**Programme specific outcomes**

**B. Sc. Chemistry Theory Learning Outcomes:**

* Students have firm foundations in the fundamentals and application of chemical and scientific theories.
* Students will appreciate the central role of chemistry in our society and use this as a basis for ethical behavior in environmental issues and key issues facing our society in energy, health and medicine.
* Student knows and follows the proper procedures and regulations for safe handling and use of chemicals
* Students are able to design, carry out, record and analyze the results of chemical experiments.
* Students are skilled in problems solving, critical thinking and analytical reasoning.
* Find employment in industry or government sector

**Course Outcomes**

**B. Sc. I (NEP-2.0) Semester I, PAPER-I**

**ICH-101- Inorganic Chemistry (Theory Credits-02, 30 hours)**

|  |  |
| --- | --- |
| Name of the topic | Expected Course outcomes |
| 1. 1. Atomic Structure and Periodicity of Elements. | To learn and understand basic knowledge of inorganic chemistry. To understand size, shape and electronic distribution in shells  and sub- shells of an atom. |
| 2. P-block Elements. | To learn and understand the properties and uses of the compounds of Boron, Carbon and  Nitrogen from p-block elements. |
| 3. Chemical Bonding and Molecular Structure: Ionic Bonding. | To learn different types of bonds and nature of bonding in inorganic compounds. Calculations of different energies associated  with ionic bonding. |
| 4. Acids and Bases. | To Understand the role of acids and bases in chemistry. The study is useful in all chemical  areas. |

**B.Sc. Part I (NEP-2.0) SEMESTER-I, PAPER-II**

**0CH-102- Organic Chemistry (Theory Credits: 02, 30 hours)**

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| **Name of the topic** | **Expected Course outcomes** |
| 1. Fundamentals of Organic Chemistry | The students are expected to understand the  fundamentals and basic principles involved in organic chemistry. |
| 2. Stereochemistry | Understanding the spatial arrangement of atoms of  organic molecule and types of stereoisomers. |
| 3. Aromaticity | Knowledge of general properties and fundamental  reactions of aromatic compounds. |
| 4. Heterocyclic Compounds | To understand the basic knowledge of heterocyclic compounds. To get knowledge of methods to preparation, physical and chemical properties of some heterocyclic compounds with five and six membered heterocycles containing N as the hetero atom ( Pyrrole and Pyridine). |

**B.Sc. Part I (NEP-2.0) SEMESTER-I, PAPER-II**

**0CH-102- Organic Chemistry (Theory Credits: 02, 30 hours)**

|  |  |
| --- | --- |
| **Name of the topic** | **Expected Course outcomes** |
| 1. Fundamentals of Organic Chemistry | The students are expected to understand the  fundamentals and basic principles involved in organic chemistry. |
| 2. Stereochemistry | Understanding the spatial arrangement of atoms of  organic molecule and types of stereoisomers. |
| 3. Aromaticity | Knowledge of general properties and fundamental  reactions of aromatic compounds. |
| 4. Heterocyclic Compounds | To understand the basic knowledge of heterocyclic compounds. To get knowledge of methods to preparation, physical and chemical properties of some heterocyclic compounds with five and six membered heterocycles containing N as the heteroatom ( Pyrrole and Pyridine). |

**B. Sc. I Semester II, Paper IV ACH-202- Analytical Chemistry**

**(Theory Credits:02, Lectures-30 hours) Expected learning Outcomes:**

|  |  |
| --- | --- |
| **Name of the topic** | **Expected Course Outcome** |
| 1. Introduction to Analytical Chemistry | Learning various analytical procedures and importance also sampling, accuracy and precision |
| 2. Fundamentals of Industrial Chemistry and IPR | 1. Distinguish between classical and industrial chemistry 2. Learning and Understanding basic concepts and concentration terms c. Knowledge of IPR |
| 3. Chromatography | Knowledge of chromatographic separation technique and terms involved in it. Learning paper chromatography and thin layer chromatography |
| 4. Theory of titrimetric Analysis | Knowledge of various type of titrations, neutralization curves, indicators used in  various titrations |

**B.Sc. Part II (NEP) Semester– III DSC-3C: Paper V (PHYSICAL CHEMISTRY)**

**(Credits: 02, 30 hours, 37 Lectures)**

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| --- | --- |
| **Name of the Topics** | **Expected Learning Outcome** |
| 1. Electrolytic Conductivity | Learning and coherent understanding of conductivity and transport number of the aqueous solutions with different applications. Experimental determination of transport number and numerical Problems |
| 2. Thermodynamics | Knowledge and coherent understanding of basic concepts in thermodynamics and concept of Entropy will be gained by the student. |
| 3. Chemical Kinetics | Learning and understanding the knowledge about basic concepts in kinetics and third order reaction with characteristics, suitable examples, and methods for determination of order of reactions and  numerical problems. |
| 4. States of Matter | Learning and coherent understanding of behavior of gases, ideal gas as model system and its extension to real gases. The dependence of physical state on P, V and T. Liquid crystals are essentials in all common and research devices, hence they are introduced with suitable examples. |
| 5. Surface Chemistry | Learning and understanding of theoretical basis of adsorption phenomenon, dynamic nature of surface and its applications. |

**B.Sc. II Semester III**

**DSC 4C- Chemistry Paper VI (Analytical Chemistry) (Theory- Credits: 02, 30 hours, 38 Lectures)**

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| **Name of the Topics** | **Expected Learning Outcome** |
| 1. Gravimetric Analysis | Learning and understanding of basic concepts in gravimetric analysis |
| 2. Water Analysis | Students will learn the different water analysis Techniques |
| 3. Corrosion and electroplating | Learning and understanding the knowledge about basic concepts in corrosion and electroplating, mechanism of corrosion, principle of electroplating |
| 4. Chromatographic  Techniques | Learning and coherent understanding of column and ion exchange chromatography |
| 5. Petroleum industry, biofuels and IPR | Learning of working of petroleum industries, understanding of biofuels, copyrights and Trademarks. |

**B. Sc. Part II (CBCS) (NEP 2020) Sem IV**

**Paper No. DSC-D3- Chemistry paper No. VII (Inorganic Chemistry) (Theory Credits: 02, 30 hours, 37 Lectures)**

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| **Name of the topic** | **Expected Learning Outcome** |
| 1. Co-ordination Chemistry | Learning and understanding basic concepts about coordination complexes. |
| 2. Chelation | Gain knowledge about applications of chelates in Analytical chemistry. |
| 3. Chemistry of elements of 3d series elements | Student will be capable of understanding the Properties of 3d series elements. |
| 4. Chemistry of 4f elements (Lanthanides). | Understanding the properties of 4f elements. |
| 5. Inorganic Semimicro  Qualitative Analysis | Student will learn the basic knowledge about the qualitative analysis of inorganic compounds. |

# B. Sc. Part II Sem IV, NEP-2020

**Paper No. DSC- D4 - Chemistry Paper No. VIII (Organic Chemistry) (Theory credits: 02, 30 hours, 38 Lectures)**

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| **Name of the topic** | **Expected Learning Outcomes** |
| 1. Carboxylic acids and their derivatives. | To impart knowledge about the synthesis, reactivity and applications of carboxylic acids. |
| 2. Amines and Diazonium  Salts | Knowledge about classification, preparation and applications of amines and diazonium salts. |
| 3. Carbohydrates | Understanding the classification,configuration and structure of carbohydrates. |
| 4. Carbonyl Compounds - Aldehydes and Ketones | Student will be capable of understanding the nomenclature and reactivity of aldehydes and ketones. |
| 5. Stereochemistry | Student will learn the basic knowledge of conformational analysis of some organic  compounds. |

**B.Sc. Part III (CBCS) SEMESTER-V**

**B. Sc. Part - III (NEP- 1.0) SEMESTER-V**

**Paper No. DSE-E5, Chemistry Paper No.– IX (Inorganic Chemistry) (Theory Credits: 02, 30 hours.)**

**Expected Learning Outcomes:**

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| --- | --- |
| Name of the topic | Expected Learning Outcome |
| 1. Acids bases and Non-aqueous solvents | Useful for the study of role of acids and bases in Chemistry. The study of non –aqueous solvents is important to learn all chemical properties of solutes and from the research  Point of view. |
| 2. Metal ligand bonding in transition metal complexes | Useful to understand geometry, stability and Nature of bonding between metal ion and ligand in complexes. |
| 3. Metals, semiconductors and Superconductors | The topic deals with the synthesis and the applications of the semiconductors and Superconductors in electrical and electronic devices. |
| 4. Organometallic compounds | The structure, method of preparation and the applications of organometallic compound in  various fields are explained. |
| 5. Catalysis | The classification, types, mechanism and applications of catalyst in industrial fields is explained. |

**B. Sc. Part III (NEP 1. 0) SEMESTER-V**

**Paper No. DSE-E6 Chemistry Paper No. X (Organic Chemistry)**

**(Theory Credits: 02, 30 hours.)**

**Expected Learning Outcomes:**

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| --- | --- |
| **Name of the Topic** | **Expected Learning Outcomes** |
| 1. Introduction to Spectroscopy | Understanding of energy associated with electromagnetic radiation and its use in analytical technique. |
| 2.UV-Vis Spectroscopy | Knowledge of chromophore, auxochrome and calculation of λmax.. |
| 3. IR Spectroscopy | Knowledge of vibrational transitions, regions of IR spectrum, functional group recognition. |
| 4.NMR Spectroscopy | Understanding of magnetic, non-magnetic nuclei, shielding-deshielding, chemical shift, splitting Pattern |
| 5. Introduction to Mass spectroscopy. Combined Spectroscopic Problems based on  UV-Vis, IR and NMR data. | Knowledge of molecular ion, fragmentation pattern and different types of ions produced. Student will predict the structure of organic compound with the help of provided spectral data. |

**B. Sc. Part III (NEP 1. 0) SEMESTER-V**

**Paper No. DSE-E7 Chemistry Paper No. XI (Physical Chemistry)**

**(Theory Credits: 02, 30 hours.)**

# Expected learning Outcomes:

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| --- | --- |
| **Name of the Topics** | **Expected Learning Outcome** |
| 1.Elementary quantum mechanics | Learning and understanding quantum Chemistry, Heisenberg’s uncertainty principle, concept of energy operators (Hamiltonian), learning of Schrodinger wave equation. Physical interpretation of the ψ and ψ2. Particle in a one dimensional box |
| 2. Spectroscopy | Knowledge about spectroscopy, Electromagnetic spectrum, Energy level diagram, Study of rotational spectra of diatomic molecules: Rigid rotor model, Microwave oven, vibrational spectra of diatomic molecules, simple Harmonic oscillator model,  Raman spectra: Concept of polarizability, pure rotational and pure Vibrational Raman spectra of diatomic molecules, related knowledge will be gained by the students. |
| 3. Photochemistry | Learning and understanding photochemical laws, reactions and various photochemical phenomena. |
| 4. Solution | Learning the various types of solutions, relations vapour pressure, temperature relations. |
| 5. Electromotive force | Learning and understanding the knowledge of emf measurements, types of electrodes, different types of cells, various applications of emf measurements. |

**B. Sc. Part III (NEP 1. 0) SEMESTER-V**

**Paper No. DSE-E8 Chemistry Paper No. XII (Analytical Chemistry)**

**(Theory Credits: 02, 30 hours.)**

**EXPECTED LEARNING OUTCOMES:**

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| --- | --- |
| **Name of the topic** | **Expected Learning Outcome** |
| 1.Potentiometric Titrations | Understanding theory and applications of  potentiometric titrations. |
| 2.Colorimetry and Spectrophotometry | Understanding, working and applications of  optical methods as an analytical tool. |
| 3.Sugar Industry | Learning and understanding the whole process of manufacture of sugar and byproducts of sugar industry. |
| 4.Manufacture of Industrial Heavy Chemicals | Learning and understanding of physico- chemical principles of production of ammonia, sulfuric acid, nitric acid and sodium carbonate along with its manufacturing plant. |
| 5. Gas Chromatography and Quality Control | Understanding the basics of Gas Chromatography, Quality control practices in analytical industries / laboratories. |

**B. Sc. Part III (NEP 1. 0) SEMESTER-VI**

**Paper No. DSE-F5 Chemistry Paper No. XIII (Inorganic Chemistry)**

**(Theory Credits: 02, 30 hours.)**

**EXPECTED LEARNING OUTCOME:**

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| --- | --- |
| Name of the topic | Expected Learning Outcome |
| 1. Coordination Chemistry | The topic focused on the mechanism of the reactions involved in inorganic complexes of transition metals. The students can understand the thermodynamic and kinetic aspects of Metal complexes. |
| 2. Nuclear Chemistry | The generation of nuclear power with the help of nuclear reactions is highlighted. Role of Radio isotopes in medicinal, industrial and Archaeology fields is explained. |
| 3. Chemistry of f-block Elements | The characteristics properties and separation of lanthanides and Actinides are discussed.  Synthesis and IUPAC Nomenclature of trans -uranic elements (TU) explained. |
| 4. Iron and Steel | The techniques involve in ore dressing and extraction of cast iron from its ore are discussed. |
| 5. Bio–inorganic Chemistry | Role of various metals and non metals in our Health are discussed. |

**B.Sc. Part III (NEP 1. 0) SEMESTER-VI**

**Paper No. DSE-F6 Chemistry Paper No. XIV (Organic Chemistry)**

**(Theory Credits: 02, 30 hours.)**

# Expected learning Outcomes:

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| --- | --- |
| **Name of the Topic** | **Expected Learning Outcome** |
| 1. 1.Reagents and Reactions in Organic Synthesis | Knowledge of reagents used in organic transformations and various reactions used in organic  synthesis. |
| 2. Retrosynthesis | Knowing basic terms used in retrosynthetic analysis,  retrosynthesis of some organic compounds. |
| 3. Electrophilic addition to >C=C< and  − C≡C− bond | Student will learn addition reaction across >C=C< bond w.r.t. hydrohalogenation, hydration hydroxylation, ozonolysis and addition of halogen, halogen acid, hydrogen, water, etc. across −C≡C−bond. |
| 4. Natural Products | Knowledge of terpenoids and alkaloids w.r.t. occurrence, isolation, characteristics and classification.  Analytical and synthetic evidences of Citral and Nicotine. |
| 5. Pharmaceuticals | Understanding classification of drugs, Qualities of  ideal drug. Synthesis and uses of some representative drugs and Drug action of sulpha drugs. |

**B.Sc. Part III (NEP 1. 0) SEMESTER-VI**

**Paper No. DSE-F7 Chemistry Paper No. XV Physical Chemistry)**

**(Theory Credits: 02, 30 hours.)**

**EXPECTED LEARNING OUTCOMES:**

|  |  |
| --- | --- |
| **Name of the Topics** | **Expected Learning Outcome** |
| 1. Phase equilibria | Learning and understanding of phase rule, learning of One component, Two component and Three component systems phase diagrams with suitable  examples. |
| 2. Thermodynamics | Knowledge about basic concept ofThermodyanamics, free energy, Gibbs-Helmholtz equation and its applications, problem related with it. |
| 3. Solid state chemistry | Learning and understanding Space lattice, lattice sites, Lattice planes, Unit cell. Laws of crystallography, Weiss indices and Miller indices, Cubic lattices and types of cubic lattice, planes or faces of a simple cubic system, Diffraction of Xrays,  Derivation of Bragg’s equation. Determination of crystal structure by Bragg’s method. crystal  structure of NaCl and KCl on the basis of Bragg’s equation.. |
| 4. Chemical kinetics | Learning of kinetics, Simultaneous reactions such as  i)opposing reaction ii)side reaction iii)consecutive reactions: iv) chain reaction v) explosive reaction |
| 5. Colloidal State | Learning and understanding the knowledge of Colloidal State, understanding of colloidal system, different types of colloidal system, preparation, properties, stability of different colloidal system, General applications of colloids. |

**B.Sc. Part III (NEP 1. 0) SEMESTER-VI**

**Paper No. DSE-F8 Chemistry Paper No. XVI (Analytical Chemistry)**

**(Theory Credits: 02, 30 hours.)**

**Expected learning Outcomes:**

|  |  |
| --- | --- |
| **Name of the topic** | **Expected Learning Outcome** |
| 1.Soap and Detergents | Knowledge about the chemical nature and  cleansing action of soap |
| 2.Synthetic polymers | Understanding and learning the classification, synthesis and applications of various polymers. |
| 3.Flame Photometry | Knowledge of instrumental analysis of alkali  and alkaline earth elements. |
| 4. Soil and Fertilizer Analysis | Knowledge of analysis of soil essential parameters and nutrients, Understanding the fertilizers used in regular farming |
| 5.Nanotechnology | Understanding and learning of nanotechnology including classification, optical properties, synthesis routes, characterization techniques and applications  of nano-materials. |

**B. Sc. Chemistry Practical component:**

The aim of the practical component of the course is to provide students with the skills that will be needed in their future practical work. Instruction is provided regarding the presentation of practical reports, awareness of health and safety procedures, practical skills in the laboratory (and the theory on which they are based).

**B. Sc. I Chemistry practicals**

Student is able to

* follow and understand general laboratory practical guidelines, including safety
* the use of an analytical balance for mass measurement
* how to maintain a detailed scientific notebook
* use of graduated cylinders, graduated pipettes, thermometers and volumetric pipettes .
* set up glassware and apparatus to conduct experiments.
* Students will be able to design and carry out scientific experiments as well as accurately record and analyze the results of such experiments.

**B. Sc. II Chemistry practicals**

Student know

* how to communicate the results of scientific work in oral, written and electronic formats
* how to critically evaluate data collected to determine the identity, purity, and yield of products
* understanding of the distinction between qualitative and quantitative chemical analysis
* to interpret data from an experiment, including the construction of appropriate graphs and the evaluation of errors.

**B. Sc. III Chemistry practicals**

Student is able to

* use modern instrumentation and classical techniques, to design experiments, and to properly record the results of their experiment.
* the application of statistical methods for the evaluation of laboratory data
* Calibration and use of pH metry, conductometric , potentiometric, calorimetry technique.
* how to design and perform experiments to determine the rate, order, and activation energy of chemical reactions by varying concentrations and/or temperature
* the preparation of buffer solutions at a required pH, given a choice of solutions of acid/conjugate base pairs
* how to perform common laboratory techniques, including reflux, distillation, steam distillation, recrystallization, vacuum filtration, aqueous extraction, thin layer chromatography, column chromatography
* how to predict the outcome and mechanism of some simple organic reactions, using a basic understanding of the relative reactivity of functional groups