

**Sant Gadge Baba Amravati University, Amravati**

**Department of Chemistry**

**M.Sc. Chemistry**

**Programme Outcomes, Programme Specific Outcomes and Course Outcomes**

**Programme outcome (POs):**

- **PO 1.** Comprehensive understanding of the principles of Chemistry .
- **PO 2.** Gain the skills to design and carry out scientific experiments and interpret the data.
- **PO 3.** Understand the interdisciplinary nature of Chemistry and to make aware of the emerging areas in Chemistry .
- **PO 4.** Build a scientific temper and to learn the necessary skills to succeed in research or industrial field. .
- **PO 5.** Be able to define and resolve new problems in Chemistry and participate in the future development of Chemistry.
- **PO 6.** Get a deep insight into the various spectroscopic methods used for the characterization of organic compounds. .
- **PO 7.** Enable the students to elucidate the structure of compounds by analyzing the spectral data.

**Programme Specific Outcomes (PSOs):**

- **PSO 1.** Gains complete knowledge about all fundamental aspects of all the elements of chemistry
- **PSO 2.** Understands the background of organic reaction mechanisms, complex chemical structures, instrumental method of chemical analysis, molecular rearrangements and separation techniques.
- **PSO 3.** Appreciates the importance of various elements present in the periodic table, coordination chemistry and structure of molecules, properties of compounds, structural determination of complexes using theories and instruments.
- **PSO 4.** Gathers attention about the physical aspects of atomic structure, dual behavior, reaction pathways with respect to time, various energy transformations, molecular assembly in nano level, significance of electrochemistry, molecular segregation using their symmetry.
- **PSO 5.** Learns about the potential uses of analytical industrial chemistry, medicinal chemistry and green chemistry.

- **PSO 6.** Carry out experiments in the area of organic analysis, Multi step Synthesis estimation, separation, derivative process, inorganic semi micro analysis, preparation, conduct metric and potentiometric analy

**Course Outcomes (COs):**

S.No.	Name of the course (Paper)	Course Code	Course Outcome
1	Inorganic Chemistry.	2101	<ul style="list-style-type: none"> <li>• Structural rationalization of molecules by VSEPR theory.</li> <li>• Structure, bonding and properties in coordination compounds by VBT, CFT, MOT.</li> <li>• Able to describe the stability of metal complexes by the use of formation constants and to calculate thermodynamic parameters from them.</li> <li>• Learn about structure and bonding in metal carbonyls and metal nitrosyl.</li> <li>• Students will able to draw character table and point groups</li> <li>• Use of Crystal Field Theory to understand the magnetic properties and the colour of coordination compounds.</li> <li>• Gains knowledge of Boron hydrides &amp; Metal Cluster.</li> </ul>
2	Organic Chemistry-I.	2102	<ul style="list-style-type: none"> <li>• Learns the fundamentals of reaction mechanisms and can propose mechanism on the basis of evidences.</li> <li>• Understands the mechanism of nucleophilic substitution, Aromatic Nucleophilic and Electrophilic and elimination reactions.</li> <li>• Appreciates the fundamentals of aromaticity in organic chemistry.</li> <li>• Gains the knowledge about separation and isolation of stereoisomers.</li> <li>• Understanding the molecular rearrangements.</li> </ul>

			<ul style="list-style-type: none"> <li>• Importance of chiral/asymmetric synthesis.</li> </ul>
3	Physical Chemistry-I	2013	<ul style="list-style-type: none"> <li>• Understand the concept of quantum Mechanics, Variation theorem and its application.</li> <li>• Gains the knowledge of eigen functions for angular momentum, eigen value of angular momentum. Pauli exclusion principle. Russel-Saunders terms&amp; coupling schemes.</li> <li>• Explain the influence of different parameters on rate of reactions.</li> <li>• Explain the concept of activation energy and its effects on the rates of chemical reactions.</li> <li>• Learns about Classical Thermodynamics and Non equilibrium Thermodynamics.</li> <li>• Know the characteristics of radioactive decay, theory of a band g decay process and different types of reactors.</li> </ul>
4	Modern Methods of Separation.	2104	<ul style="list-style-type: none"> <li>• Express the role of analytical chemistry in science and different sampling processes.</li> <li>• Can apply Various analytical tests used for rejection of data.</li> <li>• Understanding of skills in advanced methods of separation and analysis Chromatography, Ion Exchange, Solvent Extraction.</li> <li>• Learn about principle and applications of GC and HPLC techniques.</li> <li>• Gain Knowledge about laboratory safety and war-fare agents.</li> </ul>
5	Lab I	3001	<ul style="list-style-type: none"> <li>• Students can prepare nitro and bromo derivatives.</li> <li>• Expertise the various techniques of preparation, purification and confirmation of product by TLC and melting/boiling point.</li> <li>• An ability to separate the mixture of organic compounds and Qualitative analysis of the compounds separated from the mixture by chemical analysis.</li> </ul>

			<ul style="list-style-type: none"> <li>Students can estimate the different drugs, phenols and carbonyl compounds from given sample.</li> </ul>
6	Lab II	3002	<ul style="list-style-type: none"> <li>Interpret the experimental results obtained by conductometer, spectrophotometer, Ph-meter, polarimetry.</li> <li>Students can determine strength of acid, eq. conductance of electrolyte and dissociation constant.</li> <li>Can describe the principles behind the experiment performed in the laboratory.</li> <li>Studied the surface tension-concentration relationship for solution, effect of concentration of an electrolyte (KCl, NaCl) on solubility of an organic acid and the kinetics of iodine clock reaction.</li> </ul>
Semester – II (CBCS)			
7	Co-ordination Chemistry.	2111	<ul style="list-style-type: none"> <li>Students can derive the term symbol for ground and excited state of <math>d^n</math> configuration.</li> <li>Study of electronic spectra and comment on geometry of complexes.</li> <li>By studying magnetochemistry student can describe the magnetic behavior and the factors affecting the magnetic properties of coordination compounds.</li> <li>Overview of Bioinorganic chemistry and understand the biological role of alkali metal ions, ligands, ion transport across the membrane.</li> <li>Studied structure and biochemical function of haemoglobin, myoglobin and Vitamin B12.</li> <li>Gains the knowledge about different inorganic reaction, their mechanism and the factors affecting.</li> </ul>

8	Organic Chemistry-II	2112	<ul style="list-style-type: none"> <li>• Understand the Mechanistic and stereo chemical aspects of addition reaction (to C=C), Free radical reactions and molecular rearrangements.</li> <li>• Understands the importance of photochemistry and Pericyclic Reactions.</li> <li>• Students can comment on the stereochemistry of products of pericyclic reactions.</li> <li>• Learns basis of green chemistry and appreciates the importance of solvent free synthesis.</li> <li>• Validates the adverse effect of chemicals on the environment.</li> </ul>
9	Physical Chemistry-II.	2113	<ul style="list-style-type: none"> <li>• Studied Chemical kinetics of complex reactions, chain reactions and fast reactions.</li> <li>• Gains knowledge about configuration and conformation of macromolecules and their number and mass average molecular weight.</li> <li>• Construction of M.O. by LCAO for H<sub>2</sub><sup>+</sup> ion, Calculation of energy levels from wave functions,</li> <li>• Understands the Debye-Huckel-Onsager treatment and its extension.</li> <li>• Gains knowledge of types of corrosion, corrosion inhibitors, Corrosion monitoring. and prevention methods.</li> <li>• Understand the Maxwell-Boltzmann distribution law Fermi-Dirac statistics, distribution law and applications to metals. Bose-Einstein statistics - distribution law and application to helium.</li> </ul>
10	Optical Methods and Environmental Chemistry.	2114	<ul style="list-style-type: none"> <li>• By Spectrophotometry and Colorimetry students can comment on the composition of coloured complexes.</li> <li>• Learn the importance of different analytical techniques and its applications.</li> </ul>

			<ul style="list-style-type: none"> <li>• Studied sources of water, air, soil and radiation pollution and its effect on environment.</li> <li>• Understand the techniques of analysis of the different pollutants.</li> </ul>
11	Lab III	3003	<ul style="list-style-type: none"> <li>• Can interpret the experimental results obtained by refractometer, spectrophotometer, PHmeter, potentiometer.</li> <li>• Students can determine viscosity of unknown mixture, Rate constant, hydrolysis constant, <math>P^k</math> value, Standard electrode potential and <math>P^H</math>.</li> <li>• Students can find the strength of HCl and Acetic acid in a given mixture potentiometrically and the strength of mixture of halides by titration.</li> </ul>
12	Lab IV	3004	<ul style="list-style-type: none"> <li>• Students can prepare inorganic compounds by greener methods and can do their characterization by elemental analysis, MW determination, decomposition temperatures and molar conductance.</li> <li>• Perform Quantitative analysis of binary mixture of cations involving their chemical separation and separate analysis of one cation by gravimetry and another by volumetric or colorimetric.</li> <li>• Students can analyze the Inorganic mixtures qualitatively.</li> </ul>
	Semester – III (CBCS)		
	Name of the Course (Paper)	Course Code	<p>Course Outcome (Cos) – Compulsory</p> <p>Employability, Entrepreneurship and Skill Development (Please mention for respective course, if any)</p>

1	Spectroscopy -I	2121	<ul style="list-style-type: none"> <li>• Gain knowledge about the basic concepts and theories of microwave</li> <li>• Spectroscopy, IR, NMR and electronic spectroscopy</li> <li>• The students will be able to understand NOE in NMR, FT-IR, 2D NMR COSY NOESY, HETCOR- DEPT techniques.</li> <li>• An ability to calculate UV <math>\lambda_{\text{max}}</math> value of compounds.</li> <li>• Can analyze spectra and find out the correct structure of compounds as an application of spectroscopy</li> <li>• Gains knowledge of carbon NMR spectroscopy and can comments on different types of carbon.</li> <li>• Learns the principle, theory instrumentation and the fragmentation process of mass spectrometry and can analyze mass spectrum.</li> </ul>
2	Analytical Chemistry- I Thermal and Electrochemical methods	2122	<ul style="list-style-type: none"> <li>• Know the concept of thermogravimetry, factors affecting thermograms and applications of thermogravimetry.</li> <li>• Understand the importance of conductometry and coulometry with their principal of analysis.</li> <li>• Gain knowledge about the procedures for electro analytical techniques in polarography, voltammetry, amperometry and its applications in analytical chemistry.</li> <li>• Students get an idea about Chemical sensors, biosensors and their applications.</li> <li>• Students can apply the knowledge of spectrophotometry in the quantitative estimation of biological macromolecules.</li> </ul>
3	Inorganic chemistry Bio- inorganic chemistry	2123	<ul style="list-style-type: none"> <li>• Understand the structure and functions of haemoglobin, myoglobin, hemocyanin's &amp; hemerythrin.</li> <li>• Get Information about the importance of essential trace elements in biological systems and knowledge about <math>\text{Na}^+</math> / <math>\text{K}^+</math> pump.</li> <li>• Medicinal use of metal complexes and validates the role of bioinorganic chemistry in everyday life.</li> </ul>

			<ul style="list-style-type: none"> <li>• To know the mechanism of transport and storage of dioxygen association with haemoglobin and myoglobin.</li> <li>• Learns the principle involved and role of various metals in metalloenzymes.</li> <li>• Gain knowledge about Chelate therapy, metallothrapy, ATP cycle and Electron transfer in Biology.</li> <li>• Understand the importance of metalloenzymes, vit.B12 , stability and ageing of enzymes.</li> </ul>
4	Inorganic chemistry Solid state chemistry	2124	<ul style="list-style-type: none"> <li>• Understand the crystal structure and learns the covalent structure type as Diamond, Sphalerite and Wurtzite and also about lattice defects.</li> <li>• The firm understanding electronic properties of the metals, insulators, semiconductors, and their applications also know about superconductivity.</li> <li>• Explore new areas of dielectric polarization and superconductivity.</li> <li>• Knowledge of new areas of laser production and masers actions.</li> </ul>
5	Organic Chemistry II	2125	<ul style="list-style-type: none"> <li>• Learns the various methods employed for reactions like oxidation, reduction, carbocyclic and heterocyclic ring formation etc. ·</li> <li>• Get insights into novel reactions and reagents in organic synthesis.</li> <li>• Acquire knowledge about the different name reactions and modern methods of synthesis.</li> <li>• Understand the Umpolung concept and its synthetic applications as well as the importance of Phosphorus, and sulphur ylide, and Enamines ·</li> <li>• Understand the formation of C-C bond by disconnection approach.</li> </ul>
6	Organic Chemistry (Natural Product-I).	2126	<ul style="list-style-type: none"> <li>• The students will be able to understand different types of classification of Carbohydrates, Lipids, and Proteins</li> </ul>



			<ul style="list-style-type: none"> <li>• Learn Sequence determination, structure and synthesis of bio-polymers like proteins, nucleic acids and sugars.</li> <li>• Knowledge about the natural pigment, hormones and vitamins.</li> <li>• Knowledge about Alkaloids and terpenoids.</li> <li>• Understand the Structure elucidation and synthesis, deficiency syndromes of various vitamins.</li> </ul>
3	Physical Chemistry		\NA
Lab III	Inorganic Chemistry	3005 Lab V	<ul style="list-style-type: none"> <li>• An Ability to quantitatively separate binary mixtures of ions in solution and estimation by anion exchange, solvent extraction, paper chromatography volumetric, colorimetric or gravimetric methods</li> <li>• An Ability to estimate binary mixtures by ion-exchange method, spectrophotometry</li> <li>• Determination of Iron, Calcium and Phosphorus from milk powder.</li> <li>• Students' can-do Analysis of Water</li> <li>• Students can determine Iron, phosphates, Ascorbic acid from given sample.</li> </ul>
Lab IV	Organic Chemistry	3006 Lab VI	<ul style="list-style-type: none"> <li>• An ability to separate the mixture of three organic compounds</li> <li>• An ability to analyze the compounds separated from the mixture by chemical analysis</li> <li>• Students can estimate Nitrogen, Halogen and Sulphur from given organic compound.</li> <li>• Ability to prepare organic compounds by two or three steps</li> <li>• Students can extract oil from oil seeds and piperidine from black pepper.</li> </ul>

Semester IV			
	Name of the Course (Paper)		Course Outcome (Cos) – Compulsory
1	Spectroscopy II	2141	<ul style="list-style-type: none"> <li>• Get a deep insight into the various spectroscopic methods used for the characterization of organic compounds and Inorganic Compounds, such as Mossbauer Spectroscopy and ESR Spectroscopy, Raman and photoelectron spectroscopy</li> <li>• Knowledge about X-ray Diffraction, Electron and Neutron Diffraction</li> <li>• Students can do surface characterization by spectroscopy and microscopy, (SEM/TEM). atomic force microscopy (AFM).</li> <li>• Enable the students to elucidate the structure of compounds by analyzing the spectral data.</li> <li>• Students can determine oxidation state from mossbauer spectroscopy.</li> </ul>
2	General Analytical Chemistry	2142	<ul style="list-style-type: none"> <li>• Understand the principle and methods of neutron activation analysis (NAA) and isotopic dilution analysis (IDA).</li> <li>• Understand the concept of Molecular photo fluorescence and phosphorescence spectrometry.</li> <li>• Knowledge about the chemical analysis of food and Analysis of Cosmetics, Composition of Deodorant and antiperspirants.</li> <li>• Outline about the radiochemical methods of Analysis</li> <li>• Understand optical methods and flow injection Analysis.</li> </ul>
3	Organic Synthesis II	2145	<ul style="list-style-type: none"> <li>• Understand the concept of Retrosynthetic analysis and can disconnect large molecules and can give synthons for it.</li> </ul>

			<ul style="list-style-type: none"> <li>• Get an idea about Synthesis of some complex molecules by Retrosynthetic analysis.</li> <li>• While synthesizing organic compounds students can protect and deprotect the functional group.</li> <li>• Students can use phase transfer catalysts.</li> <li>• Get insights into novel reactions and reagents in organic synthesis. 3.To acquire knowledge about the reagents which causes oxidation in various compounds.</li> <li>• Students can apply nomenclature rules for Heterocyclic compounds and get knowledge of synthesis of heterocyclic compounds.</li> </ul>
4	Natural Product II	2146	<ul style="list-style-type: none"> <li>• Appreciates the role of antibiotics in everyday life.</li> <li>• Knowledge about the structures of polymers and dyes and how to synthesize.</li> <li>• Gains knowledge of different classes of agrochemicals and pesticides.</li> <li>• Understand the General aspects of drug and how to design the drugs.</li> <li>• Learns the pharmacodynamics (action of drug on human body) and pharmacokinetics (action of body on drug) of different classes of drugs which are used by us in daily life.</li> <li>• Gains knowledge of Synthesis, mode of actions of antibiotics, antimalarials, anti-inflammatory, antipyretics, analgesics Antitubercular &amp; antileprotic, Anesthetics, Antihistamine Cardiovascular.</li> </ul>
5.	Photoinorganic and organometallic chemistry	2143	<ul style="list-style-type: none"> <li>• Understand the basics of photochemistry, Properties of excited states and Ligand field photo chemistry of transition metal complexes.</li> </ul>

			<ul style="list-style-type: none"> <li>• Gains knowledge of Photocatalysis, Photocatalysts, Photoreactive oxides, relation between solar spectrum &amp; band gap.</li> <li>• Get an idea about different properties and structures for organometallic compounds.</li> <li>• Gains knowledge of bonding and structure of transition metal complexes and applications in reactions. .</li> <li>• Studied Transition metal complexes with unsaturated organic molecules like alkenes, alkynes, allyl, diene, dienyl, arene &amp; trienyl complexes:.</li> </ul>
6.	Material chemistry	2144	<ul style="list-style-type: none"> <li>• Explore new areas of research in both glass and ceramics manufacturing.</li> <li>• Understand with firm foundation for chemical reaction in furnace.</li> <li>• Gains knowledge of liquid crystal, Mesomorphic behavior, thermotropic liquid crystals and their optical properties.</li> <li>• Explore new areas of nanoparticle and their association with nonporous material.</li> <li>• The firm understanding of chemistry of fertilizers and their classification.</li> <li>• Understands the classification of coordination polymers and learns the chemical background of individual polymers</li> </ul>
Lab VII	Practical VI Inorganic Chemistry	3007	<ul style="list-style-type: none"> <li>• Students can analyze N, P, K from fertilize, analysis of talcum and nyclin powder and Determination of Phosphates from cold drink samples</li> <li>• Perform the synthesis of metal complexes/Polymers and their structural characterizations.</li> <li>• Students can synthesize metal oxides, mixed oxides, nanoparticles.</li> <li>• Understand the kinetics and mechanism of some inorganic compounds.</li> </ul>

Lab VII	Organic Chemistry	3007	<ul style="list-style-type: none"> <li>• An ability to separate the mixture of three organic compounds and can analyze the compounds separated from the mixture by chemical analysis</li> <li>• Students can interpret the structure of an unknown molecule with the help of spectral data.</li> <li>• To synthesize different drugs and other three step synthesis.</li> </ul>
	Project	3008	<ul style="list-style-type: none"> <li>• Learns about different techniques like monitoring reaction condition, purification and drying of solvents.</li> <li>• Spectral interpretation and identification of compounds.</li> <li>• Handling of sophisticated instruments like IR, TGA, UV, Microwave etc</li> <li>• An ability to write project report and can present it.</li> </ul>