



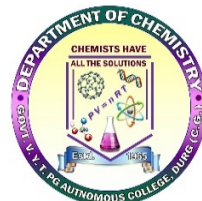
DEPARTMENT OF CHEMISTRY

(DST-FIST)

GOVT. V.Y.T. PG AUTONOMOUS COLLEGE, DURG 491001(C.G.) INDIA

(Former Name – Govt. Arts & Science College, Durg)

Website: www.govtsciencecollegedurg.ac.in



VISION

To be a torchbearer in the arena of higher education by empowering the youth through quality education that would develop intellectually alive, ethically upright, socially responsible, and philanthropic citizens, inclined to meet the global challenges of the contemporary knowledge society, in this ever-changing, technology - oriented world.

MISSION

To translate the vision into reality and transform the hopes and dreams of the diverse individuals into actuality, the department is committed to:

- ❖ Embrace in its fold students from all sections and categories especially addressing to the needs of the first-generation learners particularly the under-privileged ones.
- ❖ Develop and design outcome-based curriculum leading to employability and skill development.
- ❖ Inculcate humanistic and social values among students through community activities.
- ❖ Sensitize the students on issues relating to ecology and environment
- ❖ Kindle the entrepreneurial spirit through Academia-Industry activities.
- ❖ Inspire the young minds to develop the habits of critical thinking to achieve creative excellence.
- ❖ Expose students to recent advances in Chemical Sciences.
- ❖ Promote quality research, innovations, and patents.
- ❖ Foster collaborations and linkages for improving knowledge base.
- ❖ Encourage the students to participate to variety of activities – academic, co-curricular and extra-curricular, aiming at their overall development.
- ❖ Create an exceptional learning environment that would groom total personality.

UG Programs: Program Specific Outcome (PSO)

B.Sc. (with CHEMISTRY)

Upon completion of the B.Sc. Degree (with Chemistry), the students will be able to:

- PSO1:** Understand the fundamentals/concepts/theories in various branches of chemistry.
- PSO2:** Compare and justify various aspects, deduce and derive expressions, reaction mechanisms, etc.
- PSO3:** Apply the principles/concepts and rules in finding their solutions.
- PSO4:** Carry out experiments, record the observations, understand handling of apparatus/instruments.

B.Sc. (with INDUSTRIAL CHEMISTRY)

Upon completion of B.Sc. Degree (with Ind. Chem.), the students will be able to:

- PSO1:** Describe history and development, fundamentals and various aspects in Industrial Chemistry.
- PSO2:** Explain the principles/pre-requisites/management and its application involved in industries.
- PSO3:** Discuss the industrially important processes/reactions/natural and synthetic materials.
- PSO4:** Carry out experiments, understand various processes through industrial visits and projects.

B.Sc. (with BIOCHEMISTRY)

Upon completion of B.Sc. Degree (with Biochemistry), the students will be able to:

- PSO1:** Explain concepts of molecular biology, nutritional, clinical, environmental biochemistry, etc.
- PSO2:** Discuss application of the biophysical and biochemical principles and techniques.
- PSO3:** Describe and understand various biochemical aspects through theory and industrial visits.
- PSO4:** Carry out experiments, present effectively through presentations and project work.

PG Program: Program Specific Outcome (PSO)

M.Sc. (CHEMISTRY)

Upon completion of the M.Sc. (Chemistry) Program, the students will be able to:

- PSO1:** Understand and explain the fundamental concepts in Physical Chemistry, Organic Chemistry, Inorganic Chemistry, Analytical Chemistry and its application.
- PSO2:** Apply various concepts, interpret/derive/deduce expressions, reaction mechanism, structure, etc.
- PSO3:** Solve problems/numerical using basic chemistry knowledge and concepts.
- PSO4:** Carry out advanced experiments, investigate and explore through projects, record the observations, present the inference/results and discuss/interpret the result.

Doctral Program: Program Specific Outcome (PSO)

Ph.D. (CHEMISTRY)

Upon completion of Ph.D. in Chemistry, the candidates will be able to:

- PSO1:** Understand and apply the diverse aspects in various fields of Chemistry.
- PSO2:** Develop ethical values, scientific temper/research aptitude, logical thinking, observative skills, the ability to draw inferences and induce innovation ecosystem.

PSO3: Collaborate in team, enhance leadership qualities and make them competent and employable.

PSO4: Express and present the outcomes effectively in the form of publications and other forms.

UG Programme: Course Outcome (CO)

B.Sc. (CHEMISTRY) Part - I

BCH-01 INORGANIC CHEMISTRY

After completion of the course, students would be able:

CO1: To understand atomic structure, wave mechanical concept and electronic configuration.

CO2: To discuss about periodic properties and their variations along periods and groups.

CO3: To explain chemical bonding involved in ionic and covalent compounds.

CO4: To gain insight into valence bond theory, molecular orbital theory and concept of hybridization.

CO5: To understand the concept and develop skill for qualitative analysis of inorganic mixture.

BCH-02 ORGANIC CHEMISTRY

After completion of the course, the students would be able:

CO1: To explain the basic concepts of organic reactions, reaction mechanism, reaction intermediates, various types of organic reactions.

CO2: To define terminology associated with stereochemistry, impact of chirality on optical activity and geometrical isomerism.

CO3: To understand the conformation of alkanes and cycloalkanes, Baeyer's strain theory and conformations of substituted cycloalkanes.

CO4: To interpret the reactions, properties and mechanisms of reactions involved in alkanes, alkenes and alkynes.

CO5: To describe the aromaticity and mechanisms of typical aromatic reactions.

BCH-03 PHYSICAL CHEMISTRY

After completion of the course, the students will be able:

CO1: To have a firm foundation of the basic mathematical concepts useful for chemists and its applications.

CO2: To understand the kinetic molecular model of a gas, laws related to ideal gases and behaviour of real gases.

CO3: To explain the chemistry of liquid state and solid state and its application.

CO4: To classify different colloids and discuss the principles, properties and application of colloids, adsorption and adsorption isotherms.

CO5: To define various terms associated with chemical kinetics, derive rate equations/rate laws and describe various theories of rate, types of catalysis, catalysts and its industrial applications.

B.Sc. (CHEMISTRY) Part – II

BCH-04 INORGANIC CHEMISTRY

After completion of the course, the students would be able:

CO1: To know the meaning of various terms involved in co-ordination Chemistry

CO2: To understand Werner's formulation of complexes and identify the types of valences.

CO3: To know the limitations of VBT.

CO4: To draw the geometrical and optical isomerism of complexes

CO5: To effectively solve practical problems of analytical chemistry of non-aqueous solutions.

BCH-05 ORGANIC CHEMISTRY

After completion of the course, the students would be able:

CO1: To illustrate structure and reaction of alkyl and aryl halides, phenol, carbonyl compounds, carboxylic acids and amines.

CO2: To explain difference between nucleophilic substitution and elimination reactions and to predict kinetics and stereochemical aspects of substitution reactions.

CO3: To explain mechanism of nucleophilic addition reactions and reactivity of carbonyls.

CO4: To explain acidity of carboxylic acids based on various field effects.

CO5: To predict basicity and stereochemistry of amines, to illustrate synthetic transformation of aryl diazonium salts.

BCH-06 PHYSICAL CHEMISTRY

After completion of the course, the students would be able:

CO1: To have a firm foundation of thermodynamics and its applications, explain first and second laws, thermodynamic properties and calculate various thermodynamic functions.

CO2: To discuss the concepts/laws of thermochemistry, heat of reaction and its applications.

CO3: To explain criteria of thermodynamic equilibrium, concept of fugacity, thermodynamic derivation of relations between the various equilibrium constants

CO4: To understand and apply concept of ionic equilibria, salt hydrolysis and buffer solution, phase rule and Nernst distribution law and draw and interpret phase diagram and its application.

CO5: To differentiate between thermal and photochemical processes, explain the laws of photochemistry, low and high quantum yields, photochemical processes and reactions.

B.Sc. (CHEMISTRY) Part – III

BCH-07 INORGANIC CHEMISTRY

After completion of the course, students would be able:

CO1: To understand about limitation of VBT and concept of CFT and its limitations.

CO2: To explain magnetic properties of complexes and interpret spectra of transition metal complexes.

CO3: To understand nomenclature, classification, structure and properties of organometallics.

CO4: To understand trace and essential elements in biological process structure and mechanism of hemoglobin.

CO5: To understand role of hard and soft acids and bases, biopolymers in chemistry and their structure.

BCH-08 ORGANIC CHEMISTRY

After completion of the course, the students would be able:

CO1: To classify heterocyclic compounds and explain its structure, synthesis and reaction mechanisms.

CO2: To discuss the concept, structure, formation of organometallic reagents and synthetic applications of enolates.

CO3: To categorize and name various biomolecules and explain their structures and properties.

CO4: To describe various polymers and polymerization mechanism, classify synthetic dyes and discuss their chemistry.

CO5: To explain basic principles of UV-Visible, IR and Mass spectroscopy, and their applications, the magnetic properties of atomic nucleus and resonance and interpretation of NMR spectra.

BCH-09 PHYSICAL CHEMISTRY

After completion of the course, the students will be able

- CO1:** To explain the fundamentals/concepts/principles/postulates of quantum mechanics, Schrodinger wave equation and its applications.
- CO2:** To compare the basic ideas of Valence Bond Theory and Molecular Orbital Theory and apply LCAO method, coefficients of hybrid orbitals and Huckel MOT and its application
- CO3:** To describe the fundamentals and application of electromagnetic spectrum, microwave, infrared, Raman, electronic spectroscopy.
- CO4:** To discuss the principles and applications in electrochemistry.
- CO5:** To illustrate electrochemical cell and its applications, analyze problems and apply the principles/concepts in finding their solutions.

B.Sc. (CHEMISTRY) LAB COURSE

BCHL-01 CHEMISTRY LAB COURSE - I

After completion of the course, the students would be able:

- CO1:** To understand systematic semi-micro qualitative analysis of common acidic and basic radicals.
- CO2:** To apply the various aspects of titration.
- CO3:** To learn about laboratory glass wares and apparatus and its uses.
- CO4:** To study the effect of acid strength on the hydrolysis of an ester.
- CO5:** To identify of functional groups in organic compounds.

BCHL-02 CHEMISTRY LAB COURSE - II

After completion of the course, the students would be able:

- CO1:** To perform the semi-micro qualitative analysis including interfering radicals and its removal.
- CO2:** To apply the various types of volumetric analysis.
- CO3:** To learn about qualitative analysis of unknown organic compounds.
- CO4:** To study the transition temperature of the given substance, solubility of sparingly soluble substance, the enthalpy of solution of solid, etc .
- CO5:** To understand principle, technique and application of paper chromatography.

BCHL-03 CHEMISTRY LAB COURSE - III

After completion of the course, the students would be able:

- CO1:** To understand the gravimetric analysis.
- CO2:** To apply the various rearrangement reactions in synthesis.
- CO3:** To learn about synthesis of inorganic complexes.
- CO4:** To learn about synthesis of organic compounds.
- CO5:** To understand the application of Lambert-Beer's law, Kohlrausch law, colligative property etc using instruments/apparatus.

UG Programme: Course Outcome (CO)

B.Sc. (INDUSTRIAL CHEMISTRY) Part – I

BIC-01 INDUSTRIAL ASPECTS OF ORGANIC & INORGANIC CHEMISTRY

After completion of the course, the students would be able:

- CO1: To understand about IUPAC nomenclature of organic compounds, petroleum and natural gases.
- CO2: To have a detailed idea about coal - types, properties, distillation and chemicals derived.
- CO3: To know about renewable natural resources.
- CO4: To learn about basics of metallurgical operations and the physico-chemical principles of extraction of important metals.
- CO5: To gain insight into industrial importance of inorganic materials - alumina, silica, zeolites, mica, clay and carbon.

BIC-02 INDUSTRIAL ASPECTS OF PHYSICAL CHEMISTRY, MATERIAL AND ENERGY BALANCE

After completion of the course, the students would be able:

- CO1: To have knowledge of classification, types and properties of colloids
- CO2: To gain insight into surface chemistry - surfactants, detergents, micelles and adsorption
- CO3: To understand about catalysts and catalysis, types, factors affecting, mechanism, phase transfer catalysis and enzyme catalysis.
- CO4: To learn about various dimensions and units used for basic chemical calculations.
- CO5: To understand the concept related to material balance for systems with and without chemical reactions and energy balance.

BIC-03 UNIT OPERATION IN CHEMICAL INDUSTRY AND UTILITIES, FLUID FLOW AND HEAT TRANSPORT IN INDUSTRY

After completion of the course, the students would be able:

- CO1: To have knowledge of instruments, principles of distillation and procedure involved for separation and apply to industrial processes.
- CO2: To gain insight into types of absorbents to be utilized in various types of plants and types of evaporators and its application in various industries
- CO3: To understand about filtration methods, filter media and aids, types of filters, drying procedures and their application in various industries
- CO4: To learn about types of fuels, its advantages and disadvantages and develop ability to characterize the fuels
- CO5: To understand the concept related to fluid flow – types of pumps and its application, types of boilers, its working and importance, working, types of heat exchangers and its application

B.Sc. (INDUSTRIAL CHEMISTRY) Part - II

BIC-04 MATERIAL SCIENCE AND INDUSTRIAL POLLUTION

After completion of the course, the students would be able:

- CO1: To have basic understanding of metals and alloys, cement and ceramics, their properties, applications, manufacturing process and its economic relevance.

- CO2:** To understand about polymeric material and composites, physico-chemical properties and correlations between structure and properties in polymeric materials with wide industrial applications and composite structures.
- CO3:** To learn about glasses with one or more components, formation, crystallization, physico-chemical properties, production and applications.
- CO4:** To acquire basic electrochemical knowledge of corrosion processes, corrosion forms and their repercussions and able to apply corrosion protection measures.
- CO5:** To gain knowledge of the different types of pollution from industries, their effects, environmental regulatory legislations and standards and evaluation methods.

BIC-05 UNIT PROCESS IN ORGANIC SYNTHESIS, EFFLUENT TREATMENT AND WASTE MANAGEMENT

After completion of the course, the students would be able:

- CO1:** To understand about unit processes in organic chemicals manufacture involving nitration, nitrating agents, kinetics and mechanism of nitration processes.
- CO2:** To gain knowledge about halogenation, kinetics, reagents for halogenation, commercial manufacture of chloro-compounds.
- CO3:** To understand about sulphonation, sulphonating agents, chemical and physical factors, kinetics and mechanism of sulphonation reaction, commercial sulphonation.
- CO4:** To acquaint with principles and equipments for effluent treatment and wastemanagement.
- CO5:** To know about filters, precipitators, eliminators, scrubbers, absorbers, solid waste management and industrialsafety.

BIC-06 ORGANIC REACTION MECHANISM AND INDUSTRIAL INSTRUMENTATION

After completion of the course, the students would be able:

- CO1:** To understand about oxidation reaction, oxidising agents, commercial manufacture of important organic compound by oxidation.
- CO2:** To gain knowledge about hydrogenation reaction, catalysts for hydrogenation, manufacture of organic compounds.
- CO3:** To understand about esterification and amination reaction and amination by reduction and aminolysis.
- CO4:** To understand concept of construction, principle and working of temperature and pressure measuring instruments.
- CO5:** To know about liquid level measurement, density and viscosity measurement.

B.Sc. (INDUSTRIAL CHEMISTRY) Part – III

BIC-07 CHEMICAL PROCESS AND INDUSTRIAL ECONOMICS

After completion of the course, the students would be able:

- CO1:** To gain knowledge of the process of estimating the costs associated with completing a project within scope and according to its timeline.
- CO2:** To understand about various resources for fixed assets and land and gain knowledge regarding start-up.
- CO3:** To determining the real value of assets and fixing right price for products and calculate profit.
- CO4:** To learn about management skills and become efficient managers.
- CO5:** To deal with controlling and regulating the flow of material in relation to changes in variables like demand, prices, availability, quality, delivery schedules etc.

BIC-08 PHARMACEUTICALS

After completion of the course, the students would be able:

- CO1:** To correlate and compare historical background/development of Indian and other important pharmacopoeias and understand formulations/routes of administration/aseptic conditions/sterilization and need for sterilization in pharmaceuticals.
- CO2:** To describe the manufacture and quality specifications of pharmaceutical excipients/additives and applications of sutures, ligatures in surgical dressing.
- CO3:** To acquaint with the packaging/ancillary materials, machinery and important legal aspects of food and drugs industry, pharmaceutical quality control, etc.
- CO4:** To understand fundamentals and applications of crystallization, distillation, extraction techniques and various chromatographic techniques like paper HPLC, GLC, TLC, column and ion chromatography for evaluation/identification of crude drugs.
- CO5:** To describe the principle and applications of UV-Visible, IR, AAS, NMR spectroscopy, Flame photometry, X-Ray Fluorescence and Ion Selective Electrodes in pharmaceuticals.

BIC-09 DRUGS

After completion of the course, the students would be able:

- CO1:** To learn classification of crude drugs and manufacture of sulpha drugs.
- CO2:** To have knowledge of chemical constitution of plants and isolation procedures for active ingredients for alkaloids.
- CO3:** To get an introductory idea of Antimicrobial, Analgesic Barbiturates Blockers and Cardiovascular drugs, antibiotics, etc.
- CO4:** To understand the structure, function, deficiency disease caused by steroidal hormones and vitamins.
- CO5:** To know about fermentation process and product processing.

B.Sc. (INDUSTRIAL CHEMISTRY) LAB COURSE

BICL-01: INDUSTRIAL CHEMISTRY (LAB COURSE- I)

After completion of the course, the students would be able:

- CO1:** To have practical knowledge of simple laboratory techniques like crystallization, distillation, etc.
- CO2:** To learn preparation of standard solutions
- CO3:** To understand about various analysis procedures and their application to ores.
- CO4:** To determine various physical constants like optical rotation, surface tension, viscosity, refractive index, calibration of thermometers.
- CO5:** To understand application of various chromatographic techniques like column, TLC, etc.

BICL-02: INDUSTRIAL CHEMISTRY (LAB COURSE- II)

After completion of the course, the students would be able:

- CO1:** To have knowledge of various unit processes involving organic reaction mechanisms in industries.
- CO2:** To learn handling of various instruments and its application in analysis.
- CO3:** To analyze various parameters of water samples as per industrial specification.
- CO4:** To determine flash point and ignition points of liquids.
- CO5:** To learn about flow measuring devices and limit tests of heavy metals.

BICL-03: INDUSTRIAL CHEMISTRY (LAB COURSE- III)

After completion of the course, the students would be able:

- CO1: To synthesize common industrial compounds involving two step reactions.
- CO2: To analyze common raw materials of industrial importance.
- CO3: To get an introductory idea of analysis of active ingredients in various formulations.
- CO4: To learn about methods of evaluation of various parameters of crude drugs.
- CO5: To know about techniques of identification and testing of drugs.

UG Programme: Course Outcome (CO)

B.Sc. (with BIOCHEMISTRY) Part - I

BBC-01 BIOMOLECULES

After completion of the course, the students would be able:

- CO1: To compare and explain the structure, occurrence and function of the carbohydrates
- CO2: To recognize the structure of an amino acid, summarize the function of proteins and explain protein denaturation and the effect of heat on protein structure and function.
- CO3: To identify their chemical elements, compare saturated, mono-unsaturated, and poly-unsaturated fatty acids, explain the importance of poly-unsaturated fatty, list sources of polyunsaturated fatty acids.
- CO4: To describe the components of a nucleotide, function of DNA and differentiate DNA and RNA.
- CO5: To classify porphyrins, explain detection methods, chemical nature and physiological significance of bile pigments

BBC-02: BIOPHYSICAL AND BIOCHEMICAL TECHNIQUES

After completion of the course, the students would be able:

- CO1: To explain the principles of thermodynamics and their applications in biochemistry
- CO2: To determine of molecular weight by hydrodynamic methods and explain the method for pH measurement
- CO3: To discuss types of radioisotopes, biological applications, biological hazards and safety measures
- CO4: To discuss the theory, types of various chromatography, electrophoresis and their applications
- CO5: To elaborate the principles and applications of Spectroscopic and immunological techniques

BBC-03: ENZYMOLOGY

After completion of the course, the students would be able:

- CO1: To acquire fundamental knowledge on enzymes and their importance in biological reactions.
- CO2: To understand ability to difference between a chemical catalyst and biocatalyst.
- CO3: To understand the concept of activation energy and its importance in biological reactions.
- CO4: To understand the nature of non-protein enzymes such as ribozymes.
- CO5: To understand the role of enzymes in clinical diagnosis and industries. Biochemistry Core .

BBC-04: INTERMEDIARY METABOLISM

After completion of the course, the students would be able:

- CO1: To list the general features of metabolism, explain the experimental approaches and discuss carbohydrate metabolism

- CO2:** To understand the importance of high energy compounds, electron transport chain, synthesis of ATP under aerobic and anaerobic conditions.
- CO3:** To acquire knowledge related to lipid metabolism and describe their biosynthesis
- CO4:** To explain general reactions of amino acid metabolism, biosynthesis and their degradation
- CO5:** To discuss sources of the atoms, biosynthesis and degradation of purines, pyrimidines and porphyrins, production of bile pigments.

BBC-05: MOLECULAR BIOLOGY

After completion of the course, the students would be able:

- CO1:** To understand primary, secondary and tertiary structure of DNA and RNA.
- CO2:** To differentiate and explain replication, transcription, and translation and their mechanisms.
- CO3:** To understand coding and non-coding regions of eukaryotic genome and their importance.
- CO4:** To understand importance of E. coli lac operon, PCR, expression vectors and their importance.
- CO5:** To explain different types of mutations their causes and types, recombinant DNA technology.

BBC-06: NUTRITIONAL, CLINICAL & ENVIRONMENTAL BIOCHEMISTRY

After completion of the course, the students would be able:

- CO1:** To understand normal constituents of urine, blood and significance in maintaining good health.
- CO2:** To understand the mechanisms of causation of diseases of liver and kidney.
- CO3:** To understand the current concepts related to mechanism of Cancer.
- CO4:** To understand the variations in the levels of triglycerides and lipoproteins and their relationship with various diseases.
- CO5:** To get acquainted with the role of enzymes in diagnosis of various diseases.

B.Sc. (BIOCHEMISTRY) LAB COURSE

BBCL-01: BIOCHEMISTRY (LAB COURSE- I)

After completion of the course, the students would be able:

- CO1:** To have practical knowledge of buffers and determination of pH
- CO2:** To learn preparation of standard solutions
- CO3:** To understand Beer-Lambert's law.
- CO4:** To know how to estimate DNA and RNA.
- CO5:** To learn about separation of sugars using paper chromatography.

BBCL-03: BIOCHEMISTRY (LAB COURSE- II)

After completion of the course, the students would be able:

- CO1:** To learn estimation of protein from serum by biuret and Lowry methods.
- CO2:** To learn enzyme assay.
- CO3:** To understand A/G ratio in serum.
- CO4:** To know how to estimate blood urea nitrogen from plasma.
- CO5:** To learn about separation of polar and non-polar lipids by thin layer chromatography.

BBCL-03: BIOCHEMISTRY (LAB COURSE- III)

After completion of the course, the students would be able:

- CO1:** To learn estimation of DNA by diphenylamine method .
- CO2:** To learn denaturation of enzyme.
- CO3:** To understand Orcinol method .
- CO4:** To know how to estimate DNA by diphenylamine method .
- CO5:** To learn about separation of proteins by SDS- polyacrylamide gel electrophoresis.

PG Programme: Course Outcome (CO)

M.Sc. (CHEMISTRY) SEMESTER- I

MCH-101: COORDINATION CHEMISTRY

After completion of the course, students would be able:

- CO1:** To understand Walsh diagram, bent rule, energetics of hybridization and MOT.
- CO2:** To know structure of carbonyls, nitrosyls, dinitrogen and dioxygen complexes.
- CO3:** To understand energy profile of a reaction and determination of stability constant of transition metal complexes.
- CO4:** To know mechanism and kinetics of substitution and electron transfer reaction in complexes.

MCH-102: ORGANIC REACTION MECHANISM

After completion of the course, the students would be able:

- CO1:** To understand the basic concepts and explain the mechanism and stereochemical aspects of elimination reactions.
- CO2:** To understand the mechanism and stereochemistry of nucleophilic substitution reactions.
- CO3:** To acquire the knowledge of mechanism of electrophilic substitution in aliphatic as well as aromatic compounds.
- CO4:** To understand the mechanistic and stereochemical concepts of addition reactions.

MCH-103: MATHEMATICS FOR CHEMISTS, QUANTUM CHEMISTRY AND CHEMICAL DYNAMICS

After completion of the course, the students would be able:

- CO1:** To have basic knowledge of mathematics – vector, matrix algebra, probability, calculus and its application in chemistry which adds value to the program.
- CO2:** To understand the basic postulates of quantum mechanics and solve Schrodinger wave equation for quantum mechanical models variation theorem, perturbation theory and Huckel MO theory and its application.
- CO3:** To discuss the quantum mechanical aspect of angular momentum and spin, Russell-Saunders terms and coupling schemes, atomic states, atomic terms and evaluate term symbols.
- CO4:** To describe different theories of reaction rates, fast reactions and its methods, kinetics and mechanism of photochemical and unimolecular reactions.

MCH-104: GROUP THEORY AND COMPUTERS FOR CHEMISTS

After completion of the course, students would be able:

- CO1:** To understand symmetry properties of compounds, character tables and their uses in spectroscopy.
- CO2:** To know principles involved in interaction of electromagnetic radiation with matter.
- CO3:** To understand basic structure of computers, memory and operating systems and 'C' language.
- CO4:** To learn development of small computer codes involving simple formula in chemistry.

M.Sc. (CHEMISTRY) SEMESTER– II

MCH-201: TRANSITION METAL COMPLEXES AND DIFFRACTION METHODS

After completion of the course, students would be able:

- CO1:** To understand how to interpret electronic spectra of complexes.
- CO2:** To know magnetic properties of complexes of different geometry.
- CO3:** To understand principle of electron diffraction and x-ray diffraction and their uses in structure determination of compounds.
- CO4:** To understand neutron diffraction technique, metal cluster and metal polyacids.

MCH-202: CONCEPTS IN ORGANIC CHEMISTRY

After completion of the course, the students would be able:

- CO1:** Recognize and distinguish between aromatic and antiaromatic compounds by their structures.
- CO2:** Explain different free radicals and mechanisms of different rearrangements via free radicals.
- CO3:** Learn the terminology associated with conformational analysis and stereochemistry of various compounds
- CO4:** Know the basic concept of different types of pericyclic reactions and rules governing them.

MCH-203: THERMODYNAMICS, ELECTROCHEMISTRY AND SURFACE CHEMISTRY

After completion of the course, the students would be able:

- CO1:** To have knowledge and understanding of basic concepts in classical thermodynamics – partial molar properties, fugacity, activity and activity coefficient, construct and apply phase diagrams to 3-component systems.
- CO2:** To illustrate the concepts in statistical thermodynamics – distribution, thermodynamic probability, partition function and its application and to compare various statistics. fundamental concepts of irreversible thermodynamics and discuss the application of its laws.
- CO3:** To explain and derive equations related to the theory of strong electrolytes – Debye-Huckel law and its extensions, structure/models and thermodynamics of electrified interfaces, polarography and its applications.
- CO4:** To describe and interpret various adsorption isotherms and its applications, concept and various aspects of micelles and macromolecules.

MCH-204: SPECTROSCOPY

After completion of the course, students would be able:

- CO1:** To gain insight into the basic principle of molecular spectra and discuss rigid rotor, energy levels, origin of rotational spectra and its applications.
- CO2:** To understand the theories/principles, predict the functional groups and differentiate between IR and Raman spectra
- CO3:** To acquire knowledge of principle, technique, interpretation and applications of NMR spectroscopy.
- CO4:** To interpret the principle and applications of photo electron, photo acoustic and ESR spectroscopy.

M.Sc. (CHEMISTRY) SEMESTER – III

MCH-301: APPLICATIONS OF SPECTROSCOPY

After completion of the course, students would be able:

- CO1:** To gain detailed insight into the instrumentation and apply IR spectroscopy, explain ORD and CD, deduction of absolute configuration and octant rule for ketones.
- CO2:** To get to know in detail about the various effects, mechanism, correlations and advanced techniques related to proton and C-13 NMR spectroscopy and apply in structure determination.
- CO3:** To describe applications of ESR and Mossbauer spectroscopy in the study of bonding and structure.
- CO4:** To acquaint with the principle and interpret Mass spectra to elucidate structure of molecule on the basis of various spectral spectroscopic data.

MCH-302: BIO-ORGANIC CHEMISTRY

After completion of the course, students would be able:

- CO1:** The basic properties of enzymes, components of metabolic pathway and kinetics of enzyme action.
- CO2:** Mechanisms of enzyme action and different kinds of enzyme catalyzed reactions.
- CO3:** Different models of enzymes and co-enzymes, their structures and biological functions.
- CO4:** Biotechnological applications of enzymes and constituents of biological cell.

MCH-303: ENVIRONMENTAL CHEMISTRY

After completion of the course, the students would be able:

- CO1:** To gain an insight into the various aspects of environment, biodistribution of elements, hydrological cycle, biogeochemical cycles and industrial pollutants.
- CO2:** To know about chemical composition of various types of water bodies, water standards, soil - micro and macro nutrients, sources of pollution, waste treatment and biodegradability.
- CO3:** To learn about major regions, chemical composition of atmosphere and chemistry of air pollution and to understand the techniques of sampling, measuring and monitoring air pollutants.

CO4: To acquaint with the principle, sampling methods and procedure of analysis of water and soil parameters, public health significance of heavy metals and the general instrumental techniques.

M.Sc. (CHEMISTRY) SEMESTER – IV

MCH-401: SOLID STATE AND PHOTOCHEMISTRY

After completion of the course, the students would be able:

CO1: Understand the origin and nature of defects and crystals, electrically conducting solids and superconductors.

CO2: Apply the concept of band theory to explain the behavior of conductors.

CO3: Understand the important aspects of photochemistry, photochemical reactions of carbonyl compounds and aromatic compounds.

CO4: Identify the mechanism of rearrangement of different photo-cyclization reactions.

MCH-402: BIOPHYSICAL CHEMISTRY

After completion of the course, the students would be able:

CO1: To explain structure and function of cell membrane, ion transport, essential and trace metals, role of metal ions in biological processes, transport and storage

CO2: To describe structure and function of metalloproteins in electron transport processes and various nitrogenases model systems.

CO3: To elaborate DNA polymerization, metal complexes in transmission of energy, discuss bioenergetics of biochemical reactions, hydrolysis of ATP and synthesis of ATP from ADP.

CO4: To calculate average dimensions, explain chain configuration, protein folding problem, forces of biopolymer interaction, thermodynamics of biopolymer solutions and energy generation.

MCH-403: ANALYTICAL CHEMISTRY

After completion of the course, the students would be able:

CO1: To have basic idea of role of analytical chemistry, sampling methods, techniques and safety measures, define and calculate various statistical parameters and types of errors.

CO2: To explain into composition of blood and techniques for the analysis of body fluids, classify drugs and describe the screening methods.

CO3: To describe analysis of various contents in food, adulterants and contaminants in food.

CO4: To compare types of fuels, discuss analysis of various parameters, calorific value, explain applications of tracer techniques.

ELECTIVE COURSES

SEMESTER – III

MCH-304(A): BIOINORGANIC & SUPRAMOLECULAR CHEMISTRY

After completion of the course, students would be able:

CO1: To understand role of iron and calcium in biological system, their storage, transport and regulation.

CO2: To describe role and importance of metalloenzyme in biological system and uses of metals in medicine.

CO3: To understand molecular recognition of supramolecular compounds.

CO4: To explain transport processes and carrier design of supramolecular compounds, and supramolecular devices.

MCH-304(B): NATURAL PRODUCTS

After completion of the course, students would be able:

CO1: To classify and explain the isolation, stereochemistry, synthesis of terpenoids and carotenoids

CO2: To explain structure, chemistry and significance of alkaloids

CO3: To describe structure and biosynthesis of steroids and hormones.

CO4: To discuss chemistry of plant pigments and porphyrins, their structures and synthesis.

MCH-304(C): POLYMER AND NANOCHEMISTRY

After completion of the course, the students would be able:

CO1: To define basic concepts of polymers, explain polymerization conditions and reactions, polymer properties, its characterization techniques

CO2: To discuss the kinetics/statistics/mechanism of polymerization and derive rate laws, and illustrate techniques of polymer processing.

CO3: To compare bulk and nanomaterials, explain the role of size, shape, properties and uses of nanomaterials, describe various methods for synthesis of nanoparticles

CO4: To describe the instrumentation/principle of various characterization techniques like EDAX, FTIR, SEM, TEM, etc and its application.

MCH-304(D): NANOMATERIALS AND NANOTECHNOLOGY

After completion of the course, the students would be able:

CO1: To explain of basic concepts in nanotechnology, nanoscale, nano-dimension and properties.

CO2: To explain the preparation, characteristics and uses of nanomaterials

CO3: To understand and describe instrumentation/principle of various characterization techniques like DLS, FTIR, SEM, TEM, AFM etc and its application.

CO4: To discuss the various applications of nanomaterials especially in the field of biology.

ELECTIVE COURSES

SEMESTER – IV

MCH-404(A): ORGANOTRANSITION METAL CHEMISTRY

After completion of the course, students would be able:

CO1: To learn alkyls and aryls of transition metals, fluxionality in compounds.

CO2: To know synthesis, nature of bonding and reaction of alkylidenes & alkylidynes.

CO3: To learn preparation properties, nature of bonding and reactions of transition metal π -complexes.

CO4: To understand homogenous catalysis, bonding of hydrogen with transition metals.

MCH-404(B): MEDICINAL CHEMISTRY

After completion of the course, the students would be able:

- CO1:** To classify drugs, explain drug design and important pharmacokinetic parameters.
- CO2:** To get an insight into psychoactive drugs, their synthesis and chemotherapy of mental diseases.
- CO3:** To discuss synthesis and properties of local anti-infective, cardiovascular, anti-malarial drugs.
- CO4:** To understand and explain biosynthesis/synthesis, structure and applications of antibiotics, types of cancers and chemistry of anti-neoplastic drugs.

MCH-404(C): CHEMICAL KINETICS AND NUCLEAR CHEMISTRY

After completion of the course, the students would be able

- CO1:** To understand types/kinetics of composite reactions and elucidate mechanism and derive rate laws, calculate various activation parameters and predict feasibility of reaction of its basis.
- CO2:** To explain the concept of acidity functions and illustrate the various rate correlations, isotopic effect and solvent effect.
- CO3:** To discuss various aspects of nuclear models, nuclear reactions and nuclear reactors.
- CO4:** To understand the principles of radioactivity, its measurements, counters, apply in determining reaction mechanism, structures, physicochemical properties and in chemical analysis.

MCH-404(D): ORGANIC SYNTHESIS

After completion of the course, the students would be able

- CO1:** To understand and apply basic principles with mechanism of synthesis of organometallic compounds using various classes of metals along with their properties.
- CO2:** To explain the synthesis of some non-benzenoid and polycyclic compounds.
- CO3:** To apply various processes like oxidation, reduction in organic synthesis.
- CO4:** To discuss types of rearrangement and apply them in organic synthesis.

M.Sc. (CHEMISTRY) LABORATORY COURSES

SEMESTER – I

MCHL-01: LABORATORY COURSE I - INORGANIC CHEMISTRY

After completion of the course, students would be able:

- CO1:** To understand the basic principles involved in separation and estimation of acidic and basic radicals.
- CO2:** To apply the knowledge in real sample analysis for qualitative and quantitative estimations.
- CO3:** To get 'Hands on Training' and develop skill for synthesis of various inorganic compounds.
- CO4:** To identify and characterize prepared compounds by spectral analysis.

MCHL-02: LABORATORY COURSE II - PHYSICAL CHEMISTRY

After completion of the course, students would be able:

- CO1:** To understand basic concepts in Physical Chemistry through experiential learning.
- CO2:** To acquaint with the basic principles of equipment/instruments and its applications.
- CO3:** To develop observation skill and analytical skill through diverse practicals.
- CO4:** To develop teamwork spirit, scientific temper and logical thinking.

SEMESTER – II

MCHL-03: LABORATORY COURSE I - ORGANIC CHEMISTRY

After completion of the course, students would be able:

- CO1:** To understand the basic principles involved in separation of organic binary mixture and identify the components by qualitative analysis.
- CO2:** To get trained in one step/two-step synthesis of commercially important organic compounds based on different chemical processes.
- CO3:** To learn about separation and purification of organic mixtures by chromatography
- CO4:** To identify and characterize prepared and separated compounds by spectral analysis.

MCHL-04: LABORATORY COURSE II - ANALYTICAL CHEMISTRY

After completion of the course, students would be able:

- CO1:** To apply the concepts of statistics to laboratory data and its analysis.
- CO2:** To analyse parameters of oil and water samples using volumetric analysis.
- CO3:** To learn about separation of cations and anions by chromatography.
- CO4:** To handle instruments like spectrophotometry, nephelometry and apply it for various analysis, application of computer programs and softwares in Chemistry.

SEMESTER – III

MCHL-05: LABORATORY COURSE I - GENERAL PRACTICAL

After completion of the course, the students would be able:

- CO1:** To analyze inorganic elements in ore and minerals.
- CO2:** To apply the principle of flame photometer/polarography/gravimetry in quantitative analysis.
- CO3:** To estimate elements in organic compounds quantitatively using various methods.
- CO4:** To apply various concepts of Physical Chemistry and use instruments in studying various application.

SEMESTER – IV

PROJECT BASED

MCHL-07: LABORATORY COURSE I - PROJECT WORK

After completion of the course, the students would be able:

- CO1:** To understand to survey literature and write review.
- CO2:** To design small reaction schemes/materials.
- CO3:** To prepare Project report, learn manuscript writing and get an idea of writing thesis.
- CO4:** To learn analysis, interpretation of data and validation of the results obtained.

ELECTIVE LAB COURSES

SEMESTER – III

MCHL-06 (A): LABORATORY COURSE II-ELECTIVE A

After completion of the course, the students would be able:

CO1: To quantitatively separate inorganic ions in three component systems.

CO2: To estimate quantitatively the constituent cations using volumetric and gravimetric analysis.

CO3: To prepare selected inorganic compounds.

CO4: To interpret the characteristics using various techniques like IR, electronic spectra, etc.

MCHL-06 (B): LABORATORY COURSE II- ELECTIVE B

After completion of the course, the students would be able:

CO1: To understand various isolation methods and its applications.

CO2: To isolate and purification of various organic compounds from natural sources.

CO3: To estimate organic compounds using UV/Visible spectroscopic method.

CO4: To test various typical colour reactions and chromatographic techniques.

MCHL-06 (C): LABORATORY COURSE II- ELECTIVE C

After completion of the course, students would be able:

CO1: To understand basic concepts of kinetics and its various methods of study.

CO2: To acquaint with the various methods of determination of order of reaction.

CO3: To understand the influence of various physical parameters on rate of reaction.

CO4: To synthesize nanoparticles and interpret its characteristics.

SEMESTER – IV

MCHL-08 (A): LABORATORY COURSE II- ELECTIVE A

After completion of the course, the students would be able:

CO1: To quantitatively analysis of metals in alloy, ore and mineral samples.

CO2: To understand the kinetics and mechanism of inorganic reactions.

CO3: To extract, separate inorganic biomolecules and interpret using electronic spectra.

CO4: To acquaint with complex preparations and theoretical study of its structure and identification using spectral analysis.

MCHL-08 (B): LABORATORY COURSE II- ELECTIVE B

After completion of the course, the students would be able:

CO1: To understand the mechanism of multi-step synthesis of organic compound.

CO2: To learn about bromination and nitration of organic compounds through experiential learning.

CO3: To estimate organic constituents using spectral analysis.

CO4: To understand role of enzymes in synthesis of compounds.

MCHL-08 (C): LABORATORY COURSE II- ELECTIVE C

After completion of the course, students would be able:

CO1: To determine the order of reaction with respect to various reactants and overall order.

CO2: To study the effect of solvent, surfactant and substituent on rate of reaction.

CO3: To calculate ionic strength and study its influence on rate of reaction.

CO4: To calculate activation parameters using experimental data.

Doctoral Program - Course Outcomes (CO)

Ph.D. (CHEMISTRY)

Pre-Ph.D. Course Work

Upon completion of pre-Ph.D. Course work, the candidates would be able

Course -I

CO1: To learn the various aspects of research methodology viz conceptualization, designing, surveys, sampling, IPR, patent, etc.

CO2: To know about literature search techniques, use of computer browsing, chemical abstracts, journals impact factor, citation index.

CO3: To understand the principle, instrumentation and application of various advanced instrumental techniques and classical methods of analysis.

CO4: To get acquainted with different sampling and modelling techniques for monitoring and analysis of various environmental samples.

CO5: To apply various statistical parameters to validate the results.

Course -II

CO1: To develop skill to comprehend and analyze the previous works done in the field, organize the inference drawn and formulate and design project on the basis of the review outcome.

CO2: To express and present the review outcomes effectively through oral presentation.

CO3: To develop scientific temper/research aptitude, logical thinking, observative skills and induce innovation ecosystem.

VALUE ADDED COURSE – 1 (Effective from 2020-21)

VCH-01: CHEMISTRY OF FOOD, NUTRITION AND PRESERVATION

Upon successful completion of the course, students are expected to be able:

CO1: To have knowledge about the basics of foodscience and its significance

CO2: To gain insight of nutrition and its importance

CO3: To learn about the food preservation and its utility

CO4: To know about food contaminants, additives, food standards and food laws

CO5: To imbibe the practical skills of food preservation, food processing and quantitative estimation

VALUE ADDED COURSE – 2 (Effective from 2021-22)

VCH-02: INTRODUCTION TO PYTHON

Upon successful completion of the course, students are expected to be able:

CO1: To have knowledge about the basics of computing and coding

CO2: To have knowledge about Python and its syntax

CO3: To define functions and write equations in Python

CO4: To gain insights into modules like matplotlib, numpy that are useful for computational problems and graphical presentation

CO5: To reinforce these practices and knowledge through practical assignments

VALUE ADDED COURSE – 3 (Effective from 2018-19)

VCH – 03: LAB TECHNIQUES IN CHEMICAL ANALYSIS

Upon successful completion of the course, students are expected to be able:

CO1: To have awareness of safety measures in lab and professional ethics

CO2: To have knowledge about the basics of chemical analysis and its application

CO3: To learn about preparation of standard solutions and standardization

CO4: To gain insight into the principle of qualitative and quantitative analysis

CO5: To know about the various commonly used instruments and its operation

CO6: To instill the practical skills and entrepreneurship attitude

CERTIFICATE COURSE

CSWA: CERTIFICATE COURSE IN SOIL AND WATER ANALYSIS

PROGRAM OUTCOME

- To have awareness for judicious use of fertilizers.
- To understand proper use of organic manure.
- To perform analysis of quality of water for drinking and agriculture.
- To know about status of available water from sources like well, bore-wells and dams with particular stress on quality of water of various parts of Chhattisgarh.
- To know effect of quality of water on human beings, live-stock and agriculture.
- To have awareness on judicious use of drinking water.

PROGRAM SPECIFIC OUTCOME

- To inculcate scientific temperament to take up farming with scientific approach.
- To have awareness to take agriculture as industry by applying scientific measures.
- To identify water quality of different water resources using different analytical methods.

- To improve quality of water by using suitable purification techniques.
- To get a broad, in-depth overview of important relationship between water quality and human health.
- To understand the impact of water and water related issues in an environmental and societal context.

COURSE OUTCOMES

After completion of the course, students will be able:

CO1: To use the techniques and skills necessary for water resource management.

CO2: To apply knowledge of Chemistry and Geology.

CO3: To have knowledge of contemporary issues.

CO4: To identify, formulate and solve environmental problems.

CO5: To recognize the need for, and an ability to engage in life-long learning.




Principal
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