SLC(University of Delhi)

Shyam Lal College

Programme Specific Outcomes and Course Outcomes

B.Sc. (H) Chemistry

Programme Specific Outcomes:

Programme	Programme Specific Outcomes
B.Sc. (H) Chemistry	**PSO-1:** The students acquire in-depth knowledge of the various concepts and theoretical principles and are aware of their manifestations. **PSO-2:** The students are expected to be thoroughly conversant with all basic analytical, qualitative and quantitative laboratory techniques and demonstrate meticulousness in operation. **PSO-3:** Students are aware of the importance of working with safety and consciousness in laboratory and actively seeks information about health and environmental safety of chemicals that are used in the laboratories and follows protocols for their safe disposal. **PSO-4:** Students assimilate technical information about chemistry from various sources and convey it to intended audience, both orally and in writing in an intelligible manner. **PSO-5:** Critical thinking as an attribute enables a student to analyze a problem, assess it, reconstruct it and solve it. **PSO-6:** An integral part of chemistry curriculum is problem solving. The student will be equipped to solve problems of numerical, synthetic and analytical nature that are best approached with critical thinking. **PSO-7:** The student will be able to draw logical conclusions based on a group of observations, facts and rules. **PSO-8:** The student is inquisitive about processes and phenomena happening during experiments in laboratories and seeks answers through the research path.

Course Outcomes:

Core Subjects- Semester 1:

Course Name	Learning Outcomes
Atomic Structure & Chemical Bonding	**CO1:**Solve the conceptual questions using the knowledge gained by studying the quantum mechanical model of the atom, quantum numbers, electronic configuration, radial and angular distribution curves, shapes of s, p, and d orbitals, and periodicity in atomic radii,

	ionic radii, ionization energy and electron affinity of elements. **CO2:**Draw the plausible structures and geometries of molecules using Radius Ratio Rules, VSEPR theory and MO diagrams (homo- & hetero-nuclear diatomic molecules). **CO3:**Understand the concept of lattice energy using Born-Landé and Kapustinskii expression. **CO4:**Rationalize the conductivity of metals, semiconductors and insulators based on the Band theory. **CO5:**Understand the importance and application of chemical bonds, inter-molecular and intramolecular weak chemical forces and their effect on melting points, boiling points, solubility and energetics of dissolution.
States of Matter & Ionic Equilibrium	**CO1:**Derive mathematical expressions for different properties of gas, liquid and solids and understand their physical significance. **CO2:**Explain the crystal structure and calculate related properties of cubic systems. **CO3:**Explain the concept of ionization of electrolytes with emphasis on weak acid and base and hydrolysis of salt. **CO4:**Apply the concepts of gas equations, pH and electrolytes while studying other chemistry courses and every day life.

Core Subjects - Semester 2:

Course Name	Learning Outcomes
Basics and Hydrocarbons	**CO1:**Understand and explain the different nature and behavior of organic compounds based on fundamental concepts learnt. **CO2:**Formulate the mechanism of organic reactions by recalling and correlating the fundamental properties of the reactants involved. **CO3:**Learn and identify many organic reaction mechanisms including Free Radical Substitution,Electrophilic Addition and Electrophilic Aromatic Substitution. **CO4:**Understand the fundamental concepts of stereochemistry.

Chemical Thermodynamics and its Applications	**CO1:**Understand the three laws of thermodynamics, concept of State and Path functions, extensive and intensive properties. **CO2:**Derive the expressions of ΔU, ΔH, ΔS, ΔG, ΔA for ideal gases under different conditions. **CO3:**Explain the concept of partial molar properties. **CO4:**Explain the thermodynamic basis of colligative properties and applications in surroundings

Core Subjects - Semester 3:

Course Name	Learning Outcomes
s- and p-Block Elements	**CO1:** Learn the fundamental principles of metallurgy and understand the importance of recovery of byproducts during extraction. **CO2:** Understand the basic and practical applications in various fields of metals and alloy behavior and their manufacturing processes. **CO3:** Apply the thermodynamic concepts like that of Gibbs energy and entropy to the principles of extraction of metals. **CO4:** Understand the periodicity in atomic and ionic radii, electronegativity, ionization energy, electron affinity of elements of the periodic table. **CO5:** Understand oxidation states with reference to elements in unusual and rare oxidation states like carbides and nitrides. **CO6:** Understand vital role of sodium, potassium, calcium and magnesium ions in biological systems and the use of caesium in devising photoelectric cells.
Halogenated Hydrocarbons and Oxygen Containing Functional Groups	**CO1:** Understand preparation, properties and reactions of haloalkanes, haloarenes and oxygen containing functional groups. **CO2:** Use the synthetic chemistry learnt in this course to do functional group transformations. **CO3:** To propose plausible mechanisms for any relevant reaction.
Phase Equilibria and Electrochemical Cells	**CO1:** Understand phase equilibrium, criteria, CST, Gibbs-Duhem-Margules equation. **CO2:** Learn the working of electrochemical cells, galvanic cell,

	corrosion and happenings in surroundings related to electrochemistry.

Core Subjects - Semester 4:

Course Name	Learning Outcomes
Coordination Chemistry	**CO1:** Understand the terms, ligand, denticity of ligands, chelate, coordination number and use standard rules to name coordination compounds. **CO2:** Discuss the various types of isomerism possible in such compounds and understand the types of isomerism possible in a metal complex. **CO3:** Use Valence Bond Theory to predict the structure and magnetic behaviour of metal complexes and understand the terms inner and outer orbital complexes. **CO4:** Explain the meaning of the terms $\Delta o.$, Δt, pairing energy, CFSE, high spin and low spin and how CFSE affects thermodynamic properties like lattice enthalpy and hydration enthalpy. **CO5:** Explain magnetic properties and colour of complexes on basis of Crystal Field Theory **CO6:** Understand the important properties of transition metals like variable oxidation states, colour, magneticand catalytic properties and use Latimer diagrams to predict and identify species which are reducing, oxidizing and tend to disproportionate and calculate skip step potentials. **CO7:** Understand reaction mechanisms of coordination compounds and differentiate between kinetic and thermodynamic stability
Nitrogen containing functional groups, Polynuclear Hydrocarbons, Heterocyclic Chemistry, Alkaloids and Terpenes	**CO1:** Gain theoretical understanding of chemistry of compounds having nitrogen containing functional groups, heterocyclics, polynuclear hydrocarbons, alkaloids and terpenes which includes various methods for synthesis through application of the synthetic organic chemistry concepts learnt so far. **CO2:** Become familiar with their particular properties, chemical reactions, criterion of aromaticity with reference to polynuclear hydrocarbons and heterocyclic compounds, trends in basicity of

	amines and heterocyclic compounds and their behaviour at different pH. **CO3:** Learn practical approach to structural elucidation of organic compounds with specific examples of terpenes and alkaloids. **CO4:** Predict the carbon skeleton of amines and heterocyclic compounds via use of Hoffmann's exhaustive methylation and Emde's modification methods. **CO5:** Understand the applications of these compounds including their medicinal applications through their reaction chemistry.
Conductance & Chemical Kinetics	**CO1:** Explain the chemistry of conductance and its variation with dilution, migration of ions in solutions. **CO2:** Learn the applications of conductance measurements, **CO3:** Have understanding of rate law and rate of reaction, theories of reaction rates and catalysts; both chemical and enzymatic **CO4:** Have knowledge of the laws of absorption of light energy by molecules and the subsequent photochemicalreactions.

Core Subjects - Semester 5:

Course Name	Learning Outcomes
Biomolecules	**CO1:** Understand and demonstrate how structure of biomolecules determines their reactivity and biological functions. **CO2:** Gain insight into concepts of heredity through the study of genetic code, replication, transcription and translation. **CO3:**Demonstrate understanding of metabolic pathways, their inter-relationship, regulation and energy production from biochemical processes.
Quantum Chemistry & Spectroscopy	**CO1:** Learn about limitations of classical mechanics and solution in terms of quantum mechanics for atomic/molecular systems. **CO2:** Develop an understanding of quantum mechanical operators, quantization, probability distribution, uncertainty principle and application of quantization to spectroscopy. **CO3:** Interpret various types of spectra and know about their application in structure elucidation.

Core Subjects - Semester 6:

Course Name	Learning Outcomes
Organometallic Chemistry & Bio-inorganic Chemistry	**CO1:** Understand and explain the basic principles of qualitative inorganic analysis **CO2:** Apply 18-electron rule to rationalize the stability of metal carbonyls and related species **CO3:** Understand the nature of Zeise's salt and compare its synergic effect with that of carbonyls. **CO4:** Identify important structural features of the metal alkyls tetrameric methyl lithium and dimeric trialkyl aluminium and explain the concept of multicenter bonding in these compounds **CO5:** Diagrammatically explain the working of the sodium-potassium pump in organisms and the factors affecting it and understand and describe the active sites and action cycles of the metalloenzymes carbonic anhydrase and carboxypeptidase **CO6:** Explain the sources and consequences of excess and deficiency of trace metals and learn about the toxicity of certain metal ions, the reasons for toxicity and antidotes **CO7:** Explain the use of chelating agents in medicine and, specifically, the role of cisplatin in cancer therapy and explain the applications of iron in biological systems with particular reference to haemoglobin, myoglobin, ferritin and transferring **CO8:** Get a general idea of catalysis and describe in detail the mechanism of Wilkinson's catalyst, Zeigler- Natta catalyst and synthetic gasoline manufacture by Fischer-Tropsch process.
Spectroscopy and Applied Organic Chemistry	**CO1:** Gain insight into the basic principles of UV, IR and NMR spectroscopic techniques. **CO2:** Use spectroscopic techniques to determine structure and stereochemistry of known and unknown compounds. **CO3:** Develop a sound understanding of the structure of Pharmaceutical Compounds. They will also understand the importance of different classes of drugs and their applications for treatment of various diseases. **CO4:** Learn about the chemistry of natural and synthetic polymers including fabrics and rubbers.

	CO5: Understand the chemistry of biodegradable and conducting polymers and appreciate the need of biodegradable polymers with emphasis on basic principles. **CO6:** Learn about the theory of colour and constitution as well as the chemistry of dyeing. **CO7:** Know applications of various types of dyes including those in foods and textiles.

DSE Semester 5/6:

Course Name	Learning Outcomes
DSE-1 Course Title: Novel Inorganic Solids	**CO1:** Understand the mechanism of solid-state synthesis. **CO2:** Explain about the different characterization techniques and their principle. **CO3:**Understand the concept of nanomaterials, their synthesis and properties. **CO4:** Explain the mechanism of growth of self-assembled nanostructures. **CO5:** Appreciate the existence of bioinorganic nanomaterials. **CO6:** Explain the importance of composites, conducting polymers and their applications. **CO7:**Understand the usage of solid materials in various instruments, batteries, etc. which would help them to appreciate the real life importance of these materials
DSE-2: Inorganic Materials of Industrial Importance	**CO1:** Learn the composition and applications of the different kinds of glass. **CO2:** Understand glazing of ceramics and the factors affecting their porosity. **CO3:** Give the composition of cement and discuss the mechanism of setting of cement. **CO4:** Explain the suitability of fertilizers for different kinds of

	crops and soil. **CO5:** Explain the process of formulation of paints and the basic principle behind the protection offered by the surface coatings. **CO6:** Explain the principle, working and applications of different batteries. **CO7:** List and explain the properties of engineering materials for mechanical construction used in day to day life. **CO8:** Explain the synthesis and properties of nano-dimensional materials, various semiconductor and superconductor oxides
DSE-3: Applications of Computers in Chemistry	**CO1:** Have knowledge of most commonly used commands and library functions used in QBASIC programming. **CO2:** Develop algorithm to solve problems and write corresponding programs in BASIC for performing calculations involved in laboratory experiments and research work. **CO3:** Use various spreadsheet software to perform theoretical calculations and plot graphs
DSE-4: Analytical Methods in Chemistry	**CO1:** Perform experiment with accuracy and precision. **CO2:** Develop methods of analysis for different samples independently. **CO3:** Test contaminated water samples. **CO4:** Understand basic principle of instrument like Flame Photometer, UV-vis spectrophotometer. **CO5:** Learn separation of analytes by chromatography. **CO6:** Apply knowledge of geometrical isomers and keto-enol tautomers to analysis. **CO7:** Determine composition of soil. **CO8:** Estimate macronutrients using Flame photometry.
DSE-5: Molecular Modelling and Drug Design	**CO1:** Understand theoretical background of computational techniques and selective application to various molecular systems. **CO2:** Learn Energy minimization methods through use of different force fields.

	CO3: Learn ESP Plots by suitable soft wares, electron rich and electron deficient sites, **CO4:** Compare computational and experimental results and explain deviations. **CO5:** Carry out Molecular dynamics (MD) and Monte Carlo (MC) simulations on several molecules and polymers. **CO6:** Learn QSAR properties and their role in molecular modelling, cheminformatics and drug discovery. **CO7:** Perform Optimization of geometry parameters of a molecule (such as shape, bond length and bond angle) through use of software like Chem Sketch and Argus Lab in interesting hands-on exercises.
DSE-6: Polymer Chemistry	**CO1:** Know about history of polymeric materials and their classification **CO2:** Learn about different mechanisms of polymerization and polymerization techniques **CO3:** Evaluate kinetic chain length of polymers based on their mechanism **CO4:** Differentiate between polymers and copolymers **CO5:** Learn about different methods of finding out average molecular weight of polymers **CO6:** Differentiate between glass transition temperature (Tg) and crystalline melting point (Tm) **CO7:** Determine Tg and Tm **CO8:** Know about solid and solution properties of polymers **CO9:** Learn properties and applications of various useful polymers in our daily life. **CO10:** This paper will give glimpse of polymer industry to the student and help them to choose their career in the field of polymer chemistry.
DSE-7: Research Methodology For Chemistry	**CO1:** Learn how to identify research problems. **CO2:** Evaluate local resources and need for addressing the research problem

	CO3: Find out local solution. **CO4:** Know how to communicate the research findings.
DSE-8: Green Chemistry	**CO1:** Understand the twelve principles of green chemistry and will build the basic understanding of toxicity,hazard and risk of chemical substances. **CO2:** Understand stoichiometric calculations and relate them to green chemistry metrics.They will learn about atom economy and how it is different from percentage yield. **CO3:** Learn to design safer chemical ,products and processes that are less toxic,than current alternatives. Hence,they will understand the meaning of inherently safer design for accident prevention and the principle "what you don't have can't harm you" **CO4:** Understand benefits of use of catalyst and bio catalyst ,use of renewable feed stock which helps in energy efficiency and protection of the environment, renewable energy sources, importance led reactions in various green solvents. **CO5:** Appreciate the use of green chemistry in problem solving skills, critical thinking and valuable skills to innovate and find out solution to environmental problems. Thus the students are able to realise that chemistry can be used to solve rather than cause environmental problems. **CO6:** Green chemistry is a way to boost profits, increase productivity and ensure sustainability with absolute zero waste. Success stories and real world cases also motivate them to practice green chemistry.These days customers are demanding to know about a product: Is it green? Does it contribute to global warming? Was it made from non depletable resources? Students have many career opportunities as " green" is the path to success.
DSE-9 : Industrial Chemicals and Environment	**CO1:** The different toxic gases and their toxicity hazards **CO2:** Safe design systems for large scale production of industrial gases. **CO3:** Manufacturing processes, handling and storage of inorganic chemicals. **CO4:** Hazardous effects of the inorganic chemicals on human beings and vegetation.

	CO5: The requirement of ultra-pure metals for the semiconducting technologies **CO6:** Composition of air, various air pollutants, effects and control measures of air pollutants. **CO7:** Different sources of water, water quality parameters, impacts of water pollution, water treatment. **CO8:** Different industrial effluents and their treatment methods. **CO9:** Different sources of energy. **CO10:** Generation of nuclear waste and its disposal. **CO11:** Use of biocatalyst in chemical industries.
DSE-10: Instrumental Methods of Chemical Analysis	**CO1:**Handle analytical data **CO2:** Understand basic components of IR, FTIR, UV-Visible and Mass spectrometer. **CO3:** Interpret of IR, FTIR, UV-visible spectra and their applications. **CO4:** Understand the use of single and double beam instruments. **CO5:** Learn separations techniques like Chromatography. **CO6:** Learn elemental analysis, NMR spectroscopy, Electroanalytical Methods, Radiochemical Methods, X-ray analysis and electron spectroscopy.
DSE-11 Course Title: Nanoscale Materials and Their Applications	**CO1:** Understand the concept of nanodimensions. **CO2:** Know the various methods of preparation of nanomaterials. **CO3:** Know the different characterization techniques used for the analysis of nanomaterials and understand the basic principle behind these techniques. **CO4:** Understand the optical and conducting properties of nanostructures. **CO5:** Appreciate the real life applications of nanomaterials.
DSE-12: Dissertation	**CO1:** Do survey, study and cite published literature on a particular area of interest.

	CO2: Correlate the experimental observations with theoretical understanding. **CO3:** Interpret results, write a report and submit to the supervisor. **CO4:** Use laboratory resources judiciously. **CO5:** Work in a team under the supervision of a teacher. **CO6:** Develop scientific writing skills.

Generic Elective Semester 1/2/3/4:

Course Name	Learning Outcomes
GE-1: Atomic Structure, Bonding, General Organic Chemistry & Aliphatic Hydrocarbons	**CO1:** Solve the conceptual questions using the knowledge gained by studying the quantum mechanical model of the atom, quantum numbers, electronic configuration, radial and angular distribution curves, shapes of s, p, and d orbitals, and periodicity in atomic radii, ionic radii, ionization energy and electron affinity of elements. **CO2:** Draw the plausible structures and geometries of molecules using radius ratio rules, VSEPR theory and MO diagrams (homo- & hetero-nuclear diatomic molecules). **CO3:** Understand and explain the differential behavior of organic compounds based on fundamental concepts learnt. **CO4:** Formulate the mechanism of organic reactions by recalling and correlating the fundamental properties of the reactants involved. **CO5:** Learn and identify many organic reaction mechanisms including free radical substitution, electrophilic addition and electrophilic aromatic substitution.
GE-2 : Chemical Energetics, Equilibria and Functional Group Organic	**CO1:** Understand the laws of thermodynamics, thermochemistry and equilibria. **CO2:** Understand concept of pH and its effect on the various physical and chemical properties of the compounds. **CO3:** Use the concepts learnt to predict feasibility of chemical reactions and to study the behaviour of reactions in equilibrium.

	CO4: Understand the fundamentals of functional group chemistry through the study of methods of preparation, properties and chemical reactions with underlying mechanism. **CO5:** Use concepts learnt to understand stereochemistry of a reaction and predict the reaction outcome. **CO6:** Design newer synthetic routes for various organic compounds.
GE-3: Solutions, Phase Equilibrium, Conductance, Electrochemistry and Functional Group Organic Chemistry-II	**CO1:** Explain the concepts of different types of binary solutions-miscible, partially miscible and immiscible along with their applications. **CO2:** Explain the thermodynamic aspects of equilibria between phases and draw phase diagrams of simple one component and two component systems. **CO3:** Explain the factors that effect conductance, migration of ions and application of conductance measurement. **CO4:** Understand different types of galvanic cells, their Nernst equations, measurement of emf, calculations of thermodynamic properties and other parameters from the emf measurements. **CO5:** Understand and demonstrate how the structure of biomolecules determines their chemical properties, reactivity and biological uses. **CO6:** Design newer synthetic routes for various organic compounds.
GE-4: Chemistry of s- and p-Block Elements, States of Matter and Chemical Kinetics	**CO1:** Understand the chemistry and applications of s- and p-block elements. **CO2:** Derive ideal gas law from kinetic theory of gases and explain why the real gases deviate from ideal behaviour. **CO3:** Explain Maxwell-Boltzmann distribution, critical constants and viscosity of gases. **CO4:** Explain the properties of liquids especially surface tension and viscosity. **CO5:** Explain symmetry elements, crystal structure specially NaCl, KCl and CsCl **CO6:** Define rate of reactions and the factors that affect the rates of

	reaction. **CO7:**Understand the concept of rate laws e.g., order, molecularity, half-life and their determination **CO8:** Learn about various theories of reaction rates and how these account for experimental observations.
GE-5: Chemistry of d-Block Elements, Quantum Chemistry and Spectroscopy	**CO1:** Understand chemistry of d and f block elements, Latimer diagrams, properties of coordination compounds and VBT and CFT for bonding in coordination compounds **CO2:** Understand basic principles of quantum mechanics: operators, eigen values, averages, probability distributions. **CO3:** Understand and use basic concepts of microwave, IR and UV-VIS spectroscopy for interpretation of spectra. **CO4:** Explain Lambert-Beer's law, quantum efficiency and photochemical processes.
GE-6: Organometallics, Bioinorganic Chemistry, Polynuclear Hydrocarbons and UV, IR Spectroscopy	**CO1:** Understand the chemistry and applications of 3d elements including their oxidation states and important properties of the familiar compounds potassium dichromate, potassium permanganate and potassium ferrocyanide **CO2:** Use IR data to explain the extent of back bonding in carbonyl complexes **CO3:** Get a general idea of toxicity of metal ions through the study of Hg2+ and Cd2+ in the physiological system **CO4:** Understand the fundamentals of functional group chemistry, polynuclear hydrocarbons and heterocyclic compounds through the study of methods of preparation, properties and chemical reactions with underlying mechanism. **CO5:** Gain insight into the basic fundamental principles of IR and UV-Vis spectroscopic techniques. **CO6:** Use basic theoretical principles underlying UV-visible and IR spectroscopy as a tool for functional group identification in organic molecules.
GE-7: Molecules of Life	**CO1:** Learn and demonstrate how the structure of biomolecules determines their chemical properties, reactivity and biological uses. **CO2:** Gain an insight into mechanism of enzyme action and inhibition.

	CO3: Understand the basic principles of drug-receptor interaction and SAR. **CO4:** Understand biological processes like replication, transcription and translation. **CO5:** Demonstrate an understanding of metabolic pathways, their inter-relationship, regulation and energy production from biochemical processes.
GE-8: Green Chemistry: Designing Chemistry for Human Health and Environment	**CO1:** Understand what is waste and how waste generation can cause serious repercussions on our environment while simultaneously causing enormous damage to human health. **CO2:** Recognize and acknowledge the role of green chemistry in reducing waste, learn about new strategies (emerging green technologies-green catalysts, solvents, energy, plastics etc.) that possess tremendous potential in reducing waste **CO3:** Creatively redesign traditional experiments with a green focus (using the various principles of green chemistry) **CO4:** Learn about the green trends being practiced in pharmaceutical industries through depiction of some interesting industrial case studies **CO5:** Learn about academic-industrial collaborations and the potential these relationships hold in furtherance of green chemistry and rendering our planet earth greener **CO6:** Eliminate "Do as I Said attitude" of students as this course will enhance the creative practical skills of students **CO7:** Motivate students to choose discipline and career related to this field. Eventually a student practising green chemistry can either become an industrialist or engineer or policy maker.

SEC - Semester 3/4/5/6:

Course Name	Learning Outcomes
SEC-1: IT Skills For Chemists	**CO1:** Become familiar with the use of computers **CO2:** Use software for tabulating data, plotting graphs and charts, carry out statistical analysis of the data. **CO3:** Solve chemistry problems and simulate graphs. **CO4:** Prepare documents that will incorporate chemical structure, chemical equations, mathematical expressions from chemistry.

SEC-2 Course Title: Basic Analytical Chemistry	**CO1:** Handle analytical data **CO2:** Determine composition and pH of soil, which can be useful in agriculture **CO3:** Do quantitative analysis of metal ions in water **CO4:** Separate mixtures using separation techniques **CO5:** Estimate macro nutrients using Flame photometry
SEC-3: Chemical Technology and Society	**CO1:** Understand the use of basic chemistry to chemical engineering **CO2:** Learn and use various chemical technology used in industries **CO3:** Develop scientific solutions for societal needs
SEC-4 Course Title: Chemoinformatics	**CO1:** Have a comprehensive understanding of drug discovery process and techniques including structure-activity relationship, quantitative structure activity relationship and the use of chemoinformatics in this, including molecular modelling and docking studies. **CO2:** Appreciate role of modern computation techniques in the drug discovery process and perform their own modelling studies.
SEC-5 Course Title: Business Skills for Chemists	**CO1:** Learn basics skills of of business and project management. **CO2:** Understand the process of product development and business planning that includes environmental compliancy. **CO3:** Learn the process by which technical innovations are conceived and converted into successful business ventures. **CO4:** Understand the intellectual property rights and patents which drive business viability and commercialization of innovation. **CO5:** Relate to the importance of chemistry in daily life, along with the employment and business opportunities. They will effectively use the skills to contribute towards the well-being of the society and derive commercial value.
SEC-6: Intellectual Property Rights	**CO1:** Learn theoretical concepts of evolution of Intellectual Property Laws, and to differentiate between the different kinds of IP. **CO2:** Know the existing legal framework relating to IP in India. **CO3:** Comprehend the value of IP and its importance in their

	respective domains. **CO4:** This course may motivate the students to make their career in multifaceted field of intellectual property rights.
SEC-7: Analytical Clinical Biochemistry	**CO1:** Understand and establish how the structure of biomolecules determines their reactivity and biological uses. **CO2:** Understand the basic principles of drug-receptor interaction and structure activity relation (SAR). **CO3:** Gain an insight into concept of heredity through biological processes like replication, transcription and translation. **CO4:** Demonstrate an understanding of the biochemistry of diseases. **CO5:** Understand the application of chemistry in biological systems.
SEC-8: Green Methods in Chemistry	**CO1:**Get idea of toxicology, environmental law, energy and the environment **CO2:** Think to design and develop materials and processes that reduce the use and generation of hazardous substances in industry. **CO3:** Think of chemical methods for recovering metals from used electronics materials. **CO4:** Get ideas of innovative approaches to environmental and societal challenges. **CO5:** Know how chemicals can have an adverse/potentially damaging effect on human and vegetation. **CO6:** Critically analyse the existing traditional chemical pathways and processes and creatively think about bringing environmentally benign reformations in these protocols. **CO7:** Convert biomass into valuable chemicals through green technologies.
SEC-9 Course Title: Pharmaceutical Chemistry	**CO1:** Gain insight into retro-synthesis approach in relation to drug design and drug discovery. **CO2:** Learn synthetic pathways of major drug classes. **CO3:** Understand the fermentation process and production of ethanol, citric acids, antibiotics and some classes of vitamins.
SEC-10: Chemistry of	**CO1:** Learn basic of cosmetics, various cosmetic formulation,

Cosmetics and Perfumes	ingredients and their roles in cosmetic products. **CO2:** Learn the use of safe, economic and body-friendly cosmetics **CO3:** Prepare new innovative formulations.
SEC-11: Pesticide Chemistry	**CO1:** Students will be able to learn about the basic role of pesticide in everyday life, various ingredients and their role in controlling the pest. **CO2:** Students can also educate the farmers/gardeners to choose the appropriate pesticides for their crop production.
SEC-12: Fuel Chemistry	**CO1:** The course covers both conventional petroleum-based fuels, and alternative & renewable fuels, including gaseous fuels. **CO2:** The students will learn the chemistry that underpins petroleum fuel technology, will understand the refining processes used to produce fuels and lubricants and will know how differences in chemical composition affect properties of fuels and their usage in different applications. **CO3:** The course will also cover origin of petroleum, crude oil, composition, different refining processes employed industrially to obtain different fractions of petroleum. Further, course will cover various alternative and renewable fuels like Biofuels (Different generations), Gaseous Fuels (e.g. CNG, LNG, CBG, Hydrogen etc.). **CO4:** The course will also cover fuel product specifications, various test methods used to qualify different types of fuels as well characterization methods. **CO5:** Review of energy scenario (Global & India), Energy sources (renewable and non-renewable). Types of Crude Oils, Composition and Properties. Crude oil assay