

I -SEMESTER

COURSE 1:

ESSENTIALS AND APPLICATIONS OF MATHEMATICAL, PHYSICAL AND CHEMICAL SCIENCES

Hours: 5hrs/week

Credits: 4

Course Objective:

The objective of this course is to provide students with a comprehensive understanding of the essential concepts and applications of mathematical, physical, and chemical sciences. The course aims to develop students' critical thinking, problem-solving, and analytical skills in these areas, enabling them to apply scientific principles to real-world situations.

Learning outcomes:

1. Apply critical thinking skills to solve complex problems involving complex numbers, trigonometric ratios, vectors, and statistical measures.
2. To Explain the basic principles and concepts underlying a broad range of fundamental areas of physics and to Connect their knowledge of physics to everyday situations
3. To Explain the basic principles and concepts underlying a broad range of fundamental areas of chemistry and to Connect their knowledge of chemistry to daily life.
4. Understand the interplay and connections between mathematics, physics, and chemistry in various applications. Recognize how mathematical models and physical and chemical principles can be used to explain and predict phenomena in different contexts.
- 5 To explore the history and evolution of the Internet and to gain an understanding of network security concepts, including threats, vulnerabilities, and countermeasures.

I - SEMESTER

COURSE 2: ADVANCES IN MATHEMATICAL, PHYSICAL AND CHEMICAL SCIENCES

Hours: 5 hrs/week

Credits: 4

Course Objective:

The objective of this course is to provide students with an in-depth understanding of the recent advances and cutting-edge research in mathematical, physical, and chemical sciences. The course aims to broaden students' knowledge beyond the foundational concepts and expose them to the latest developments in these disciplines, fostering critical thinking, research skills, and the ability to contribute to scientific advancements.

Learning outcomes:

1. Explore the applications of mathematics in various fields of physics and chemistry, to understand how mathematical concepts are used to model and solve real-world problems.
2. To Explain the basic principles and concepts underlying a broad range of fundamental areas of physics and to Connect their knowledge of physics to everyday situations.
3. Understand the different sources of renewable energy and their generation processes and advances in nanomaterials and their properties, with a focus on quantum dots. To study the emerging field of quantum communication and its potential applications. To gain an understanding of the principles of biophysics in studying biological systems. Explore the properties and applications of shape memory materials.
3. Understand the principles and techniques used in computer-aided drug design and drug delivery systems, to understand the fabrication techniques and working principles of nano sensors. Explore the effects of chemical pollutants on ecosystems and human health.
4. Understand the interplay and connections between mathematics, physics, and chemistry in various advanced applications. Recognize how mathematical models and physical and chemical principles can be used to explain and predict phenomena in different contexts.
- 5 Understand and convert between different number systems, such as binary, octal, decimal, and hexadecimal. Differentiate between analog and digital signals and understand their characteristics. Gain knowledge of different types of transmission media, such as wired.

II - SEMESTER

Course Code 3: GENERAL AND INORGANIC CHEMISTRY

Credits: 03

Course Outcomes: At the end of the course the student will be able to-

1. Understand the structure of atom and the arrangement of elements in the periodic table.
2. Understand the nature and properties of ionic compounds.
3. Identify the structure of a given inorganic compound.
4. Explain the existence of special types of compounds through weak chemical forces.
5. Define acids and bases and predict the nature of salts.

II - SEMESTER

Course Code 3: GENERAL AND INORGANIC CHEMISTRY

Credits: 01

Practical- I Qualitative Analysis of SIMPLE SALT

Qualitative inorganic analysis (Minimum of Six simple salts should be analysed)
50 M

I. Course outcomes:

At the end of the course, the student will be able to;

1. Understand the basic concepts of qualitative analysis of inorganic simple salt.
2. Use glassware, equipment and chemicals and follow experimental procedures in the laboratory
3. Apply the concepts of common ion effect, solubility product and concepts related to qualitative analysis

II - SEMESTER

Course Code 4: INORGANIC CHEMISTRY- I

Credits: 03

Course outcomes:

At the end of the course, the student will be able to:

1. Understand the basic concepts of p-block elements.
2. Explain the concepts of d-block elements
3. Distinguish lanthanides and actinides.
4. Describe the importance of radioactivity.

II -SEMESTER

Course Code 4: INORGANIC CHEMISTRY- I

Credits: 01

Course outcomes:

At the end of the course, the student will be able to:

1. Understand the basic concepts of inorganic preparations.
2. Use glassware, equipment and chemicals and follow experimental procedures in the laboratory
3. Apply the properties of various elements for the preparation of inorganic compounds.

III -SEMESTER

Course Code 5: FUNDAMENTALS IN ORGANIC CHEMISTRY

Credits: 03

Course outcomes:

At the end of SEMESTER the student will be able to

1. Understand and explain the differential behaviour of organic compounds based on fundamental concepts learnt.
2. Formulate the mechanism of organic reactions by recalling and correlating the fundamental properties of the reactants involved.
3. Learn and identify many organic reaction mechanisms .
4. Correlate and describe the stereo-chemical properties of organic compounds and reactions.

III -SEMESTER

Course Code 6: ORGANIC CHEMISTRY

(Halogen and Oxygen containing organic compounds)

Credits: 03

Course outcomes:

At the end of the course, the student will be able to:

1. Understand the concept of SN_1 and SN_2 and SN_i mechanisms.
2. Describe the reactivity of alcohols and phenols.
3. Achieve the skills required to propose various mechanisms
4. Apply the concepts for synthesising various oxygen containing organic compounds
5. Interconvert the monosaccharides.

III - SEMESTER

Course Code 6:

Organic preparations

Credits: 01

Organic preparation

Course outcomes:

On the completion of the course, the student will be able to do the following:

1. How to use glassware, equipment and chemicals and follow experimental procedures in the laboratory.
2. How to calculate limiting reagent, theoretical yield, and percent yield.
3. How to perform common laboratory techniques including reflux, distillation, recrystallization, vacuum filtration.
4. How to critically evaluate data collected to determine the identity, purity and percent yield of products and to summarize findings in writing in a clear and concise manner.

III - SEMESTER

Course Code 7: PHYSICAL CHEMISTRY - I

(Solutions & Electro

Chemistry) Credits:

03

Course outcomes:

At the end of the SEMESTER the student will be able to

1. Understand the ideal and non ideal behaviour of solutions.
2. Determine the molecular mass of non-volatile solutes.
3. Discuss the basic concepts of Photochemistry.
4. Apply the principles of electrical conductivity.
5. Explain the importance of emf and its applications.

III - SEMESTER

Course Code 7: PHYSICAL CHEMISTRY -I

Credits: 01

PHYSICAL CHEMISTRY

Course outcomes:

At the end of the course, the student will be able to:

1. Use of glassware, equipment and chemicals and follow experimental procedures in the laboratory.
2. Understand and apply the concepts of solutions practically.
3. Apply concepts of electrochemistry in experiments.

III -SEMESTER
COURSE CODE 8: INORGANIC AND PHYSICAL
CHEMISTRY

Credits: 03

I. Course outcomes:

At the end of the SEMESTER the student will be able to:

- 1) Apply IUPAC nomenclature for Coordination compounds
- 2) Understand the various theories, structure and stereo chemistry of coordination compounds.
- 3) Explain the reaction mechanism in complexes.
- 4) Apply the 18 electron rule.
- 5) Discuss the basic concepts of thermodynamics.

IV - SEMESTER

COURSE CODE 9: PHYSICAL CHEMISTRY -II

(States of Matter, Phase Rule & Surface

Chemistry) Credits: 03

Course outcomes:

At the end of the SEMESTER the student will be able to:

1. Explain the difference between solids liquids and gases in terms of intermolecular interactions.
2. Differentiate ideal and real gases.
3. Discuss the basic concepts of two component systems
4. Apply the concepts of adsorption.
5. Understand the basic concepts of crystallography.

IV - SEMESTER

Course Code 9: Organic Preparations

Credits: 01

Course outcomes:

At the end of the course, the student will be able to:

- 1) Use glassware, equipment and chemicals and follow experimental procedures in the laboratory
- 2) Apply concepts of surface chemistry in experiments.
- 3) Be familiar with the concepts & practical applications of Surface tension and viscosity of liquids.

IV - SEMESTER

Course Code 10: GENERAL AND PHYSICAL CHEMISTRY

Credits: 03

Course outcomes:

At the end of the SEMESTER the student will be able to:

1. Correlate and describe the stereochemical properties of organic compounds.
2. Explain the biological significance of various elements present in the human body.
3. Apply the concepts of ionic equilibrium for the qualitative and quantitative analysis.
4. Determine the order of a chemical reaction.
5. Describe the basic concepts of enzyme catalysis.

IV - SEMESTER

Course Code 11: Nitrogen containing Organic Compounds &

Spectroscopy Credits: 03

Nitrogen containing Organic Compounds & Spectroscopy

Course outcomes:

At the end of the SEMESTER the student will be able to:

1. Distinguish primary secondary and tertiary amines and their properties.
2. Describe the preparation and properties of amino acids.
3. Explain the reactivity of nitro hydrocarbons.
4. Discuss heterocyclic compounds with N, O and S.
5. Apply the concepts of UV and IR to ascertain the functional group in an organic compound.

V- SEMESTER

Course Code 12 A:

ANALYTICAL METHODS IN CHEMISTRY-

QUANTITATIVE ANALYSIS

Credits: 03

ANALYTICAL METHODS IN CHEMISTRY- QUANTITATIVE ANALYSIS

SKILL ENHANCEMENT COURSE (ELECTIVE)

Learning Outcomes:

Students after successful completion of the course will be able to:

- 1) Identify the importance of solvent extraction and ion exchange method.
- 2) Acquire knowledge on the basic principles of volumetric analysis and gravimetric analysis.
- 3) Demonstrate the usage of common laboratory apparatus used in quantitative analysis.
- 4) Understand the theories of different types of titrations.
- 5) Gain knowledge on different types of errors and the minimization methods.

V- SEMESTER

Course 12 B : Environmental Chemistry Credits: 03

Learning Outcomes:

Students after successful completion of the course will be able to:

- 6) Understand the environment functions and how it is affected by human activities.
- 7) Acquire chemical knowledge to ensure sustainable use of the world's resources and
- 8) ecosystems services.
- 9) Engage in simple and advanced analytical tools used to measure the different types of pollution.
- 10) Explain the energy crisis and different aspects of sustainability.
- 11) Analyze key ethical challenges concerning biodiversity and understand the moral principles, goals
- 12) and virtues important for guiding decisions that affect Earth's plant and animal life.

V - SEMESTER

Course 13A :Chromatography and Instrumental methods of

Analysis Credits: 03

Learning Outcomes:

- 1) Students after successful completion of the course will be able to:
- 2) Identify the importance of chromatography in the separation and identification of compounds in a mixture
- 3) Acquire a critical knowledge on various chromatographic techniques.
- 4) Demonstrate skills related to analysis of water using different techniques.
- 5) Understand the principles of spectrochemistry in the determination of metal ions.
- 6) Comprehend the applications of atomic spectroscopy.

V - SEMESTER

Course 13 B Green Chemistry and Nanotechnology.

Credits: 03

Learning Outcomes:

Students after successful completion of the course will be able to:

1. Understand the importance of Green chemistry and Green synthesis.
2. Engage in Microwave assisted organic synthesis.
3. Demonstrate skills using the alternative green solvents in synthesis.
4. Demonstrate and explain enzymatic catalysis .
5. Analyse alternative sources of energy and carry out green synthesis.
6. Carry out the chemical method of nanomaterial synthesis.

V - SEMESTER

Course 14A: Synthetic Organic Chemistry.

Credits: 03

Learning Outcomes:

Students after successful completion of the course will be able to:

- 1) Identify the importance of reagents used in the synthesis of organic compounds.
 - 2) Acquire knowledge on basic concepts in different types of pericyclic reactions.
 - 3) Understand the importance of retro synthesis inorganic chemistry.
- Comprehend the applications of different reactions in synthetic organic chemistry.

V - SEMESTER

Course 14 B:Industrial Chemistry- Fertilisers and Surface coatings

Credits: 03

Learning Outcomes:

Students after successful completion of the course will be able to:

- 1) Identify the importance of different surface coatings.
- 2) Acquire a critical knowledge on manufacture of ceramics and cement.
- 3) Understand various steps in the manufacture of cane sugar.
- 4) Explain the manufacture of pulp and paper.

V - SEMESTER

Course 15 A Analysis of Organic Compounds Credits: 03

Learning Outcomes:

Students after successful completion of the course will be able to:

- 1) Identify the importance of mass spectrometry in the structural elucidation of organic compounds.
- 2) Acquire the knowledge on structural elucidation of organic compounds.
- 3) Understand various chromatography methods in the separation and identification of organic compounds.
- 4) Demonstrate the knowledge gained in solvent extraction for the separate the organic compounds.

V - SEMESTER

Course 15 B : Industrial Chemistry- Polymers and water analysis

Credits: 03

Learning Outcomes:

Students after successful completion of the course will be able to:

- 1) Understand the basic concepts of polymers
- 2) Acquire a critical knowledge on the preparation and applications of organic polymers.
- 3) Explain the sources of air pollution.
- 4) Demonstrate the analysis of water quality parameters.
Identify the importance of industrial waste management.

VII - SEMESTER

Course 16A: Inorganic Chemistry-I: Advance Studies in Complexes and Group theory

Course Learning Outcomes:

On successful completion of this course, student shall be able to:

- 1) The student will understand the VSEPR theory, symmetric and unsymmetric Hydrogen bonds in inorganic molecules.
- 2) Understanding the Crystal field theory and Jahn Teller Effects.
- 3) The Students will be able to understand the basics of molecular orbital theory and energetic of hybridization.
- 4) The Students are able to understand the Jobs method, hard and soft acids and bases.
- 5) The students will acquire the knowledge of symmetry

VII - SEMESTER

Course 16B: Inorganic Materials of Industrial Importance

Course learning Outcomes:

By the end of the course, the students will be able to:

1. Learn the composition and applications of the different kinds of glass.
2. Understand glazing of ceramics and the factors affecting their porosity.
3. Give the composition of cement and discuss the mechanism of setting of cement.
4. Explain the suitability of fertilizers for different kinds of crops and soil.
5. Explain the process of formulation of paints and the basic principle behind the protection offered by the surface coatings.
6. Explain the principle, working and applications of different batteries.
7. List and explain the properties of engineering materials for mechanical construction used in day today life.
8. Explain the synthesis and properties of nano-dimensional materials, various semiconductor And superconductor oxides

VII -SEMESTER

Course 17A:Spectroscopy of Organic compounds

Learning Outcomes:

By the end of the course, the students will be able to:

- 1) Gain insight into the basic fundamental principles of IR and UV-Vis spectroscopic techniques.
- 2) Use basic theoretical principles underlying UV-visible and IR spectroscopy as a tool for functional group identification in organic molecules
- 3) Interpret of IR, UV-visible spectra and their applications
- 4) Interpret of NMR, Mass spectra and their applications
- 5) Interpret the spectra in identifying the organic compounds

VII - SEMESTER

Course 17 B: Organic Chemistry: Stereo Chemistry and Natural Products

Course Learning outcomes:

On successful completion of this course, student shall be able to:

- 1) Understand and apply the substitution and elimination reaction mechanisms at aliphatic and aromatic substrates for various reactions leading to research
- 2) Write the stereo chemical forms for different organic molecules.
- 3) Understand the conformations of acyclic, monocyclic and fused ring systems and applying it to organic compounds.
- 4) Explain formation of various heterocyclic compounds and their synthesis and importance.
- 5) Describe the importance of natural products in medicinal chemistry

VII - SEMESTER

Course 18A: Physical Chemistry – I : Thermodynamics, Electrochemistry and Chemical Kinetics

Course Learning outcomes:

On successful completion of this course, student shall be able to:

- 1) Understand the classical thermodynamics, fugacity.
- 2) Describe the Electrochemical cells, Liquid junction potential.
- 3) Derive the Butler - Volmer equation and Ilkovic equation
- 4) Understand the complex reactions, chain reactions.
- 5) Demonstrate the Branching Chain Reactions, Enzyme catalysis and Photochemical equilibrium.

VII - SEMESTER

Course 18 B: Instrumental Methods of Chemical Analysis **Learning Outcomes**

By the end of the course, the students will be able to:

- 1) Handle analytical data
- 2) Understand basic components of IR, FTIR, UV-Visible and Mass spectrometer.
- 3) Interpret of IR, FTIR, UV-visible spectra and their applications.
- 4) Understand the use of single and double beam instruments.
- 5) Learn elemental analysis, Electro analytical Methods, Radiochemical Methods, X-ray analysis and electron spectroscopy

VII - SEMESTER

Skill Enhancement Course

19 A: Green Chemistry

Learning Outcomes:

By the end of the course Students will be able to:

1. Understand the twelve principles of green chemistry and will build the basic understanding of toxicity, hazard and risk of chemical substances.
2. Understand stoichiometric calculations and relate them to green chemistry metrics.
3. They will learn about atom economy and how it is different from percentage yield.
4. Learn to design safer chemical, products and processes that are less toxic, than current alternatives. Hence, they will understand the meaning of inherently safer design for accident prevention and the principle "what you don't have can't harm you"
5. Understand benefits of use of catalyst and bio catalyst, use of renewable feed stock which helps in energy efficiency and protection of the environment, renewable energy sources, and importance led reactions in various green solvents.
6. Appreciate the use of green chemistry in problem solving skills, critical thinking and valuable skills to innovate and find out solution to environmental problems. Thus the students are able to realize that

chemistry can be used to solve rather than cause environmental problems.

7. Green chemistry is a way to boost profits, increase productivity and ensure sustainability with absolute zero waste. Success stories and real world cases also motivate them to practice green chemistry.

VII - SEMESTER

Skill Enhancement Course

Course 19 B: Analysis of Drugs, Foods, Dairy Products & Bio-Chemical Analysis

Learning Outcomes:

Students after successful completion of the course will be able to:

1. Explain the principles of formulation and application of Drugs.
2. Acquire a critical knowledge on synthetic techniques of drugs.
3. Demonstrate the skills in analysis of **Foods, Dairy Products.**
4. Comprehended the applications of **Bio-Chemical Analysis.**
5. Acquire a critical knowledge on analysis of **Foods, Dairy Products.**

SEMESTER – VII

Skill Enhancement course

20A: Polymer Chemistry

Course Learning Outcomes

By the end of this course, students will be able to:

1. Know about history of polymeric materials and their classification
2. Learn about different mechanisms of polymerization and polymerization techniques
3. Evaluate kinetic chain length of polymers based on their mechanism
4. Differentiate between polymers and copolymers
5. Learn about different methods of finding out average molecular weight of polymers
6. Differentiate between glass transition temperature (T_g) and crystalline melting point (T_m)
7. Determine T_g and T_m
8. Know about solid and solution properties of polymers
9. Learn properties and applications of various useful polymers in our daily life.

SEMESTER – VII

Skill Enhancement Course

Course 20B. Industrial Chemicals and Environment

Learning Outcomes:

Students after successful completion of the course will be able to:

1. Identify the importance of Manufacture of *Inorganic Chemicals*
2. Acquire knowledge on production, uses, storage and hazards of *Industrial Gases*.
3. Understand the importance of **Environment**.
4. Understanding about water pollution and its effects.

Acquire knowledge on **Energy and its effects on Environment**

VIII - SEMESTER

Course 21A: Inorganic Chemistry-II: Metal clusters, Electronic spectra of Complex compounds and Bio-inorganic chemistry

Course Learning outcomes:

On successful completion of this course, student shall be able to:

- 1) Understand the study of age compounds of oxygen, phosphorous and sulphur..
- 2) Explain the various metal clusters and metal π complexes.
- 3) Describe the reactions of organo metallic compounds and its applications.
- 4) Understand the reaction mechanism in transition metal complexes.
- 5) Demonstrate the Orgel diagrams and electronic spectra of transition metal complexes.

Discuss structure and functions of hemoglobin, myoglobin and vitamin B12, photochemical laws.

VIII - SEMESTER

Course 21B: Organo Metallic Chemistry

I. Learning Outcomes:

By the end of this course, students will be able to

1. Apply 18-electron rule to rationalize the stability of metal carbonyls and related species
2. Understand the nature of Zeise's salt and compare its synergic effect with that of carbonyls.
3. Identify important structural features of the various haptic metal complexes
4. Get a general idea of catalysis and describe in detail the mechanism of Wilkinson's catalyst,
5. Zeigler-Natta catalyst and synthetic gasoline manufacture by Fischer-Tropsch process
6. Understand the importance of organometallic compounds in the synthesis of organic compounds

VIII- SEMESTER

Course 22A: Organic Chemistry: Modern Organic synthesis and Natural products

Course Learning outcomes:

On successful completion of this course, student shall be able to:

- 1) Understand various types of reaction intermediates and the bonding present in various organic compounds.
- 2) Explain how to protect various functional groups in organic synthesis.
- 3) Describe the mode of addition reactions by electrophile and nucleophiles.
- 4) Discuss mechanisms of named reactions and their applications in organic synthesis.
- 5) Know about the importance of flavones, flavonoids and hormones.

VIII - SEMESTER
Course 22B: Chemistry of Natural Products

I. Course learning Outcomes

By the end of the course students will be able to:

Understand isolation, purification and characterization of simple chemical constituents from the natural source

1. Learn the different types of alkaloids and their chemistry
2. To know the classification of terpenoids, isoprene rule, structures and their natural sources.
3. Learn advanced methods of structural elucidation of compounds of natural origin
4. Understand isolation, purification, chemical constituents from the natural source
5. To know the structure characterization and synthesis of steroids

VIII - SEMESTER
Course 23A: Physical Chemistry: Quantum and Molecular Spectroscopy

Course Learning outcomes:

On successful completion of this course, student shall be able to:

- 1) Learn the basic non-relativistic quantum mechanics.
- 2) Understand the time-dependent and time-independent Schrödinger equation.
- 3) Describe the principles and theories of rotational, vibrational and vibrational spectroscopy methods.
- 4) Interpret the molecular spectra and find molecular properties from molecular spectra.

VIII - SEMESTER

Course 23B: Analytical Methods of Analysis

Learning Outcomes:

By the end of this course, students will be able to:

- 1· Perform experiment with accuracy and precision.
- 2· Develop methods of analysis for different samples independently.
- 3· Test contaminated water samples.
- 4· Understand basic principle of instrument like Flame Photometer, UV-vis spectrophotometer.
- 5· Learn separation of analytes by chromatography.
- 6· Apply knowledge of geometrical isomers and keto-enol tautomers to analysis.
- 7· Determine composition of soil.
- 8· Estimate macronutrients using Flame photometry.

VIII - SEMESTER

Skill Enhancement courses

Course 24A: Pharmaceutical and Medicinal Chemistry

Learning Outcomes:

successful completion of this practical course, student shall be able to:

- 1) Know the Terminology in Pharmaceutical chemistry.
- 2) Describe the classification of Pharmaceutical chemistry
- 3) Learn the procedure for Synthesis and therapeutic activity of the compounds.
- 4) Acquire knowledge on Pharmacodynamics and Anesthetics Drugs
- 5) Gain knowledge on HIV-AIDS and Drugs.

VIII – SEMESTER

Skill Enhancement course

Course-24B. Pesticides and Green Chemistry

I. **Learning Outcomes:**

On completion of this course, the student will be able to

1. Understand the basic knowledge of pesticides and their classification.
2. Explain the synthetic methods of pesticides.
3. Acquire knowledge about the different types of pesticide formulations and their use.
4. Explain concepts in green chemistry.
5. State and explain the principles of green chemistry.
6. Identify the need of green chemistry and green synthesis.
7. Think to design and develop materials and processes that reduce the use and generation of hazardous substances in industry.

VIII - SEMESTER

Skill Enhancement course

Course-25A: Corrosion and Its Prevention

I. **Learning Outcomes:**

1. This course will create awareness of corrosion and its control process
2. It focuses on protective metallic coatings for prevention of corrosion
3. It focuses on protective coatings of materials.
4. It covers about the insulating materials in electric industries and also aware about semiconductors.

VIII - SEMESTER

Skill Enhancement course

Course 25B: Material & Energy Balances and Utilities in Chemical Industry

I. Learning Outcomes:

At the end of the course student will be able to

1. Describe the distinction between Atomic weight, Molecular weight and Equivalent Weight.
2. Write down the flow diagrams for chemical engineering operations.CO3
3. Describe the capacities of gases and gaseous mixtures.
4. Write down water treatment procedures for industrial use.
5. Describe the types of boilers.
6. Demonstrate knowledge acquired in steam generation.
7. Write down compressors and blowers.
8. Classify pumps based on their function.