

B. Sc. CHEMISTRY
MODEL I & MODEL II
(2016 Admissions)

PROGRAMME OBJECTIVES (POs)

The main objective is to provide to the students an in-depth understanding of the basic concepts of chemical sciences and enable them with tools needed for the practice of chemistry, which remains a discipline with much stress on experimentation. It attempts to provide a detailed knowledge of the terms, concepts, methods, principles and experimental techniques of chemistry.

- To provide a broad foundation in chemistry that stresses scientific reasoning and analytical problems.
- To provide students with the skills required to succeed in graduate school, the chemical industry.
- To expose the students to a breadth of experimental techniques using modern instrumentation.
- The student will acquire a foundation of chemistry of sufficient breadth and depth to enable them to understand and critically interpret the primary chemical literature.

PROGRAMME SPECIFIC OUTCOMES (PSOs)

- Global level research opportunities to pursue master programmes in chemistry or industrial chemistry across the globe.
- Clear to Joint Admission for Masters (JAM) exam conducted by IITs, IISc and IISERs and other entrance exams pursue master degree or integrated Ph. D. programmes in reputed institutes or universities in India.
- Job opportunities at all level of chemical, pharmaceutical, food products, material and plastic industries.
- Chemistry specific competitive exams conducted by government bodies.

COURSE OUTCOMES (COS)

SEMESTER I

METHODOLOGY OF CHEMISTRY AS A DISCIPLINE OF SCIENCE (CHE1CRT01)

- Get a broad outline of the methodology of science in general and Chemistry in particular.
- Understand the important analytical and instrumental tools used for practicing chemistry.
- Learn computer based presentation and statistical analysis of data using spreadsheet software.
- Apply these skills in the analysis of experimental data in chemistry practical.

SEMESTER I CORE CHEMISTRY PRACTICALS

VOLUMETRIC ANALYSIS (CHE1CRP01)

- Acquire thorough knowledge on the basics principles behind volumetric analysis.
- Will be able to decide the choice of indicator for different volumetric estimations.
- Will be confident to make solutions of desired concentration for estimation of any unknown acid/base.
- Will be efficient in determining the hardness of water.
- Will be able to ascertain the Ca content in various food products and thereby hinting about adulteration if any.

SEMESTER II

THEORETICAL AND INORGANIC CHEMISTRY (CHE2CRT01)

- Compare the various atom models
- Understand the important features of the quantum mechanical model of the atom.
- Examine the periodic properties of elements

- Explain the formation of different types of bonds
- Predict the geometry of simple molecules
- Explain the different types of hybridisation and draw shapes of simple covalent molecules
- Understand the molecular orbital theory of diatomic molecules
- Develop interest in various branches of inorganic chemistry.
- Study nuclear models and nuclear reactions.

SEMESTER II CORE CHEMISTRY PRACTICALS

VOLUMETRIC ANALYSIS (CHE2CRP01)

- Will be able to quantify the amount of Fe present in various salts/minerals encountered in routine life.
- Will be able to quantify the presence of oxidizing/reducing agents by redox titration

SEMESTER III

Fundamentals of Organic Chemistry (CHE3CRT01)

- Acquire a basic understanding about the classification and nomenclature of organic compounds, fundamentals of organic reaction mechanism, aromaticity and stereochemistry.
- Make students capable of understanding and studying organic reactions.
- Have exposure to various emerging new areas of organic chemistry.
- Develop skills required for the qualitative analysis of organic compounds.

SEMESTER III CORE CHEMISTRY PRACTICALS

QUALITATIVE ORGANIC ANALYSIS (CHE3CRP01)

- Gain experience in the identification of organic compounds.
- Determine the functional group of an unknown compound by using different classification tests.

- Know the fundamental principles of chemistry of various types of organic reactions and mechanism of organic reactions.
- Able to write down the structure of different organic compounds like alcohol, aldehyde, ketone, carboxylic acid, 1,2 dicarboxylic acid, ester, primary and secondary amines.
- Understand the preparation of a derivative for a given organic compound.
- Understand the physical properties of organic compounds.

SEMESTER IV

BASIC ORGANIC CHEMISTRY -I (CHE4CRT01)

- Learn the chemistry of alcohols, phenols, carboxylic acids, derivatives of Carboxylic acids, Sulphonic acids, carbonyl compounds, poly nuclear hydrocarbons, active methylene compounds and Grignard reagents.
- To understand and study Organic reaction mechanisms.

SEMESTER IV CORE CHEMISTRY PRACTICALS

QUALITATIVE ORGANIC ANALYSIS (CHE4CRP01)

- Gain experience in the identification of organic compounds.
- Determine the functional group of an unknown compound by using different classification tests.
- Know the fundamental principles of chemistry of various types of organic reactions and mechanism of organic reactions.
- Able to write down the structure of different organic compounds like reducing and non- reducing sugars, phenol, tertiary amines, amide, nitro and halogen compounds diamide , anilide, polynuclear hydrocarbons
- Understand the preparation of a derivative for a given organic compound.
- Understand the physical properties of organic compounds.

SEMESTER V

CHEMISTRY OF d AND f BLOCK ELEMENTS (CHE5CRT01)

- Understand the general characteristics of the d and f block elements
- Examine the physical and chemical properties of d and f block elements
- Evaluate the Werner's theory of coordination compounds
- Recognize and analyze various isomerisms in metal complexes
- Understand the bonding in coordination compounds
- Understand the applications of coordination compounds
- Understand the classification, properties and applications of organometallic compounds
- Learn the methods of preparation, properties, structure and bonding of metal carbonyls and metal clusters
- Understand the role of metals in biological systems.

SEMESTER V PRACTICALS

QUALITATIVE INORGANIC ANALYSIS (CHE5CRP01)

- Adequate understanding of reactions of cationic and anionic radicals with a view to their identification and confirmation.
- Acquire the Skill to analyze qualitatively the mixtures containing acid and basic radicals.
- Attain competency to systematically analyze mixtures of acid and basic radicals containing one interfering radical by Semi-micro method.

BASIC ORGANIC CHEMISTRY-II (CHE5CRT02)

- Learn the chemistry of nitro compounds, amines, dyes, organic polymers,
 - soaps, detergents and organic reagents.
- Understand and study mechanism of reactions of nitro compounds and amines.
 - Have an elementary idea of chemotherapy, organic spectroscopy and
 - photochemistry.
- Identify organic compound using UV, IR and PMR spectroscopic techniques.
 - Develop basic skills required for crystallisation, distillation, solvent

- extraction, TLC and column chromatography.

SEMESTER V PRACTICALS

PREPARATION AND BASIC LABORATORY SKILLS (CHE5CRP02)

- Acquire ample expertise in Basic laboratory techniques such as Crystallisation, Distillation, Solvent extraction, Separation and Purification
- Competent enough to perform organic reactions involving Oxidation, Hydrolysis, Nitration, Halogenation and Diazocoupling.

STATES OF MATTER (CHE5CRT03)

- Analyze and evaluate the intermolecular forces in gases and liquids.
- Understand the dynamics of the molecules in the gases and liquids.
- Understand liquefaction of gases.
- Learn the structure of solids.
- Learn defects in crystals.
- Understand and analyze adsorption.

SEMESTER V PRACTICALS

PHYSICAL CHEMISTRY PRACTICALS (CHE5CRP03)

- Students will have a firm foundation in the fundamentals and application of current chemical and scientific theories in physical chemistry.
- Students will be able to explore new areas of research in both chemistry and allied fields of science and technology.
- Students will gain an understanding of chemical kinetics and able to determine the order of chemical reactions.
- Able to handle viscometer in order to measure the viscosity of an unknown solution
- Gain knowledge on heat of solution and neutralization.

- Acquire knowledge on electrochemical cells using conductometric and potentiometric titrations and able to measure the concentration of an unknown sample.
- Gain knowledge on transition temperature and able to measure it.

QUANTUM MECHANICS AND SPECTROSCOPY (CHE5CRT04)

After this, the student will be able to

- Differentiate between classical and quantum mechanics
- Study the postulates of quantum mechanics and the quantum mechanical model of the hydrogen atom
- Study valence bond and molecular orbital theory
- Study the principle and applications of microwave, infra red, Raman, electronic and magnetic resonance spectroscopy.
- Study the fundamentals of mass spectrometry To study the fundamentals of photochemistry.

SEMESTER VI

APPLIED INORGANIC CHEMISTRY (CHE6CRT01)

- the principle of inorganic qualitative analysis
- thermodynamic concepts in the extraction of metals
- the applications of radioactivity and radioisotopes
- the preparation and uses of inorganic polymers preparation and application of nanomaterials
- the chemistry of refractory and ceramic materials
- the chemistry of the compounds of p block elements thermal and chromatographic techniques.

SEMESTER VI PRACTICALS

QUALITATIVE INORGANIC ANALYSIS (CHE6CRP01)

- Adequate understanding of reactions of cationic and anionic radicals with a view to their identification and confirmation.
- Acquire the Skill to analyze qualitatively the mixtures containing acid and basic radicals.
- Attain competency to systematically analyze mixtures of acid and basic radicals containing one interfering radical by Semi-micro method.

CHEMISTRY OF NATURAL PRODUCTS AND BIOMOLECULES (CHE6CRT02)

- Learn in detail the chemistry of carbohydrates, heterocyclic compounds, amino acids, proteins and nucleic acids.
- Have a thorough idea on the structures of carbohydrates and some heterocyclic compounds.
- Understand the structure and functions of enzymes, proteins and nucleic acids.
- Study the fundamentals of terpenoids, alkaloids, vitamins, lipids and steroids.
- Have an elementary idea of supramolecular chemistry and Green Fluorescent Proteins

SEMESTER VI PRACTICALS

PREPARATION AND BASIC LABORATORY SKILLS (CHE6CRP02)

- Acquire ample expertise in Basic laboratory techniques such as Distillation and Purification
- Competent enough to perform organic reactions involving Acylation, Esterification, Side chain oxidation, condensation etc.
- Trained to perform separation and identification of organic compounds using TLC and Column Chromatography.
- Acquire knowledge on R_f value.
- Acquire the technique of quantitative dilution.

EQUILIBRIUM AND KINETICS (CHE6CRT03)

- Study the laws of thermodynamics.
- Derive Gibbs-Helmholtz, Clausius-Clapeyron, Gibbs-Duhem equations.
- Derive the relation between K_p , K_c and K_x

- Derive the phase rule.
- Derive the rate equations for zero, first and second order reactions.
- Study the phase diagrams of one and two component systems.
- Understand the theories of chemical kinetics.
- Get an elementary idea of catalysis including enzyme catalysis

SEMESTER VI PRACTICALS

PHYSICAL CHEMISTRY PRACTICALS (CHE6CRP03)

- Students will have a firm foundation in the fundamentals and application of current chemical and scientific theories in physical chemistry.
- Students will be able to explore new areas of research in both chemistry and allied fields of science and technology.
- Students will gain an understanding of chemical kinetics and able to determine the order of chemical reactions.
- Able to do data analysis of kinetic experiments using spreadsheet program.
- Acquire knowledge on electrochemical cells using conductometric and potentiometric titrations and able to measure the concentration of an unknown sample.
- Able to determine the equivalence point of potentiometric and conductometric titrations using spreadsheet program.

SOLUTION CHEMISTRY (CHE6CRT04)

- Study the behaviour of binary liquid mixtures, CST, azeotropes, colligative properties.
- Study solubility of gases in liquids.
- Study ionic equilibria and electrical properties of ions in solution.
- Study the concepts of acids and bases, pH and buffer solutions.

SEMESTER VI PRACTICALS

GRAVIMETRIC ANALYSIS (CHE6CRP04)

- Competent enough to perform the quantitative estimation of the metals such as Nickel, Copper, Iron, Barium and radicals such as sulphate gravimetrically.

SEMESTER VI: CHOICE BASED COURSES

ENVIRONMENTAL CHEMISTRY (CHE6CBT01)

- Environmental management and impact assessment.
- Toxic effects of pollutants.
- Air, water, and soil pollution

NANOCHEMISTRY AND NANOTECHNOLOGY (CHE6CBT02)

The student will be able to understand the

- History,terminology,and scales of nano systems.
- Synthesis and characterisation of nano systems
- Electrical and optical properties of nano systems.
- Applications of nanomaterials

OPEN COURSES

ENVIRONMENTAL CHEMISTRY (CHE5COT01)

- Environmental management and impact assessment
- Toxic effects of pollutants
- Air, water, and soil pollution
- Effluent and waste management

NANOSCIENCE AND NANOTECHNOLOGY (CHE5COT02)

The student will be able to understand the

- History,terminology,and scales of nano systems.
- Synthesis and characterisation of nano systems
- Electrical and optical properties of nano systems.
- Applications of nanomaterials

B. Sc. CHEMISTRY (COMPLEMENTARY)

SEMESTER I

BASIC THEORETICAL AND ANALYTICAL CHEMISTRY (CHE1CMT01)

- Study atomic structure, basics of thermodynamics and the concept of equilibrium.
- Understand principles of analytical chemistry and chromatographic techniques.

SEMESTER II

BASIC ORGANIC CHEMISTRY (CHE2CMT01)

- Stereochemistry of organic compounds.
- Mechanisms of some basic organic reactions.
- Classification of polymers, polymerization reactions, and the structure and uses of some commercial and natural polymers.

COMPLEMENTARY PRACTICALS

SEMESTER I & II

VOLUMETRIC ANALYSIS (CHE1CMP01/CHE2CMP01)

(Common to Physical sciences and Life sciences)

- Acquire knowledge on the basics principles/chemical changes that occur during a strong acid/strong base titration.
- Acquire thorough knowledge on the chemical change that occur during a weak acid/strong base (or strong acid/weak base) titration.
- Will be able to decide the choice of indicator for different volumetric estimations
- Will be confident to make solutions of desired concentration for estimation of any unknown acid/base

- Will be able to calculate the concentration in terms of molarity and hence the amount of an unknown acid/base in the given solution.
- Acquire thorough knowledge on the basic principle and chemical changes of redox titrations/redox indicators.
- Acquire thorough knowledge on oxidizing and self-indicating nature of KMnO_4 in presence of acid medium.
- Will be able to calculate the concentration of an unknown Fe^{2+} solution using standard dichromate solution with the help of external and internal indicators.
- Will be able to determine the concentration of oxidising agents through indirect process involving iodine as the intermediary. In the presence of iodine, the thiosulphate ions oxidise quantitatively to the tetrathionate ions.

SEMESTER III

ADVANCED INORGANIC AND ORGANIC CHEMISTRY (CHE3CMT01)

(For students who have opted Life Sciences as core)

- To give the students a basic understanding of nuclear chemistry and heterocyclic compounds.
- Attained insight into the cause of radioactivity.
- Understand the applications of radioactivity in Tracer techniques, Radio diagnosis and radiotherapy.
- Develop deep insight into the thermodynamics of living cell.
- Acquainted the metal ions in biological systems and their biochemistry.
- Recognize the various types of fertilizers such as NPK, superphosphates, triple super phosphate, micronutrients etc.
- Understand the various classifications and sub classifications of pesticides.
- Understand the concept of aromaticity applied to heterocyclic compounds.
- Understand the preparation, properties and structure of various heterocyclic compounds.
- Acquire knowledge of the Classification, Structure, therapeutic uses and mode of action of various classes of drugs; their addiction and abuse alongside prevention and treatment.

- Familiarize with the chemistry of food Additives and Cosmetics.

PHYSICAL CHEMISTRY - I (CHE3CMT02)

(For students who have opted Physical Sciences as Main)

- Get a clear idea about the molecular structure
- Understand and study electrical and nuclear properties of molecules.
- Explain the properties and characteristics of three states of matter.
- Analyse the differences between solids, liquids and gases.
- Develop a detailed understanding of different types of crystal systems.
- Familiarize the concepts about the three states of matter.
- Evaluate the surface phenomena, their importance and characteristics of colloids and how they can be applied in day to day life.
- Solve problems related to three states of matter, adsorption etc.

SEMESTER IV

ADVANCED BIO-ORGANIC CHEMISTRY (CHE4CMT01)

(For students who have opted Life Sciences as core)

- The classification and properties of amino acids
- The structure and functions of proteins, nucleic acids, ADP, ATP and AMP.
- Classification, properties and structure of carbohydrates.
- Classification and characteristics of enzymes and mechanism of enzyme action.
- Fundamentals of vitamins, hormones, steroids, essential oils, lipids and alkaloids

ADVANCED PHYSICAL CHEMISTRY - II (CHE4CMT02)

(For students who have opted Physical Sciences as Main)

- Explain basic principles of microwave, IR, UV-Visible, and rotational spectroscopy.
- Predict which signals are to be observed in the rotational, vibrational, electronic and NMR spectrum of various materials ranging from single to

large molecules.

- Solve problems related to different spectroscopic methods.
- Discuss how spectroscopic methods are used for qualitative and quantitative analysis.
- Explain the basic principles of nanochemistry and its application
- Explain different varieties of electrodes, electrolytic cells etc.
- Discuss the principles behind potentiometric and conductometric titrations
- Acquire knowledge in chemical kinetics and basics of photochemistry.

SEMESTER III & IV PRACTICAL-II

ORGANIC CHEMISTRY PRACTICALS (CHE4CMP01)

(For students who have opted Biological Sciences as Main)

- Gain experience in the identification of organic compounds.
- Determine the functional group of an unknown compound by using different classification tests.
- Know the fundamental principles of chemistry of various types of organic reactions and mechanism of organic reactions.
- Able to write down the structure of different organic compounds like carboxylic acids, amines, amides, esters, aldehydes, ketones, phenols etc.
- Understand the preparation of a derivative for a given organic compound.
- Understand the physical properties of organic compounds.

PHYSICAL CHEMISTRY PRACTICALS (CHE4CMP02)

(For students who have opted Physical Sciences as Main)

- Students will have a firm foundation in the fundamentals and application of current chemical and scientific theories in physical chemistry.
- Students will be able to explore new areas of research in both chemistry and allied fields of science and technology.
- Students will gain an understanding of chemical kinetics and able to determine the order of chemical reactions.
- Able to handle viscometer in order to measure the viscosity of an unknown solution

- Gain knowledge on heat of solution and neutralization.
- Acquire knowledge on electrochemical cells using conductometric and potentiometric titrations and able to measure the concentration of an unknown sample.
- Gain knowledge on transition temperature and able to measure it.

B. Sc. INDUSTRIAL CHEMISTRY MODEL -II

SEMESTER I

INDUSTRIAL ASPECTS OF INORGANIC AND ORGANIC CHEMISTRY (CHE1CMT02)

- The various natural sources of energy and industrially important materials derived from them
- The basic concepts of metallurgical operations.
- The basic concepts of the energy and material balance.
- Recognize different fuels, their properties and applications.
- Understand the basic properties of fuels.
- Identify various metals and alloys that are industrially applied.
- Select appropriate type of material for specific application.
- To understand/predict the behavior of a metallic material to a certain application.

SEMESTER II

INDUSTRIAL ASPECTS OF PHYSICAL CHEMISTRY (CHE2CMT02)

- Study the surface phenomena of liquid.
- Study the different methods of separation.
- Provide basic knowledge about catalysts, their preparation and characterization,
- Recognize the properties and uses of colloids
- Recognize catalysts used for chemical, pharmaceutical and environment applications.

SEMESTER I & II PRACTICAL

VOCATIONAL COURSE PRACTICALS: PRACTICAL-I (CHE2CMP02)

- Design, carry out and analyse the various experiments in industrial inorganic and organic chemistry.
- Perform the basic purification and separation experiments like distillation, crystallization etc.
- Carry out hands on training in ore analysis and alloy analysis.
- Standardize several acids in a mixture.

SEMESTER-III

UNIT OPERATIONS IN CHEMICAL INDUSTRY (CHE3CMT03)

- Learn the basic concepts of process of various unit operations in chemical industry
- Perform distillation, crystallation etc.
- Design columns for separation purposes.
- Purify materials through distillation, crystallation, filtration etc.

UNIT PROCESSES IN ORGANIC CHEMICALS MANUFACTURE (CHE3CMT04)

- Understand the basic idea of various unit operations
- Identify the appropriate unit operations involved in process of manufacture of various materials
- Identify suitable unit operations in chemical industries.
- Apply the basic concepts for the development of different industrially important materials.
- Nitration, Halogenation, Sulphonation, Oxidation, Hydrogenation, Alkylation, Esterification Ammination and Hydrolysis.

SEMESTER IV

INSTRUMENTAL METHODS OF CHEMICAL ANALYSIS - I (CHE4CMT03)

- Acquire a working knowledge of analytical instruments like UV-Visible spectroscopy, AAS, HPLC, GC etc.
- Demonstrate knowledge of sampling methods for all states of matter.

- Integrate a fundamental understanding of the underlining physics principles as they relate to specific instrumentation used for atomic, molecular, and mass spectrometry, and chromatography
- Understand and be able to apply the theory and operational principles of analytical instruments.
- Distinguish between qualitative and quantitative measurements and be able to effectively compare and critically select methods for elemental and molecular analysis.
- Distinguish between Column, Paper, Thin- layer, and Gas Chromatography
- Acquire knowledge about different Electroanalytical techniques

SEMESTER IV

INSTRUMENTAL METHODS OF CHEMICAL ANALYSIS-II (CHE4CMT0417)

- The principle, construction and working of devices for the measurement of temperature, pressure, liquid level, density and viscosity
- The working of microprocessor based instruments
- The use of computers in chemistry

SEMESTER III & IV PRACTICALS

VOCATIONAL COURSE PRACTICALS: PRACTICAL-II (CHE3CMP03/CHE4CMP03)

- Be able to design and carryout various unit processes involving Nitration, Sulphonation, Hydrolysis, Oxidation and Halogenation.
- To determine the acid value, saponification value and iodine value of different oils.
- To perform various purification methods of an organic compounds. (Thin Layer Chromatography and Column Chromatography).
- To perform Ore analysis-dolomite, lime stone, calcite, analysis of alloys such as cuprous nickel

VOCATIONAL COURSE PRACTICALS: PRACTICAL-III (CHE3CMP04/CHE4CMP04)

- Acquire the foundation in the fundamentals and applications of Physical Chemistry.
- Explore the fundamentals of colorimetry.
- Find out the flash and fire point of liquids.
- Perform water analysis and analysis of heavy metals.

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