SHRIMATI INDIRA GANDHI COLLEGE

(Nationally Accredited at "A" Grade (3rd Cycle) by NAAC)

Chatram Bus Stand, Tiruchirappalli – 620002.

CRITERION - II

2.6.2. PO CO MAPPING FOR CHEMISTRY

SHRIMATI INDIRA GANDHI COLLEGE
Nationally Accredited at 'A' grade(3 rd cycle) by NAAC
Tiruchirappalli – 620 002
B.Sc CHEMISTRY
2021-22
ODD SEMESTER

PROGRAMME OUTCOMES IN SCIENCE (UG)(PO)

• UG Graduands exhibit **Livelihood Competences** in the field of Science and Technology in terms of relevant **Knowledge, Skills and Attitude.**

• UG Graduands with expected sense of being **Seasoned and Spirited** are tuned with required qualities of productive contribution to **society.**

• UG Graduands instilled with Confidence shall rise up to take up **Leadership Roles** in the field of Science and Technology, given the occasion.

• UG Graduands realize that pursuit of knowledge is an integral part of a **Life-long Activity** towards a successful life.

• UG Graduants are able to spread knowledge, creating **Awareness** about social evils and participate **Voluntarily** in social and cultural activities.

PROGRAMME SPECIFIC OUTCOMES (PSO)

- Enlighten the knowledge about all fundamental aspects of physical, inorganic, organic and other applied field of chemistry.
- Demonstrate an understanding of the fundamental principles, including scientific reasoning to solve problems, of organic chemistry, inorganic chemistry, analytical chemistry and physical chemistry.
- Acquire knowledge about the fundamentals and applications of chemical and scientific theories.
- Create foundation for research and development in Chemistry and to familiarize with current and recent developments in Chemistry.
- Ability to perform scientific experiments skilfully by applying procedural knowledge.

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Dept of Chemistry
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ODD SEMESTER

SEMESTER-I

CORE COURSE I

GENERAL CHEMISTRY I - 16SCCCH1

OBJECTIVES

1. To learn the periodic properties of elements and its classifications.
2. To understand the theoretical aspects of qualitative and quantitative analyses.
3. To understand the basics of alkanes, reactive intermediates and reaction mechanisms.
4. To learn about the chemistry of cycloalkanes, alkenes and alkynes.
5. To learn about the types, preparation and properties of sols, colloids and emulsionsand the determination of molecular weight of macromolecules.

UNIT I PERIODIC TABLE AND PERIODIC PROPERTIES

1.1 Quantum Numbers, Filling up of atomic orbitals: Pauli's exclusion principle, Aufbau Principle, Hunds rule of maximum multiplicity – electronic configuration. Stability associated with half-filled and completely filled orbitals.

1.2 Periodic properties of elements – variation of atomic volume, atomic and ionic radii, onization potential, electron affinity, electronegativity along periods and groups. Pauling scale of electronegativity.

1.3 Classification of elements into s, p, d and f block elements.

UNIT II ANALYTICAL METHODS

2.1 Qualitative Inorganic Analysis – Dry Test, flame test, cobalt nitrate test–wet confirmatory test for acid radicals, interfering acid radicals – elimination ofinterfering acid radicals.

2.2 Solubility product, common ion effect, complexation, oxidation-reduction reactions involved in identification of anions and cations – separation of cations into groups – Semi micro analysis of simple salts.

2.3 Volumetric analysis – preparation of standard solutions – normality, molarity and molality by titrimetric reactions – acid-base, redox, precipitation and complex metric titrations – indicators – effect of change in Ph – selection of suitable indicators.

UNIT III ALKANES, REACTIVE INTERMEDIATES AND METHODS FOR REACTION MECHANISMS

3.1 Introduction: Inductive, mesomeric, electromeric effects and hyperconjugation – structure of organic molecules based on sp^3, sp^2 and sp hybridization. Alkanes – sources of alkanes – general preparation – general properties – conformational analysis of ethane and n-butane.

3.2 Carbocations, Carbanions, Carbenes and Nitrenes: Generation and stability of reactive intermediates – Correlation of reactivity with structure of reactive intermediates. Free radicals: Generation, stability, identification methods – Free radical halogenation reactions and their mechanism.

3.3 Homolytic and Heterolytic cleavages of bonds, Characteristics of nucleophilic, electrophilic and free radical reactions. Thermodynamic and kinetic aspects, Hammond's postulates, isotope effects. Energy profile diagrams – Intermediate versus transition state, Product analysis and its importance, crossover experiments, kinetic methods, Isotopic effects.

UNIT IV CHEMISTRY OF CYCLOALKANES, ALKENES, DIENES AND ALKYNES

4.1 Preparation of cycloalkanes – Chemical properties – Relative stability of cyclopropane to cyclooctane – Baeyer's Strain theory – Limitations – Mono and disubstituted cyclohexanes.

4.2 Alkenes: Nomenclature – Petroleum source of alkenes and aromatics – General methods of preparation of alkenes – Chemical properties – Markovnikov's rule and peroxide effect-Uses – Elimination reactions and its mechanisms (E_1,E_2).

4.3 Dienes: Structures and properties – conjugated dienes – stability and resonance – electrophilic addition – 1,2 addition and 1,4 addition. Alkynes: Nomenclature – General methods of preparation – Physical properties – Chemical properties – Uses.

UNIT V COLLOIDS AND MACROMOLECULES

1.1. Definition and types of Colloids- preparation, Purification (dialysis, electrodialysis and ultrafilteration) and stability of colloids, gold number.

1.2. Properties of colloids- kinetic, optical and electrical properties.

1.3. Emulsions – Types of emulsions, preparation, properties and applications, Donnan membrane equilibrium.

5.4 Osmosis – reverse osmosis and desalination. Macromolecules- Molecular weight of macromolecules- determination of molecular weight by osmotic pressure and light scattering methods.

COURSE OUTCOME
GENERAL CHEMISTRY I
16SCCCH1

- Describe the arrangement of elements in the periodic table based on their electronic configuration, bonding, and properties
- Acquire knowledge about the theoretical aspects of volumetric, qualitative and quantitative analyses
- To learn the involvement of reactive intermediates and understand their structure and reactivity through various organic reactions.
- Explicates the structures, nomenclature and reactivity of Cycloalkanes, Alkenes, Dienes and Alkynes.
- Understand colloids, macromolecules and concepts behind catalysis and its applications.

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MAPPING

- **CO - PO – PSO matrices of course**

- 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)
  - If there is no correlation, put "-"

  - **GENERAL CHEMISTRY I - 16SCCCH1**

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	1	2	1	1	2	1	1	2	2	2
CO2	2	2	2	2	2	2	2	2	3	3
CO3	2	1	1	1	1	2	1	2	2	1
CO4	2	2	1	1	1	1	1	2	2	2
CO5	2	2	1	2	2	2	2	3	3	3
Average	1.8	1.8	1.2	1.4	1.6	1.6	1.4	2.2	2.4	2.2

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SEMESTER III

CORE COURSE III

GENERAL CHEMISTRY – III - 16SCCCH3

OBJECTIVES

1. To learn the chemistry of p-block elements.
2. To study about the preparations and properties of interhalogen compounds.
3. To understand the arrangement of atoms in space, isomersand their nomenclature.
4. To learn about the gas laws, properties of real gases and types of molecularvelocities.
5. To learn the types, structure and properties of solids and liquid crystals.

UNIT I CHEMISTRY OF p-BLOCK ELEMENTS

1.1 General characteristics of p-block elements. Comparative study of elements of III A& their compounds. Compounds of boron –boric acid, borax, borazole.

1.2 Extraction of Al and Pb - alums, alloys of Al. Chemistry of oxides of carbon – CO,CO_2. Allotropic forms of carbon.

1.3 Compounds of nitrogen and phosphorous – $NH_2.NH_2$, H_2NOH, hydrazoic acid, N_2–Cycle, fixation of N_2, PH_3 and P_2O_5.

Unit II INTERHALOGEN COMPOUNDS

2.1 Peracids of sulphur, Thionic acids, sodium thiosulphate – preparation, properties,structure and uses.

2.2 Classification of oxides – acidic, amphoteric, neutral oxides, peroxides andsuperoxides.

2.3 Interhalogen compounds, Pseudohalogens, Oxyacids of halogens, Polyhalides andbasic nature of iodine.

UNIT IIISTEREOCHEMISTRY

3.1 Principles of symmetry – symmetry elements (Cn, Ci and Sn) - asymmetry and dissymmetry – isomerism – constitutional isomers - stereoisomers – enantiomers – diastereomers - geometrical isomerism – meso and dl compounds - conventions used in stereochemistry: Newman, Sawhorse and Fischer notations and their interconversions.

3.2 Nomenclature, correlation of configuration – Cahn-Ingold-Prelog rules for simple molecules - R,S and D,L notations to express configurations - chirality - optical isomerism - optical activity – polarimeter – specific rotation - stereochemistry of allenes and spiranes

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3.3 Atropisomerism - erythro and threo conventions – stereoselectivity, stereospecificity in organic reactions with examples. Resolution of racemic mixture
– Walden Inversion – conformational analysis of cyclohexane - asymmetric induction.

UNIT IVGASEOUS STATE

4.1. Gases – Boyle's law, Charle's law and Avagadro's law- ideal gas equation.

4.2. Real Gases- deviation from ideal behaviour – van der Waals equation of states- derivation – significance of critical constants- law of corresponding states-compressibility factor.

4.3. Inversion temperature and liquefaction of gases- Linde and Claude – demagnetization methods.

4.4. Maxwell's distribution of molecular velocities (Derivation not needed).Types of molecular velocities- mean, most probable and root mean square velocities-Inter relationships. Collision diameter, mean free path and collision number.

UNIT V SOLID STATES AND LIQUID CRYSTALS

5.1. Classification of solids- Isotropic and anisotropic crystals- elements of symmetry- basic seven crystal systems- laws of crystallography- representation of planes- miller indices, space lattice and unit cell.

5.2. X-ray diffraction- derivation of Bragg's equation- determination of structures of NaCl by Debye Scherrer (powder method) and rotating crystal methods.

5.3. Types of crystals, close packing of identical solid spheres, interstitial sites, limiting radius ratios (derivation not needed), radius ratio rule and shapes of ionic crystals, structures of NaCl, CsCl and ZnS.

5.4. Semiconductors- intrinsic and extrinsic semi conductors- n and p-type semiconductors.Liquid crystals- types and applications.

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COURSE OUTCOME
GENERAL CHEMISTRY III
16SCCCH3

- To provide elementary knowledge of s-block elements and its properties.
- To study the preparations and properties of the interhalogen compounds.
- Learn and apply the various concepts such as stereochemistry and fundamental principles of stereoselectivity in organic chemistry.
- To impart knowledge on states of matter – Gas, gas laws, properties of real gases and types of molecular velocities.
- Understand the types, structure and properties of solids and liquid crystals.

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MAPPING

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- **GENERAL CHEMISTRY – III - 16SCCCH3**

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	2	2	1	1	2	1	2	2	2	2
CO2	2	1	1	1	2	1	2	2	1	1
CO3	2	2	1	1	2	1	2	2	2	2
CO4	2	2	2	2	2	1	2	2	3	3
CO5	2	1	1	1	2	1	2	2	2	2
Average	2	1.6	1.2	1.2	2	1	2	2	2	2

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SEMESTER V

CORE COURSE V

INORGANIC CHEMISTRY – I-16SCCCH5

OBJECTIVES

1. To understand the basics and theories of coordination compounds.
2. To study a few biologically important coordination compounds.
3. To understand the preparation and properties of nitrosyl compounds
4. To learn the basic principles and applications of magnetic properties.

UNIT I COORDINATION COMPOUNDS-I

1.1 Introduction - Types of ligands: unidentate, bidentate and polydentate ligands, chelating ligands and chelates- IUPAC nomenclature of coordination compounds.

1.2 Isomerism in coordination compounds: Structural isomerism, hydrate isomerism, coordination isomerism, ionisation isomerism, linkage isomerism, coordination position isomerism.

1.3 Stereoisomerism: Geometrical isomerism of four and six coordinate complexes, optical isomerism of four and six coordinate complexes, Werner and Sidgwick theories, methods of detecting complex formation.

UNIT II COORDINATION COMPOUNDS-II

2.1 Theories of coordination compounds : Valence bond theory, limitations of valence bond theory, crystal field theory – splitting of d orbitals in octahedral, tetrahedral and square planar fields, CFSE, factors affecting CFSE, colour, geometry and magnetic properties of coordination compounds, Jahn – Teller distortion (an elementary idea).

2.2 Molecular orbital theory: Molecular orbital diagram for $[Co(NH_3)_6]^{3+}$. Ligand field theory. (An elementary treatment only).

UNIT III COORDINATION COMPOUNDS-III

3.1 Labile and inert complexes, stability of coordination compounds – thermodynamic and kinetic stability, relationship between stepwise formation constant and overall formation constant, factors affecting the stability of complexes.

3.2 Unimolecular and biomolecular nucleophilic substitution reactions in octahedral and square planar complexes, trans effect – theories of trans effect and applications.

3.3 A few biologically important coordination compounds : Chlorophyll, haemoglobin and vitamin B_{12}.

UNIT IV CARBONYLS AND BINARY METALLIC COMPOUNDS

4.1 Metal carbonyls : Mono and binuclear carbonyls of Ni, Fe, Cr, Co and Mn – preparation, structure, reactions, bonding and uses.

4.2 Structure and bonding in p-metal alkenyl and p-metal alkynyl complexes of $[PtCl_3(C_2H_4)]^-$, $[Co(CO)_6(RC \text{ º } CR)]$ and ferrocene.

4.3 Binary metallic compounds : borides, carbides, hydrides and nitrides – classification, preparation, properties and uses.

UNIT V NITROSYL COMPOUNDS AND MAGNETIC PROPERTIES

5.1 Nitrosyl compounds: Classification-nitrosyl chloride and sodium nitroprusside - preparation, properties and structure.

5.2 Magnetic properties-meaning of the terms-magnetic susceptibility-magnetic moment-types of magnetism-Gouy balance-applications of magnetic properties.

5.3 Dipole moment-determination, application in the study of simple inorganic molecules.

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COURSE OUTCOME
INORGANIC CHEMISTRY - I
16SCCCH5

- Understand the basics of coordination compounds.
- Acquire knowledge of various coordination theories
- Study a few biologically important coordination Compounds.
- Learn the carbonyls and binary metallic compounds
- Understand the preparation and properties of nitrosyl compounds

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- **INORGANIC CHEMISTRY – I-16SCCCH5**

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	2	2	1	1	2	1	1	2	2	2
CO2	2	2	1	1	2	1	1	2	2	2
CO3	2	2	1	3	3	1	2	3	3	3
CO4	2	1	1	1	1	1	2	2	1	2
CO5	1	1	2	1	2	1	1	2	2	2
Average	1.8	1.6	1.2	1.4	2	1	1.7	2.2	2	2.2

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ORGANIC CHEMISTRY I-16SCCCH6

SEMESTER V

CORE COURSE VI

OBJECTIVES

1. To learn the reactions of carbonyl compounds, carboxylic acids, amines,heterocycles.
2. To know the requirement of the oxidation and reducing agents for synthesis.

UNIT I CHEMISTRY OF CARBONYL COMPOUNDS

1.1 Nomenclature - structure of carbonyl compounds - chemical properties - nucleophilic addition mechanism at carbonyl group (eg: HCN, ROH, RNH_2)
- acidity of alpha hydrogen – keto-enol Tautomerism (proof for the two forms).

1.2 Reduction and oxidation reactions of carbonyl compounds – paraformaldehyde, metaformaldehyde - uses of aliphatic carbonyl compound - Claisen condensation – Aldol condensation – Robinson annulation.

1.3 General methods of preparation of aromatic carbonyl compounds - physical and chemical properties – uses - Effect of aryl group on the reactivity of carbonyl group.

UNIT II CHEMISTRY OF CARBOXYLIC ACIDS

2.1 Nomenclature - Acidity of carboxylic acids based on substituent effect - comparison of acid strengths of halogen substituted acetic acids - acid strengths of substituted benzoic acids - Acid derivatives - Nucleophilic substitution mechanism at acyl carbon.

2.2 Preparation, properties and uses of acid derivatives: acid chloride, anhydrides, esters, amides - chemistry of compounds containing active methylene group – synthesis and synthetic applications of acetoacetic ester and malonic ester.

2.3 Preparation of dicarboxylic acid - physical and chemical properties - uses. Introduction to oils and fats - fatty acids - manufacture of soap - mechanism of cleaning action of soap.

UNIT III CHEMISTRY OF NITROGEN COMPOUNDS

3.1 Nomenclature - nitro alkanes - alkyl nitrites - differences - aromatic nitro compounds - preparation and reduction of nitro benzene under different conditions, TNT.

3.2 Amines – effect of substituents on basicity of aliphatic and aromatic amines - Reactions of amino compounds (primary, secondary, tertiary and

quaternary amine compounds) - Mechanism of carbylamine reaction,diazotization and comparison of aliphatic and aromatic amines.

3.3 Diazonium compounds - preparation and synthetic applications of diazomethane, benzene diazonium chloride and diazo acetic ester.

UNIT IV CHEMISTRY OF HETEROCYCLIC COMPOUNDS AND DYES

4.1 Introduction – nomenclature of heterocyclic compounds having not more than two heteroatoms such as oxygen, nitrogen and sulphur - structure, synthesis and properties of furan, pyrrole, thiophene. Pyridine – structure, preparation - compare the basicity of pyridine with pyrrole and amines.

4.2 Quinoline - structure and Skraup synthesis. Isoquinoline – structure and Napieralski synthesis and Indole – structure and Ficher-indole syntheses.

4.3 Dyes - color and constitution – chromophore - auxochrome - classification according to application and structure - preparation and uses of - methyl orange, fluorescein, Alizarin, Indigo and malachite green dyes.

UNIT V OXIDATION AND REDUCTION

5.1 Oxidation: Osmium tetroxide – Chromyl chloride – Ozone – DDQ – Dioxiranes.

5.2 Lead tetraacetate - selenium dioxide – DMSO either with Ac_2O or oxalyl chloride – Dess-Martin reagent.

5.3 Reduction: Catalytic hydrogenation using Wilkinson Catalyst – Reduction with LAH, $NaBH_4$, tritertiarybutoxy aluminum hydride, $NaCNBH_3$, hydrazines.

COURSE OUTCOME

ORGANIC CHEMISTRY-I

16SCCCH6

- Learn the reactivity of carbonyl compounds
- Acquire knowledge of carboxylic acids, amines and heterocyclic compounds.
- An in-depth study of Nitrogen compounds
- Understand the Chemistry of Heterocyclic compounds
- To know the requirement of the oxidizing and reducing agents for synthesis.

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ORGANIC CHEMISTRY I-16SCCCH6

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	2	2	2	1	2	1	2	1	2	2
CO2	2	2	2	2	3	2	2	2	2	2
CO3	2	2	2	2	3	2	1	1	2	2
CO4	2	2	2	2	3	2	2	2	2	2
CO5	2	2	2	2	3	2	2	2	2	2
Average	2	2	2	1.8	2.8	1.8	1.8	1.6	2	2

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SEMESTER V

CORE COURSE VII

PHYSICAL CHEMISTRY I-16SCCCH7

OBJECTIVES

1. To know the various concepts of photochemistry and group theory.
2. To learn the second law of thermodynamics, carnot cycle, carnot theorem, entropy,free energy and Maxwell's relations.
3. To learn the third law of thermodynamics, Van't Hoff isotherm, Clausius –Clapeyron equation and Nernst heat theorem.
4. To understand the laws and properties of solutions.
5. To learn the fundamental concepts of phase rule and its applications to one, twoand three component systems.

UNIT I PHOTOCHEMISTRY AND GROUP THEORY

1.1. Consequences of light absorption- Jablonski diagram- radiative and non-radiative transitions. Lambert's Beer law, quantum efficiency.

1.2. Photochemical reactions-Comparison between thermal and photochemical reactions. Photosensitization and quenching. Fluorescence, phosphorescence andchemiluminescence. Laser and uses of lasers.

1.3. Group theory – symmetry elements and symmetry operation- group postulates and types of groups- abelian and non abelian – symmetry operation of H_2O molecule.

1.4. Illustration of group postulates using symmetry operations of H_2O molecule - construction of multiplication table for the operation of H_2O molecule – point group- definition- elements (symmetry operations) of the following molecules- H_2O, BF_3 and NH_3.

UNIT II THERMODYNAMICS II

2.1. Second law of thermodynamics – need for the law- different statements of the law- Carnot's cycle and efficiency of heat engine- Carnot's theorem- thermodynamic scale of temperature.

2.2. Concept of entropy- definition and physical significance of entropy- entropy as a function of P, V and T – entropy changes during phase changes- entropy of mixing
– entropy criterion for spontaneous and equilibrium processes in isolated system.

2.3. Gibb's free energy (G) and Helmholtz free energy(A) – variation of A and G with P, V and T- Gibb's – Helmholtz equation and its applications.

2.4. Thermodynamic equation of state, Maxwell's relations- DA and DG as criteria for spontaneity and equilibrium.

UNIT III THERMODYNAMICS III

3.1. Equilibrium constant and free energy change- thermodynamic derivation of law of mass action- equilibrium constants in terms of pressure and concentration – NH_3, PCl_5 and $CaCO_3$.

3.2. Thermodynamic interpretation of Lechatelier's principle (Concentration, temperature, pressure and addition of inert gases).

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3.3. Systems variable composition- partial molar quantities- chemical potential – variation of chemical potential with T, P and X (mole fraction) – Gibb's Duhem equation. Van't Hoff's reaction isotherm-van't Hoff's isochore. Clapeyron equation and Clausius – Clapeyron equation- applications.

3.4. Third law of thermodynamics- Nernst heat theorem. Statement of III law and concept of residual entropy – evaluation of absolute entropy from heat capacity data.

UNIT IV SOLUTIONS

4.1. Raoult's law, Henry's law, Ideal and non-ideal solutions, completely miscible liquid systems-benzene and toluene. Deviation from Raoult's law and Henry' law. Duhem-Margules equation. Theory of fractional distillation. Azeotropes- HCl – water and ethanol- water system.

4.2. Partially miscible liquids- phenol- water, triethylamine- water and nicotine- water systems. Lower and upper CSTs – effect of impurities on CST.Completely immiscible liquids- principle and applications of steam distillation. Nernst distribution law – derivation.

4.3. Dilute solutions- colligative properties, relative lowering of vapour pressure, osmosis, law of osmotic pressure, derivation of elevation of boiling point and depression in freezing point.

4.4. Determination of molecular masses using colligative properties. Abnormal molecular masses, molecular dissociation- degree of dissociation- molecular association.

UNIT V PHASE CHANGES

5.1. Definitions of terms in the phase rule- derivation and application to onecomponent system – water and sulphur- super cooling, sublimation.

5.2. Two-component systems-solid liquid equilibria, simple eutectic (lead- silver, Bi-Cd), desilverisation of lead.

5.3. Compound formation with congruent melting point (Mg-Zn) and incongruentmelting point (Na-K).

5.4. Solid Solutions-(Ag-Au)-fractional crystallization, freezing mixtures- $FeCl_3$-H_2Osystems, $CuSO_4$-H_2O system.

COURSE OUTCOME

PHYSICAL CHEMISTRY – I

16SCCCH7

- Understand the various concepts of photochemistry and group theory.
- Learn the second law of thermodynamics, carnot cycle, carnot theorem, entropy, free energy and Maxwell's relations.
- Learn the third law of thermodynamics, Van't Hoff isotherm, Clausius – Clapeyron equation and Nernst heat theorem.
- Understand the concepts of solutions.
- Understand the fundamental concepts of phase rule and its applications to one, two and three component systems.

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MAPPING

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PHYSICAL CHEMISTRY – I

16SCCCH7

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
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CO3	2	2	2	2	2	2	2	2	2	2
CO4	3	3	3	3	3	2	2	3	3	3
CO5	2	2	2	2	2	2	2	2	2	2
Average	2.2	2.2	2.2	2.2	2.4	2	2	2.4	2.4	2.4

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SEMESTER V

MAJOR BASED ELECTIVE I (A)

ANALYTICAL CHEMISTRY-16SMBECH 1:1

OBJECTIVES

1. To know the storage and handling of various chemicals and first aidprocedures.
2. To learn data analysis, various separation techniques.
3. To learn gravimetric analysis and various thermo analytical methods.
4. To learn visible spectrophotometry and colorimetry.
5. To know the various electroanalytical techniques.

UNIT I LABORATORY HYGIENE AND SAFETY

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

1.2. Simple first aid procedures for accidents involving acids, alkalies, bromine,burns and cut by glass.

1.3. Precautions to avoid poisoning-treatment for specific poisons, thresholdvapour concentrations-safe limits-laboratory safety measures.

1.4. Waste disposal-fume disposal-precautions for avoiding accidents.

UNIT II DATA ANALYSIS

2.1. The Mean-significant numbers, the median-precision, accuracy- confidencelimits, standard deviation.

2.2. Errors-method for improving accuracy-rejection of data-presentation oftabulated data-Scatter diagram –method of least squares- S.I. units.

2.3. Separation techniques: Precipitation-solvent extraction-chromatography –types, column chromatography-thin layer chromatography.

2.4. Paper chromatography – paper electrophoresis –Ion exchange chromatography –Gas liquid chromatography.

UNIT III GRAVIMETRIC ANALYSIS AND THERMO ANALYTICAL METHODS

3.1. Gravimetric analysis - principles-methods of gravimetric analysis - requirement of gravimetric analysis-precipitation-theories of precipitation.

3.2. Types of precipitation – co–precipitation, post precipitation - and precipitation from homogeneous solution-digestion, filtration and washing, drying and ignition. Inorganic and organic precipitating agents.

3.3 Thermo analytical techniques – types-TGA principle-Instrumentation - TGA analysis of $CaC_2O_4.H_2O$.

3.4 Differential thermal analysis-principle-DTA of $CaC_2O_4.H_2O$.-factors affecting TGA & DTA

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UNIT IV VISIBLE SPECTROPHOTOMETRY AND COLORIMETRY

4.1. Theory of spectrophotometry and colorimetry, Beer-Lambert's law (statement only), Molar absorptivity and absorbance.

4.2. Visual comparators-multiple standard methods, duplication and dilution method, balance method, photoelectric colorimeter, spectrophotometer.

4.3. Criteria for satisfactory colorimetric estimation-advantages of colorimetric estimation, determination of composition of complexes, colorimetric estimation of iron.

UNIT V ELECTROANALYTICAL TECHNIQUES

5.1. Electro gravimetry –theory - electro gravimetric analysis of Fe and Cu.

5.2. Electrolytic separation of metals: principle –separation of copper and nickel, Electro deposition- principle –overvoltage.

5.3. Coulometry -Principle of coulometric analysis –coulometry at controlled potential-apparatus and technique-separation of nickel and cobalt. Amperometry titrations-principle –Instruments –types-applications.

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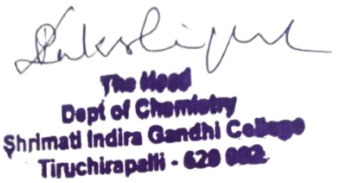
COURSE OUTCOME
MAJOR BASED ELECTIVE
ANALYTICAL CHEMISTRY
16SMBECH 1:1

- Know the storage and handling of various chemicals and first aid procedures.
- Learn data analysis,various separation techniques.
- Find out the gravimetric analysis and various thermo analytical methods.
- Learn visible spectrophotometry and colorimetry
- Discover the various electroanalytical techniques.



MAPPING

- **CO - PO – PSO matrices of course**

- 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)
  - If there is no correlation, put "-"

- **ANALYTICAL CHEMISTRY-16SMBECH 1:1**

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	2	3	2	2	3	2	2	2	2	2
CO2	2	3	2	2	3	2	2	2	2	2
CO3	2	3	2	2	2	2	2	3	3	3
CO4	2	2	2	2	2	2	2	3	3	3
CO5	2	3	2	2	2	1	2	3	3	3
Average	2	2.8	2	2	2.4	1.8	2	2.6	2.6	2.6

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SEMESTER V

CORE PRACTICAL III

PHYSICAL CHEMISTRY (P)- 16SCCCH3P

OBJECTIVES

1. To learn the fundamentals of conductometric and potentiometric titrations.
2. To understand the method of determination of molecular weight, CST, TTand rate constant.

LIST OF EXPERIMENTS:

1. Critical Solution Temperature
2. Effect of impurity on Critical Solution Temperature
3. Transition Temperature
4. Rast Method
5. Phase Diagram (Simple eutectic system)
6. Kinetics of Ester Hydrolysis
7. Partition Co-efficient of iodine between water and carbon tetrachloride.
8. Conductometric Acid-Base Titration
9. Potentiometic Redox Titration
10. Determination of cell constant

COURSE OUTCOME

PHYSICAL CHEMISTRY (P)

16SCCCH3P

- Perform potentiometric and conductometric titrations skillfully.
- Acquire knowledge about the variation of mutual solubility temperature with different concentration and determination of CST.
- Understand the method of determination of transition temperature and rate constant.
- Construct the phase diagram of simple eutectic system.
- Develop skills in procedures and instrumental methods applied in analytical and practical tasks of physical chemistry.

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- **PHYSICAL CHEMISTRY (P)- 16SCCCH3P**

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	2	2	2	2	2	2	2	2	2	3

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SHRIMATI INDIRA GANDHI COLLEGE
Nationally Accredited at 'A' grade(3 rd cycle) by NAAC
Tiruchirappalli – 620 002
B.Sc CHEMISTRY
2021-22
EVEN SEMESTER

PROGRAMME OUTCOMES IN SCIENCE (UG)(PO)

• UG Graduands exhibit **Livelihood Competences** in the field of Science and Technology in terms of relevant **Knowledge, Skills and Attitude.**

• UG Graduands with expected sense of being **Seasoned and Spirited** are tuned with required qualities of productive contribution to **society.**

• UG Graduands instilled with Confidence shall rise up to take up **Leadership Roles** in the field of Science and Technology, given the occasion.

• UG Graduands realize that pursuit of knowledge is an integral part of a **Life-long Activity** towards a successful life.

• UG Graduants are able to spread knowledge, creating **Awareness** about social evils and participate **Voluntarily** in social and cultural activities.

PROGRAMME SPECIFIC OUTCOMES (PSO)

- Enlighten the knowledge about all fundamental aspects of physical, inorganic, organic and other applied field of chemistry.
- Demonstrate an understanding of the fundamental principles, including scientific reasoning to solve problems, of organic chemistry, inorganic chemistry, analytical chemistry and physical chemistry.
- Acquire knowledge about the fundamentals and applications of chemical and scientific theories.
- Create foundation for research and development in Chemistry and to familiarize with current and recent developments in Chemistry.
- Ability to perform scientific experiments skilfully by applying procedural knowledge.

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EVEN SEMESTER

SEMESTER II

CORE COURSE II

GENERAL CHEMISTRY – II-16SCCCH2

OBJECTIVES

1. To understand the principles of bonding and theories of chemical bonding.
2. To understand the chemistry of S-block elements and metallurgy of zero groupelements.
3. To understand the aromatic character of benzene type molecules and to learn thereaction mechanisms involved in haloalkanes and halobenzenes.
4. To understand about the properties of atoms, characteristics, effect of radiationsand the significance of wave functions.

UNIT I CHEMICAL BONDING

1.1 Ionic bond – formation, variable electrovalency – Lattice energy, Born – HaberCycle. Covalent bond - formation, variable covalency, maximum covalency, covalent character in ionic bond – Fajans Rule. Polarisation – partial ionic character of a covalent bond.

1.2 VB theory, MO theory – Basic principles of bonding and antibonding orbitals, applications of MOT to H_2 He_2, N_2 & O_2 – molecular orbital sequence, comparison of VB & MO Theories.

1.3 Hybridisation – Formation of $BeCl_2$ & BCl_3. VSEPR theory of simple inorganic molecules – $BeCl_2$, $SiCl_4$, PCl_5, SF_6, IF_7, XeF_6, BF_3 & H_2O.

1.4 Hydrogen bonding – Intermolecular & Intramolecular H_2 – bonding and consequences.

UNIT II CHEMISTRY OF s-BLOCK & ZERO GROUP ELEMENTS AND METALLURGY

2.1 General characteristics of s-block elements – comparative study of elements – alkali metals and their hydroxides, oxides and halides, alkaline earth metals and their oxides, carbonates and sulphates.

2.2 Diagonal relationship of Li & Mg, Be & Al, chemistry of NaOH, KI & $Mg(NH_4)PO_4$.

2.3 Metallurgy : Occurrence of metals – concentration of ores – froth floatation, magnetic separation, calcination, roasting, smelting, flux, aluminothermic process, purification of metals – electrolysis, zone refining, van Arkel de-Boer process.

2.4 Zero group elements – position in the periodic table, occurrence, isolation, applications, compounds of Xe – XeF_6 & $XeOF_4$.

UNIT IIICHEMISTRY OF BENZENE AND BENZENOID COMPOUNDS

3.1 Aromaticity – Huckle's rule - structure of benzene – Benzene-preparation, chemical properties and uses. Aromatic electrophilic substitution reactions and mechanism – Orientation and reactivity in substituted benzenes.

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3.2 Polynuclear aromatic hydrocarbons – Nomenclature, Naphthalene from coal tar and petroleum – Laboratory preparation, Structure of Naphthalene, Aromatic character, Physical properties, Chemical properties, Uses. Mechanism of Aromatic electrophilic substitution – Theory of orientation and reactivity.

Anthracene, Phenanthrene from coal tar and petroleum, Laboratory preparation, Molecular Orbital structures, Aromatic Characters, Physical Properties, Chemical properties and uses. Preparation of biphenyls, Physical and Chemical properties and uses.

UNIT IVALKYL AND ARYL HALOGENS

4.1 Nomenclature of haloalkanes – structure - general preparations of haloalkanes - physical and chemical properties and uses.

4.2 Nucleophilic aliphatic substitution reaction mechanisms (S_N1 and S_N2) – Stereochemical aspects.

4.3 Halobenzenes: Theory of orientation and reactivity - general preparation – properties - uses. Electrophilic and nucleophilic aromatic substitution reaction mechanisms.

UNIT V ATOMIC STRUCTURE AND BASIC QUANTUM MECHANICS

5.1. Rutherford's and Bohr's model an atom- Bohr's theory and origin of hydrogen spectrum. Sommerfield's extension of Bohr's theory.

5.2. Electromagnetic radiation- definitions for l, υ and velocity.

5.3. Dualism of light -Particle nature of radiation- black body radiation and Planck's quantum theory, photoelectric effect and Compton effect of matter.

5.4. De Broglie hypothesis and Davisson and Germer experiment. Heisenberg's uncertainty principle. Schrodinger wave equation (Derivation not needed). Physical significance of Y and Y^2.

COURSE OUTCOME

GENERAL CHEMISTRY II

16SCCCH2

- Understand the common themes running through ionic, covalent and metallic descriptions of chemical bonding.
- Learn the fundamental principles of metallurgy of zero group elements and chemistry of S-block elements.
- Understand the aromatic character of benzene type molecules and discuss the reaction mechanisms involved in haloalkanes and halobenzenes.
- Explicates the structures, nomenclature and reaction mechanisms of alkyl and aryl halogen compounds.
- Understand the basic concepts of atoms, the effect of radiations and the significance of wave functions.

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- **GENERAL CHEMISTRY – II-16SCCCH2**

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CO2	2	2	2	2	2	2	2	2	2	2
CO3	2	2	2	2	2	1	2	2	2	2
CO4	2	1	1	2	2	2	2	1	2	1
CO5	2	1	1	1	1	2	2	2	3	3
Average	2	1.6	1.6	1.8	1.8	1.6	2	1.8	2.2	2

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SEMESTER IV

CORE COURSE IV

GENERAL CHEMISTRY – IV-16SCCCH4

OBJECTIVES

1. To learn the general characteristics of d and f block elements.
2. To understand the reactions of organometallic compounds, alcohols, phenols andethers.
3. To learn about the fundamental concepts of first law of thermodynamics, to relateheat, work and energy and to calculate work from pressure – volume relationships.
4. To learn about the fundamental concepts of rate of the reaction, determination oforder of the reaction and theories of reaction rates.

UNIT I d-BLOCK & f-BLOCK ELEMENTS

1.1 General characteristics of d-block elements, comparative study of zinc groupelements, extraction of Mo & Pt - Alloys of copper, amalgams and galvanization.
Evidences for the existence of Hg^{2+} ions.

1.2 General characteristics of f-block elements – Lanthanide contraction and its consequences. Extraction of Th.

1.3 Arrhenius, Lowry – Bronsted and Lewis concept of acids and bases.

UNIT II CHEMISTRY OF ORGANOMETALLIC COMPOUNDS

2.1 Introduction – preparation of organomagnesium compounds- physical and chemical properties- uses. Organozinc compounds – general preparation, properties and uses.

2.2 Organolithium, organocopper compounds – preparation, properties and uses.

2.3 Organolead, organophosphorous and organoboron compounds– preparation, properties and uses.

UNIT III CHEMISTRY OF ALCOHOLS, PHENOLS AND ETHERS

3.1 Nomenclature – industrial source of alcohols – preparation of alcohols: hydration of alkenes, oxymercuration, hydroboration, Grignard addition, reduction – physical properties – chemical properties - uses – glycols from dihydroxylation, reduction, substitution reactions and glycerols and their uses.

3.2 Preparation of phenols including di- and trihydroxy phenols – physical and chemical properties - uses – aromatic electrophilic substitution mechanism – theory of orientation and reactivity.

3.3 Preparation of ethers: dehydration of alcohols, Williamson's synthesis – silyl ether. epoxides from peracids - sharpless asymmetric epoxidation – reactions of epoxides
– uses – introduction to crown ethers – structures – applications.

UNIT IV THERMODYNAMICS-I

4.1 Definitions- system and surrounding- isolated, closed and open system- state ofthe system- Intensive and extensive variables. Thermodynamic processes- reversible and irreversible, isothermal and adiabatic processes- state and path functions.

4.2 Work of expansion at constant pressure and at constant volume. First law of thermodynamics- statement- definition of internal energy (E), enthalpy (H) andheat capacity. Relationship between Cp and Cv.

4.3 Calculation of w, q, dE and dH for expansion of ideal and real gases under isothermal and adiabatic conditions of reversible and irreversible processes.

4.4 Thermochemistry- relationship between enthalpy of reaction at constant volume (q_v) and at constant pressure (q_p)- temperature dependence of heat of reaction- Kirchoff's equation- bond energy and its calculation from thermochemical data- integral and differential heats of solution and dilution.

UNIT V CHEMICAL KINETICS

5.1. Rate of reaction- rate equation, order and molecularity of reaction. Rate Laws- rate constants- derivation of first order rate constant and characteristics of zero order, first order and second order reactions- derivation of time for half change ($t_{1/2}$) with examples.

5.2. Methods of determination of order of reactions- experimental methods- determination of rate constant of a reaction by volumetry, colorimetry and polarimetry.

5.3. Effect of temperature on reaction rate- concept of activation energy, energy barrier, Arrhenius equation. Theories of reaction rates- collision theory- derivation of rate constant of bimolecular reaction- failure of collision theory- Lindemann's theory of unimolecular reaction.

5.4. Theory of absolute reaction rates – derivation of rate constant for a bimolecular reaction- significance of entropy and free energy of activation. Comparison of collision theory and absolute reaction rate theory (ARRT).

COURSE OUTCOME
GENERAL CHEMISTRY IV
16SCCCH4

- Explicates the general characteristics and properties of d and f block elements.
- To understand the reactions of organometallic compounds,
- Understand the Nomenclature and preparations of alcohols, phenols and ethers.
- Learn about the fundamental concepts of first law of thermodynamics, to relate heat, work and energy and to calculate work from pressure – volume relationships.
- To learn about the fundamental concepts of rate of the reaction, determination of order of the reaction and theories of reaction rates.

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- **GENERAL CHEMISTRY – IV-16SCCCH4**

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CO1	2	2	2	2	2	2	2	2	3	3
CO2	2	1	2	2	2	2	1	2	2	2
CO3	2	2	2	2	2	2	2	2	2	2
CO4	2	2	2	2	2	2	2	3	3	3
CO5	2	2	2	2	2	2	2	3	3	3
Average	2	1.8	2	2	2	2	1.8	2.4	2.6	2.6

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SEMESTER VI

CORE COURSE VIII

ORGANIC CHEMISTRY II-16SCCCH8

OBJECTIVES

1. To learn the chemistry of carbohydrates, proteins, vitamins, alkaloids andterpenoids.
2. To understand the rearrangements and spectroscopy techniques for the elucidationof structures.

UNIT I CHEMISTRY OF CARBOHYDRATES

1.1 Carbohydrate - classification, properties of mono saccharides (glucose andfructose), structure and configuration of mono saccharides, interconversion.

1.2 Ascending and descending series, muta rotation, epimerization- cyclic structure - determination of size of sugar rings.

1.3 Disaccharides - sucrose, maltose - structure elucidation - polysaccharide - starchand cellulose (elementary treatment).

UNIT II CHEMISTRY OF PROTEINS AND VITAMINS

2.1 Amino acids – Zwitter ion – isoeletric point - general methods of preparation and reactions of amino acids. Peptides - Peptide linkages – proteins - classification of proteins.

2.2 Structure of proteins - primary structure - end group analysis - Edman method - secondary structure - tertiary structure - denaturation - colour reactions of proteins.

2.3 Nucleic acids - elementary treatment of DNA and RNA - Vitamins - classification,structure and biological importance of vitamins A, B_1, B_2, B_6, B_{12} and C.

UNIT IIICHEMISTRY OF ALKALOIDS AND TERPENOIDS

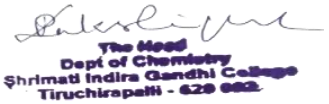
3.1 Chemistry of natural products - alkaloids – classification, isolation - methods for synthesis of coniine, piperine, nicotine and quinine.

3.2 Terpenoids - classification - isoprene, special isoprene rule, methods for synthesis of citral, limonene, menthol, camphor.

UNIT IVMOLECULAR REARRANGEMENTS

4.1 Molecular rearrangements - types of rearrangement (nucleophilic and electrophilic) – mechanism with evidence for the following re-arrangements: pinacol – pinacolone.

4.2 Benzil - benzilic acid, benzidine, Claisen, Fries, Hofmann. Curtius, Lossen, Beckmann and dienone – phenol rearrangements.



UNIT V ORGANIC SPECTROSCOPY

5.1 UV - VIS spectroscopy - types of electronic transitions – Instrumentation- solvent effects on λ max - Woodward - Fieser rules for calculation of λ max : dienes only – bathochromic shift and hypsochromic shift.

5.2 IR spectroscopy - number and types of fundamental vibrations – selection rules- modes of vibrations and their energies. Instrumentation - position of IR absorption frequencies for functional groups like aldehyde, ketone, alcohol, acid, amine and amide.

5.3 NMR spectroscopy - principle - chemical shift- factors affecting the chemical shift - inductive effect and hydrogen bonding - TMS, delta scales, splitting of signals - spin-spin coupling, NMR spectrum of EtOH, n -propyl bromide and isopropyl bromide.

5.4 IR spectroscopy - number and types of fundamental vibrations – selection rules- modes of vibrations and their energies. Instrumentation - position of IR absorption frequencies for functional groups like aldehyde, ketone, alcohol, acid, amine and amide.

5.5 NMR spectroscopy - principle - chemical shift- factors affecting the chemical shift - inductive effect and hydrogen bonding - TMS, delta scales, splitting of signals - spin-spin coupling, NMR spectrum of EtOH, n -propyl bromide and isopropyl bromide.

COURSE OUTCOME

ORGANIC CHEMISTRY – II

16SCCCH8

- Learn the chemistry of carbohydrates
- Acquire knowledge about Vitamins and Proteins
- Understand the fundamental concepts of Spectroscopy techniques for the elucidation of structure
- Understand the molecular rearrangements
- Learn the chemistry of alkaloids and terpenoids

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CO2	2	3	2	2	2	2	2	3	3	3
CO3	2	3	2	2	2	2	2	3	3	3
CO4	2	1	1	2	2	1	1	2	2	2
CO5	2	3	2	2	2	1	1	2	3	3
Average	2	2.4	1.8	2	2	1.6	1.6	2.6	2.8	2.8

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SEMESTER VI

CORE COURSE IX

PHYSICAL CHEMISTRY II-16SCCCH9

OBJECTIVES

1. To learn the various concepts of electrochemistry.
2. To know the types and theories of catalysis.
3. To learn the adsorption isotherms.
4. To know the spectroscopic techniques such as IR, UV-visible, Raman and NMR.

UNIT I ELECTRICAL CONDUCTANCE

1.1. Conductance in metal and in electrolytic solution- specific conductance and equivalent conductance. Arrhenius theory of electrolytic dissociation and its limitation. Weak and strong electrolyte according to Arrhenius theory. Ostwald's dilution law- Derivation, applications and limitation.

1.2 Effect of dilution on equivalent conductance and specific conductance. Kohlrausch's law and its applications. The elementary treatment of the Debye- Huckel- Onsager equation for strong electrolytes-evidence for ionic atmosphere.

1.3. Transport number and Hittorf's rule. Determination of transport number by Hittrof's method and moving boundary method.

1.4. Application of conductance measurements- determination of degree of dissociation of weak electrolytes -determination of solubility product of a sparingly solublesalt. common ion effect, conductometric titrations.

UNIT II ELECTROCHEMICAL CELLS

2.1. Galvanic cells - reversible and irreversible cells. Conventional representation of electrochemical cells. Electromotive force of a cell and its measurement – computation of E.M. F. – calculation of thermodynamic quantities of cell reactions (DG, DH, DS and K).

2.2. Types of reversible electrodes- gas/metal ion- metal/metal ion, metal/ insoluble salt/anion and redox electrodes, electrode reactions.

2.3. Nernst equation – derivation of cell E. M. F and single electrode potential – standard hydrogen electrode- reference electrodes- standard electrode potentials- sign convention- electrochemical series and its significance.

2.4. Potentiometric titrations -Acid-Base titrations- Oxidation-reduction (Redox) titrations- Precipitation titrations.Corrosion- general and electrochemical theory – passivity-prevention of corrosion.

UNIT III CATALYSIS AND SURFACE PHENOMENA

3.1. Catalyst-Definition and Characteristics - Types of catalysis-Homogeneous and heterogeneous, induced, auto, positive and negative catalysis, catalytic poisonsand catalytic promoters.

3.2. Enzyme catalysis – Michaelis-menten equation and Michaelis-menten law.

3.3. Adsorption-types-chemical and physical, characteristics of adsorption. Theories of catalysis-intermediate compound formation theory and adsorption theory.

3.4. Different types of isotherms- Freundlich and Langmuir adsorption

UNIT IVSPECTROSCOPY I

4.1. Electromagnetic spectrum- the region of various types of spectra. Microwave spectroscopy- rotational spectra of diatomic molecules treated as rigid rotator, condition for a molecule to be active in microwave region.
4.2. Rotational constants (B) and selection rules for rotational transition. Frequency of spectral lines, calculation of inter-nuclear distance in diatomic molecules.
4.3. Infrared spectroscopy- vibrations of diatomic molecules- harmonic oscillators, zero point energy, dissociation energy and force constant, condition for molecule to be active in the IR region, selection rules for vibrational transition, fundamental bands, overtones and hot bands.
4.4. UV- Visible spectroscopy-conditions- Franck-Condon principle- pre dissociation-applications.

UNIT 5 SPECTROSCOPY II

5.1. Raman spectroscopy – Rayleigh scattering and Raman scattering. Stokes and anti- stokes lines in Raman spectra, Raman frequency, quantum theory of Raman effect, conditions for a molecule to be Raman active.
5.2. Comparison of Raman and IR spectra – structural determination from Raman and IR spectroscopy, rule of mutual exclusion.
5.3. NMR spectroscopy- nuclear spin and conditions for a molecule to give rise to NMR spectrum – theory of NMR spectra, number of NMR signals, equivalent and non- equivalent protons.

COURSE OUTCOME

PHYSICAL CHEMISTRY – II

16SCCCH9

- Learn the various concepts of electrochemistry.
- Know the types and theories of catalysis.
- Learn the adsorption isotherms.
- Understand the spectroscopic techniques such as IR, UV-visible, Raman and NMR.
- Understand the structural determination from Raman and IR spectroscopy

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SEMESTER VI

MAJOR BASED ELECTIVE II

NUCLEAR, INDUSTRIAL CHEMISTRY & METALLIC STATE-16SMBECH2

OBJECTIVES

1. To know the fundamentals of nuclear chemistry.
2. To understand the applications of nuclear chemistry.
3. To study the metallic bond, theories and applications.
4. To understand the applications of inorganic polymers.

UNIT I NUCLEAR CHEMISTRY I

1.1 Introduction, nuclear structure – composition of the nucleus, subatomic particles, nuclear forces, nuclear stability – mass defect and binding energy, whole number rule and packing fraction, n-p ratio, odd even rules, nuclear models – liquid drop and shell models, isobars, isotones and isomers.

1.2 Isotopes – detection, physical and chemical methods of separation, isotopic constitution of elements.

1.3 Radioactivity – introduction – radioactive emanations – characteristics of a, b and g-rays, disintegration theory, modes of decay-group displacement law, rate of integration and half-life period, disintegration series, Geiger- Nuttal rule.

UNIT II NUCLEAR CHEMISTRY II

2.1 Detection and measurement of radioactivity – Wilson cloud chamber, Geiger – Muller counter.

2.2 Particle accelerators – linear accelerator and cyclotron.

2.3 Artificial radioactivity – nuclear transformation – classification of nuclear reactions, fission – atom bomb, fusion – hydrogen bomb, Stellar energy – nuclear reactor – atomic power projects in India.

2.4 Applications of radioisotopes as tracers in reaction mechanism, medicine, agriculture, industry and carbon dating. Hazards of radiations.

UNIT IIIMETALLIC STATE

3.1 Metallic bond : Packing of atoms in metals (BCC, CCP, HCP) electron gas, Pauling and band theories, structure of alloys, substitutional and interstitial solid solutions, Hume-Rothery ratios, crystal defects – stoichiometric and non- stoichiometric defects.

3.2 Semi conductors - intrinsic and extrinsic – n-type and p-type. Composition, properties, structure and uses in electronic industry.

UNIT IV INORGANIC POLYMERS AND THERMO ANALYTICAL METHODS

4.1 Inorganic polymers – coordination polymers, metal alkyls, phosphonitrilicpolymers.

4.2 Silicates – classification into discrete anions – one, two and threedimensional structures with typical examples.

4.3 Composition, properties and uses of beryl, asbestos, talc, mica, feldsparand zeolite.

UNIT V INDUSTRIAL CHEMISTRY

5.1 Gaseous fuels : Natural gas, gobar gas, water gas, semi water gas, carburetted water gas, producer gas and liquified petroleum gas (LPG) – composition, manufacture and applications.
5.2 Fertilizers : Manufacture of nitrogen, phosphorus, potassium and mixed fertilizers, micro nutrients and their role in plant life.
5.3 Safety matches : Introduction, raw materials and manufacturing method.
5.4 Paints and varnishes : Definition, types and composition.
5.5 Glass : Composition, manufacture, types and uses.
5.6 Cement : Manufacture – wet and dry processes, composition and settingof cement.

COURSE OUTCOME
NUCLEAR, INDUSTRIAL CHEMISTRY & METALLIC STATE
16SMBECH2

- Know the fundamentals of nuclear chemistry.
- Understand the applications of nuclear chemistry.
- Study the metallic bond,theories and applications.
- Know the applications of inorganic polymers.
- Attain knowledge about the industrial chemistry

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CO2	2	2	2	2	2	2	2	3	3	3
CO3	2	2	2	2	2	2	2	3	3	3
CO4	2	2	3	2	2	2	2	3	3	3
CO5	2	2	3	3	3	2	2	3	3	3
Average	2	2	2.4	2.2	2.2	2	2	3	3	3

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SEMESTER VI

MAJOR BASED ELECTIVE III (A)

POLYMER CHEMISTRY-16SMBECH3:1

OBJECTIVES

1. To know the chemistry of polymers.
2. To study the importance of polymers.
3. To study the concepts of polymerization and techniques.

UNIT 1 INTRODUCTION TO POLYMERS AND RUBBERS

Basics of polymers – monomers and polymers - definition .classification of polymers on the basis applications - thermosetting and thermoplastics - distinction among plastics. Functionality -. Copolymers. Degree of polymerization. Types of polymerization reactions – chain polymerization -free radical and ionic polymerization – coordination and step polymerization reactions- polyaddition and polycondensation – miscellaneous reactions: ring- opening and group transfer polymerization. Basics of rubbers: types - vulcanization of rubber- ebonite- uses of rubbers.

UNIT II PROPERTIES AND REACTIONS OF POLYMERS

Properties: Glass transition temperature (Tg) -definition – factors affecting Tg. Relationship between Tg and molecular weight. Importance of Tg. Molecularweight of polymers: number average (Mn), weight average (Mw), sedimentation and viscosity average molecular weights. Reactions: Hydrolysis – hydrogenation
– addition – substitutions – cross linking and cyclisations reaction. Polymer degradation-thermal, photo and oxidation degradation of polymers (basics only)

UNIT III POLYMERIZATION TECHNIQUES AND MOULDING TECHNIQUE

Polymerization techniques: bulk, solution, emulsion, melt condensation and interfacial polycondensation polymerization. Moulding technique: Injection, compression, extrusion, rotational and calendaring.

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UNIT IV CHEMISTRY OF COMMERCIAL POLYMERS

Preparation, properties and uses of the polymers: Polyethylene, polypropylene, polystyrene, PVC, teflon and polymethylmethacrylate, polycarbonate, polyurethanes, polyamides (Kevlar), phenol-formaldehyde, urea-formaldehyderesin, epoxy resins, rubber-styrene and neoprene rubbers.

UNIT V ADVANCES IN POLYMERS

Biopolymers – biomaterials. Polymers in medical field - High temperature and fire – resistant polymers. Silicones - conducting polymers- carbon fibers.(basic idea only) and polymer composites.

COURSE OUTCOME

POLYMER CHEMISTRY

16SMBECH3:1

- Distinguish the chemistry of polymers.
- Comprehend the importance of polymers.
- Study the concepts of polymerisation and techniques.
- Understand the chemistry of commercial polymers.
- Explore the advances of polymers

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MAPPING

- **CO - PO – PSO matrices of course**

- 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)
  - If there is no correlation, put "-"

- **POLYMER CHEMISTRY-16SMBECH3:1**

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	2	2	3	2	2	2	2	2	3	3
CO2	2	2	3	2	2	2	2	2	3	3
CO3	2	2	3	3	3	2	2	3	3	3
CO4	2	2	3	3	3	2	2	3	3	3
CO5	2	2	3	3	3	2	2	3	3	3
Average	2	2	3	2.6	2.6	2	2	2.6	3	3

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CORE PRACTICAL I

VOLUMETRIC ANALYSIS (P)- 16SCCCH1P

OBJECTIVES

1. To learn the techniques of titrimetric analyses.
2. To know the estimation of several cations and anions.
3. To know the estimation of total hardness of water.

Titrimetric Quantitative Analysis

1. Estimation of HCl Vs NaOH using a standard oxalic acid solution
2. Estimation of Na_2CO_3 Vs HCl using a standard Na_2CO_3 solution
3. Estimation of oxalic acid Vs $KMnO_4$ using a standard oxalic acid solution
4. Estimation of Iron (II) sulphate by $KMnO_4$ using a standard Mohr's salt solution.
5. Estimation of Ca (II) Vs $KMnO_4$ using a standard oxalic acid solution.
6. Estimation of $KMnO_4$ Vs thio using a standard $K_2Cr_2O_7$ solution.
7. Estimation of Fe (III) by using $K_2Cr_2O_7$ using a standard Mohr's salt solution using internal and external indicators.
8. Estimation of copper (II) sulphate by $K_2Cr_2O_7$ solution
9. Estimation of Mg (II) by EDTA solution
10. Estimation of Ca (II) by EDTA solution
11. Estimation of As_2O_3 using I_2 solution and standard Arsenious oxide solution.
12. Estimation of chloride (in neutral and acid media)

II. Applied Experiments

1. Estimation of Total Hardness of water
2. Estimation of Bleaching Powder
3. Estimation of saponification value of an oil
4. Estimation of copper in brass

COURSE OUTCOME

VOLUMETRIC ANALYSIS (P)

16SCCCH1P

- Learn the techniques of titrimetric analysis.
- Familiar with safe-handling of chemical balance
- Know the estimation of several cations and anions.
- Know the estimation of total hardness of water.

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MAPPING

- **<u>CO - PO – PSO matrices of course</u>**

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  - If there is no correlation, put "-"

- **VOLUMETRIC ANALYSIS (P)**
- **16SCCCH1P**

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	2	2	2	2	2	2	2	2	1	3

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CORE PRACTICAL II

SEMIMICRO ANALYSIS (P)- 16SCCCH2P

OBJECTIVES

To learn the techniques of semimicro qualitative analysis of inorganic salt mixtures.

SEMIMICRO INORGANIC QUALITATIVE ANALYSIS

Analysis of a mixture containing two cations and two anions of which one willbe an interferring acid radical. Semimicro methods using the conventional scheme with hydrogen sulphide may be adopted.

Cations to be Studied: lead, copper, bismuth, cadmium, iron, aluminium, zinc, manganese, cobalt, nickel, barium, calcium, strontium, magnesium and ammonium.

Anions to be studied: Carbonate, Sulphide, Sulphate, nitrate, chloride, bromide, fluoride, borate, oxalate and phosphate.

COURSE OUTCOME

SEMIMICRO ANALYSIS (P)

16SCCCH2P

- Learn the techniques of semimicro qualitative analysis of inorganic salt mixtures.
- Familiar with elimination of interfering acid radicals.

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MAPPING

- **CO - PO – PSO matrices of course**

- 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)
  - If there is no correlation, put "-"

- **SEMIMICRO ANALYSIS (P)**
- **16SCCCH2P**

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	2	1	2	2	2	2	2	2	2	3

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SEMESTER VI

CORE PRACTICAL IV

GRAVIMETRIC & ORGANIC ANALYSIS (P) - 16SCCCH4P

OBJECTIVES

1. To learn the techniques of gravimetric analysis.
2. To learn the methods of different organic compounds preparation andanalysis.

GRAVIMETRIC ANALYSIS:

1. Estimation of Lead as lead chromate.
2. Estimation of Barium as barium chromate.
3. Estimation of Nickel as Nickel - DMG complex.
4. Estimation Calcium as calcium oxalate monohydrate
5. Estimation of Barium as barium sulphate.

ONLY FOR DEMONSTRATION:

1. Estimation of Copper as copper (I) thiocyanate
2. Estimation of Magnesium as magnesium oxinate
3. Estimation of Iron as Iron (III) oxide.

ORGANIC QUALITATIVE ANALYSIS AND ORGANIC PREPARATION:

Organic Analysis
Analysis of Simple Organic compounds (a) characterization of functional groups
(b) confirmation by preparation of solid derivatives / characteristic colour reactions.
Note: Mono –functional compounds are given for analysis. In case of bi- functional compounds, students are required to report any one of the functional groups.

ORGANIC PREPARATION: (ANY FOUR)

Preparation of Organic Compounds involving the following chemical conversions.
1.Oxidation 2. Reduction 3. Hydrolysis 4. Nitration 5. Bromination 6. Diazotization 7. Osazone formation.

DETERMINATION OF PHYSICAL CONSTANTS

Determination of boiling /melting points by semimicro method.

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COURSE OUTCOME

GRAVIMETRIC & ORGANIC ANALYSIS (P)

16SCCCH4P

- Understanding the principles behind the gravimetric methods.
- Learn the techniques of organic qualitative analysis.
- Familiarize the solubility nature of organic substances of different functional groups.
- Practice single stage preparation of organic compounds, involving drying and recrystalliation by various methods.
- Determine the physical constant of Melting point and Boiling point.

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MAPPING

- **CO - PO – PSO matrices of course**
-
- 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)
  If there is no correlation, put "-"

16SCCCH4P – Gravimetric and Organic Analysis(P)

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	2	2	2	2	2	2	3	2	2	3

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