

# **ASANSOL GIRLS' COLLEGE**

## **Department of Chemistry**

### **Programme Specific Outcome (PSO) and Course Outcome (CO)**

#### **Programme Specific Outcome (PSO):**

The Programme enables the students

PSO1: To become familiar with the different branches of chemistry like organic, inorganic, physical, environmental, solid state, pharmaceutical, fuel, nano and green chemistry.

PSO2: To 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.

PSO3: To develop problem solving skills

PSO4: To understand the causes of environmental pollution and can open up new methods for environmental pollution control.

## Course Outcome (CO)

Semester	Course and Module	Module Specific CO
<b>SEMESTER – I</b> <b>(MAJOR AND MINOR)</b>	<b>General Chemistry - I</b>  Unit-I: Atomic Structure	<b>Students learn about</b>  CO1: Scientific theory of atoms, concept of wave function CO2: Atomic structure, chemical bonding, and molecular geometry based on accepted models CO3: Identity of given element, relative size, charges of proton, neutron and electrons, and their assembly to form different atoms
	Unit – II: Periodicity of Elements	CO4: Elements in periodic table; physical and chemical characteristics, periodicity CO5: Physical and chemical characteristics of elements in various groups and periods according to ionic size, charge, etc. and position in periodic table
	Unit – III: Chemical Bonding	CO6: Bonding between atoms, molecules, interaction and energetic, hybridization and shapes of atomic, molecular orbitals, bond parameters, bond- distances and energies
	Unit – IV: Basics of Organic Chemistry	CO7: Basic of organic molecules, structure, bonding, reactivity and reaction mechanisms CO8: Aromatic compounds and aromaticity, mechanism of aromatic reactions CO9: Hybridization and geometry of atoms, 3-D structure of organic molecules, identifying chiral centers CO10: Electrophile, nucleophiles, free radicals, electronegativity, resonance, and intermediates along the reaction pathways CO11: Mechanism of organic reactions (effect of nucleophile/leaving group, solvent), substitution vs. elimination.
	Organic Practical Chemistry	CO12: Students gets idea about qualitative analysis of organic compound which includes special element detection functional group detection.
	<b>Industrial Chemistry (SEC Paper) (only for Major Students)</b> Unit - I: Paints	CO13: The chemistry of paints, varnishes and dyes
	Unit - II: Electrochemical and Electro-thermal Industries	CO14: Preparation and uses of various compounds including KMnO <sub>4</sub> , CaC <sub>2</sub> , alloy steels etc.
	Unit - III: Ceramics	CO15: The chemistry of ceramics
	Unit - IV: Rusting of Iron and Steel	CO16: Concepts of corrosion: cause and prevention

SEMESTER – II  
(MAJOR & MINOR)

Unit - V: Industrial Safety and Fire Protection	CO17: Various fire-extinguishers and their chemical contents
<b>General Chemistry – II</b>	
Unit-I: Acid-Base and Ionic Equilibrium	CO1: Various 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, Henderson equation, 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 CO5: Theories of reaction rates, determination of rate of opposing/parallel/chain reactions with suitable examples CO6: Application of steady state kinetics, Steady-state approximation.
Unit-IV: Properties of Fluids	CO7: Maxwell distribution, Physical properties and related laws of gas and liquid states CO8: Understanding Kinetic model of gas and its properties. 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 Practical Chemistry	CO12: Volumetric analysis: Acid-base titration, permanganometry, dichromatometry
Physical Practical Chemistry	CO13: The method of determination of surface tension of liquid by drop number method and method of determination of viscosity coefficient of liquid using Ostwald viscometer.
<b>Pharmaceutical Chemistry (SEC Paper) (only for Major Students)</b>	
Unit – I : Drugs & Pharmaceuticals	CO14: Drug discovery, design and development; Synthesis of the representative drugs of the following classes: analgesics agents, antipyretic agents, anti-inflammatory agents; antibiotics; antibacterial and antifungal agents; antiviral agents, Central Nervous System agents, Cardiovascular, antilaprosy, HIV-AIDS related drugs

Unit – II: Fermentation	CO15: Aerobic and anaerobic fermentation. Production of (i) Ethyl alcohol and citric acid, (ii) Antibiotics; Penicillin, Cephalosporin, Chloromycetin and Streptomycin, (iii) Lysine, Glutamic acid, Vitamin B2, Vitamin B12 and Vitamin C
<p><b>Inorganic Chemistry - II</b></p> <p>Unit – I: Coordination Chemistry-I: Bonding in Coordination Compounds (Preliminary Concept) and Properties of Coordination Compounds</p>	<p>CO1 : Coordination compounds – its nomenclature, and various types of ligands</p> <p>CO2 : Concept of Valence Bond Theory and its applications and drawbacks</p> <p>CO3 : Different types of isomerism (both geometrical and optical) in coordination chemistry</p> <p>CO4 : Chelate effect, macrocyclic effect and their relation with the stability of the complex</p> <p>CO5 : Application of coordination complexes</p>
Unit – II: Acids and Bases	<p>CO6 : Various concepts of acids and bases</p> <p>CO7 : Different factors favouring acid-base strength</p> <p>CO8 : HSAB concepts and its application in chemistry</p> <p>CO9 : Concepts of other non-aqueous solvents</p>
Unit-III: a) Chemistry of s and p Block Elements b) Compounds of Noble Gases	CO10 : Chemistry, reactivity and various properties of s- and p-block elements
<p><b>Organic Chemistry- III</b></p> <p>Unit - I: Nitrogen Compounds</p>	<p>CO11: Preparation and important reactions of aliphatic and aromatic nitro compounds, nitriles and isonitriles and aqmines.</p> <p>CO12: Order of basicity of different aliphatic and aromatic amines.</p> <p>CO13: Different name reactions e.g. Gabriel’s phthalimide synthesis, carbylamine reaction, Mannich reaction, Hofmann bromoamide degradation, reductive amination, Hoffmann’s exhaustive methylation, Hofmannelimination reaction etc.</p>

SEMESTER – III  
(HONOURS)

	<p>CO14: Distinction between 1°, 2° and 3° amines with Hinsberg reagent and nitrous acid.</p> <p>CO15: Nitrophenols, amionophenols, nitro anilines, amino carboxylic acids. diazomethane, diazonium salts.</p>
Unit – II: Heterocyclic Compounds	<p>CO16: Structures and synthetic approaches and reactivities of oxiranes, aziridines; oxaziranes, diaziridines and diazirines; oxitanes, azatidanes and thietanes</p> <p>CO17: General synthetic approaches, properties and reactions of furans, pyrroles and thiophenes.</p> <p>CO18: General synthetic approaches, properties and reactions of pyridine and its derivatives.</p> <p>CO19: General synthetic approaches, properties and reactions of indole, quinoline and isoquinoline.</p>
Unit – III: Polynuclear Hydrocarbons	<p>CO20: Preparations, Properties and Reactions of naphthalene, phenanthrene and anthracene.</p>
Unit - IV: Rearrangements, Name Reactions & Organometallics Rearrangements:	<p>CO21: Rearrangement to electron-deficient carbon, e.g. Wagner-Meerwein rearrangement, pinacol rearrangement, dienonephenol; Wolff rearrangement in Arndt-Eistert synthesis, benzil-benzilic acid rearrangement, Demjanov rearrangement, Tiffeneau–Demjanov rearrangement.</p> <p>CO22: Rearrangement to electron-deficient nitrogen, e.g. Hofmann, Curtius, Lossen, Schmidt and Beckmann.</p> <p>CO23: Rearrangement to electron-deficient oxygen: Baeyer-Villiger oxidation, cumene hydroperoxidephenol rearrangement and Dakin reaction.</p> <p>CO24: Rearrangement in Aromatic system, e.g. Fries rearrangement and Claisen rearrangement.</p> <p>CO25: Migration from nitrogen to ring carbon, e.g. Hofmann-Martius, Sommelet Houser, Fischer-Hepp, Bamberger, Orton and benzidine</p>

SEMESTER – III  
(HONOURS)

	<p>rearrangement.</p> <p>CO26: Various name Reactions, e.g. Birch, Von Richter, Houben-Hoesch, Arndt-Eistert homologation, HVZ, Hunsdiecker, Oppenaur, Sandmeyer, Stephen and Williamson's ether synthesis.</p> <p>CO27: Preparation and reactions: Grignard reagent; Organolithiums; addition of Grignard and organolithium to carbonyl compounds; abnormal behavior of Grignard reagents.</p> <p>CO28: Use of ortho lithiation of arenes; Gilman cuprates: substitution on COX; conjugate addition by Gilman cuprates; Corey-House synthesis; Reformatsky reaction; Blaise reaction etc.</p>
<b>Physical Chemistry- II</b>	
Unit – I: Thermodynamics I	CO29: First law of thermodynamics, reversible and irreversible process, concept of $C_p$ and $C_v$ etc.
Unit – II: Chemical Kinetics –I	CO30 : The basics of chemical kinetics: determination of order, molecularity, theories of reaction rates, determination of rate of opposing/parallel/Chain reactions with suitable examples, application of steady state theory.
Unit – III: Electrochemistry	CO31: The concept of conductance, molar conductance, equiv. conductance, Kohlrausch law, conductometric titration, Debye-Huckel theory and Debye-Huckel limiting law
Unit – IV: Interface & Dielectrics	CO32 : Understand the special features of interface, Langmuir and Freundlich isotherm, Heterogeneous catalysis, concept of colloids origin and types of intermolecular forces
Inorganic Practical Chemistry: Qualitative analysis	CO33 : Identifications of various acid and basic radicals and qualitative estimation of radicals from a mixture of salts
Organic Practical Chemistry:	CO34: Identification with general reaction and tests of the following compounds: a) Methyl alcohol, b) Ethyl alcohol, c) Acetone, d) Formic acid, e) Acetic acid, f) aniline, g) Nitro benzene, h) Tartaric acid, i) Succinic acid, j) Salicylic acid, k) Glucose, l) Resorcinol.
Physical Practical Chemistry:	CO35: The method of determination of solubility product of Mg-carbonate in presence and absence of common ion and kinetics of decomposition of $H_2O_2$ in presence of KI

<b>Industrial Chemistry (SEC Paper)</b> Unit - I: Paints	CO36: Understanding to the chemistry of paints, varnishes and dyes
Unit - II: Electrochemical and Electro-thermal Industries	CO37: Preparation and uses of various compounds including $\text{KMnO}_4$ , $\text{CaC}_2$ , alloy steels etc.
Unit - III: Ceramics	CO38: Understanding the chemistry of ceramics
Unit - IV: Rusting of Iron and Steel	CO39: Concepts of corrosion: cause and prevention
Unit - V: Industrial Safety and Fire Protection	CO40: Various fire-extinguishers and their chemical contents
<b>Inorganic Chemistry- III</b>	
Unit - I: Coordination Chemistry-II: Crystal Field Theory; Magnetochemistry: Origin of Colours in Transition Metal Compounds	CO1 : Coordination compounds – Crystal field theory, and some preliminary idea about Ligand Field Theory CO2: Jahn-Teller Distortion and application to the Z-in and Z-out chemistry CO3: Explanation of the origin of colour of complexes CO4: Magnetic properties of the complexes CO5: d- block chemistry including 1st, 2nd and 3rd row transition elements on their various oxidations state, magnetic properties, complex formation etc.
Unit - II: Chemistry of d and f Block Elements	CO6: f-block chemistry including both lanthanides and actinides. CO7: Concepts of Lanthanide contraction, abnormal electronic configuration and magnetic properties and their chemistry
Unit - III Inorganic Substitution Reaction Mechanism	CO8: Introductory idea of inorganic reaction mechanism, labile-inert complex, reaction mechanism on various substitution reaction, trans-/cis-effect and its consequences etc.
Inorganic Practical Chemistry	CO9 : Preparations of some inorganic complexes
<b>Organic Chemistry- IV</b>	
Unit - I: Alkaloids & Terpenoids	CO10 : Natural occurrence; Isolation, general structural features and their physiological properties, Hoffmann's exhaustive methylation, Emde's degradation. CO11: Structure elucidation and synthesis of piperine, ephedrine and coniine.

Unit - II: Organic Spectroscopy

CO12: Medicinal properties of nicotine, hygrine, quinine, and cocaine, Isoprene rule.

CO13: Elucidation of structure and synthesis of Citral, Neral and  $\alpha$ -Terpineol.

CO14: The concept of electromagnetic radiation, Lambert-Beer law, electronic transitions,  $\lambda_{\max}$  &  $\epsilon_{\max}$ .

CO15: Concept of chromophore, auxochrome, bathochromic, hypsochromic hyperchromic and hypochromic shifts and the Effect of solvent on  $\lambda_{\max}$  &  $\epsilon_{\max}$ .

CO16: Application of electronic spectroscopy and Woodward-Fiser rules for calculating  $\lambda_{\max}$  of acyclic and cyclic conjugated dienes and  $\alpha$ ,  $\beta$ -unsaturated carbonyl compounds.

CO17: Hooke's law, stretching and bending vibrations, characteristic and diagnostic stretching frequencies, factors affecting stretching frequencies.

CO18: The concept of finger-print region, diagnostic bending frequencies for benzene and its o-, m- and p-isomers.

CO19: Principle, nuclear spin, NMR-active nuclei, chemically equivalent and nonequivalent protons; chemical shift, upfield and downfield shifts.

CO20: Shielding/deshielding of protons in systems involving C-C, C=O, C=C, benzene, cyclohexane, spin-spin splitting.

CO21: characteristic  $^1\text{H}$  NMR signals for simple molecules. Mass Spectrometry, Elementary idea and fragmentation rule in characterization of organic compounds.



Unit – III: Pericyclic reactions	<p>CO22: The electrocyclic reactions, FMO approach involving <math>4\pi</math>- and <math>6\pi</math>-electrons and corresponding cyclo-reversion reactions, Woodward-Hofmann selection rules.</p> <p>CO23: The cycloaddition reactions, FMO approach, Diels-Alder reaction, Alder ene reaction, photochemical [2+2]cycloadditions.</p> <p>CO24: The sigmatropic reactions, FMO approach, sigmatropic shifts and their order; [1,3]- and [1,5]-H shifts and [3,3]-shifts with reference to Claisen and Cope rearrangements.</p>
Unit – IV: Carbohydrates	<p>CO25 : Concept of monosaccharides, Aldoses up to 6 carbons, structure of D-glucose &amp; D-fructose, the ring structure of monosaccharides , the ring-size determination.</p> <p>CO26: The Haworth representations and non-planar conformations, anomeric effect , mutarotation, epimerization, reactions, osazone formation, bromine-water oxidation, HNO<sub>3</sub> oxidation, selective oxidation of terminal – CH<sub>2</sub>OH of aldoses, reduction to alditols.</p> <p>CO27: The Lobry de Bruyn-van Ekenstein rearrangement, stepping-up and stepping-down of aldoses, end-group interchange of aldoses, acetonide and benzylidene protections, Configuration of (+) glucose.</p> <p>CO28: The concept of disaccharide glycosidic linkages, structure of sucrose.</p> <p>CO29: The Polysaccharides, Elementary idea about starch and cellulose</p>
Organic Practical Chemistry	C30: The quantitative analysis of organic compounds and their estimation of Glucose by Fehling's solution, acetone and aniline.
<b>Physical Chemistry – III</b>	
Unit – I: Thermodynamics II & Application	CO31: Understand the concept of 2 <sup>nd</sup> law and its need, Carnot's cycle, physical concept of entropy, Joule Thomson coefficient.
Unit – II: Electrochemical Cells	CO32: Concept of electrochemical cells, half cell/ electrodes with types and examples, Nernst equation, potentiometric titration.
Unit – III: Chemical kinetics –II	CO33: The concept of collision theory of bimolecular reaction, concept of activation energy, types of catalyst and its specificity and

**SEMESTER – IV  
(HONOURS)**

	reactivity.
Unit – IV: Phase Equilibria & Colligative Properties	CO34: The concept phase, component, degree of freedom, clayperon equation, Duhem Murgules equation, phase diagram of one component system and colligative properties.
Physical Practical Chemistry	CO35: The method of determination equilibrium constant of the reaction $KI + I_2 = KI_3$ by partition method and Conductometric titrations of an acid or a base
<b>Fuel Chemistry (SEC Paper)</b>	
Unit – I: Energy Sources	CO36 : Different renewable and non-renewable energy sources CO37 : The Coal as a fuel CO38 : Fractionation of coal tar and coal liquification
Unit – II: Petroleum and Petrochemical Industry	CO39 : Other non-petroleum fuels and their production and uses C40 : Various petrochemicals and their uses
Unit – III: Lubricants	CO41 : Concepts of lubricants and their various properties

**SEMESTER – V  
(HONOURS)**

<b>Organic Chemistry – V</b>	
Unit I: Biomolecules	CO1 : Classification and physical properties of amino acid, concept of isoelectric point and its determination. CO2: The Strecker, Gabriel, acetamido malonic ester, azlactone, Bücherer hydantoin synthesis of amino acids. CO3: The Ninhydrin reaction, Dakin-West reaction, resolution of racemic amino acids, estimation of amino acids by Sorensen formol titration. CO4: Peptide linkage and its geometry of protein, syntheses of peptides using N-protection & C-protection, solid-phase peptidesynthesis. CO5: C-terminal and N-terminal unit determination, concept of primary, secondary and tertiary structure of proteins, classification of proteins and denaturation of proteins. CO6: Pyrimidine and purine bases nucleic acid, nucleosides and nucleotides corresponding to

	DNA and RNA, mechanism for acid catalysed hydrolysis of nucleosides, comparison of alkaline hydrolysis of DNA and RNA, elementary idea of double helical structure of DNA and complimentary base-pairing in DNA.
Unit II: Bioenergetics	<p>CO7: Brief Introduction to metabolism, ATP- The source of cellular energy, ATP hydrolysis and free energy change.</p> <p>CO8: Electron transfer process in biological redox systems, NAD<sup>+</sup>, FAD.</p> <p>CO9: Conversion of food to energy, outline of catabolic pathways of carbohydrateglycolysis, fermentation and Krebs cycle.</p>
Unit III: Pharmaceutical Compounds	<p>CO10 : Classification, structure and therapeutic uses of antipyretics.</p> <p>CO11: Synthesis of Paracetamol , Ibuprofen, Chloroquine.</p> <p>CO12: An elementary treatment of Antibiotics and detailed study of chloramphenicol, Medicinal values of curcumin, azadirachtin, vitamin C and antacid.</p>
Unit IV: Synthetic Methodology	<p>CO13 : The retrosynthetic analysis, disconnections and concept of synthons and synthetic equivalents, donor and acceptor synthons.</p> <p>CO14: Electrophiles and nucleophiles, natural reactivity and umpolung, synthesis involving umpolung strategy, latent polarity in bifunctional compounds, consonant and dissonant polarity.</p> <p>CO15: Interconversion and addition of functional groups and functional group removal.</p> <p>CO16: C-C disconnections and synthesis: one-group and two-group, reconnection 1,6dicarbonyl. Synthesis involving enolates and enamines with special reference to diethyl malonate and ethyl acetoacetate.</p> <p>CO17: The Robinson annelation, synthesis through protection of functional groups, Strategy of ring synthesis, thermodynamic and kinetic factors, synthesis of large rings,</p>

SEMESTER – V  
(HONOURS)

	application of high dilution technique. Concept and examples of cascade reaction.
Organic Practical Chemistry	CO18 : Concept of ylides, organic synthesis involving sulphur and phosphours.
<b>Inorganic Chemistry – IV</b>	
Unit-I: Redox Potential and Redox Equilibria	CO19 : Redox potentials and redox titrations
Unit-II: Nuclear Chemistry	CO20 : Radioactivity and stability of any nucleus , radio carbon dating
Unit-III: Organometallic Compounds	CO21: Organometallic compounds, their preparations nomenclature and properties.
Inorganic Practical Chemistry	CO22: Volumetric analysis: Redox titrations- permanganometry, dichromatometry, iodometry and iodimetry
Solid State Chemistry (DSE Paper)	
Unit-I: Basic Concepts and selected structure	CO23: Basic knowledge of structure of solids and crystal structure
Unit-II: Crystallographic Basics	CO24: Laws of crystallography and designation of crystal planes
Unit-III: Chemical Bonding in Solids	CO25 : Different types of bonding in crystals
Unit-IV: Properties of Solids	CO26 : Concepts of superconductor, semiconductors, transistors etc
<b>Environmental Chemistry (DSE paper)</b>	
Unit-I: The Atmosphere	CO27 : composition and structure of atmosphere, major air pollutant and their harmful effects and detection and collection of different air pollutants
Unit-II: Aspects of Environmental Inorganic Chemistry	CO28 : Atmospheric stability, Green house effect, ozone layer depletion, acid rain different diseases due to pollution.
Unit-III: The Hydrosphere	CO29 : Causes of water pollution and its effect; Waste water treatment, thermal pollution and radioactive pollution , water quality standard and hardness parameters
Unit-IV: The Lithosphere and Pollution control	CO30 : Soil pollution and its control, Biochemical method of different metals, Noise pollution agriculture and industrial pollution.

<b>Inorganic Chemistry – V</b>	
Unit-I: Bioinorganic Chemistry	CO1: 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 a) Errors in chemical analysis b) Solvent extraction c) Chromatography	CO2 : Basic idea of analytical chemistry  CO3: Concept of extraction and purification process of compounds  CO4: Different chromatography techniques
Unit-III Catalytic Inorganic Reaction	CO5 : Wilkinson, Zigler-Natta catalyst
Unit-IV Polymer	CO6 : Polymer chemistry
Inorganic Practical Chemistry	CO7: Complexometric Titration, Gravimetric Analysis, Solvent extraction
<b>Physical Chemistry - V</b>	
Unit – I: Chemical Equilibrium	CO8 :thermodynamic condition of equilibrium, Le Chatelier’s principle, Van’t Hoff isotherm, isobar and isochore
Unit – II: Statistical Thermodynamics & Third Law	CO9 : Probability, entropy and probability Residual entropy, Boltzmann distribution formula (with derivation) Einstein’s theory of heat capacity of solids and its limitations.
Unit – III: Symmetry & Group Theory	CO10 : Symmetry elements and operations with illustrations, symmetry elements and physical properties.point group classification.
Unit – IV: Quantum Chemistry	CO11 : Black body radiation, Planck’s radiation law, photoelectric effect. Wilson-Sommerfeld quantization rule Heisenberg uncertainty principle, Bohr’s correspondence principle and its applications to Bohr atom and particle in 1-d box, Elementary concept of operators, eigen functions and eigen values.
Unit – V: Photochemistry & Spectroscopy	CO12: Primary photo-physical processes, potential energy diagram. Franck-Condon principle and vibrational structure of electronic spectra, Fluorescence and phosphorescence, Jablonsky diagram, laws of photochemistry etc.
Physical Practical Chemistry	CO13 : Kinetics of saponification of ester by conductometric method; Ostwald dilution law
<b>Chemistry of Nanomaterials (DSE Paper)</b>	
Unit-I: Basic Concepts on Nanomaterials	CO14 : Basic concepts of nanomaterials and their activity

Unit-II: Synthesis and Fabrication of Nanomaterials	CO15 : Synthesis of nanomaterials
Unit-III: Special Nanomaterials	CO16 : Concepts of some special types of nanomaterials
Unit-IV: Characterization, Properties and Applications of Nanomaterials	CO17 : Characterisations of nanomaterials by using different instrumental techniques
<b>Dynamic Stereochemistry (DSE Paper)</b> Unit-I: General Introduction	CO18: The concept of regioselective, regio specific and chemoselective reactions.  CO19: Stereo-selectivity and stereospecificity, stereoselective reactions
Unit-II: Synthetic Approach	CO20: Asymmetric synthesis and asymmetric induction, diastereo selective synthesis.  CO21: Asymmetric synthesis with chiral substrates, Cram's rule – its application and deviation.  CO22: Felkin-Anh Model Prelog's rule, Enantio Selective synthesis.
Unit-III: Stereochemical Aspects of a few Organic Reactions	CO23: Polar addition reactions to alkene, Prevost and Woodward Hydroxylation, Hydroxylation by OsO <sub>4</sub> followed by reductive cleavage.  CO24: Catalytic reductions of alkenes and alkynes, nucleophilic substitution on saturated carbon, E <sub>1</sub> and E <sub>2</sub> reaction.  CO25: Stereoconvergent elimination, stereochemical aspects of a few molecular rearrangement – Pinacol rearrangement, Beckmann rearrangement, Claisen rearrangement and Cope rearrangement.
Unit-IV: Alicyclic system	CO26: Conformation and reactivity in cyclohexanes, steric effect and stereoelectronic effect.  CO27: Neighbouring group effects, effects of conformation on rearrangement and transannular reactions in alicyclic system.  CO28: Diastereo selection in cyclic system, reactions of cyclohexane derivatives, Hydrolysis of ester of cyclohexane carboxylic acids, esterification reaction of cyclohexane carboxylic acids, S <sub>N</sub> 1, S <sub>N</sub> 2, E <sub>1</sub> , E <sub>2</sub> , NGP,

		<p>reactions.</p> <p>CO29: Hydride reduction of cyclohexanones to cyclohexanols, oxidation of cyclohexanols with chromic acid, Merged substitution – elimination reaction.</p> <p>CO30: Reaction of 2-aminocyclohexanol by nitrous acid, Pinacol-pinacolone rearrangement in cyclohexanediols.</p>
	<p><b>Quantum Chemistry &amp; Spectroscopy (DSE Paper)</b> Unit – I: Quantum Mechanics</p>	<p>CO31 : Limitations of classical mechanics and solution in terms of quantum mechanics for atomic/molecular systems, develop an understanding of quantum mechanical operators, quantization, probability distribution, uncertainty</p>
	Unit – II: Atomic structure	CO 32: Principle, knowledge of spectral lines of atoms in the light of quantum mechanics,
	Unit – III: Molecular Spectroscopy	CO33: Some basic concepts of different types of molecular spectra such as vibrational, rotational, Raman, NMR, Mossbauer.
SEMESTER - III (GE/ PROGRAM)	<p><b>Physical Chemistry &amp; Inorganic Chemistry</b></p>	
	Unit – I: Phase Equilibria and Colligative Properties	CO1: Basic concept of phase rule in a binary liquid mixture, basic knowledge about colligative properties of solutions
	Unit – II: Electrochemistry	CO2: Introduction on electrochemistry, electrochemical cell formation, electrode potentials, concepts about conductance, transport number, limiting law
	Unit – III: Chemical Kinetics	CO3: 1st and 2nd order kinetics of chemicals reaction, information about catalysis and catalyst
	Unit – IV: Chemical and Ionic Equilibrium	CO4: Some idea about acid-base chemistry, Concepts of ionic equilibria
SEMESTER - IV (GE/ PROGRAM)	<p><b>Inorganic Chemistry &amp; Organic Chemistry</b></p>	
	Unit – I: Chemical Forces and Molecular Structure	CO5: Chemical bonding between atoms, molecules, interaction and energetic, hybridization and shapes of atomic, molecular orbitals, bond parameters, bond- distances
	Unit – II: Acids, Bases and Buffers	CO6: Concepts of acids and bases, electrolytes and electrolytic dissociation, salt hydrolysis
	Unit – III: Oxidation and Reduction	CO7: Understanding redox reaction.

	Unit – IV: Organic Synthesis	CO8: Understanding the preparation method of few organic compound,
SEMESTER - III (PROGRAM)	<b>Industrial Chemistry (SEC Paper)</b> Unit - I: Paints	CO9: Understanding to the chemistry of paints, varnishes and dyes
	Unit - II: Electrochemical and Electro-thermal Industries	C10: Preparation and uses of various compounds including KMnO <sub>4</sub> , CaC <sub>2</sub> , alloy steels etc.
	Unit - III: Ceramics	CO11: Understanding the chemistry of ceramics
	Unit - IV: Rusting of Iron and Steel	C12: Concepts of corrosion: cause and prevention
SEMESTER - IV (PROGRAM)	<b>Fuel Chemistry (SEC Paper)</b> Unit - I: Industrial Safety and Fire Protection	CO1: Various fire-extinguishers and their chemical contents
	Unit – II: Petroleum and Petrochemical Industry	CO2 : Other non-petroleum fuels and their production and uses CO3 : Various petrochemicals and their uses
	Unit – III: Lubricants	CO4 : Concepts of lubricants and their various properties
SEMESTER - V (PROGRAM)	<b>Applied Chemistry (DSE Paper)</b> Unit – I: Analytical Chemistry	CO1: Basic concepts of accuracy and precision in analysis, different types of errors, redox titration and various redox problems
	Unit – II: Basic Principle of Green Chemistry	CO2: Tools of green chemistry including the use of alternative starting materials, reagents, solvents, target molecules and catalyst (homogeneous, heterogeneous and biocatalysis)
	Unit III: Colloidal Chemistry	CO3: Concepts of coagulation, peptization, protective colloid, dialysis, gold number, isoelectric point, brownian motion
	Unit IV: Macromolecular Chemistry	CO4: Concepts of natural and synthetic polymers, different classification of polymers; structure and uses of some synthetic polymers.
	<b>Pharmaceutical Chemistry (SEC Paper)</b> Unit – I: Drugs & Pharmaceuticals	CO5 : Drug discovery, design and development; Synthesis of the representative drugs of the following classes: analgesics agents, antipyretic agents, anti-inflammatory agents; antibiotics; antibacterial and antifungal agents; antiviral agents, Central Nervous System agents, Cardiovascular, antilaprosy,



		HIV-AIDS related drugs
	Unit – II: Fermentation	CO6 : Aerobic and anaerobic fermentation. Production of (i) Ethyl alcohol and citric acid, (ii) Antibiotics; Penicillin, Cephalosporin, Chloromycetin and Streptomycin, (iii) Lysine, Glutamic acid, Vitamin B2, Vitamin B12 and Vitamin C
SEMESTER - VI (PROGRAM)	<b>Advanced Inorganic Chemistry (DSE Paper)</b>	
	Unit - I : Coordination Chemistry	CO1: Basic coordination chemistry, IUPAC nomenclature, idea about different ligand systems
	Unit – II: Chemistry of Main Group Elements	CO2 : A 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 distribution and position in the periodic table.
	Unit – III: Transition Metals	CO3: A 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 and position in the periodic table.
	<b>Chemistry of Cosmetics &amp; Perfumes (SEC paper)</b>	
	Unit – I: Preparation and Use of Cosmetics & Perfumes	CO4: A very details concepts of different component used in cosmetic and perfumes etc; Information regarding essential oils and their importance in cosmetic industries.