

DESHABANDHU MAHAVIDYALAYA, CHITTARANJAN

Department of Chemistry

Program Specific Outcome (PSO) and Course Outcome (CO)

Program Specific Outcome (PSO)

The Program enables the students to

PSO1: Demonstrate, solve and develop an understanding of major concepts in all branches of chemistry like organic, inorganic, physical, environmental, industrial, solid state, pharmaceutical, fuel, nanomaterial and green chemistry.

PSO2: Gain theoretical as well as practical knowledge of handling chemicals.

PSO3: Get practical knowledge about qualitative and quantitative analysis of chemicals in laboratories and to acquire the ability to synthesize, separate and characterize compounds using laboratory and instrumentation techniques.

PSO4: Solve the problem and also think methodically, independently and draw a logical conclusion.

PSO5: Understand the causes of environmental pollution and can open up new methods for environmental pollution control.

PSO6: Understand the concept of chemistry to inter relate and interact to the other subject like mathematics, physics, biological science etc.

PSO7: Create an awareness of the impact of chemistry on the environment, society, and development outside the scientific community.

PSO8: Familiar with various opportunities related to chemistry available in the government services through public service commission particularly in the field of food safety, health inspector, pharmacist etc.

Course Outcome (CO)

Course Name	Course Content	Course Outcome(CO)
Semester I (NEP)		
General Chemistry-I (Major and Minor)	Unit-I Atomic structure	Students will learn about CO1: Evolution of atomic theory CO2: Quantum mechanical concept of atoms and concept of wave function CO3: Conceptual and mathematical tools to express and predict atomic and molecular behavior.
	Unit-II Periodic table	CO4: Physical and chemical characteristics of elements in various groups and periods according to ionic size, charge, etc. and position in periodic table CO5: Elements in periodic table; physical and chemical characteristics, periodicity
	Unit-III Chemical bonding	CO6: Various aspects of chemical bonding in ionic and covalent compounds and associated theories thereof CO7: Explaining shapes of molecules in the light of VSEPR theory CO8: Drawing MO diagram of homo-nuclear and hetero-nuclear molecules CO9: Importance of metallic bonding
	Unit-IV: Basics of organic chemistry	CO10: Basics of organic molecules, structure, bonding, reactivity and reaction mechanisms CO11: Mechanism of organic reactions (effect of nucleophile/ leaving group, solvent), substitution vs. elimination CO12: Stereochemistry of organic molecules- conformation and configuration, asymmetric molecules and nomenclature
	Organic Chemistry Practical	CO13: Students acquire practical knowledge on qualitative analysis of organic compounds in reference to detection of special elements and functional groups
Industrial Chemistry (SEC paper) [For major students only]	Unit I Paints	CO14: Chemistry of paints, varnishes and dyes
	Unit II Electrochemical and electro-thermal industries	CO15: Preparation and uses of various compounds like KMnO_4 , CaC_2 and alloy steels
	Unit III Ceramics	CO16: Chemistry of ceramics in reference to refractories, pottery, porcelain, glass and fibre glass
	Unit IV Rusting of iron and steel	CO17: Concepts of corrosion: cause and prevention
	Unit V Industrial safety and fire protection	CO18: Various fire-extinguishers and their composition

Semester II (NEP)		
General Chemistry- II (Major and Minor)	Unit I Acid-base and ionic equilibrium	Students will learn about CO1: Different concepts of acids and bases, HSAB principle and its application in chemistry CO2: Different types of electrolytes and their degree of ionization, Ostwald's dilution law, buffer solution and buffer capacity, salt hydrolysis, indicators, Henderson equation and Hammett acidity function,
	Unit II Redox potential and redox equilibria	CO3: Basic concepts of redox potential and redox equilibria, redox titrimetric analysis
	Unit III Chemical Kinetics	CO4: Basics of chemical kinetics: determination of order, molecularity, theories of reaction rates, determination of rate of opposing/parallel/chain reactions with suitable examples CO5: Application of steady state kinetics, steady-state approximation
	Unit IV Properties of fluids	CO6: Physical properties and related laws of gas and liquid states CO7: Kinetic model of gas and its properties CO8: Maxwell distribution, mean free path and kinetic energies CO9: Behaviour of real gases, its deviation from ideal behaviour, equation of state, isotherm, and law of corresponding states. CO10: Liquid state and its physical properties related to temperature and pressure variation. CO11: Properties of liquid as solvent for various household and commercial use
	Inorganic chemistry and physical chemistry practical	CO12: Titrimetric estimation: acid-base titration, permanganometry, dichromatometry and complexometric titrations CO13: Surface tension and viscosity coefficient determination of a liquid
Pharmaceutical Chemistry (SEC paper) [For major students only]	Unit 1 Drugs and pharmaceuticals	CO14: Different drug design and discoveries CO15: Different classes of drugs and their examples CO16: Aerobic and anaerobic fermentation chemistry CO17: Production of various drug related components
	Unit II Fermentation	CO18: Aerobic and anaerobic fermentation. Production of (a) Ethyl alcohol and citric acid, (b) Antibiotics; Penicillin, Cephalosporin, Chloromycetin and Streptomycin (c) Lysine, Glutamic acid, Vitamin B2, Vitamin B12 and Vitamin C

Semester III (NEP)		
Inorganic chemistry-I (Major)	Unit 1 Coordination chemistry	Students will learn about CO1: Concept of ligands, nomenclature and applications of coordination compounds CO2: Valence bond theory and its applications and drawbacks CO3: Different types of isomerism in coordination chemistry CO4: Chelate effect, macrocyclic effect and their relation with the stability of the complex
	Unit II Chemistry of s and p block elements	CO5: Chemistry, reactivity and different properties of s and p block elements
	Unit III Chemistry of d block elements	CO6: d block chemistry including 1 st , 2 nd and 3 rd row transition elements on their various oxidation state, magnetic properties, complex formation etc.
	Inorganic chemistry practical	CO7: Hands on experience on the identifications of various acid and basic radicals and qualitative analysis of radicals from a mixture
Physical chemistry-I (Major)	Unit I Mathematics in physical chemistry	CO8: Different mathematical functions CO9: Mathematical probability and correlations CO10: Concepts of sampling and analysis of data
	Unit II Thermodynamics-I	CO11: First Law of thermodynamics and concepts CO12: The concept of system, variables, heat, work, and their relations CO13: Concept of heat of reactions and use of equations in calculations of bond energy, enthalpy, etc
	Unit III Properties of solids	CO14: Solids, lattice parameters and its calculation, application of symmetry, solid characteristics of simple salts
	Unit IV Electrochemistry	CO15: Basic principle of laws of electrochemistry CO16: Concept of ion atmosphere CO17: Application of conductance measurement.
	Physical chemistry practical	CO18: Acid base titration, kinetic study, conductometric titrations
Inorganic and organic chemistry (Minor)	Unit I Nuclear chemistry	CO19: Scientific theory of atoms CO20: Atomic theory of matter, composition of atom CO21: Identity of given element, relative size, charges of proton, neutron and electrons, and their assembly to form different atoms CO22: Defining isotopes, isobar and isotone
	Unit II Coordination chemistry	CO23: Concept of ligands, nomenclature and applications of coordination compounds CO24: Valence bond theory and its applications and drawbacks CO25: Different types of isomerism in coordination chemistry CO26: Chelate effect, macrocyclic effect and

		their relation with the stability of the complex
	Unit III Stereochemistry II	CO27: Reactivity, stability of organic molecules, structure, stereochemistry CO28: Stereochemistry of organic molecules – conformation and configuration, asymmetric molecules and nomenclature
	Unit IV Carbohydrate chemistry	CO29: Understandings of Carbohydrates, classification, structure and configuration
	Inorganic chemistry practical	CO30: Hands on experience on the identifications of various acid and basic radicals and qualitative analysis of radicals from a mixture
Semester IV (NEP)		
Organic chemistry-I (Major)	Unit I Reaction mechanism II	Students will learn about CO1: Thermodynamic criteria for reactivity, stability of organic molecules, structure, stereochemistry CO2: Reaction mechanism of substitution, elimination and addition reaction CO3: Mechanism of organic reactions (effect of nucleophile/leaving group, solvent), substitution vs. elimination CO4: Electrophile, nucleophiles, free radicals, electronegativity, resonance, and intermediates along the reaction pathways
	Unit II Stereochemistry II	CO5: Stereochemistry and concept of different types of isomerism CO6: Optical purity and enantiomeric excess, concept of prostereogenic centre with descriptor, Conformational analysis
	Unit III Functional group chemistry	CO7: Preparation, properties and reaction of some functional groups like alcohols, phenols, ethers and epoxides CO8: Different types of name reaction
	Organic chemistry practical	CO9: Identification of single organic compound (solid and liquid) with general reaction and tests involved
Physical chemistry-II (Major)	Unit I Thermodynamics-II	CO10: Second Law of thermodynamics and its need CO11: Understanding the concept of entropy; reversible, irreversible processes CO12: The application of thermodynamics: Joule Thomson effects, partial molar quantities
	Unit II Chemical equilibrium	CO13: The equilibrium on the basis of thermodynamic parameters CO14: Understanding the Le Chatelier's principle from thermodynamics.
	Unit III Statistical thermodynamics	CO15: Concepts of thermodynamic probability and relation with entropy CO16: Calculation of entropy using 3 rd law of thermodynamics CO17: Concepts of partition

		functions
	Unit IV Colligative properties	CO18: Concepts of four colligative properties, their interrelations and applications CO19: Thermodynamic parameters related to mixing for binary solutions
	Physical chemistry practical	CO20: Effect of ionic strength on Rate, conductometric verification of Ostwald dilution law and kinetics of saponification reaction by conductometric method
Fuel chemistry (SEC paper) [For major students only]	Unit I Energy sources	CO21: Concepts of different renewable and non-renewable energy sources CO22: Understanding the Coal as a fuel CO23: Fractionation of coal tar and coal liquification
	Unit II Petroleum and petrochemical industry	CO24: Non-petroleum fuels and their production and uses CO25: Understanding of various petrochemicals and their uses
	Unit III Lubricants	CO26: Concepts of lubricants and their various properties
	Project report on industrial/academic institute visit	CO27: To give exposure to the students about the practical working environment with theoretical learning
Organic and physical chemistry (Minor)	Unit I Organic synthesis	CO28: Preparation and synthetic uses of some organic compounds
	Unit II Macromolecules	CO29: Definition, classification, methods of synthesis and molecular weight determination of macromolecules. CO30: Structure and uses of some macromolecules
	Unit III Amino acid and protein	CO31: Understandings of different types of biomolecules, e.g, amino acids. proteins, etc, synthesis and properties of these molecules.
	Unit IV 1 st law and 2 nd law of thermodynamics	CO32: Laws of thermodynamics and concepts CO33: Understanding the concept of system, variables, heat, work, and laws of thermodynamics CO34: Understanding the concept of heat of reactions and use of equations in calculations of bond energy, enthalpy, etc. CO35: Understanding the concept of entropy; reversible, irreversible processes
	Unit V Chemical equilibrium	CO36: The equilibrium on the basis of thermodynamic parameters CO37: Understanding the Le Chateliers' principle from thermodynamics.
	Organic chemistry practical	CO38: Quantitative Estimation of: 1. Glucose by Fehling's solution 2. Phenol by bromate bromide method

Semester V (CBCS) (Honours)		
Organic chemistry-V (Honours)	Unit I Biomolecules	CO1: Understandings of different types of biomolecules, e.g, amino acids. proteins, nucleic acids etc, synthesis and properties of these biomolecules CO2: Knowledge of structure of DNA
	Unit II Bioenergetics	CO3: Concepts of reactions and mechanism of metabolism in human body system
	Unit III Pharmaceutical compounds	CO4: Concepts of Information, use and synthesis of some pharmaceutical compound
	Unit IV Synthetic methodology	CO5: Knowledge of different types of organic synthesis, cascade reaction
	Organic chemistry practical	CO6: Hands on experience to prepare some imporative organic compounds
Inorganic chemistry-IV (Honours)	Unit I Redox potential and redox equilibria	CO7: Basic concepts of redox potential and redox equilibria, redox titrimetric analysis
	Unit II Nuclear chemistry	CO8: Understandings of radioactivity and stability of any nucleus CO9: Knowledge of radio carbon dating.
	Unit III Organometallic compounds	CO10: Concepts of organometallic compounds, their preparations nomenclature and properties
	Inorganic chemistry practical	CO11: Hands on experience on redox titrations- permanganometry, dichromatometry, iodometry and iodimetry. volumetric analysis of mixtures
Green chemistry (DSE) (Honours)	Unit I Introduction to green chemistry	CO12: Learn need and goal of green chemistry CO13: To inspire the students about the chemistry which is good for human health and environment
	Unit II Principles of Green Chemistry and Designing a Chemical synthesis	CO14: To make students aware of how chemical processes can be designed, developed and run in a sustainable way CO15: To acquire the knowledge of the twelve principles of green chemistry and how to apply in green synthesis.
	Unit III Examples of Green Synthesis/ Reactions and some real world cases	CO16: Learn some examples of green synthesis and alternatives of classical methods. CO17: To make students aware about the benefits of using green chemistry.
Environmental chemistry (DSE) (Honours)	Unit I The atmosphere	CO18: Concepts of different sphere and layers of earth atmosphere.
	Unit II Aspects of Environmental Inorganic Chemistry	CO19: To make students aware of different toxic chemicals and how they spoils the environment CO20: To make students aware of different toxic chemicals and how they spoils the environment.
	Unit III The hydrosphere	CO21: Learn water pollutants, waste water treatment and detection of elements present in water
	Unit IV The Lithosphere and Pollution control	CO22: Idea on soil pollution and control measures, noise pollution, agricultural pollution and industrial pollution

		CO23: Learn about green solution to various environmental hazards
Solid state chemistry (DSE) (Honours)	Unit I Basic concepts and selected structures	CO24: Basic knowledge of structure of solids and crystal structure
	Unit II Crystallographic Basics	CO25: Concepts of laws of crystallography and designation of crystal plane
	Unit III Chemical Bonding in Solids	CO26: Knowledge of different types of bonding in crystals.
	Unit IV Properties of solids	CO27: Concepts of superconductor, semiconductors, transistors etc
Semester VI (CBCS) (Honours)		
Inorganic chemistry-V (Honours)	Unit I Bioinorganic chemistry	CO1: Concepts of the role of metal ions in our biological systems and mechanisms of action of drugs in our body system.
	Unit II Introduction to analytical chemistry	CO2: : Basic idea of analytical chemistry CO3: Concept of extraction and purification process of compounds CO4: Idea on different chromatography techniques
	Unit III Catalytic inorganic reactions	CO5 : Learning of Wilkinson, Zigler-Natta catalyst
	Unit IV Polymer	CO6: Knowledge of polymer chemistry
	Inorganic chemistry practical	CO7: Practical experiences on complexometric titration, gravimetric analysis, solvent extraction
Physical chemistry-V (Honours)	Unit I Chemical equilibrium	CO8: Understand the equilibrium on the basis of thermodynamic parameters CO9: Understand the Le Chatelier's principle from thermodynamics.
	Unit II Statistical thermodynamics and third law	CO10: Concepts of thermodynamic probability and relation with entropy CO11: Calculation of entropy using 3rd law of thermodynamics.
	Unit III Symmetry and group theory	CO12: Symmetry elements and operations with illustrations, symmetry elements and physical properties. point group classification.
	Unit IV Quantum chemistry	CO13: Learn about limitations of classical mechanics and solution in terms of quantum mechanics for atomic/molecular systems CO14: Develop an understanding of quantum mechanical operators, quantization, probability distribution, uncertainty principle.
	Unit V Photochemistry and spectroscopy	CO15: Knowledge of the laws of absorption of light energy by molecules and the subsequent photochemical reactions CO16: Interpret rotational and vibrational spectra and know about their application.
	Physical chemistry practical	CO17: Kinetics of saponification of ester by conductometric method, Ostwald dilution law

Chemistry of nanomaterials (DSE) (Honours)	Unit I Basic concepts on nanomaterials	CO18: Basic concepts of nanomaterials and their activity
	Unit II Synthesis and fabrication of nanomaterials	CO19: Knowledge of synthesis of nanomaterials
	Unit III Special nanomaterials	CO20: Concepts of some special types of nanomaterials
	Unit IV Characterization, properties and applications of nanomaterials	CO21: Characterisations of nanomaterials by using different instrumental techniques, properties and applications
Dynamic stereochemistry (DSE) (Honours)	Unit I General introduction	CO22: The concept of regioselective, regio specific and chemoselective reactions. CO23: Knowledge of stereoselective and stereospecific reactions
	Unit II Synthetic approach	CO23: Learning of asymmetric synthesis with chiral substrates, Cram's rule – its application and deviation CO24: Felkin-Anh Model, Prelog's rule, enantioselective synthesis
	Unit III : Stereochemical aspects of a few organic reactions	CO25: Concepts of stereochemical aspects of some organic reactions
	Unit IV Alicyclic systems	CO26: Knowledge of conformation and reactivity for alicyclic compounds CO27 Knowledge of stereochemical change of substitution, elimination and NGP reaction
Quantum chemistry and spectroscopy (DSE) (Honours)	Unit I Quantum mechanics	CO28: Learn about limitations of classical mechanics and solution in terms of quantum mechanics for atomic/molecular systems. CO29: Develop an understanding of quantum mechanical operators, quantization, probability distribution, uncertainty principle.
	Unit II Atomic structure	CO30: Knowledge of spectral lines of atoms in the light of quantum mechanics.
	Unit III Molecular spectroscopy	CO31: Some basic concepts of different types of molecular spectra such as vibrational, rotational, Raman, NMR, Mossbauer
Semester V (CBCS) (Program)		
Applied chemistry	Unit I Analytical chemistry	CO1: Basic concepts of accuracy and precision in analysis, different types of errors, redox titration
	Unit II Basic principles of green chemistry	CO2: To inspire the students about the chemistry which is good for human health and environment CO3: To acquire the knowledge of the twelve principles of green chemistry and how to apply in green synthesis CO4: To make students aware about the benefits of using green chemistry. CO5: To acquire the knowledge of the twelve principles of green chemistry and how to apply in

		green synthesis.
	Unit III Colloidal state	CO6: Concepts of coagulation, peptization, protective colloid, dialysis, gold number, isoelectric point, brownian motion
	Unit IV Macromolecular chemistry	CO7: Concepts of natural and synthetic polymers, different classification of polymers; structure and uses of some synthetic polymers.
Quantum chemistry, spectroscopy and photochemistry	Unit I Quantum chemistry	CO8: Learn about limitations of classical mechanics and solution in terms of quantum mechanics for atomic/molecular systems CO9: Develop an understanding of quantum mechanical operators, quantization, probability distribution, uncertainty principle CO10: Knowledge of spectral lines of atoms in the light of quantum mechanics.
	Unit II Photochemistry	CO11: Idea on primary photo-physical processes, potential energy diagram. Franck-Condon principle, Fluorescence and phosphorescence, Jablonsky diagram, laws of photochemistry etc.
	Unit III Spectroscopy	CO12: Some basic concepts of different types of molecular spectra such as vibrational, rotational, NMR
Pharmaceutical chemistry (SEC)	Unit I Drugs and pharmaceuticals	CO13: Understanding of different drug design and discoveries CO14: Learn about different classes of drugs and their examples CO15: Some idea about production of various drug related components
	Unit II Fermentation	CO16: Some knowledge about aerobic and anaerobic fermentation chemistry
Semester VI (CBCS) (Program)		
Chemistry of biomolecules and chemotherapy	Unit I Carbohydrate chemistry	CO1: Concept of monosaccharides, Aldoses up to 6 carbons, structure of D-glucose & Dfructose, the ring structure of monosaccharides , the ring-size determination CO2: Learn about Stepping-up and stepping-down of aldoses CO3: The polysaccharides, elementary idea about starch and cellulose
	Unit II Amino acid and protein	CO4: Understandings of different types of biomolecules, e.g, amino acids. proteins, etc, synthesis and properties of these molecules. CO5: Elementary idea about primary and secondary structure of protein, denaturation of protein
	Unit III Heterocyclic compound and nucleic acids	CO6: Idea about structure, reactivity and basicity of some heterocyclic compounds CO7: Learn about pyrimidine and purine bases nucleic acid, nucleosides and nucleotides corresponding to DNA and RNA, secondary

		structure of DNA
	Unit IV Enzymes and biochemical process	CO8: Knowledge on activity of enzymes in biological systems
	Unit V Chemotherapy	CO9: Basic concepts of chemotherapy CO10: Knowledge of synthesis of different drug molecules
Advanced inorganic chemistry	Unit I Coordination chemistry	CO11: Basic coordination chemistry, IUPAC nomenclature, idea about different ligand system CO12: Coordination compounds – Concepts of double salts and complex salts, Werner theory
	Unit II Chemistry of main group elements	CO13: Understanding on comparative study of the elements belonging to a particular group (Group – 1, 2, 12, 13, 14, 15, 16, 17, 18) to be made in brief on the basis of their electron configuration, abundance in nature, properties and reactions
	Unit III Transition metals	CO14: Understanding on comparative study of the elements belonging to a particular group (Group – 6, 7, 8, 9, 10, 11) to be made in brief on the basis of their electron distribution, preparation and properties
Fuel chemistry (SEC)	Unit I Energy sources	CO15: Concepts of different renewable and non-renewable energy sources CO16: Understanding the Coal as a fuel CO17: Idea on fractionation of coal tar and coal liquification
	Unit II Petroleum and petrochemical industry	CO18: Idea about other non-petroleum fuels and their production and uses CO19: Understanding of various petrochemicals and their uses
	Unit III Lubricants	CO20: Concepts of lubricants and their various properties