**Semester-I**

|  |  |  |  |
| --- | --- | --- | --- |
| **Subject** | **Subject Code** | **Objective**  | **Outcome** |
| **INORGANIC CHEMISTRY-I** | **CH 401** | **Objective**:1. To understand the concepts of bonding and stereochemistry of main group elements,
2. To learn about the formation and stability of metal complexes and their determination and
3. Mechanistic aspects of different types of reaction of metal complexes in solution.
 | **Outcome:** At the end of the course the student will 1. Acquire the knowledge and have the ability to describe the bonding and stereochemistry of different inorganic compounds and ions.
2. Be able understand the concept stability constant, its determination and application in different fields
3. Understand the reactions and mechanism of different types of reactions in coordination compounds and their applications in practical fields.
 |
| **ORGANIC CHEMISTRY-I** | **CH 402** | **Objective**: To understand the molecular details in greater depth on following topics: aromaticity, stereochemistry, and substitution reactions in aliphatic compounds. | **Outcome:** At the end of the course the student will be able to1. Understand the fundamental aspects of aromaticity, nonaromaticity and antiaromaticity,
2. Feel the structural details of organic compounds and the origin of optical activity of the chiral molecules,
3. Understand the origin of stereoselectivity as far as asymmetric catalysis is concern, and the basic mechanism of substitution reactions in aliphatic compounds.
 |
| **PHYSICAL CHEMISTRY-I** | **CH 403** | **Objective**: The topics covered under the course are inherently very fundamental and intended to provide the basic understanding at atomic and subatomic level. The objective of the course to study and understand the concept of energy, the transfer of energy into work, capacity of energy to function, entropy, enthalpy, chemical potentials, thermodynamic laws, criterion for determination of the feasibility or spontaneity of a given transformation, partial molar properties, their determinations. The course is designed in a manner in which a bridge between classical thermodynamics and quantum mechanics can be established.  | **Outcome:** Understanding the underlying concepts and realization of quantum mechanics will be useful in solving problems at realistic atomic and molecular level, in particularly in the field of spectroscopy and analytical chemistry. Understanding thermodynamics requires knowledge of how the microscopic world operates and importance of reversible and irreversible processes. |
| **INORGANIC CHEMISTRY PRACTICAL-I** | **CH 404** | **Objective**:1. Qualitative analysis of inorganic salts mixture containing acid and basic radicals with insoluble compound
2. To separate the mixture of cations and anions by chromatographic technique
3. To learn the best laboratory practice
 | **Outcome:**1. Ability to separate and identify different cations and anion from a mixture of inorganic salts.
2. Understanding the principles of separation and analysis of different ions and their applications in real fields.
3. Learn the techniques of chromatographic separation of mixture of cations and anions
 |
| **ORGANIC CHEMISTRY PRACTICAL-I** | **CH 405** | **Objective**: To introduce the theory and procedures of qualitative analysis of unknown organic compounds in a mixture by conventional methods as well by chromatography and IR spectra. | **Outcome:** Upon completion of this course students will be able to1. Understand how to detect the presence of different functional groups
2. Demonstrate/apply the techniques involved in organic binary mixture separation
3. Understand how to characterize different functional groups using IR spectroscopy technique.
4. Understand the art of identifying the unknown organic compounds.
 |
|  | **CH 406** | **Objective**:1. To introduce the concept of symmetry and group theory and their application in chemistry
2. To provide theoretical basis of understanding the atomic, molecular, microwave and photoelectron spectroscopies and their applications.
 | Outcome: Completion of the course will enable the studentsto understand importance group symmetry and group theory in chemistry, classifying different compounds in to point groups and derive the character tables for various applications.  to explain the theory and applications atomic, molecular and microwave spectroscopy  to explain the basic principles of photoelectron spectroscopy and its application to chemical analysis. |
| **COMPUTERS FOR CHEMISTS** | **CH 407** | **Objective**: This is a theory-cum-Laboratory course with more emphasis on laboratory work. The objectives are to study different computer programmes, to learn various concepts and basic techniques essential for conduct of practical in computers and to study various computer languages useful in Chemistry. | **Outcome:** After the completion of course students will able to acquire basic understanding about Computer, computer programmes, computer languages, understanding the basic concept associated with C- and C++ Language and program designing, develop different programs, Run and Retrieve results, use of variables, arithmetic assignment operators and conditional operator, and in future student may be able to develop a big program(s)(Software) which may simulate the behaviour of the chemical reaction/processes/events. |

**Semester-II**

|  |  |  |  |
| --- | --- | --- | --- |
| **Subject** | **Subject Code** | **Objective**  | **Outcome** |
| **INORGANIC CHEMISTRY-II** | **CH 408** | **Objective**:1. To understand the theoretical basis of boding of structurally different coordination compounds.
2. To understand the basis of electronic spectra of metal complexes as well as to understand the basis of anomalous magnetic behaviour of metal complexes.
3. To impart knowledge on preparative methods, structure and bonding of metal-π complexes and cultures.
 | **Outcome:** On completion of this course student will be able to:1. Understand and explain the bonding in coordination and organometallic compounds.Describe the fundamental requirement to interpret the electronic spectra of metal complexes for prediction of their properties.
2. Describe the synthesis, structure and bonding of metal carbonyls, metal nitrosyls, dioxygen, dinitrogen complexes as well as metal clusters.
 |
| **ORGANIC CHEMISTRY-II** | **CH 409** | **Objective**: To impart knowledge of substitution reactions of aromatic compounds, addition reactions to carbon-carbon and carbon-heteroatom multiple bonds, and rearrangement of reactive intermediates. | **Outcome:** Upon completion of this course students will be able to understand the basic principle of substitution reaction in aromatic compounds along with reaction mechanism, Understand the mechanism of addition reactions of carbon-carbon (C=C C≡C, etc.) multiple bonds and carbon-heteroatom (C=O, C=N, etc.) multiple bonds, and the structure and reactivity of various reactive intermediates. |
| **PHYSICAL CHEMISTRY-II** | **CH 410** | **Objective**: Chemical kinetics is the study of the rates of chemical reactions, factors which are influential in the rates and the explanation of the rates with respect to the reaction mechanisms of chemical processes. The course content is designed to provide a fundamental understanding of basic surface properties such as surface tension, capillarity and adsorption etc. Also the content describes the importance and application of surfactants, starting from basic definition to micelle formation and factors responsible for micelle formation. This course contents have a balance between conventional and modern electrochemistry.  | **Outcome:** Students can follow the concept of rate of change associated with chemical reaction, recognizing that the rate of change and how it can be measured. Learning and discussion of surface chemistry certainly enable a student to solve problems associated with catalysis and nanochemistry, as most of the reactions are observed at the interface. It is believed that after going through the course a student will find its utility in chemistry of batteries, fuel cells, solar cells etc.  |
| **INORGANIC CHEMISTRY PRACTICAL-II** | **CH 411** | **Objective**: To introduce multistep inorganic synthesis, separation and estimation of different metals from mixture. | **Outcome:** Ensures the students to understand and have hands on experience to preparer inorganic (coordination) compounds in multi steps and acquire knowledge of separation of metals from mixture. |
| **ORGANIC CHEMISTRY PRACTICAL-II** | **CH 412** |  **Objective**: To impart knowledge of art of organic synthesis. | **Outcome:** Upon completion of this course students will be able to understand the different reactivity pattern of different reagents, and understand how to synthesize different organic compounds. |

|  |  |  |  |
| --- | --- | --- | --- |
| **SPECTRO-SCOPY-II** | **CH 413** | **Objective**: The course is designed to understand the nuclear and electron spin resonance spectroscopy in a fundamental way. It also contains vibrational and Raman spectroscopy. A thorough discussion on all basic principles and applications are being included. | As it can be seen the spectroscopic techniques discussed are very routine and useful, it is essential every student must have exposure to the course, and by this they will be competent in explaining and solving most of chemical structure analysis. |
| **ANALYTICAL CHEMISTRY** | **CH 414** | **Objective**:1. To familiarize the students with some instrumental techniques of characterization of different sample.
2. To understand the basic/working principles, instrumentation, analysis of thermal and electrochemical methods.
3. To understand the basic/working principles and instrumentation of some spectroscopic techniques and their use in chemical analysis.
 | At the end of the students will be able 1. Explain the theoretical basis of different analytical techniques with understanding on operational procedure.
2. Selection of appropriate analytic techniques for analysis of sample and interpretation of analytical results
3. Interference in different analytical techniques and their elimination
 |

**Semester-III**

|  |  |  |  |
| --- | --- | --- | --- |
| **Subject** | **Subject Code** | **Objective**  | **Outcome** |
| **PERICYCLIC REACTIONS AND PHOTO-CHEMISTRY** | **CH 501** |  **Objective**: To impart knowledge of pericyclic reactions, photochemistry of alkene, carbonyl compounds and aromatic compounds. | Upon completion of this course students will be able to understand the molecular origin of pericyclic reactions, understand the concept of interaction of organic compounds with light and subsequently trigger the reaction, understand the mechanism photochemistry of alkene, carbonyl compounds and aromatic compounds. |
| **BIO-INORGANIC & SUPRA-MOLECULAR CHEMISTRY** | **CH 502** | **Objective**:1. To study the role on the role of metals in biological systems and medicine.
2. To introduce the student on structure, stereochemistry and biological functions of different metalloenzymes.
3. To study the structure and function of biomolecules in nitrogen fixation and photosynthesis.
4. To introduce concept molecular recognition, interactions in supramolecular systems and their applications
 | On completion of the course the student will1. Understand and acquire knowledge of effect of deficiency and toxicity of metals in both human and plant systems.

Describe the structural and functional relationships, mechanisms and importance of metaloenzymes.Understand the fundamentals of supramolecules, supramolecular reactions and catalysis, devises. |
| **APPLIED CHEMISTRY PRACTICAL** | **CH 503** | **Objective**:1. To familiar the student with the chemistry of synthesis of Nylon 6, 6 and other similar polymers,
2. To acquire a minimum practical skill to determine the molecular weight of polymers and thier characterization by other methods
3. To learn the conventional techniques of analysis of different water parameters and specific components in different samples by classical/instrumental methods.
 | After the completion of course students will be able 1. To perform experiment on preparation of polymers and their basic characterizations.
2. To perform the analysis of different water parameters using classical and instrumental methods.
3. To understand the principles behind the experiment performed in the laboratory
 |
| **: PHYSICAL CHEMISTRY PRACTICAL-I** | **CH 504** | **Objective**: The laboratory course is framed on the basis of instruments such as conductivity meter, pH meter and potentiometer, where a number of experiments based on conductivity measurement, pH measurement and potential measurement can be performed.  | It is believed that students performing the experiments will be capable of handling the conductivity meter, pH meter and potentiometer. Also it gives a real feel of the electrochemistry, such a verification of Debye-Huckel-Onsager equation, neutralisation of weak acids, determination of Ksp of sparingly soluble salt and conductometric titrations, which are taught in theory. |
| **APPLICATION OF SPECTROSCOPY-I** | **CH 505** |  **Objective**: The course content is aimed at providing a very basic entry into the subject of shift reagents, in particular the influence of paramagnetic substances on a NMR signal. It also attempts to introduce a student in the field of NMR of metalloenzymes. Mössbauer spectroscopy is a versatile technique that can be used to provide information about the chemical bonding, chemical structural, oxidation states of a material. It is a useful technique involving gamma ray spectroscopy | The discussion on the course content is definitely beneficial in terms of a student getting idea of NMR of biomolecules and the application of shift/contrast reagents, used in MRI studies. Further, students will understand a Mössbauer spectrum, understand the concept of chemical shift, determine oxidation state, electric quadrapole interaction, determines the chemical structure and bonding, hyperfine interactions. |
| **ORGANIC SYNTHESIS** | **CH 506** | **Objective**: To impart knowledge of oxidation and reduction, protection of alcohol, amine, carbonyl and carboxyl compounds and disconnection approach in synthesis of various natural products. | **Outcome**: Upon completion of this course students will be able to understand the philosophy of synthesis of various natural products, understand the reactivity pattern and underlying reaction mechanism of different oxidizing and reducing reagents, and understand the art of selective protection and deprotection of alcohol, amine, carbonyl and carboxyl groups in organic compounds. |
| **ENVIRONMENTAL CHEMISTRY** | **CH 507** | **Objective:** To acquaint the student with a basic understanding of the concept and structure of environment, about the chemical composition of the different matrices of the environment (air, water, soil) and the interaction involved between them, understand different types of air, water, soil and radiation pollution and its consequences, different steps of waste management, to study about different industrial effluents, pollution by industry and their remedies, global environmental issues and disasters, and green solution to environmental problems. | **Outcome**: After the completion of course students will able to describe the structure and significance of the spheres of the environment, the important environmental issues and the factors responsible for their cause, understand the significance of environmental science as a subject, explain the chemical nature and interaction of the air, water and soil, apply analytical tools to determine and measure pollutants in various environmental samples, explain environmental pollution issues and the remedies thereof, and understand about green chemistry principles and their applications. |

**Semester- IV**

|  |  |  |  |
| --- | --- | --- | --- |
| **BIOORGANIC CHEMISTRY** | **CH 508** |  **Objective**: To impart knowledge of biological catalysts, mechanism of enzyme action and reactions catalyzed by enzymes and co-enzyme. | **Outcome**: Upon completion of this course students will be able to understand how enzyme catalyzes the reaction with outmost efficiency, acid-base catalysis and covalent catalysis of enzyme, strain and distortion during enzyme catalysis, structure and biological functions of various coenzymes, and the origin of mechanism of enzyme action. |
| **ORGANOTRANSITION METAL CHEMISTRY** | **CH 509** |  **Objective:** 1. To introduce the students on preparations, structure and bonding aspects of simple organometallic compounds
2. To study the methods of synthesis, properties and reactivity of organometallic compounds with metal-carbon multiple bonds.
3. To introduce on types of common organometallic reactions and mechanistic study of some homogeneous catalytic reaction systems involving organometallic compounds
4. To study the concept of fluxionality in organometallic compounds
 | **Outcome:** On completion of this course, the student will be able to 1. Describe the structure and bonding aspects of different organotransition metal compounds and their correlations with the stability and reactivity of such compounds.
2. Identify the different types of organotranstion metal complexes catalyzed reactions and explain mechanistic pathways of different catalytic reactions.

Describe the important applications of organometallic homogeneous catalysis in the production of organic chemicals**.** |
| **POLYMER CHEMISTRY** | **CH 510** |  **Objective**: To study the fundamental concepts of polymer chemistry, structure of monomers, functionality, and classification of polymers on the basis of source, composition, conditions, molecular weight, geometry, industrial polymer fabrication process, and nomenclature of polymers.  | **Outcome**: After the completion of course students will able to understand about the basics of polymer and the differences between crystalline melting temperature and glass transition temperature, as well as the effect of kinetics on both, develop specific skills, competencies, and thought processes sufficient to support further study or work in this field of polymer chemistry, evaluate the effect of factors such as polymer structure, molecular weight, branching and diluents on crystallinity, and apply knowledge to build up small scale industry for developing endogenous plastic product. |
| **SOLID STATE CHEMISTRY** | **CH 511** |  **Objective:** To obtain the knowledge on understanding solid state reactions, chemical synthesis methods, the structure of solids and crystal defects, insight into electronic structure and properties of crystals. These portions of solid state chemistry involves to introduction of optical and magnetic properties of solids, with basic understanding of several physical concepts such as optical reflectance, optical refraction and magnetic hysteresis. Also it gives an account of the generation of X-ray radiation and its effects of on matter. It includes neutron diffraction with a basic understanding of neutron properties and their utility in analysis of soft materials.  | **Outcome:** Students will learn the structure, properties and the synthesis of solid materials. More significantly, crystal defects, electronic properties of solid can be easily explained. Also it will enable the student to interpret of crystal structure by X-ray diffraction and neutron diffraction method. After going through the course, it is believed that the student will be self-confident to explain certain optical and magnetic properties of solid state materials. |
| **PHYSICAL CHEMISTRY PRACTICAL-II** | **CH 512** |  **Objective:** The laboratory course is designed based on UV Visible spectrophotometer. Experiments such as determination of indicator constant, stoichiometry of a metal complex by Job’s method are included. | **Outcome:** The conduct of these experiments will enable a student to understand Beer-Lambert’s law in a better manner also the handling of an instrument will be learnt. |
| **PROJECT****WORK** | **CH 513** | **Objective:** Students will research or review articles in a particular topic1. To train the student to design experiment oriented project on particular context
2. To search literature on the selected topic of project work
3. To conduct the experiments scientifically as per selected topic and analyse the data
4. To develop the art of wiring the project report with proper citation of literature, data analysis, and presentation
 | **Outcome:** After completion of the project work the students will 1. Learn the design the experimental set up and perform the experimental as per specific problem selected for project
2. Gain the knowledge and competency to search literature and write the dissertation
3. Learn the skill for presentation of the project work.
 |
| **APPLICATION OF SPECTROSCOPY-II** | **CH 514** |  **Objective**: To impart knowledge of different spectroscopic technique for structural elucidation of organic compounds. | **Outcome**: Upon completion of this course students will be able to understand how Ultraviolet and Visible Spectroscopy, Infrared Spectroscopy, Nuclear Magnetic Resonance Spectroscopy and Mass Spectrometry are powerful technique to analyze the structural details of organic compounds, and predict different unknown compound based on UV-Vis, IR, 1HNMR, 13CNMR and mass spectroscopic data. |