B.Sc., CHEMISTRY (UG) COURSE STRUCTURE UNDER CBCS PATTERN

(For the Candidates admitted from (2019-2020 onwards)

Sem		Title of the Course	H/ W	Credit	Internal	External	Total
I	Part-I	LC-I Language Course-I Tamil	6	3	25	75	100
	Part-II	ELC-I English Language Course-I	6	3	25	75	100
	Part-III	CC-I General Chemistry – I	5	4	25	75	100
		CC-II Volumetric Analysis Practical– I	3	-	-	-	-
		AC-I Mathematics – I	5	4	25	75	100
		AC-II Mathematics – II	5	4	25	75	100
	Part-IV	VE Value Education	2	2	25	75	100
			32	20			600
II	Part-I	LC-II Language Course-II Tamil	6	3	25	75	100
	Part-II	ELC-II English Language Course-II	6	3	25	75	100
	Part-III	CC-III General Chemistry – II	4	4	25	75	100
		CC-II Volumetric Analysis Practical-I	3	4	40	60	100
		AC-III Mathematics – III	5	4	25	75	100
	Part-IV	SKBC-I Material Chemistry and Nanotechnology	2	2	25	75	100
	Part-IV	EVS Environmental Studies	2	2	25	75	100
			28	22			700
III	Part-I	LC-III Language Course-III Tamil	6	3	25	75	100
	Part-II	ELC-III English Language Course-III	6	3	25	75	100
	Part-III	CC-IV General Chemistry – III	5	5	25	75	100
		CC-V Inorganic Microscale Qualitative Analysis – Practical II	3	-	-	-	-
		AC-IV Physics –I	5	4	25	75	100
		AC-V Practical-I	3	-	-	-	-
	Part-IV	SKBC-II Chemistry of consumer products	2	2	25	75	100
	Part-IV	Gender Studies	-	1	-	100	100
		Total	30	18			600

IV	Part-I	LC-IV Language Course-IV Tamil	6	3	25	75	100
	Part-II	ELC-IV English Language Course-IV	6	3	25	75	100
	Part-III	CC-VI General Chemistry – IV	5	5	25	75	100
		CC-VII Inorganic Microscale Qualitative Analysis – Practical II	3	4	40	60	100
		AC-V Physics –Allied practical II	3	4	40	60	100
		AV-VI Allied Physics – II	5	4	25	75	100
	Part-IV	NMEC-I Agricultural Science	2	2	25	100	100
	Part-IV	SS Soft skill	-	2	25	75	100
			30	27			800
V	Part-III	CC-VIII Inorganic Chemistry – I	6	5	25	75	100
		CC-IX Organic Chemistry – I	6	5	25	75	100
		CC-X Physical chemistry – I	5	5	25	75	100
		CC-XI Gravimetric Analysis & Organic compound analysis	3	-	-	-	-
		CC-XII Physical chemistry experiment & Organic preparation – Lab	3	-	-	-	-
	Part-III	EC-I Analytical chemistry	5	5	25	75	100
	Part-IV	NMEC-II Dairy Chemistry	2	2	25	75	100
			30	22			500
VI	Part-III	CC-XIII Inorganic Chemistry – II	6	5	25	75	100
		CC-XIV Organic Chemistry – II	6	5	25	75	100
		CC-XI Gravimetric analysis & Organic compound analysis	3	5	40	60	100
		CC-XII Physical chemistry experiment & Organic preparation – Lab	3	5	40	60	100
		EC-II Electrochemistry and Molecular Spectroscopy	6	5	25	75	100
		EC-III Molecular Dynamics	6	5	25	75	100
	Part-IV		-	1	-	-	100
			30	31			700
			180	**140**			4000
	Part-IV	CC Comprehensive Course	-	4	-	-	100

Course code & Title	CC-1- General Chemistry-I		
I year Chemistry	Semester -I	Credits: 4	Hrs/Wk:5

UNIT 1: Electronic Structure and Periodic Properties

1.1 **Electronic configuration:**

Quantum numbers and their significance – dual nature of electron. Principles governing the occupancy of electrons in various quantum levels-Pauli's exclusion principle, Hund's rule, Aufbau principle, Heisenberg uncertainty principle, stability of half-filled and fully filled orbitals – inert pair effect.

1.2 **Periodic Properties**

Size of atoms and ions – atomic radii, ionic radii, covalent radii - Periodic law and arrangement of elements in the periodic table. Ionization potentials, electron affinity and electronegativity along periods and groups. Pauling's and Mullikan's scales of electronegativity.

UNIT 2: Chemical bonding

2.1 Ionic bonding-ionic crystal, NaCl and CsCl structure**,** Lattice energy and Born Haber cycle, Polarizing power and polarizability-Partialionic character fromelectronegativity – Transition from ionic to covalent characterandFajan's rule-
applications of Fajan's rule.

2.2 **VSEPR** theory – shapes of inorganic molecule ($BeCl_2$, BF_3, $SiCl_4$, PCl_5, SF_6, IF_7, NH_3, H_2O and XeF_6).

2.3 **MO theory**: LCAO method-types of molecular orbitals-σ, π-and δ-MOs; combination of atomic orbitals to give σ- andπ-MOs and their schematic illustration; qualitative MO energy level diagram of homo- and heterodiatomic molecules- H_2,He_2,He_2^{2+}, O_2,N_2, F_2, CO, NO bond order and stability of molecules.

2.4 Hydrogen bonding – its nature, types, effect on properties. Intermolecular forces – London forces.

UNIT 3: Nomenclature, Classification and Basic Properties

3.1 IUPAC nomenclature, Classification of organic compounds, Hybridization (Methane, Ethane, Ethylene and acetylene).

3.2 Cleavage of bonds: homolytic and heterolytic cleavages. Stability of reactionintermediates, carbocation, carbanion, and free radicals.

3.3 Aromaticity and resonance structures, Huckel's rule.

3.4 Inductive, Inductomeric, Electromeric, Mesomeric, Resonance, Hyper conjugation and steric effects.

UNIT 4: Alkanes and Cycloalkanes

4.1 **Preparation of alkanes:** Wurtz reaction, reduction or hydrogenation of alkenes, Corey- House method, petroleum refining.

4.2 **Reactions:** Mechanism of halogenation, free radical substitution, sulphonation, nitration, oxidation, cracking and aromatization.

4.3 **Cycloalkanes:** Preparation using Wurtz reaction, Dieckmann's ring closure and reduction of aromatic hydrocarbons. Mechanism of substitution and ring-opening reactions.

4.4 Baeyer's strain theory and theory of strain less rings.

UNIT 5: Gaseous State

5.1 The perfect gas equation of state – Boyle's law, Charles's law and Avogadro's principle. Derivation of ideal gas equation.

5.2 Real gas equation –critical temperature – compression factor –Vander Waals equation of state- Boyle temperature - joule –Thomson effect- Linde refrigerator.

5.3 Molecular velocities-Root mean square, average and most probable velocities-Max well-Boltzmann distribution of molecular velocities (No derivation).– collision number and mean free path – collision diameter.

Course code & Title	CC-2*- VOLUMETRIC ANALYSIS		
I Year Chemistry	Semester - I & II	Credits: 4	Hrs/Wk: 3

I. Acidimetry – Alkalimetry

1. Estimation of Hydrochloric acid
2. Estimation of Sodium hydroxide

II. Permanganimetry

3. Estimation of Ferrous iron in Mohr's salt
4. Estimation of Oxalic acid
5. Estimation of calcium
6. Estimation of sodium Nitrite

III. Dichrometry

7. Estimation of Ferrous iron
8. Estimation of Ferric iron – by using both internal and external indicators (Demonstration Experiment)
9. Estimation of Potassium chlorate

IV. Iodo and Iodimetry

10. Estimation of copper
11. Estimation of potassium permanganate
12. Estimation of arsenious oxide

V. Complexometry

13. Estimation of Mg using EDTA.
14. Estimation of Ca using EDTA

Course code & Title	CC-3- General Chemistry-II		
II BSc., Chemistry	Semester - II	Credits: 4	Hrs/Wk: 4

UNIT I: Principles of titration and Halogen family

1.1 Basic requirement of a titration reaction – standard solutions – primary and secondary standards – types of titrimetric reactions – redox titrations – precipitation titrations.

1.2 Oxidation and reduction reactions – oxidation number concept, balancing redox equations by oxidation number method and ion electron method – equivalent weight of oxidizing and reducing agents.

1.3 Halogens family – Oxides and Oxyacids of halogens – estimation of available chlorine in bleaching powder – Interhalogen compounds – preparation, properties and uses. – Pseudohalogens – preparation, properties and uses of cyanogen and thiocynogens – chemistry of Astatine

UNIT II: Alkenes

1.1. **Alkenes**: General methods of preparations, dehydrogenation, dehydrohalogenation, dehydration - Mechanism of electrophilic and free radical addition, addition of hydrogen, halogen, hydrogen halide (Markownikoff's rule), hydrogen bromide (peroxide effect), sulphuric acid, water, hydroboration, ozonolysis, dihydroxylation with $KMnO_4$, allylic bromination by NBS.

1.2. Dienes: Types of dienes (conjugated, isolated and cumulative dienes)-Stability and chemical reactivity of 1,2 and 1,4 –additions. Synthesis of dienes - 1,3-butadiene, Isoprene and chloroprene.

1.3. 2.3. Kinetic and Thermodynamiccontrols of a reaction - Diels-Alder reactions.

UNIT III: Alkynes and Homocyclic Aromatic Hydrocarbons

1.1. **Alkynes**: Preparations - Acidity of alkynes- formation of acetylides- additionof water with $HgSO_4$ catalyst, hydrogen halides and halogens, oxidation, ozonolysis and hydroboration/oxidation.

1.2. **Benzene:** Extraction, industrial and laboratory preparations, purification.

1.3. **Properties:** Electrophilic substitution reactions, Nitration, sulphonation, halogenation, Friedel Crafts alkylation and acylation with mechanisms. Disubstitution reactions aromatic compounds, orientation and reactivity.

UNIT: IV Colloidal and Liquid States

1.1. **Colloidal state:** True solution and colloids – types of colloids peptisation, coagulation - Applications – reverse osmosis – desalination of sea water – dialysis – delta formation – artificial rain – clarification of water (addition of polyvalent electrolytes), detergent action of soap – sewage disposal – Cottrell's precipitator.

1.2. **Liquid state** – Liquid crystal –classification, structure, properties and applications.

1.3. **Gels** and Emulsions.

UNIT–V-Electrical and Magnetic Properties of Molecules

5.1 Induced dipole moment – polarisability polarization of a molecule in an electric field – Clausius – Mosotti equation and Debye equation (derivation not required) – measurement of dipole moment for molecules – vapour temperature method, dilute solutionmethod.Bond moments-bond angle - dipole moment and molecular structure (CO_2, NH_3,CCl_4 and o,m and p-dichlorobenzene)

5.2 Magnetic permeability, magnetic flux, density(B), magnetic field intensity(H), magnetic susceptibility, magneticmoment (M), Diamagnetism, Paramagnetism, Ferromagnetism – anti ferromagnetism.

5.3 Measurements of magnetic susceptibility – Gouy method-number of unpaired electrons-spin only value for magnetic moment – application to structural problems of $K_3[Fe(CN)_6]$, $K_4[Fe(CN)_6]$ and $[Ni(CO)_4]$.

Course code & Title	Skill Based Subject I -Material Chemistry and Nanotechnology		
I B.Sc., Chemistry	Semester – II	Credits : 2	Hrs/Wk : 2

UNIT I: IONIC CONDUCTIVITY AND SOLID ELECTROLYTES:

1.2 Types of ionic crystals – alkali halides – silver chloride-alkali earth fluoride–simple stoichiometric oxides. Types of ionic conductors – halide ion conductors – oxide ion conductors – solid electrolytes – applications of solid electrolytes.

2.2 Electrochemical cell – principles – batteries, sensors and fuel cells

UNIT II: MAGNETIC MATERIALS

1.1 Introduction – types of magnetic materials – diamagnetism –paramagnetism, ferromagnetism. Ferrites: Preparation and their applications in microwave –floppy disk – magnetic bibble memory and applications.

1.2 Insulating Materials: Classification on the basis of temperature – Blymer insulating materials and ceramic insulating materials. FerroElectric materials: examples – applications of ferroelectrics.

UNIT III: MODERN ENGINEERING MATERIALS:

1.1. Metallic glasses – introduction –composition, properties and applications. Shape memory alloys: introduction – examples – application of SMA –advantages and disadvantages.

1.2. Biomaterials: Introduction –metals and alloys in biomaterials –ceramic biomaterials,composite biomaterials-polymer biomaterials.

UNIT IV: NANOPHASE MATERIALS:

1.1. Introduction – techniques for synthesis of Nano phase materials –sol-gel synthesis-electrodeposition –inert gas condensation-mechanical alloying –properties of Nano phase materials.

1.2. Applications of Nano phase materials, composite materials: Introduction –types.

UNIT V: NANO TECHNOLOGY

5.1 Introduction –importance –various stages of nanotechnology –nanotube technology – nanoparticles.

5.2 Fullerenes-nanodendrimers –nanopore channels, fibres and scaffolds – CVD dismond technology –FCVA technology and its applications –Nano imaging techniques.

Course code & Title	CC-4 - GENERAL CHEMISTRY- III		
II B.Sc., Chemistry	Semester - III	Credits : 5	Hrs/Wk : 5

UNIT 1: Chemistry of S-Block Elements

1.1 Position of Hydrogen in the Periodic Table, atomic hydrogen, nascent hydrogen, occluded hydrogen, uses of hydrogen – General characteristics of s-block elements – generalcharacteristics of IA group elements – Diagonal relationship between Li and Mg.

1.2 Extraction of Lithium, Sodium –physical and chemical properties – uses. Preparationof

NaOH and Na_2CO_3 (Laboratory and Industrial methods) – properties and uses. Extraction of potassium – properties and uses. Chemistry of KOH, KBr and KI.

1.3 General characteristics of Elements of Group IIA – diagonal relationship between Be and Al – Extraction of Mg – physical and chemical properties – uses – chemistry of some compounds of Mg, $MgSO_4$, $MgCO_3$, $MgCl_2$, $Mg(NH_4)PO_4$ $6H_2O$. Extraction of calcium – physical and chemical properties – uses.

UNIT II: P-Block Elements - Boron and Carbon and Nitrogen Families

2.1 General characterization of p-block elements – general characteristics of GroupIIA – diagonal relationship between B and Si. Extraction of Boran and Aluminium – physical and chemical properties and uses. Chemistry of some compounds of Boron and Aluminium Boric acid, Borax,, Diboran, Boron nitride, Al_2O_3, $AlCl_3$, Alum – Alloys of aluminium.

2.2 General characteristics of elements of Group IVA. Difference of carbon and silicon – allotropic forms of carbon-Chemistry of charcoal – chemistry of oxides of carbon (CO and CO_2) – uses of CO_2 in fire extinguishers. Manufacture of glass – types of glass – extraction of Lead – physical and chemical properties – uses – Lead pigments.

2.3 General characteristics of elements of VA group – the unique features of nitrogen from the rest of the family – preparation of Nitrogen - physical and chemical properties of Nitrogen – uses. Industrial preparation of ammonia, physical and chemical properties – uses. Chemistry of some compounds of Nitrogen, Hydrazine, Hydroxylamine,

Hydrazoic acid. Physical and chemical properties – uses-chemistry of PH_3, PCl_3, PCl_5, $POCl_3$, P_2O_5 and oxyacids of phosphorous.

UNIT III: Alkyl halides

1.1 Alkyle halides, Haloalkanes and Haloalkenes – Grignard reagents and their synthetic Uses - Aliphatic Nucleophilic substitutions, SN_1, SN_2 and SN_i reactions mechanism. Effect of solvents, leaving groups, nucleophiles and structure of substrate.

1.2 Elimination reactions – Hofmann and Satyzeff's eliminations. Mechanism of E1 and E2 reactions. – Relative reactivity of ethyl, vinyl, allyl, aryl and benzyl halides.

1.3 Aromatic hydrocarbons –structure, stability of benzene ring, resonance in benzene and electron cloud in benzene – Aromaticity, Huckel's rule and examples. Benzene, Naphthalene, Anthracene, Furan, Pyrrole, thiophene and pyridine.

UNIT–IV- Substitution Reactions

1.1 Electrophilic substitution in aromatic compounds – General mechanism of electrophillic substitution reactions. Effect of substituents, activating and deactivating groups, orientation.

1.2 Nitration, sulphonation, halogenation, friedel-grafts alkylation and acylation reactions. Nuclear and side chain halogenation - Polynuclear Hydrocarbons – Naphthalene and Anthracene – isolation, properties structure and uses.

1.3 Aromatic nucleophilic substitution – Benzene mechanism and intermediate complex formation mechanism. Effect of substituents on reactivity.

UNIT-V: Introduction to group theory.

5.1. Group theory and its applications – Definition of group, class, subgroup, abelian and multiplication table- Symmetry elements- symmetry operations.

5.2. Point group - point group of simple molecules (H_2,CO_2,H_2O,NH_3,BF_3,C_6H_6 and CH_4).

Course code & Title	CC-5-Practical-II-Inorganic Micro Scale Qualitative Analysis		
II B.Sc., Chemistry	Semester: III & IV	Credits:4	Hrs/Wk:3

1. Analysis of simple and acid radical: carbonate, sulphide, sulphate, chloride, bromide, iodide, nitrate.
2. Analysis of interfering radicals: fluoride, oxalate, borate, phosphate and their elimination.
3. Analysis of basic radicals (group wise)-lead, copper, bismuth, cadmium, antimony, iron, aluminum, zinc, manganese, nickel, cobalt, calcium, strontium, barium, magnesium, ammonium.
4. Analysis of mixture containing two cations and anions of which one will be interfering anion.
5. Demonstration experiments:
   i) Determination of calcium, magnesium, iron, sulphate, chloride, &carbonate water.
   ii) Detection of potassium, sodium, nitrate, chloride and phosphate in soil.

Course code & Title	Skill Based Subject II – Chemistry of consumer products		
II B.Sc., Chemistry	Semester - III	Credits : 2	Hrs/Wk : 2

Unit I: Household materials

1.1. Manufacturing process – composition and uses of safety matches.

1.2. Agarbathis, naphthalene balls, wax candles, shoe polish, writing/ fountain pen ink, chalk crayons and gum paste.

Unit II: Soaps

1.1. Soaps – introduction – types – hot process – batch process – continuous process – manufacture of soap by continuous process.

1.2. Toilet and transparent soaps, laundry soaps – oils to be used in soaps – cleaning action of soaps.

Unit III: Paints and varnishes

1.1. Paints: Introduction – manufacture – setting of the paint. Pigments: Definition – classification.

3.2 Varnishes: Introduction – types – manufacture – solvents and thinner – paint and varnish industry in India.

Unit IV: Detergents

1.1. Detergents: Introduction – principal groups of synthetic detergents – classification of surface active agents – biodegradability of surfactants – anionic detergents – oxo process

1.2. Alfol process – Welsh process – cationic detergents.

Unit V: Shave lotion and shampoo

5.1. Shave lotion: Introduction – factors for growth of shave lotion industries – uses – Formulation with process.

5.2 Hair shampoo: Introduction – properties – uses and application – raw materials – types– protein and egg shampoo, herbal shampoo, vitamin shampoo, anti-dandruff shampoo– manufacturing process – flow sheet.

Text Books:

1. B.K.Sharma, Industrial Chemistry, Goel Publishing House, 6th edition, 1994.

2. P.K.Chattopadhyay, Modern Technology of Soaps, Detergents and Toiletries, 2nd edition, 2005.

Course code & Title	CC-6 - GENERAL CHEMISTRY- IV		
II B.Sc., Chemistry	Semester - IV	Credits : 5	Hrs/Wk : 5

UNIT 1: Chemistry of P-Block elements O, X and Noble Gas Families

1.1 Anomalous behavior of oxygen – paramagnetic nature of oxygen, preparation, properties, structure and uses of oxyacids of Sulphur. Classification of oxides based on their chemical behavior – acidic oxide – amphoteric oxide and neutral oxides. Classification of oxides, peroxides, super oxides, dioxides. Chemistry of selenium and Tellurium.

1.2 General characteristics of halogen with reference of electronegativity, electron affinity, oxidation states and oxidizing power. Peculiarities of fluorine. Hydrides, oxides and oxoacids of halogens. Inter halogen compounds and pseudo halogens – basic nature of iodine.

1.3 Nobel gases: Position of periodic table – isolation from atmosphere – General characteristics – structure and shape of xenon compounds – XeF_4, SeF_6, $XeO_3$and $XeOF_4$ – uses of noble gases.

UNIT II: Inner Transition elements

1.1. Lanthanides – occurrence – general study of lanthanides involving electronic configuration, oxidation states, magnetic properties and complexation behavior – Lanthanides separation by ion exchange and solvent extraction methods – Lanthanide contraction.

1.2. Actinides – occurrence – electronic configuration, oxidation states, magnetic properties and complexation behavior – comparison of lanthanides and actinides and their position intheperiodic table.

1.3. Elements with atomic number 104 and 105. Preparation and their position in the periodic table – Chemistry of Thorium and Uranium – occurrence, ore, extraction and uses

UNIT III: Hydroxy Derivatives

1.1 Aliphatic alcohols: Preparation by hydroboration, oxidation, Reduction of carbonyl compounds, epoxidation, and Grignard synthesis.

1.2 Reactions with reference to C-OH bond cleavage and O-H bond cleavage, iodoform test.

1.3 Phenols: Nomenclature, physical properties, hydrogen bonding.

1.4 Preparation: Industrial source, preparation from diazonium salts and sulphonic acids.

1.5 Reactions: acidity, ether formation, ester formation, mechanism of ring substitution, nitration, sulphonation, halogenation, Friedel-Craft's reaction, nitration, coupling reactions, Kolbe's reaction and Riemer-Tiemen reaction.

UNIT –IV Chemical Kinetics

1.1 Definition – concentration versus time curves to determine rate – rate laws for zero, first, second and third order reactions – rate constant – units of rate constants – order and molecularity – derivation of expressions for rate constants for zero, first, second and third order reactions (same concentration) – half – life period pseudo first order reaction, methods of determination of order of reactions integration, graphical, half-life and Ostwald's isolation methods.

1.2 Temperature dependence of reaction rates – Arrhenius parameters and calculations – Theories of reaction rates-simple collision theory – limitations ARRT – thermodynamics derivation of rate constant.

1.3 Steady state approximation-Lindemann's hypothesis of unimolecular reactions.

UNIT V: Catalysis

5.1 **Homogeneous catalysis:**Intermediate complex and adsorption theories – Types of catalyst. Promotors and poisons**.** Reactions in gases and in solutions (Acid, base and Wilkinson's catalysts).

5.2 **Enzyme catalysis –** mechanism – factors affecting enzyme catalysis – Michalis Menton equation.

5.3 **Heterogeneous catalysis -**Langmuir adsorption isotherm. Its application to slightly, strongly, and moderately adsorbed systems. Theory of heterogeneous catalysis on the basis of Langmuir adsorption –Uni- and bimolecular reactions on solid surfaces.

Course code & Title	NMEC- I Agricultural Science		
II B.Sc., Chemistry	Semester - IV	Credits : 2	Hrs/Wk : 2

Unit-I: Soil formation.

1.1. Origin of earth-Geological formation of India-soil forming rocks and minerals. Classification –Weathering of ricks and minerals-processes of weathering and factors affecting them.

1.2 .Soil formation-factors of soil formation soil forming processes-profile development-Definition of soil-soil composition.

Unit-II: Properties of soil.

2.1. Soil chemical properties-soil colloids-inorganic colloids-clay minerals-Amorphous –Ion exchange reactions-Organic colloids-soil organic matter-Decomposition.

2.2. Humus formation-significance on soil fertility, soil reaction-Biological properties of soil-Nutrient availability.

Unit-III: Fertilizers.

3.1. Fertilizer-Definition-Fertilizer recommendation based on soil testing-Nitrogenous fertilizer-Effect of nitrogen on plant growth and development.

3.2. Phosphate fertilizer. Effect of phosphorous on plant growth and development-functions of potassium on plant growth-Mixed fertilizer-Micro nutrients and their role in plant life.

Unit-IV: Pest management and control.

4.1. Pesticides-Formulations- Emulsifiable concentrate, water miscible liquids, wet table powders, dusts, granules.

4.2. classification of pesticide-mode of action-characteristics-uses- impact of pesticides on environment-safety measures in the analysis and handling of pesticides.

Unit-V: Fungicides and herbicides.

5.1. Fungicide-Inorganic-sulphur compounds-Organic-Dithiocarbamates. Herbicides-Inorganic herbicides-Arsenic compounds.

5.2. Cyanamide-Cyanides-chorates and sulphamates. Organic herbicides and nitro compounds

Course code & Title	CC-7- INORGAMIC CHEMISTRY-I		
III B.Sc., Chemistry	Semester - V	Credits :5	Hrs/Wk : 6

UNIT -I Coordination Chemistry-I

1.1 Definition of the terms-Classification of ligands-Nomenclature of mononuclear and polynuclear complexes-chelating ligands and chelates effect - Co-ordination Number and stereochemistry of complexes.

1.2 Werner‘s theory- - Sidgwick‘s theory-Effective Atomic Number concept.

1.3 Isomerism in complexes-Structural Isomerism—types. Stereoisomerism Geometrical isomerism in 4 and 6 coordinated complexes. Optical isomerism in 4- and 6-coordinated complexes-

UNIT-II Coordination Chemistry-II

2.1 Theories of bonding in complexes-Valence Bond Theory-Postulates – Hybridization and geometries of complexes-Outer orbital and inner orbital octahedral complexes. Square planar and tetrahedral complexes-V.B. Theory and magnetic properties of complexes-limitations of V.B. Theory.

2.2 Crystal Field Theory-postulates-d-orbital splitting in octahedral, tetrahedral and square planar complexes-strong and weak ligands-Spectrochemical series-High spin and low spin complexes-C.F. Theory and magnetic properties of complexes-Crystal Field Stabilization Energy (CFSE) and its uses-Calculation of CFSE values of d^1 to d^{10} Octahedral and Tetrahedral complexes- C.F theory and colour of complexes-limitations of C.F. theory-comparison between VBT and CFT.

UNIT-III Reaction Mechanism and Application ofComplexes

3.1 Substitution reactions in square planar complexes-Trans Effect-uses of Trans effect-Theories of Trans effect-polarization theory and π-bonding theory.

3.2 A brief outline of thermodynamic and kinetic stability of metal complexes, stepwise and overall stability constants, factors affecting the stability of complexes, chelate effect.

3.3 Application of coordination compounds in Qualitative and Quantitative analysis-separation of Copper and Cadmium ions, Cobalt and Nickel ions- Identification of Cu, Fe, and Ni. .

3.4 EDTA and its applications - hardness of water and sequesterisation.

UNIT IV: Transition Elements

1.1 Occurrence of transition metals - important uses of transition metals and their alloys, toxicity of Cd and Hg.

1.2 Metallurgy of Ti, V, W, Cr. Interstitial compounds: nitrides, carbides, hydrides, borides of Ti, V, Cr, W, U and their industrial uses.

1.3 Biological importance of transition metals: biological roles of Cr, Mo, Mn, Fe, Co, Cu, and Zn (mention of metal containing proteins and enzymes and their biological roles).

UNIT V: Industrial Inorganic Chemistry

1.1 Fossil fuels - varieties of coal and petroleum - petroleum refineries in India- fuel gases - calorific value - composition and preparation of water gas, semi water gas, carbureted water gas, producer gas, natural gas, LPG and biogas.

1.2 Safety matches, fireworks and explosives - manufacturing details paints and varnishes - manufacture and uses. Effluents and their treatment (Dye, Cement, Tannery, distillery units)

Course code & Title	CC-8- ORGANIC CHEMISTRY-I		
III B.Sc., Chemistry	Semester - V	Credits: 5	Hrs/Wk : 6

UNIT I: STEREOCHEMISTRY-I

1.1 Stereoisomerism – Definition – Types - classification into optical and geometrical isomerism.

1.2 Optical isomerism – optical activity – optical and specific rotation – Criteria for optical activity. Asymmetric center – chirality – Achiral molecule – Meaning of (+) and (-). D and L notation – Elements of symmetry , enantiomers, diastereomers, enatiomeric excess – Recemization – (by substitution and tautomerism), Resolution – Methods of Resolution (Mechanical separation biochemical and Conversion to diastereoisomers), Asymmetric synthesis – Partial and Absolute asymmetric synthesis. Walden inversion.

1.3 Notations for optical isomers – Cahn-Ingold – Prelog rules – R-S notations for optical isomers with one asymmetric carbon. Optical activity in compounds containing no asymmetric carbon – Biphenyl, Allenes and spiranes. Optical activity of symmetric (meso tartaric acid), asymmetric system (Lactic acid).

UNIT II: STEREOCHEMISTRY- II

2.1. Conformational isomerism – conformers, dihedral angle – torsional strain – Conformational analysis of Ethane and n-butane , conformers of cyclohexane (chair, boat and skew form), axial – equatorial position and their inter conversion, conformers mono and disubstituted cyclohexanes, 1,2 and 1,3 interactions.

2.2. Geometrical isomerism – Cis-trans, Syn-Anti and E-Z notations – Geometrical isomerism in Maleic and Fumaric acids and in unsymmetrical Ketoximes – Methods of distinguishing geometrical isomers (Dipole moment, Dehydration, Heat of hydrogenation, cyclization)

UNIT – III: REACTIONS OF CARBONYL COMPOUND

1.1 Carbonyl polarization – Reactivity of carbonyl group

1.2 Mechanisms of Aldol, Perkin, Knoevenagal and Benzoin condensation, Mechanisms of Claisen and Cannizaro reactions.

1.3 Mechanism of Reduction (Sodium borohydride, Lithium aluminium Hydride and Wolf Kishner reductions, Birch reduction)

1.4 Photo chemistry of carbony compounds – Norrish – I and Norrish – II types.

UNIT – IV: ACIDS AND ACIDS DERIVATIVES

4.1 Ionization of carboxylic acids – acidity constant – comparison of acid strengths of substituted haloacids – avid strength of substituted Benzoic acids = Hammett equation.

4.2 Dicarboxylic acids – preparation and properties of oxalic acid, malonic acid, succinic acid, unsaturated dicarboxylic acids – Maleic acid, Fumaric acid – preparation – properties and uses.

4.3 Malonic and Acetoacetic ester – characteristics of reactive methylene group – synthetic uses of acetoacetic ester.

4.4 Tautomerism – Definition – Keto enol tautomerism(Identification, acid and base catalysed interconversion mechanism) Amido-imdio and Nitro, Acinitro tautomerism (interconversions alone).

UNIT –V: HETEROCYCLIC COMPOUNDS

5.1. Polynuclear hydrocarbons-Naphthalene, anthracene and phenanthrane-Isolation, properties and uses.

5.2. Heterocyclic compounds-Aromatic Characteristics of heterocyclic compounds. Preparation, properties and uses of Furan, pyrrole and Thiophene. Structure, synthesis and reactions of pyridine and piperidine.

5.3. Synthesis and reactions of Quinoline, Isoquinoline and indole with special references to Skraup, Bischler- Napieralski and Fischer - Indole synthesis

Course code & Title	CC-9- PHYSICAL CHEMISTRY-I		
III B.Sc., Chemistry	Semester - V	Credits: 5	Hrs/Wk: 5

Unit-I: First law of thermodynamics.

1.1 Definition of system, surrounding, isolated, closed, open, homogeneous and heterogeneous system. State of a system –extensive and intensive properties. Thermodynamics process-Cyclic, Reversible, Irreversible, isothermal and adiabatic process. Difference between reversible and irreversible process-state and path functions. Concept of work and heat. Work of expansion at constant pressure and free expansion.

1.2 The Zeroth law and first law of thermodynamics –statements. Definition of internal energy enthalpy and heat capacity –Relation between C_p and C_v-calculation of W,Q, dE, dH for expansion of ideal gas under reversible isothermal and adiabatic conditions.

1.3 Joule's law-Joule-Thomson effect. $\mu_{J.T}$ and its relation with thermodynamic quantities and inversion temperature – temperature dependence ofΔH- Kirchoff's equation.

Unit-ll: Second law of the thermodynamics:

1.1 Need for the II - law – Different statements – Heat engine – Carnot's cycle and its efficiency – Carnot's thermodynamic scale of temperature.

1.2 Concept of entropy – entropy as a state function – entropy as a function of P, V& T- Entropy change in phase changes – Entropy of mixing – entropy as a criterion of spontaneous and equilibrium processes in isolated system.

1.3 Gibbs (G) and Helmholtz (A) function - A and G as criteria for thermodynamic equilibrium and spontaneity Variation of A and G with P,V and T.- Gibbs – Helmholtz equation and its applications- Maxwell's relations. Thermodynamic equations of state.

Unit-lll: Applications of ll -Law of thermodynamics & Third law:

1.1 Equilibrium constant and free energy change – Reaction isotherm – vant Hoff's equation – van't Hoff's isochors – clapeyron and Classius – Clapeyron equation and

applications. Thermodynamic interpretation of Le-Chatelier's principle (concentration, temperature, pressure and addition inert gases.

1.2 Equilibrium between different phases – System of variable composition – Partial molar quantities – Chemical potential in an ideal mixture – Gibb's – Duhem equation

1.3 Need for the lll- law – Nernst heat theorem – Evaluation of absolute entropy form heat capacity data – Exception to the third law (Ortho-para hydrogen and CO_2 only).

Unit-lV: Phase equilibria.

1.1 Meaning of the terms – Phase, component and degree of freedom – Derivation of Gibb's phase rule – equilibrium in one component systems – Water and sulphur.

1.2 Phase equilibrium of two component systems – Solid-Liquid equilibria – simple eutectic systems Bi-Cd and Pb-Ag system. Desilverisation of lead.

1.3 Compound formation with congruent melting point (Mg-Zn) and incongruent melting points (Na-K), NaCl – water system – freezing mixtures – Gas-Solid equilibria – ($CuSO_4$– H_2O system) – Efflorescence and Deliquescence.

Unit-V: Solutions

5.1 Henry's law and its limitations. Activity activity co-efficient in liquids. Duhem – Margule's equation and its application to fractional distillation of binary miscible liquids – Azeotropes (HCl-H_2O system).

5.2 Partially miscible liquid pairs, Phenol – Water, Triethylamine – water system.

5.3 Immiscible liquid pairs – Principles and application of steam distillation – Nernst distribution law – Derivation and applications.

Course code & Title	CC-10-PRACTICAL-III-GRAVIMETRIC AND ORGANIC ANALYSIS		
III B.sc., Chemistry	Semester - V & IV	Credits : 5	Hrs/Wk : 3

GRAVIMETRIC ANALYSIS

1. Estimation of calcium as calcium Oxalate monohydrate.
2. Estimation of barium as barium sulphate.
3. Estimation of barium as barium Chromate.
4. Estimation of lead as lead sulphate.
5. Estimation of lead as lead Chromate.
6. Estimation of magnesium as magnesium oxinate.

ORGANIC ANALYSIS

Characterization of organic compounds by their functional groups and conformation by preparation of derivatives.

Demonstration experiment.

Extraction of Rose oil from Rose (soxhlet extraction)

UV visible spectrum – simple compound analysis

Course code & Title	CC-11-PHYSICAL CHEMISTRY EXPERIMENTS AND ORGAMIC PREPARATIONS		
III B.Sc., Chemistry	Semester - IV & V	Credits : 5	Hrs/Wk: 3

PHYSICAL CHEMISTRY EXPERIMENT:

1. Distribution law:

   Partition co-efficient of Iodine between carbon tetra chloride and water.

2. Kinetics:

   Acid catalyzedhydrolysis of an ester (Methyl acetate or Ethyl acetate).

3. Molecular weight:

   Rast's method: Naphthalene, m- dinitro benzene and diphenyl as solvents.

4. Heterogeneous equilibrium:

a) Critical solution temperature of phenol-water system –effect of impurity

(2%NaCl or2%Succinic acid solutions)

b) Simple eutectic systems: Naphthalene- Biphenyl, Naphthalene- Diphenylamine.

a) Determination of transition temperature: (sodium acetate, sodium thiosulphate, $SrCl_2.6H_2O$ and $MnCl_2.4H_2O$)

5. Electro chemistry:

a)Conductivity:(I) Cell constant(II)Equivalent conductivity(III)Conductometric Titrations

A) Strong Acid Vs Strong base

B) Weak Acid Vs Strong base

b) Potentiometry: (1) P^H Determination (2) Potentiometic titrations (Acid Base and Redox titrations)

ORGANIC PREPARATIONS:

Preparation involving oxidation, reduction, hydrolysis, Nitration, sulphonation, halogenations and diazotisation.

Course code & Title	ELECTIVE-I-ANALYTICAL CHEMISTRY		
III B.Sc., Chemistry	Semester– V	Credits : 5	Hrs/Wk : 5

UNIT-l: LABORTORY HYGIENE AND SAFETY:

1.1 Storage and handling of chemicals- Corrosive, flammable, explosive, poisonous, carcinogenic and toxic chemicals.

1.2 **First Aid Techniques:**Acid in eye, alkali in eye, acid burns, alkali burns, bromine burns, poisoning, inhalation of toxic vapours, cut by glasses and burns.

1.3 **Data Analysis:**Errors in chemical analysis – Types of errors. Determinate errors, personal errors, instrumental errors, correction of determinate errors- indeterminate errors. Precision, accuracy and rejection of data, significant figures –Mean – Mean deviation and standard deviation. Curve fitting, Method of least squares.

UNIT-ll: SEPARATION TECHNIQUES:

1.1 Precipitation – principle – solvent Extraction – Continuous extraction and soxhlet extractor.

1.2 **Chromatography:** Chromatography – Types – General principles involved in adsorption, partition and ion exchange, paper thin layer, column, gas liquid chromatography, Electro chromatography.

1.3 **Purification techniques:** Desiccants, Vacuum drying, distillation – fractional distillation, steam distillation, Azeotropic distillation, Crystallization and sublimation – principles and techniques.

UNIT-lll: THERMOANALYTICAL METHODS:

1.1 Thermogravimetric analysis and differential thermal analysis – principle and instrumentation. Characteristics of TGA ($CaC_2O_4.H_2O$). Factors affectingTGA and DTA curves.-Thermometric titration of HCl Vs NaOH.

1.2 **Gravimetric Analysis:**Characteristics of precipitation agent – choice of precipitants – specific and selective precipitant. Condition of Precipitation. Types of precipitates – Purity of Precipitates. Co-precipitation and post precipitation. Precipitation from homogeneous solution.

1.3 Digestion and washing of precipitate. Ignition of the precipitate. Use of sequestering agents. Electro gravimetric Analysis and polarography.

UNIT-lV: COLORIMETRIC ANALYSIS:

4.1 Laws of Calorimetry – Instrumentation, Nessler's and photoelectric colorimetric method – operation and applications. Estimation of Ni, Cu and Fe.

4.2 **Techniques in Kinetics:**Principles and techniques used to follow the kinetics of ordinary and fast – photo chemical reactions.

4.3 **Organic Estimations:** Principles and methods to estimate glucose, ascorbic acid, phenol, aniline, ketone, oils and fats. Iodine value, saponification value, RM value and acetyl value.

UNIT-V: COMPUTER APPLICATON IN CHEMISTRY:

5.1 The block diagram of a PC – Algorithms and flow charts.

5.2 Introduction to 'C'- Features of C language – Question mark operator – control statement - switch statement – Go to statement – Loops.

5.3 Examples of simple chemistry programs.

1. Conversion of Celsius temperature to Kelvin temperature.
2. Application of Beer Lambert Law.
3. Molecular weight from atomic weights.
4. Use of question mark operator – Work of isothermal or adiabatic expansion of ideal gases.

Course code & Title	NMEC – II-DAIRY CHEMISTRY		
III Year other major students	**Semester - V**	**Credits : 2**	**Hrs/Wk : 2**

5. Calculation of molecular weights of different organic compounds from formulas and data on atomic weights of C,H,S,O and halogens.
6. Calculation of molar heat capacity.
7. Calculation of first order rate constant.
8. Calculation on Enthalpy of a reaction. **UNIT I:**

1.1 **Milk:** General composition of milk.

1.2 Factors affecting the gross composition of milk, physico-Chemical change taking place in milk due to processing parameters-boiling pasteurization- sterlilzation and homogenization.

UNIT II:

2.1 Milk lipids-terminology and definitions

2.2 Milk proteins: Physical properties of milk proteins-Electrical properties and hydration, solubility. Reaction of milk proteins with formaldehyde and ninhydrin.

2.3 Milk carbohydrate-Lactose- Estimation of lactose in milk.

2.4 Milk vitamins-water and soluble vitamins, effect of heat and light on vitamins

2.5 Ash and mineral matters in milk.

UNIT III:

3.1 **Creams:** Definition-composition-chemistry of creaming process-gravitational and centrifugal methods of separation of cream-Factors influencing cream separation (Mention the factors only)-Cream neutralization. Estimation of fat in cream.

3.2 **Butter:** Definition-% composition-manufacture-Estimation of fat, acidity, salt and moisture content-Desi butter.

UNIT IV:

4.1 **Milk powder:** Definition-need for making powder-drying process-spraying, drum drying, jet drying and foam drying-principles involved in each. Manufacture of whole milk powder by spray drying process-keeping quality of milk powder.

4.2 Ice cream: Definition-percentage composition-types- ingredients needed - manufacture of ice-cream stabilizers-emulsifiers and their role.

UNIT V:

5.1 Dairy Detergents: Definition-characteristics-classification-washing procedure (modern method) sterilization-chloramin-T and hypochlorite solution.

Course code & Title	CC-12- INORGAMIC CHEMISTRY-II		
III B.Sc., Chemistry	Semester - VI	Credits : 5	Hrs/Wk: 6

UNIT-I NUCLEAR CHEMISTRY-I

1.1. Composition of Nucleus, Fundamental particles, nuclear radius, nuclear massand nuclear forces operating between the nucleons–Meson field theory- .

1.2. Nuclear stability - N/P ratio, curves, stability belts. Nuclear binding energy. Mass defect, packing fraction - simple calculations involving mass defect and B.E per nucleon, magic numbers - liquid drop model - shell model.

1.3. Isotopes- Detection and separation. Deviation atomic weights from whole number - isobars, isotones. Isomers.

UNIT - II NUCLEAR CHEMISTRY-II

1.1 Radioactivity – discovery, detection and measurements (Wilson Cloud chamber) radioactive emanations - radioactive series including neptunium series - group displacement law. Units of radioactivity – radioactive disintegration-Half life and average life-Radioactive equilibrium – Numerical problems.

1.2 Nuclear transformation – Nuclear fission and fusion, Nuclear reactors. Application of radioactive isotopes-C-14 dating, rock dating –Numerical problems - isotopes as tracers-

study of reaction mechanism (e.g. ester hydrolysis), radio diagnosis and radiotherapy. Radioactive waste disposal.

1.3 Nuclear reactors-types-common features like fuels, moderators, coolant control materials, reactor shielding- uses-Nuclear reactors in India.

UNIT III: METALLIC BONDING

1.1 Metallic state - packing of atoms in metal (BCC, FCC, HCP and Simple cube).

1.2 Theories of metallic bonding - electron gas, Pauling and band theories.

1.3 Structure of alloys - substitutional and interstitial solid solutions - Hume Rothery ratio-crystal defects - Semiconductors –Extrinsic and Intrinsic = n-type and p-type, transistors Composition, structure – Applications in electronic industry.

UNIT-IV: ORGANOMETALLIC COMPOUNDS-I

4.1. Definition and classification of organometallic compounds on the basis of bond type. Concept of hapticity of organic ligands.

4.2. **Metal carbonyls:** 18 electron rule, electron count of mononuclear, polynuclear and substituted metal carbonyls of 3d series. General methods of preparation (direct combination, reductive carbonylation, thermal and photochemical decomposition) of mono and binuclear carbonyls of 3d series. Structures of mononuclear and binuclear carbonyls of Cr, Mn, Fe, Co and Ni using VBT.

4.3. Metal ions present in biological systems. Use of chelating agents in medicine. Iron and its application in bio-systems, Hemoglobin; Storage and transfer of iron.

Unit-V- Organometallic Compounds-II

5.1. **Zeise's salt:** Preparation and structure, evidences of synergic effect and comparison of synergic effect with that in carbonyls.

5.2. **Metal Alkyls:** Important structural features of methyl lithium (tetramer) and trialkylaluminium (dimer), concept of multicentre bonding in these compounds. Role of triethylaluminium in polymerisation of ethene (Ziegler – Natta Catalyst). Species present in ether solution of Grignard reagent and their structures,

5.3. **Ferrocene:** Preparation and reactions (acetylation, alkylation, metallation). Structure and aromaticity. Comparison of aromaticity and reactivity with that of benzene.

Course code & Title	CC-13- ORGANIC CHEMISTRY-II		
III B.Sc., Chemistry	Semester - VI	Credits : 5	Hrs/Wk : 6

UNIT 1: Nitrogen Containing Compounds

1.1. **Nitrocompounds:** aliphatic and aromatic nitro compounds, classification, generalProperties, Preparation by nitration. **Reactions:** reduction by chemical and electrolytic methods.Di- and tri-substitutionof aromatic nitro compounds: synthesis of o-, m-, p-dinitrobenzenesand trinitrobenzene.

1.2. Aromatic amines. Preparation of primary, secondary and tertiary amines. **Reactions:**basicity of amines, effect of substituents on basicity of aromatic amines. Somesulpha drugs.

1.3. Diazonium salts: Preparation, diazotisation reactions, replacement reactions (Sandmeyer,Gatterman and Gomberg reactions), coupling reactions.

UNIT II: Amino acids and Proteins

1.1. Amino acids– classification –Synthesis of amino acids and their identification.

2.2. Peptide bond- stereochemistry, synthesis of peptides by solution and solid phase techniques.

2.3. Proteins– classification based on physical properties – Physiological functions of proteins. Primary and secondary structure of proteins Helical and sheet structure. Denaturation and renaturation of proteins molecule.

2.4. Nucleic acids: Types of nucleic acids – DNA and RNA polynucleotide chain (structure). Components– Biological function.

UNIT:III Phenols and Carbohydrates

3.1 **Phenols**: Acidic character of phenols, Explanation on the basis of resonance stabilization. Ring substitution in phenols –Orientation of phenolic group towards electrophiles nitration, Reimer-Tiemann reaction, Gattermann reaction. Sulphonation, halogenations, coupling with diazonium salts. Kolbe's reaction and Houben – Hoesh reactions. Nitro phenols, amino phenols, Dihydric and Trihydric phenols. Alpha and Beta naphthols – preparations.

3.2 **Carbohydrates:** classification, constitution of glucose and fructose. Reactions of glucose and Fructose –Muta rotation and its mechanism, configuration of

monosaccharides, Determination of ring size, Epimerisation, chain lengthening and chain shortening of aldoses. Interconversion of aldoses and ketoses.

3.3 Disaccharides – Reactions and stricture of maltose and sucrose. Polysaccharides

- reactions of starch and cellulose (structural elucidation not necessary).

UNIT:IV Natural Products

4.1 Terpenes – General methods of isolation and structural determination of Geraniol, Menthol and α-terpineol.

4.2. **Alkaloids:** General methods of isolation and structural determination of conine, piperine and nicotine.

4.3. **Vitamins:** Thiamine, Riboflavine, Pyridoxine and Ascorbic acid – occurrence and biological importance. Structural elucidations of Pyridoxine.

UNIT V: Molecular Rearrangements

5.1 Classification as anionotropoic, cationotropic, free radical, inter andintramolecular

rearrangement.

5.2 Pinacol-pinacolone rearrangement (mechanism, evidence for carbonium ion intermediate formation-migratory aptitude).

5.3 Beckmann, Hoffmann, Curtius and Benzilic acid rearrangements.

5.4 Claisen rearrangement (sigmatropic-evidence for inramolecular nature and allylic

carbon attachment)-para Claisen, Cope and oxycope rearrangements and Fries rearrangement.

Course code & Title	EC-II – ELECTROCHEMISTRY AND MOLECULAR SPECTROSCOPY		
III B.Sc., Chemistry	Semester - VI	Credits : 5	Hrs/wk : 6

UNIT-I:ElectricalConductance.

1.1 Electrical transport and ohm's law-conduction in metals and in electrolytic solutions-specific conductance, equivalent conductance and molar conductance-variation of equivalent conductance in the concentration.

1.2 Migration of ions-Kohlrausch's law and its application-Arrhenius theory of electrolytic dissociation and its limitations-Weak and strong electrolytes according to Arrhenius theory-Ostwald's dilution law-uses and limitations. Transport number-Hitorff's rule-Determination of transport number by Hitorff's method and moving boundary method.

1.3 Application of conductance measurements-determination α-for strong electrolytes – Ka for weak acids-solubility product of sparingly soluble salt-conductometric titration.

UNIT-ll: Equilibrium in Electrochemical Cells.

.1 Electrolytic and galvanic cells-reversible and irreversible cells-representation of electrochemical cells-origin of electromotive force. Nernstequation- types of electrodes-Gas/Metal ion –metal/metal ion-metal/insoluble salt and redox electrode-electrode reactions single electrode potential and computation of cell EMF. Standard electrode-SHE, calomel electrode, Ag-AgCl electrode-determination of standard potential- electrochemical series and its applications.

.2 Concentration cell with and without transport-liquid – liquid junction potential-applications of concentration cells valence of ions – solubility product-potentiometric titrations –pKa determination –pH determination using hydrogen quinhydrone and glass electrode- corrosion –electro chemical theory –prevention of corrosion.

UNIT-lll: Microwave and IR Spectroscopy.

1.1 Definition of spectrum. Electromagnetic radiations-interaction of electromagnetic radiations with molecules-Quantization of different of different forms of energy in molecules.

1.2 Microwave spectroscopy –condition –molecular rotation theory of microwave spectroscopy – selection rule- effect of isotopic substitution and calculation of moment of inertia and Bond length of diatomic molecules.

1.3 Infrared spectroscopy-conditions –molecular vibration-modes of vibrations in linear and nonlinear molecules (CO_2, H_2O only)-stretching and bending vibrations-selection rules, Applications of IR spectra in identifying >C=O,NO_2,-OH groups only.

UNIT-lV: Raman, Mass & UV-Visible Spectroscopy.

1.1 Raman spectroscopy-Rayleigh and Raman scattering – strokes and Anti strokes lines-Difference between Raman and I.R.

1.2 Mass spectroscopy- Basic principles-Molecular ion peak –Base peak-Isotopic peak-Meta stable peak –Nitrogen rule-Ring rule- Mass spectrum of CH_3CHO,CJ_3NH_2,C_6H_5-CH_3 only.

1.3 U.V-visible spectroscopy-condition-theory of electronic spectroscopy-Types of electronic transitions-Frank-Condon principle – predissociation –applications.

UNIT-V: NMR and ESR spectroscopy.

5.1 NMR Spectroscopy –Magnetic and nonmagnetic nuclei-condition –principle of nuclear magnetic resonance-ring current effect-shielding mechanism – Chemical shift –Number of signals –spin-spin coupling constant (J)-splitting of signals-NMR Spectra ofCH_3.CH_2.OH, phenol and C_6H_5-O-CH_3.

5.2 ESR Spectroscopy-conditions –theory of E S R spectra –Hyperfine splitting –E S R Spectra of simple radicals·CH_3, Naphthalene negative ion only.

Course code & Title	ELECTIVE – II –MOLECULAR DYNAMICS		
III B.Sc., Chemistry	Semester - IV	Credits : 5	Hrs/Wk : 6

UNIT-I: Transition from Classical Mechanics to Quantum Mechanics

1.1 **Classical mechanics:** Concepts – failures. Photoelectric effect. Energy distribution in blackbody radiation.

1.2 Bohr's theory of atom – derivation for energy of an electron in hydrogen like species. - Emission spectrum of hydrogen atom – Zeemanneffect. .**Self-study:** Concept of orbitals and quantum numbers – Pauli's exclusion principle.

UNIT–II: Principles of Quantum Chemistry

1.1 Postulates of quantum mechanics. Concepts of operators, Eigen functions, Eigen values.Schrodinger equation.

1.2 Particle in one-dimensional box - derivation for energy. Application to linear conjugated polyenes (ethylene and butadiene).

UNIT–III: Basic Principles of Statistical Thermodynamics

3.1. Thermodynamic probability – macro and microstates, most probable distribution.Maxwell– Boltzmann statistics. Partition function – relation between partition function andenergy. Separation of partition function – partition function for translation.

3.2. Entropy and probability. Translational entropy: Sackur-Tetrode equation. Residual entropy.

UNIT–IV: Photo Physical Processes in Electronically Excited Molecules

1.1 Laws of photochemistry. Jablonski energy level diagram – primary and secondary Photochemical processes. Radiation less transition – internal conversion and inter systemCrossing. Radiative transitions – fluorescence. Phosphorescence – Chemiluminscence–Bioluminescence – Photosensitization.

1.2 Experimental techniques of photochemical reactions – chemical actinometers– quantumyield. Mechanism of photosynthesis

UNIT–V: Photochemical Kinetics

1.1 Kinetics of photochemical reactions between hydrogen and chlorine and bromine – ratelaw, comparison with thermal reactions.

1.2 Bimolecular quenching – Stern-Volmer equation – photosensitization.

1.3 Kinetics of fast reactions - relaxation techniques and flash photolysis.

Course code & Title	AC4-ALLIED CHEMISTRY-I FOR PHYSICS		
II B.Sc., Physics	Semester - III	Credits : 5	Hrs/Wk : 5

UNIT – I

1.1. **Laboratory Hygiene and Safety**

Storage and handling of corrosive, flammable, explosive, toxic, carcinogenic and poisonous chemicals.

1.2. Quantum numbers – Principal, Azimuthal, Magnetic and Spin quantum numbers and their significance – Principles governing the occupancy of electrons in various quantum levels – Pauli's exclusion principle, Aufbau principles, Hund's rule – Stability of half-filled and fully-filled orbitals.

1.3. **VSEPR Theory**

Shapes of simple inorganic molecules ($BeCl_2$, BF_3, $SiCl_4$, PCl_5, SF_6, IF_7, H_2O, NH_4) containing lone pair and bond pair of electrons.

UNIT – II

1.1 **Coordination Chemistry:**Nomenclature of Mononuclear Complexes, Sedgwick and Pauling Theories. Chelation and industrial importance of EDTA, Biological role of Hemoglobin and chlorophyll. Application of complexes in qualitative and quantitative analysis.

1.2 **Industrial Chemistry:**Fuel gases – Water gas, Producer gas, LPG gas, Gobar gas and Natural gas, **Fertilizers** – NPK and mixed fertilizer, Micronutrients and their role in plant life and Bio fertilizers. **Soaps and Detergents** – Preparation and manufacture cleaning action of soap and detergents.

UNIT – III

3.1 Polar Effects-Inductive effects – Relative strength of aliphatic monocarboxylic acid and aliphatic amines. Resonance – Condition for resonance – consequence of resonance – resonance of energy. Basic property of aniline and acidic property of phenol – Hyperconjucation – consequences of hyperconjugation.

3.2 Halogen containing Compounds-Important chloro hydrocarbons used as solvents and pesticides (chloroform, carbon tetrachloride, DDT, BHC) preparation, properties and uses.

UNIT – IVAromaticity and Aromatic Compounds

1.1 Aromaticity – Huckel's (4n+2) n electron rule and examples of benzene Naphthalene, Furan, Pyrrole, Thiophene, Pyridine, cyclopropenyl cation and anion.

1.2 Aromatic electrophilic substitution reactions – Nitration, halogenations and alkylation. Chemotherapy – Sulpha drugs – sulpha pyridine, sulphathiazole and sulphadiazine – structural formula and use only.

UNIT – V

5.1 **Solid state:** Typical crystal lattices – Unit cell, Elements of symmetry, Bragg equation,Weissindices, Miller indices, Simple, body centered and face centered cubes.

5.2 **Phase Rule:** Phase, Component, Degrees of freedom – Phase rule definition – one component water system. Reduced phase rule – Two component system Pb-Ag system.

5.3 Photo chemistry – Laws of photo chemistry(Lambert's law, Lambert-Beers law, Growthus-Draper law of photochemical equivalence) Quantum yield – low and high quantum yield (decomposition of HI)

Course code & Title	AC-5-ALLIED CHEMISTRY PRACTICAL FOR PHYSICS, ZOOLOGY AND BOTONY		
II B.Sc., Zoology & Physics	Semester – III & IV	Credits : 4	Hrs/Wk : 3

I .VOLUMETRIC ANALYSIS:

1. **Acidimetry- Alkalimetry**

   a)Strong Acid Vs Strong Base

   b) Weak Acid Vs Strong Base

   c) Determination of Hardness of Water

2. **Permanganimetry**

   a) Estimation of Ferrous Sulphateusing $KMnO_4$.

   b) Estimation of Oxalic Acid using $KMnO_4$.

3. **Complexometry**

a) Estimation of Mg using EDTA.

b) Estimation of Ca using EDTA

c) Estimation of copper content of the given solution by EDTA method.

II.ORGANIC ANALYSIS:

A study of reactions of the following organic compounds:

1. Acid 2.Phenol 3.Aldehyde 4.Ketone 5.Carbohydrate 6.Amine 7.Amide.

The students may be trained to perform the specific reactions like test for element (Nitrogen only) Aliphatic or Aromatic, saturated or Unsaturated and Functional group present, confirmative Testsand record their observations.

Course code & Title	AC6-ALLIED CHEMISTRY-II FOR PHYSICS		
II B.Sc., Physics	Semester - IV	Credits:	Hrs/Wk:

UNIT – I

1.1. **Nuclear Chemistry:** Fundamental particles of nucleus, isotopes, isobars, isotones and isomers – Difference between chemical reactions and nuclear reactions, fusion and fission. Radioactive series.

1.2. **Metallic bond:** Electron gas, Pauling and Band theories, Semiconductors – Intrinsic, n-type and p-type.

1.3. Preparation and properties of compounds of sulphur and sodium thiosulphate

UNIT – II

2.1. Carbohydrate: Classification –glucose and fructose – preparation and properties – Elucidation of structure of glucose – Configuration of glucose – Fischer and Haworth cyclic structures.

2.2. Amino acids and Proteins: - Classification based on structure. Essential and non-essentials amino acids – Preparation and properties – Peptides. Proteins – Classification based on physical properties and biological functions. Structure of proteins – Primary and secondary structure.

UNIT – III

3.1. Synthetic polymers – Telflon, alkyd and epoxy resins, polyesters – preparation and properties.

3.2. **Heterocyclic Compounds:** Furan, thiophene, Pyrrole and Pyridine- preparation and properties. Basic property of pyridine and pyrrole.

3.3. **Stereoisomerism:** Optical isomerism – lactic acid and tartaric acid-racemic mixture and resolution. Geometrical isomerism – maleic andfumaric acid.

UNIT – IV- KINETICS

4.1 Rate law, order and Molecularity, derivation of rate expression for first and second order kinetics of reaction.

4.2 Catalysis – Homogeneous and Heterogeneous catalysis, enzymes catalysis, enzymes used inindustry.

UNIT – V

5.1 Electro chemistry – Specific and Equivalent conductance – their determination – effect of dilution on conductivity. Ionic theory – Oswald's dilution law, Kohlrausch law. Conductivity measurements, conductometric titrations.

5.2 **pH and Buffer:** Importance of pH and buffers in living systems – pH determination by colorimetric and electrometric methods.

Course code & Title	AC4-ALLIED CHEMISTRY-I FOR ZOOLOGY & BOTONY		
II B.Sc., Zoology	**Semester - III**	**Credits: 4**	**Hrs/Wk: 5**

UNIT – I

1.1. Volumetric principles – basic requirement of titration – concentration units – Normality, molarity, molality, mole fraction and weight percentage of the solution

1.2. Quantum numbers – Principal, Azimuthal, Magnetic and Spin quantum numbers and their significance – Principles governing the occupancy of electrons in various quantum levels – Pauli's exclusion principle, Aufbau principle, Hund.s rule – stability of half-filled and fully filled orbital.

1.3. VSEPR Theory – Shapes of simple inorganic molecules ($BeCl_2$, BF_3, $SiCl_4$, PCl_5, SF_6, IF_7H_2O, NH_3) containing lone pair and bond pair of electrons.

UNIT – II

1.1. Classification of organic compounds – classification of functional group – IUPAC names of simple organic compounds.

1.2. Isomerism- structural, chain and position isomerism – stereo isomerism – Cis-Trans isomerism - Optical isomerism.

1.3. Hetero cyclic compounds – Furan, Pyrrol and Pyridine – preparation and properties.

UNIT – III

1.1 Carbohydrates – Glucose and Fructose – preparation and properties. Sucrose – manufacture and properties.

1.2 Amino acids and proteins – classification, preparation and properties. Peptides – preparation and properties. Proteins – biological functions of proteins –Primary and secondary structure of proteins.

UNIT – IV SURFACE CHEMISTRY AND CHROMATOGRAPHY

1.1 **Surface Chemistry:-** colloids, Emulsions, gels – preparation and properties and applications. Electrophoresis.

1.2 **Chromatography:**Coloumn, Paper and Thin layer chromatography

UNIT-V POLYMER CHEMISTRY

5.1 An introduction to polymer and macromolecules. Natural and synthetic polymers.

5.2 Classification of polymers – addition and condensation polymers. General methods of preparation of polymerization through functional groups (step growth), multiple bonds (chain growth) and ring opening.

5.3 Coordination polymerization. Mechanism of free radical, cationic and anionic polymerization reactions.

Course code & Title	AC6-ALLIED CHEMISTRY-II FOR ZOOLOGY & BOTONY		
II B.S., Zoology	Semester - IV	Credits: 4	Hrs/Wk: 5

UNIT – I MOLECULAR ORBITAL THEORY AND INDUSTRIAL CHEMISTRY

1.1. Valence Bond theory, Molecular orbital theory (LCAO) – Types of Overlapping, bonding, anti-bonding and nonbonding molecular Orbital diagram of simple homonuclear – diatomic molecule and their ions(H_2, H_2+, He_2, He_2+, N_2, O_2 and F_2)

1.2. Industrial chemistry – Fuel gases – water gas, semi-water gas, Producer gas, LPG and Gobar gas. Soaps and detergents – preparation and manufacture – cleaning action of soaps.

UNITE – II CO-ORDINATION CHEMISTRY AND MAGNETIC PROPERTIES OF MATTERS

2.1 Nomenclature of mononuclear complexes – Werner and Sedgwick theories. Chelation and its industrial importance with particular reference to EDTA. Biological role of Hemoglobin and Chlorophyll.

2.2. Magnetic properties of matter – Magnetic permeability – Magnetic susceptibility – diamagnetism, Paramagnetism, Ferromagnetism, Anti-ferromagnetism. Determination of Magnetic susceptibility using Guoy balance.

UNIT – III NUCLEIC ACID AND HORMONES

3.1 Nucleoproteins – Types of nucleic acid – DNA and RNA polynucleotide chain Differencebetween DNA and RNA – Components, Biological functions. Structure of nucleic acids.

3.2 Hormones – Classification, definition and biological functions – Thyroxine – Disorders of type and hyper secretion hormones.

UNIT – IV

1.1 ChemotheraphySulpha drugs – sulphapyridine, sulphathiazole and sulphadiazine – structural formula and use only.

1.2 Antibiotics – Penicillin-G and Chloromycetin – structural formula and uses only.

1.3 **Water chemistry:**Hard water and soft water – Temporary and permanent hardness - purification methods – Desalination.

UNIT – V

5.1 Colloids – Types – properties – Tyndall effect – Brownian movement – Electrophoresis – Electro osmosis. Purification by dialysis and ultra-filtration.

5.2 Acid-base concept – Arrhenius, Lowry-Bronsted and Lewis concept. Definition of pH.Determination of pH by colorimetric methods.

5.3 Photo chemistry – Laws of photo chemistry(Lambert's law, Lambert, Beers law, Growthus-Draper law of photochemical equivalence) Quantum yield – low and high quantum yield (decomposition of HI