Washing action of soap and detergents.</p> <p>5) The students are expected to learn Dyes - Students should know about, Dyes: introduction, Dye intermediates, Structural features of a dye; Classification of dyes, Synthesis, Structures, properties and applications of dyes. Pigments: Students should know about Introduction, Classification and general properties of pigment, Production processes of zinc oxide and iron oxide.</p>
	CH-506: Inorganic Chemistry Practical - I	<ol style="list-style-type: none"> <li>1. Preparation of inorganic complexes and spot tests for metal ions and ligands</li> <li>2. Qualitative and confirmatory tests of inorganic toxicants of any four ions</li> </ol>
	CH-507: Organic Chemistry - I	<ol style="list-style-type: none"> <li>1. Define and classify polynuclear and hetroonuclear aromatic hydrocarbons.</li> <li>2. Synthetic applications ethyl acetoacetate and malonic ester</li> <li>3. To write the mechanism of some named rearrangement reactions and their applications</li> </ol>
	CH-508DSEC-III: CH-508: Chemistry of Biomolecules	<ol style="list-style-type: none"> <li>1. Introduction to molecular logic of life: 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 macromolecule.</li> <li>2. Carbohydrates: The student will understand the types of carbohydrates and their biochemical significance in living organisms, structure of carbohydrates and reactions of carbohydrates with Glucose as example. Properties of carbohydrates.</li> </ol>
	CH-509: Organic Chemistry Practical-I	<ol style="list-style-type: none"> <li>1. Perform the quantitative chemical analysis of binary mixture, explain principles behind it.</li> <li>2. Understand the techniques involving drying and recrystallization by various method.</li> <li>3. Synthesis of various organic compounds through greener approach.</li> </ol>

		CH-510 (A) Introduction of Medicinal Chemistry	<p>Upon completion of the course the student shall be able to understand,</p> <ol style="list-style-type: none"> <li>1. The basics of medicinal chemistry, biophysical properties, overview of basic concepts of traditional systems of medicine.</li> <li>2. Over view of the overall process of drug discovery, and the role played by medicinal chemistry in this process.</li> <li>3. Biological activity parameters and importance of stereochemistry of drugs and receptors.</li> <li>4. Knowledge of mechanism of action of drugs belonging to the classes of infectious and non-infectious diseases.</li> <li>5. Enhancement of practical skills.</li> </ol>
		CH-511: Skills Enhancing Course-II	<ol style="list-style-type: none"> <li>1. Importance and conservation of environment.</li> <li>2. Organic and inorganic pollutants</li> <li>3. Water quality parameters</li> </ol>
T. Y. Semester II		CH-601	<ol style="list-style-type: none"> <li>1. Electrochemical cells: Explanation of Daniell cell, Conventions to represent electrochemical cells</li> <li>2. Thermodynamic conditions of reversible cell, Explanations of reversible and irreversible electrochemical cell with suitable example</li> <li>3. Weiss and Millers Indices, determination of Miller Indices</li> <li>4. Bravais lattices, space groups, seven crystal systems and fourteen Bravais lattices</li> <li>5. The Group Displacement Law, Radioactive Disintegration Series</li> </ol>
		CH-602	<ol style="list-style-type: none"> <li>1. Meaning of the terms-Solution, electrolytes, nonelectrolytes and colligative properties</li> <li>2. Lowering of vapour pressure of solvent in solution</li> <li>3. Applying rate laws for solid state reactions</li> <li>4. Results of kinetics studies</li> <li>5. phenomena of photoconductivity</li> </ol>
		CH-603	<ol style="list-style-type: none"> <li>1. To determine the PKa value of given monobasic weak acid by potentiometric titration.</li> <li>2. Determination of Pka of given weak acid by pH metry titration with strong base</li> <li>3. To determine the molecular weight of a given polymer by turbidometry</li> <li>4. Analysis of crystal structure from X-ray diffraction spectra of any two compounds</li> </ol>
		CH-604 : Inorganic Chemistry -II	<ol style="list-style-type: none"> <li>1. To understand M-C bond and to define organometallic compounds</li> <li>2. Understand the phenomenon of catalysis, its basic principles and terminologies.</li> <li>3. Understand the role of metals in non-enzymatic processes.</li> </ol>
		CH-605: Inorganic Chemistry -III	<ol style="list-style-type: none"> <li>1. Student will learn the concept of acid base and their theories.</li> <li>2. Be able to solve simple problems based on Pauling's univalent radii and crystal radii.</li> <li>3. Different Zeolite Framework Types and their classification</li> </ol>
		CH-606: Inorganic Chemistry Practical-II	<ol style="list-style-type: none"> <li>1. Estimation of Na by flame photometry by calibration curve method.</li> <li>2. Purification of water using cation/anion exchange resin and analysis by qualitative analysis /conductometry.</li> </ol>

			3. Solvent free microwave assisted one pot synthesis of pthalocynin copper (II) complex.
		CH-607: Organic Chemistry-II	<ol style="list-style-type: none"> <li>1. Students will learn the principle of mass spectroscopy, its instrumentation and nature of mass spectrum.</li> <li>2. Students will understand the principle of UV spectroscopy and the nature of UV spectrum. They will learn types of electronic excitations.</li> <li>3. Students will understand the principle of IR spectroscopy, types of vibrations and the nature of IR spectrum.</li> </ol>
		CH-608: Organic Chemistry-III [Credit -2, 36 L] Synthetic Organic Chemistry	<ol style="list-style-type: none"> <li>1. Chemistry of reactive intermediates (carbocations, carbanions, free radicals, carbenes, nitrenes, benzyne etc</li> <li>2. Introduction, Isolation, Classification. Citral- structure determination using chemical and spectral methods, Synthesis of Citral by Barbier and Bouveault Synthesis.</li> </ol>
		CH-609: Organic Chemistry Practical-II	<ol style="list-style-type: none"> <li>1. Determination of functional group of organic compound from given IR spectra.</li> <li>2. Estimation of glucose</li> <li>3. Caffeine from tea leaves</li> </ol>
		CH610(Chemistry of Soil And Agrochemicals)	<ol style="list-style-type: none"> <li>1. Know the different components and properties of soil.</li> <li>2. Know classification of soil on the basis of pH.</li> <li>3. Identify the problematic soil and recommend method for their reclamation.</li> <li>4. Know the different plant nutrients required for plants and their functions.</li> <li>5. Know the role of various fertilizers and manures required for plant growth.</li> <li>6. Know the various methods and their techniques in analysis of soil.</li> <li>7. Know importance of manures as compared to chemical fertilizers.</li> <li>8. Know various techniques to protect the plants.</li> <li>9. Have the knowledge of various pesticides, insecticides, fungicides and herbicides.</li> </ol>
		CH-611(A): Analytical Chemistry-II	<ol style="list-style-type: none"> <li>1. Explain different principles involved in the analyses using solvent extraction, basics of instrumental chromatography, HPLC, GC, and atomic spectroscopic techniques.</li> <li>2. Perform quantitative calculations depending upon equations students has studied in the theory. Furthermore, student should able to solve problems on the basis of theory.</li> <li>3. Discuss / Describe procedure for different types analyses included in the syllabus.</li> <li>4. Select particular method of analysis if analyte sample is given to him.</li> </ol>

**M.SC. PART I (CHEMISTRY):**

Sr. No.		Course	Outcomes
1	<b>M.Sc. Part I Organic Chemistry Semester-I (Theory)</b>	CHP-110 Physical Chemistry	<ul style="list-style-type: none"> <li>*Realize the terms ionic strength, activity coefficient, Debye-Hückel equation.</li> <li>*Know the eigen function, eigen value, operator and postulates of quantum mechanics.</li> <li>*Learn two and three dimensional box, mechanics of particle.</li> <li>* Understand the adsorption of gases by solid type of isotherms</li> <li>* Recognized the Fricke and ceric sulphate Dosimeter.</li> <li>* Learn parent-daughter relationship, application of radioactivity, NAA, IDA. Effect of radiation and units of radiation.</li> </ul>
2		CHI-130 Inorganic Chemistry	<ul style="list-style-type: none"> <li>*Determine and Learn about Dipole moment and bond order of the inorganic molecule.</li> <li>*Learn about geometry and shape of the molecule.</li> <li>*Known the preparation and properties of transition metal carbonyls</li> <li>* To understand the 18 electron rule and its application.</li> <li>* Find out the point group of inorganic molecules.</li> <li>* Learn molecular orbital and its orientation.</li> <li>*learn concept of symmetry elements in molecules.</li> </ul>
3		CHO-150 Organic Chemistry	<ul style="list-style-type: none"> <li>*Learn SN1, SN2 and SNi Mechanism and stereochemistry.</li> <li>*Learn classical and non-classical carbocation, NGP bypi and sigma bonds.</li> <li>*Solve the elimination problems.</li> <li>*Distinguish between type of addition, elimination and substitution reaction.</li> <li>Learn E and Z nomenclature in C, N, S, P containing compound, Stereochemical principal, enantiomeric relationship R and S.</li> </ul>
4		CHA-190 General Chemistry	<ul style="list-style-type: none"> <li>*study the importance of safety and security, responsibility types of hazards and risk in chemical laboratory.</li> <li>*Understand the use of personal protective and other safety equipments, handling of chemical in laboratory.</li> <li>*Understand the route of explosion for toxic chemicals.</li> <li>*Learn good laboratory practices and its applications.</li> </ul>
5	<b>M.Sc. Part I Organic Chemistry. Semester-I Practical's</b>	CH-P-1 Physical Chemistry Practical's	<ul style="list-style-type: none"> <li>*Calculate molar and normal solution of various concentrations.</li> <li>*determine specific rotations and percentage of optically active substances by polarimetrically.</li> <li>*Study the energy of activation and second order reaction.</li> <li>*study the stability of complex ion and standard free energy change and equilibrium constant by potentiometry.</li> <li>Find out the acidity, Basicity and PKa Value on pH meter.</li> </ul>
6		CH-I-1 Inorganic Chemistry practical's	<ul style="list-style-type: none"> <li>*Study the gravimetric and volumetric analysis of ore and alloy.</li> <li>*Prepare a various inorganic complexes and determine its %purity.</li> <li>*Preparation of non material.</li> <li>*To understand the chromatographic techniques.</li> </ul>
7		CH-O-1 Organic Chemistry practical's	<ul style="list-style-type: none"> <li>*perform the ternary mixtures.</li> <li>*Preparation of organic compounds, their purifications and run TLC.</li> <li>* Determination of physical constant: Melting point, Boiling point.</li> <li>* Different separation techniques.</li> </ul>

Sr. No.		Course	Outcomes
1	<b>M.Sc. Part I Organic Chemistry. Semester-II (Theory)</b>	CHP-210 Physical Chemistry	<ul style="list-style-type: none"> <li>*Learn the thermodynamic description of exact, inexact differential and state function.</li> <li>*Know the qualitative properties of solution, the depression in freezing point, elevation in boiling point and osmotic pressure.</li> <li>*Know the statistical thermodynamics and various partition function.</li> <li>*Study the steady state approximation michaelis- menten mechanism, lindemann-hinshelwood mechanism, chain reaction, Rate determining stapes and consecutive elementary reactions.</li> <li>*Learn the molecular spectroscopy, R. Raman, Electronic and Mossbauer and its application.</li> </ul>
2		CHI-230 Inorganic Chemistry	<ul style="list-style-type: none"> <li>*Understand the mechanism in transition metal complexes, Born Haber cycle to calculate lattices energy.</li> <li>*Learn the use of catalyst, radius ratio rule of coordination number 3,4.</li> <li>*Study the structure of atom, Hunds rule, term symbol, calculation of microstate and selection rule.</li> <li>*Understand the metal complexes in biological system.</li> </ul>
3		CHO-250 Name reaction, synthetic Organic Chemistry and Spectroscopy	<ul style="list-style-type: none"> <li>*Studied the various name reaction with examples.</li> <li>*Learn the mechanism of rearrangement reaction, use synthetic reagent of oxidation and reduction for solving the problems.</li> <li>*Understand the factors affecting UV-absorption spectra, Interpret IR-spectra on basic values of IR-frequencies.</li> <li>*Discuss the problem of UV, IR and NMR.</li> </ul>
4		CHA-290 General Chemistry	<ul style="list-style-type: none"> <li>*Study the instrumentation, sample injection system, columns for HPLC and GC, Solvent treatment system and choice of mobile phase.</li> <li>*Learn instrumentation of mass spectrometry, fragmentation, structure determination.</li> <li>*Solve mean and standard deviation problems.</li> <li>*Understand the accuracy and precision and classification error.</li> <li>*Learn distillation, solvent extraction, crystallization, and other separation techniques.</li> </ul>
5	<b>M.Sc. Part I Organic Chemistry. Semester-II (Practical's)</b>	CH-P-1 Physical Chemistry Practical's	<ul style="list-style-type: none"> <li>*Calculate molar and normal solution of various concentrations.</li> <li>*Determine specific rotations and percentage of to optically active substances by polarimetrically.</li> <li>*Study the energy of activation and second order reaction.</li> <li>*Study the stability of complex ion and stranded free energy change and equilibrium constant by potentiometry.</li> <li>Find out the acidity, Basicity and PKa Value on pH meter.</li> </ul>
6		CH-I-1 Inorganic Chemistry practical's	<ul style="list-style-type: none"> <li>*Study the gravimetric and volumetric analysis of ores and alloy.</li> <li>*Prepare a various in organic complexes and determine its % purity.</li> <li>*Preparation of nonmaterial.</li> <li>*To understand the chromatographic techniques.</li> </ul>
7		CH-O-1 Organic Chemistry Practical's	<ul style="list-style-type: none"> <li>*Perform the ternary mixtures.</li> <li>*Preparation of organic compounds, their purifications and run TLC.</li> <li>* Determination of physical constant: Melting point, Boiling point.</li> <li>* Different separation techniques.</li> </ul>



## M.SC. PART II (ORGANIC CHEMISTRY):

Sr. No.		Course	Outcomes
1	<b>M.Sc. Part-II Organic Chemistry Semester-III (Theory)</b>	CHO-350 Organic reaction mechanism	<ul style="list-style-type: none"> <li>*Study of carbanion-formation, stability and related name reaction, enamines and its applications.</li> <li>*Understand the NGP.</li> <li>*Learn the carbines and nitrenes.</li> <li>*Study of free radicals: generation of radicals, Nucleophilic electrophilic radicals, inter and intramolecular C-C bond formation via mercuric hydride.</li> <li>*Study of oxidative coupling and SNA reaction.</li> </ul>
2		CHO-351 Spectroscopic methods in structure determination.	<ul style="list-style-type: none"> <li>*Study <sup>1</sup>H NMR Spectroscopy: Chemical Shift, deshielding, correlation for protons bonded to carbon and other nuclei.</li> <li>*Study of <sup>13</sup>C NMR spectroscopy: FT- NMR, type of <sup>13</sup>C NMR spectra, proton decoupled, off resonance, APT, INEPT, DEPT, Chemical shift, nuclear and heteronuclear coupling constant</li> <li>*2D NMR techniques: COSY, homo and hetero nuclear 2D resorts spectroscopy, NOESY and the applications</li> <li>*Study of mass spectrometry: Instrumentation, various methods of ionization, SIMS, FAB, MALDI. Different detectors rules of fragmentations of different Functional groups.</li> </ul>
3		CHO-352 Organic stereochemistry	<ul style="list-style-type: none"> <li>*Study of stereochemistry of six member ring.</li> <li>*Learn the stereochemistry of rings other than six members.</li> <li>*Understand fused bridge and Caged rings.</li> <li>*Learn resolution of racemic modification, stereochemistry of organic compound using NMR.</li> <li>*Determine geometrical isomerism and stereochemistry of olefins.</li> </ul>
4		CHO-353 Photochemistry, Pericyclic reaction and heterocyclic chemistry.	<ul style="list-style-type: none"> <li>*Study of photochemistry: Carbonyl compounds, alkenes, dienes, polyenes and aromatic compounds.</li> <li>*Study photo rearrangement Barton reaction, application of photochemical reaction.</li> <li>* Learn Pericyclic reaction: Electro cyclic, Cycloaddition, Ene Reaction, analysis by correlation diagram, FMO approach and ATS concept.</li> <li>*Study of heterocyclic chemistry: Five and six member heterocyclic with one or two heteroatoms.</li> <li>*Understand condensed five and six member's heterocyclic.</li> <li>*Study the synthesis, reactivity, aromatic character and importance of heterocyclic compounds.</li> </ul>
5		<b>M.Sc. Part-II Organic Chemistry Semester - III (Practical's)</b>	CHO-354: Practical-I Solvent Free Organic Synthesis

Sr. No.		Course	Outcomes
1	<b>M.Sc. Part-II Organic Chemistry Semester- IV (Theory)</b>	CHO-450 Chemistry of Natural Product	*Understanding and planning of total synthesis while maintaining the stereochemistry. A case study: Longifolene, Hirsutellone B, Ribisins A and B, Vannusals and Pinnaic acid.
2		CHO-451 Advance Synthetic Organic Chemistry	*Study of transition metal complexes inorganic synthesis. * Learn C=C formation reaction, multi compound reaction, ring formation reaction. *Study of sharpless azides Cycloaddition, use of boron and silicon in organicsynthesis.
3		CHO-452 Carbohydrate and chiral approach, chiral drugs and medicinal chemistry.	*Study of carbohydrates: Introduction of sugar, structure of triose tetrosa, panctose, hexoes, stereochemistry of glucose. *Understand the chiral approach, concept of chiral templates, and utilization of the basic concept for reterosynthetic strategy. *Study of chiral drug. *Learn medicinal chemistry, the action and discovery. *Study the structure activity and drug targets. *Study of antimicrobial drugs, antibacterial, antifungal, antiviral, antimalarial etc.
4		CHO-453 Designing organic synthesis and asymmetric synthesis.	*Study the design of organic synthesis, protection deprotonation of hydroxyl, aminocarboxyl, ketones and aldehyde. *Learn reterosynthesis. *Understand the principle and application of asymmetric synthesis. *Study of cram's rule, felkin-Anh rule, Cram's chelate model asymmetric synthesis using chiral reagent.
5		CHO-453: Practical-III: Select ANY TWO Section I, II and III	* Understand and employ concept of type determination and separation * Meticulously record physical constants * Perform micro scale chemical elemental analysis * Perform qualitative estimation of functional groups * Recrystallize /distill the separated compounds * Extend these skills to organic synthesis
6		CHO-454: Practical-II: Convergent and Divergent Organic Syntheses	* Students should acquire pre-experiment (Reading MSDS, purification of reactants and reagents, mechanism, stoichiometry etc) and post-experiment skills (work-up, isolation and purification of products, physical constants characterization using any spectroscopic methods etc.)

## **M. SC. PART II (ANALYTICAL CHEMISTRY):**

<b>Sr. No</b>	<b>Class</b>	<b>Course</b>	<b>Outcome</b>
1.	M.Sc. II Analytical Chemistry Semester-III (Theory)	<b>CHA-390</b> Electrochemical and Thermo - gravimetric Methods of Chemical Analysis	<ol style="list-style-type: none"><li>1. Define various terms in electrochemistry and thermogravimetry.</li><li>2. Explain instrumentation in electrochemistry and thermogravimetry.</li><li>3. describe basic principles of electrochemistry and thermogravimetry.</li><li>4. Explain /Describe applications of electrochemistry and thermogravimetry in industry and in analytical laboratory.</li><li>5. Apply / select particular method of analysis for sample to be analysed.</li><li>6. Solve numerical problems on electrochemistry and thermogravimetry.</li><li>7. Interpret polarogram, cyclic voltammogram, pulse polarogram, thermogram, differential thermogram and DSC thermogram.</li><li>8. Differentiate among the various methods of electrochemistry and thermogravimetry.</li></ol>
2.	M.Sc. II Analytical Chemistry Semester-III (Theory)	<b>CHA-391</b> Analytical Method Development and Extraction Techniques	<ol style="list-style-type: none"><li>1. Define / understand various terms in analytical extraction and method development and validation.</li><li>2. Explain instrumentations and methodology in analytical extraction.</li><li>3. Explain / describe basic principles of analytical extraction method development and validation.</li><li>4. Explain /Describe applications analytical extraction and method development and validation in industry and in analytical laboratory.</li><li>5. Apply / select particular method of analysis for sample to be analysed.</li><li>6. Solve numerical problems on analytical extraction and method development and validation.</li><li>7. Develop analytical method for analysis of given sample. Apply statistical treatment to the analytical data. Select appropriate parameters for the development of analytical method</li><li>8. Differentiate among the methods of analytical extraction.</li></ol>
3.	M.Sc. II Analytical Chemistry Semester-III (Theory)	<b>CHA-392</b> Advanced Chromatographic Methods of Analysis	<ol style="list-style-type: none"><li>1. Define / understand various terms in chromatography (GC and HPLC) and mass spectroscopy.</li><li>2. Explain instrumentations in chromatography (GC and HPLC) and mass spectroscopy.</li><li>3. Explain / describe i) basic principles of chromatography (GC and HPLC) and mass spectroscopy. ii) separation in GC / HPLC column. iii) Functioning and construction of GC / HPLC/ MS detectors.</li><li>4. Explain /Describe applications chromatography (GC and HPLC) in industry and in analytical laboratory.</li><li>5. Apply / select particular method / instrumental parameters for analysis for sample GC / HPLC.</li><li>6. Solve numerical problems on chromatography (GC and HPLC) and mass spectroscopy.</li><li>7. Integrate GC and HPLC chromatogram, Mass spectrum</li><li>8. Differentiate among the chromatography (GC and HPLC)</li></ol>

			methods of analysis.
4.	M.Sc. II Analytical Chemistry Semester-III (Theory)	CHA-393 A) Bioanalytical Chemistry	<ol style="list-style-type: none"> <li>1. Define / understand various terms in Electrophoresis, capillary electrophoresis, HPTLC, Body fluid analysis, ELISA, RIA.</li> <li>2. Explain instrumentations in in Electrophoresis, capillary electrophoresis, HPTLC, Body fluid analysis, ELISA, RIA.</li> <li>3. Explain / describe i) basic principles of chromatography (GC and HPLC) and mass spectroscopy. ii) Separation in GC / HPLC column. iii) Functioning and construction of GC / HPLC/ MS detectors.</li> <li>4. Explain /Describe applications chromatography (GC and HPLC) in industry and in analytical laboratory.</li> <li>5. Apply / select particular method / instrumental parameters for analysis for sample GC / HPLC.</li> <li>6. Solve numerical problems on chromatography (GC and HPLC) and mass spectroscopy.</li> <li>7. Integrate GC and HPLC chromatogram, Mass spectrum</li> <li>8. Differentiate among the chromatography (GC and HPLC) methods of analysis.</li> </ol>
5.	M.Sc. II Analytical Chemistry Semester-III (Practical)	CHA-394 CCPP3: Practical I: Basics of Instrumental Methods of Chemical Analysis	<ol style="list-style-type: none"> <li>1 Maintain proper record of analytical data in notebook. Observer personal safety in laboratory and able handle all chemicals, instruments, etc safely in laboratory.</li> <li>2. Define / understand various terms involved practical methods of quantitative analysis.</li> <li>3. Explain instrumentations of colorimeter, spectrophotometer, photoflurometer, TGA, HPLC, GC, Flame-photometer, CV, AAS, etc.</li> <li>4. Explain / describe basic principles of chromatography different instrumental methods of analysis. Able to handle particular instrument according to SOP.</li> <li>5. Design / modify and validate new analytical method for chemical analysis of particular sample.</li> <li>6. Apply / select particular method / instrumental parameters for analysis of given sample.</li> <li>7. Give mathematical treatment to analytical data and able to interpret the results accurately.</li> <li>8. Verify theoretical principle practically or apply theory to explain practical observations.</li> <li>9. To conclude the results able to take the decision regarding quality of sample.</li> </ol>
6.	M.Sc. II Analytical Chemistry Semester-IV (Theory)	CHA-490: Advanced Analytical Spectroscopic Techniques	<ol style="list-style-type: none"> <li>1. Define / understand various terms in atomic absorption, atomic emission, fluorescence, ESR and electron spectroscopy.</li> <li>2. Explain instrumentation of atomic absorption, atomic emission, ICPAES, ICPAES-MS, fluorescence, ESR and electron spectroscopy.</li> <li>3. To describe basic principles of atomic absorption, atomic emission, ICPAES, ICPAESMS, fluorescence, ESR and electron spectroscopy.</li> <li>4. Select appropriate methods for sample treatment in AAS / AES, ICPAES, ICPAES-MS.</li> <li>5. Explain advantages of ICPAES-MS over AES spectroscopy, fluorescence spectroscopy.</li> <li>6. Solve numerical problems on analysis all these spectroscopic methods.</li> <li>7. Interpret ESR spectra, super hyperfine splitting and g value in</li> </ol>

			<p>ESR, and parameters affecting it.</p> <p>8. Calculate theoretical parameters from ESR data and characterize compound.</p> <p>9. Solve problems based on atomic absorption, atomic emission, ICPAES, ICPAES-MS, fluorescence, ESR and electron spectroscopy.</p>
7.	M.Sc. II Analytical Chemistry Semester-IV (Theory)	CHA-491: Chemical Methods of Pharmaceuticals Analysis	<ol style="list-style-type: none"> <li>1. Define / understand various terms in pharmaceutical raw material and finished product analysis.</li> <li>2. Explain various pharmaceutical dosage forms and types of raw materials used.</li> <li>3. To describe basic principles of methods of pharmaceutical analysis according to IP.</li> <li>4. Explain importance particular test in pharmaceutical raw material and finished product analysis.</li> <li>5. Perform and explain importance of limit tests, identification tests and microbiological limit test of raw materials and finished products.</li> <li>6. Solve numerical problems on analysis pharmaceutical raw material and finished product analysis.</li> <li>7. Interpret IR spectra, HPLC chromatogram, UV-Visible spectra of pharmaceutical materials.</li> <li>8. To perform total analysis of pharmaceutical raw material and finished product analysis according to IP / BP / USP.</li> <li>9. Standardize analytical instruments according IP /BP/ USP.</li> <li>10. Take a decision on the basis of analytical results regarding quality of raw materials so that material can be accepted for production or rejected.</li> </ol>
8.	M.Sc. II Analytical Chemistry Semester-IV (Theory)	CHA-492: B) Analytical Chemistry of agriculture, Polymer and Detergents	<ol style="list-style-type: none"> <li>1. Define / understand various terms in soil analysis, pesticide residue analysis, detergent analysis and polymer analysis.</li> <li>2. Explain / describe techniques / methods of soil analysis, pesticide residue analysis, detergent analysis and polymer analysis.</li> <li>3. To describe basic principles techniques / methodssoil analysis, pesticide residue analysis, detergent analysis and polymer analysis.</li> <li>4. Explain importance of soil analysis, pesticide residue analysis, detergent analysis and polymer analysis.</li> <li>5. Choose suitable method / techniques to characterize quality of soli polymer and detergent.</li> <li>6. Describe / explain results of analysis soil, pesticide residue, detergent and polymer.</li> <li>7. Solve numerical problems on analysis soil, pesticide residue, detergent and polymer.</li> <li>8. Draw conclusion regarding soil, detergent and polymer quality from analytical results.</li> </ol>
9.	M.Sc. II Analytical Chemistry Semester-IV (Practical)	CHA-493-A: Optional Analytical Chemistry Practical OR CHA-493-B: Project	<ol style="list-style-type: none"> <li>1. Maintain proper record of analytical data in notebook. Observer personal safety in laboratory and able handle all chemicals, instruments, etc safely in laboratory.</li> <li>2. Define / understand various terms involved practical methods of quantitative analysis.</li> <li>2. To analyse organic and inorganic materials using appropriate chemical / instrumental methods</li> <li>3. Explain / describe basic principles of chemical / instrumental methods used for analysis. Able to handle particular instrument</li> </ol>

			<p>according to SOP.</p> <ol style="list-style-type: none"> <li>4. Perform analysis of sample with described procedure. Able to handle analytical instruments.</li> <li>5. Apply / select particular method / instrumental parameters for analysis of given sample.</li> <li>6. Maintain appropriate reaction conditions as described in procedures.</li> <li>7. To perform i) selective analysis of particular component from sample. ii) Analysis at trace level from sample.</li> <li>8. To conclude the results able to take the decision regarding quality of sample.</li> <li>9. To perform calculations and interpret the results.</li> </ol>
		CHA-493-B: Project	<ol style="list-style-type: none"> <li>1. Maintain proper record of analytical data in note book for research purpose.</li> <li>2. Perform review of literature related to the topic of project work and design the problem for project work. 3. Decide and describe methodology for problem to solve proposed problem in the form of project. Decide and perform application of research work.</li> <li>4. To design experiment for research work. Collect the resources, design small equipment, etc. for completion of research work.</li> <li>5. Collect experimental data (raw data) and analyse the data in the perspective of problem. Present data in graphical forms for the conclusive results.</li> <li>6. Use computer as a tool for result analysis, presentation and writing the project.</li> <li>7. To obtain concrete conclusion from the results on the basis of reported theory / research work and analytical results.</li> <li>8. To perform report writing, scientifically.</li> <li>9. To write research project / paper in scientific manner</li> </ol>
10	M.Sc. II Analytical Chemistry Semester- IV  (Practical)	CHA-494: Practical II: Applied Analytical Chemistry	<ol style="list-style-type: none"> <li>1. Maintain proper record of analytical data in notebook. Observe personal safety in laboratory and able to handle all chemicals, instruments, etc safely in laboratory.</li> <li>2. Define / understand various terms involved practical methods of quantitative analysis.</li> <li>3. To analyse organic and inorganic materials using appropriate chemical / instrumental methods</li> <li>4. Explain / describe basic principles of chemical / instrumental methods used for analysis. Able to handle particular instrument according to SOP.</li> <li>5. Perform analysis of sample with described procedure. Able to handle analytical instruments.</li> <li>6. Apply / select particular method / instrumental parameters for analysis of given sample.</li> <li>7. Maintain appropriate reaction conditions as described in procedures.</li> <li>8. To perform i) selective analysis of particular component from sample. ii) Analysis at trace level from sample.</li> <li>9. To conclude the results able to take the decision regarding quality of sample.</li> <li>10. To perform calculations and interpret the results.</li> </ol>