SCHOOL OF BASIC AND APPLIED SCIENCES
Department of Chemistry
(Syllabus and Scheme of Studies w. e. f. 2022-25 onwards)
B.Sc. (PCM) I Year (I Semester)

Schedule per week Lectures: 2
Examination Time : 3 Hrs **Maximum Marks: 50(20+30)**
Subject : Inorganic Chemistry **Paper Code : CH-101**

Note: *Examiner will set nine questions in all and the students will be required to attempt only five questions selecting one question from each unit which will be of 6 marks each.* ***Question number one is compulsory containing six short answer type*** *questions covering the entire syllabus and will be of 1 mark.*

UNIT-I

Atomic Structure: Idea of de-Broglie matter waves, Heisenberg's uncertainty principle, atomic orbital's, quantum numbers, Aufbau and Pauli exclusion principles, Hund's multiplicity rule. Electronic configuration of the elements, radial and angular wave functions and probability distribution curves, shapes of s, p, and d orbitals.

UNIT-II

Periodic Table: General principles of periodic table, effective nuclear charge, Slater's rules, Atomic and ionic radii, ionization energy, electron affinity and electronegativity: definition, methods of determination or evaluation, trends in periodic table (s & p block elements).

UNIT-III

Covalent Bond: Valence bond theory and its limitations, directional characteristics of covalent bond, various types of hybridization and shapes of simple inorganic molecules and ions (BeF_2, BF_3, CH_4, PF_5, SF_6, IF_7 SO_4^{-2}, ClO_4^{-1})Valence shell electron pair repulsion (VSEPR) theory to NH_3, H_3O^+, SF_4, ClF_3, ICl_2^- and H_2O. MO theory of heteronuclear (CO and NO) diatomic molecules, bond strength and bond energy, percentage ionic character from dipole moment and electronegativity difference.

UNIT-IV

Ionic Solids: Ionic structures (NaCl, CsCl, ZnS, CaF_2) radius ratio effect and coordination number, limitation of radius ratio rule, lattice defects, semiconductors, lattice energy (mathematical derivation excluded) and Born- Haber cycle, solvation energy and its relation with solubility of ionic solids,polarizing power and polarisability of ions, Fajan's rule.

Suggested books:

1. Fundamental concepts of Inorganic Chemistry, A.K. Das [Publisher: CBS]
2. Inorganic Chemistry, Malik, Tuli Madan, [Publisher: S.Chand]
3. Principles of Inorganic Chemistry, Puri, Sharma, Pathania [Publisher: VPC]
4. Inorganic Chemistry, James E. Huheey, E.A. Keiter, R. L. Keiter, O. K. Medhi
5. Concise Inorganic Chemistry, J. D. Lee, [Publisher: Oxford]

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Department of Chemistry
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B.Sc. (PCM) I Year (I Semester)

Schedule per week Lectures: 2
Examination Time : 3 Hrs **Maximum Marks: 50(20+30)**
Subject : Organic Chemistry **Paper Code : CH-103**

Note: *Examiner will set nine questions in all and the students will be required to attempt only five questions selecting one question from each unit which will be of 6 marks each.* ***Question number one is compulsory containing six short answer type*** *questions covering the entire syllabus and will be of 1 mark.*

UNIT-I

Structure and Bonding: Localized and delocalized chemical bond, vander Waals' interactions, resonance conditions, resonance effect and its applications, hyperconjugation, inductive effect, Electromeric effect & their comparison.

Stereochemistry of Organic Compounds-I: Concept of isomerism. Types of isomerism. Optical isomerism, elements of symmetry, molecular chirality, enantiomers, stereogenic centre, optical activity, properties of enantiomers, chiral and achiral molecules with two stereogenic centres, diastereomers, threo and erythro diastereomers, meso compounds, resolution of enantiomers, inversion, retention and racemization.

UNIT-II

Stereochemistry of Organic Compounds-II: Relative and absolute configuration, sequence rules, R & S system of nomenclature, Geometric isomerism, determination of configuration of geometrical isomers, E & Z system of nomenclature, Conformational isomerism conformational analysis of ethane and n-butane, conformations of cyclohexane, axial and equatorial bonds, Newman projection and Sawhorse formulae, Difference between configuration and conformation.

UNIT-III

Mechanism of Organic Reactions: Curved arrow notation, drawing electron movements with arrows, half-headed and double-headed arrows, homolytic and heterolytic bond breaking. Types of reagents – electrophiles and nucleophiles. Types of organic reactions. Energy considerations.Reactive intermediates carbocations, carbanions, free radicals, carbenes , arynes and nitrenes (formation, structure & stability). Assigning formal charges on intermediates and other ionic species.

UNIT-IV

Alkanes and Cycloalkanes: IUPAC nomenclature of branched and unbranched alkanes, the alkyl group, classification of carbon atoms in alkanes. Isomerism in alkanes, sources, methods of formation (with special reference to Wurtz reaction, Kolbe reaction, Corey-House reaction and decarboxylation of carboxylic acids), physical properties. Cycloalkanes: nomenclature, synthesis of cycloalkanes and their derivatives– photochemical (2+2) cycloaddition reactions, dehalogenation of dihalides, pyrolysis of calcium or barium salts of dicarboxylic acids, Baeyer's strain theory and its limitations, theory of strainless rings.

Suggested books:

1. Basic Stereochemistry of Organic molecules, Subrata Sengupta [Publisher: Oxford]
2. Organic Chemistry Vol-I, I. L. Finar [Publisher: Pearson]
3. Organic Chemistry Vol-I, Nemai Tewari, [Publisher: McGraw Hill]
4. Stereochemistry of Organic Compounds, D Nasipuri, [Publisher: New Age Central]

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B.Sc. (PCM) I Year (I Semester)

Schedule per week Lectures: 2

Examination Time	**: 3 Hrs**	**Maximum Marks: 50(20+30)**
Subject	**: Physical Chemistry**	**Paper Code : CH-105**

Note: *Examiner will set nine questions in all and the students will be required to attempt only five questions selecting one question from each unit which will be of 6 marks each.* ***Question number one is compulsory containing six short answer type*** *questions covering the entire syllabus and will be of 1 mark.*

UNIT-I

Gaseous States: Maxwell's distribution of velocities and energies (derivation excluded) Calculation of root mean square velocity, average velocity and most probable velocity. Collision diameter, collision number, collision frequency and mean free path. Deviation of Real gases from ideal behaviour. Derivation of Vander Waal's Equation of State, its application in the calculation of Boyle's temperature (compression factor) Explanation of behavior of real gases using Vander Waal's equation.

UNIT-II

Critical Phenomenon: Critical temperature, Critical pressure, critical volume and their determination. PV isotherms of real gases, continuity of states, the isotherms of Vander Waal's equation, relationship between critical constants and Vander Waal's constants. Critical compressibility factor. The Laws of corresponding states. Liquefaction of gases.

UNIT-III

Liquid States: Structure of liquids. Properties of liquids – surface tension, viscosity, vapour pressure and optical rotations and their determination.

UNIT-IV

Solid State: Classification of solids, Laws of crystallography – (i) Law of constancy of interfacial angles (ii) Law of rationality of indices (iii) Law of symmetry. Symmetry elements of crystals, Definition of unit cell & space lattice. Bravais lattices, crystal system. X-ray diffraction by crystals. Derivation of Bragg equation. Determination of crystal structure of NaCl, KCl.
Liquid crystals: Difference between solids, liquids and liquid crystals, types of liquid crystals, Applications of liquid crystals.

Suggested books:

1. Physical Chemistry, P.C. Rakshit [Publisher: SBH]
2. A Textbook of Physical Chemistry Vol-2, K. L. Kapoor [Publisher: McGraw Hill]
3. Principles of Physical Chemistry, Puri, Sharma, Pathania [Publisher: VPC]
4. Essentials of Physical Chemistry, Bahl, Bahl and Tuli [Publisher: S.Chand]

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B.Sc. (PCM) I Year (I Semester)

Schedule per week Practical: 6
Examination Time : 4 Hrs **Maximum Marks: 50 (20+30)**
Subject : Chemistry Lab-I **Paper Code : CH-107**

UNIT-I (Inorganic)

Volumetric Analysis

1. **Redo titrations**: Determination of Fe^{2+}, $C_2O_4^{2-}$ (using $KMnO_4$, $K_2Cr_2O_7$)
2. **Iodometic titrations:** Determination of Cu^{2+} (using standard hypo solution).
3. **Complexometric titrations:** Determination of Mg^{2+}, Zn^{2+} by EDTA.

UNIT-II (Physical)

1. To determine the specific reaction rate of the hydrolysis of methyl acetate/ethyl acetate catalyzed by hydrogen ions at room temperature.
2. To prepare arsenious sulphide sol and compare the precipitating power of mono, bi and trivalent anions.

UNIT-III (Organic)

1. Preparation and purification through crystallization or distillation and ascertainingtheir purity through melting point or boiling point
   - (i) Iodoform from ethanol (or acetone)
   - (ii) *m*-Dinitrobenzene from nitrobenzene (use 1:2 conc. HNO_3 H_2SO_4 mixture if fuming HNO_3 is not available)
   - (iii) *p*-Bromoacetanilide from acetanilide
   - (iv) Dibenzalacetone from acetone and benzaldehyde
   - (v) Aspirin from salicylic acid

Distribution of marks

1. UNIT-I	10 (6+4) marks
2. UNIT-II	10 (6+4) marks
3. UNIT-III	10 (6+4) marks
4. Viva-voce	10 (6+4) marks
5. Lab Record	10 (6+4) marks

SCHOOL OF BASIC AND APPLIED SCIENCES
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B.Sc. (PCM) I Year (II Semester)

Schedule per week Lectures : 2
Examination Time : 3 Hrs **Maximum Marks: 50(20+30)**
Subject : Inorganic Chemistry **Paper Code : CH-102**

Note: *Examiner will set nine questions in all and the students will be required to attempt only five questions selecting one question from each unit which will be of 6 marks each.* ***Question number one is compulsory containing six short answer type*** *questions covering the entire syllabus and will be of 1 mark.*

UNIT-I

Hydrogen Bonding & Vander Waals Forces: Hydrogen Bonding-Definition, Types, effects of hydrogen bonding on properties of substances, application Brief discussion of various types of Vander Waals Forces**.** Metallic Bond and Semiconductors Metallic Bond- Brief introduction to metallic bond, band theory of metallic bond Semiconductors- types and applications.

UNIT-II

s-Block Elements: Comparative study of the elements including diagonal relationships, salient features of hydrides (methods of preparation excluded), solvation and complexation tendencies including their function in biosystems.

Chemistry of Noble Gases: Chemical properties of the noble gases with emphasis on their low chemical reactivity, chemistry of xenon, structure and bonding of fluorides, oxides & oxyfluorides of xenon.

UNIT-III

p-Block Elements: Emphasis on comparative study of properties of p-block elements (including diagonal relationship and excluding methods of preparation).

Boron family (13th group): Diborane-properties and structure (as an example of electron-deficient compound and multicentre bonding), Borazine-chemical properties and structure Trihalides of Boron – Trends in acid character, structure of aluminium (III) chloride.

Carbon Family (14th group): Catenation, p–d bonding (an idea), carbides, fluorocarbons, silicates (structural aspects), silicons – general methods of preparations, properties and uses.

UNIT-IV

Nitrogen Family (15th group): Structures of oxides of N, P. oxyacids–structure and relative acid strengths of oxyacids of N and P. Structure of white, yellow and red phosphorus

Oxygen Family (16th group): Oxyacids of sulphur – structures and acidic strength, H_2O_2 structure,properties and uses.

Halogen Family (17th group): Basic properties of halogen, interhalogens, types, properties, hydroand oxyacids of chlorine – structure and comparison of acid strength

Suggested books:

1. Fundamental concepts of Inorganic Chemistry, A.K. Das [Publisher: CBS]
2. Inorganic Chemistry, Malik, Tuli Madan, [Publisher: S.Chand]
3. Principles of Inorganic Chemistry, Puri, Sharma, Pathania [Publisher: VPC]
4. Inorganic Chemistry, R.P. Sarkar [Publisher: NCBA]
5. Concise Inorganic Chemistry, J. D. Lee, [Publisher: Oxford]

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B.Sc. (PCM) I Year (II Semester)

Schedule per week Lectures : 2
Examination Time : 3 Hrs **Maximum Marks: 50(20+30)**
Subject : Organic Chemistry **Paper Code : CH-104**

Note: *Examiner will set nine questions in all and the students will be required to attempt only five questions selecting one question from each unit which will be of 6 marks each.* ***Question number one is compulsory containing six short answer type*** *questions covering the entire syllabus and will be of 1 mark.*

UNIT-I

Alkenes: Nomenclature of alkenes, mechanisms of dehydration of alcohols and dehydro- halogenation of alkyl halides, The Saytzeff rule, Hofmann elimination, physical properties and relative stabilities of alkenes. Chemical reactions of alkenes and mechanisms involved in hydrogenation, electrophilic and free radical additions, Markownikoff's rule, hydroboration- oxidation, oxymercurationreduction, ozonolysis, hydration, hydroxylation and oxidation with $KMnO_4$,

UNIT-II

Arenes and Aromaticity: Nomenclature of benzene derivatives, Aromatic nucleus and side chain. Aromaticity: the Huckel rule, aromatic ions, annulenes up to 10 carbon atoms, aromatic, antiaromatic and non-aromatic compounds. Aromatic electrophilic substitution general pattern of the mechanism, mechansim of nitration, halogenation, sulphonation, and Friedel-Crafts reaction. Energy profile diagrams; Activating , deactivating substituents and orientation.

UNIT-III

Dienes and Alkynes: Nomenclature and classification of dines isolated, conjugated and cumulated dienes. Structure of butadiene, Chemical reactions 1, 2 and 1, 4 additions (Electrophilic & free radical mechanism), Diels-Alder reaction, Nomenclature, structure and bonding in alkynes. Methods of formation. Chemical reactions of alkynes, acidity of alkynes. Mechanism of electrophilic and nucleophilic addition reactions, hydroboration-oxidation of alkynes,

UNIT-IV

Alkyl and Aryl Halides: Nomenclature and classes of alkyl halides, methods of formation, chemical reactions. Mechanisms and stereochemistry of nucleophilic substitution reactions of alkyl halides, SN_2 and SN_1 reactions with energy profile diagrams. Methods of formation and reactions of aryl halides, The addition elimination and the elimination-addition mechanisms of nucleophilic aromatic substitution reactions. Relative reactivities of alkyl halides vs allyl, vinyl and aryl halides.

Suggested books:

1. Organic Chemistry, Subrata Sengupta [Publisher: Oxford]
2. Organic Chemistry Vol-I, I. L. Finar [Publisher: Pearson]
3. Organic Chemistry Vol-I, Nemai Tewari, [Publisher: McGraw Hill]
4. Organic Chemistry, Jerry March, [Publisher: Willey]
5. A guidebook to mechanism in organic chemistry, Peter Sykes, [Publisher: Pearson]

SCHOOL OF BASIC AND APPLIED SCIENCES
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B.Sc. (PCM) I Year (II Semester)

Schedule per week Lectures : 2
Examination Time : 3 Hrs **Maximum Marks: 50(20+30)**
Subject : Physical Chemistry **Paper Code : CH-106**

Note: *Examiner will set nine questions in all and the students will be required to attempt only five questions selecting one question from each unit which will be of 6 marks each.* ***Question number one is compulsory containing six short answer type*** *questions covering the entire syllabus and will be of 1 mark.*

UNIT-I

Kinetics-I: Rate of reaction, rate equation, factors influencing the rate of a reaction concentration, temperature, pressure, solvent, light, catalyst. Order of a reaction, integrated rate expression for zero order, first order, second and third order reaction. Half-life period of a reaction. Methods of determination of order of reaction,

UNIT-II

Kinetics-II: Effect of temperature on the rate of reaction-Arrhenius equation. Theories of reaction rate – Simple collision theory for unimolecular and bimolecular collision, Transition state theory of Bimolecular reactions.

UNIT-III

Electrochemistry-I: Electrolytic conduction, factors affecting electrolytic conduction, specific, conductance, molar conductance, equivalent conductance and relation among them, their variation with concentration. Arrhenius theory of ionization, Ostwald's Dilution Law, Debye- Huckel-Onsager's equation for strong electrolytes (elementary treatment only) Transport number, definition and determination by Hittorfs methods, (numerical included),

UNIT-IV

Electrochemistry-II: Kohlarausch's Law, calculation of molar ionic conductance and effect of viscosity temperature & pressure on it. Application of Kohlarausch's Law in calculation of conductance of weak electrolytes at infinite dilution. Applications of conductivity

Measurements: determination of degree of dissociation, determination of Ka of acids determination of solubility product of sparingly soluble salts, conductometric titrations. Definition of pH and pKa, Buffer solution, Buffer action, Henderson – Hazel equation, Buffer mechanism of buffer action.

Suggested books:

1. Physical Chemistry, Peter Atkins, De Paula [Publisher: Oxford]
2. Physical Chemistry, P.C. Rakshit [Publisher: SBH]
3. A Textbook of Physical Chemistry, K. L. Kapoor [Publisher: McGraw Hill]
4. Principles of Physical Chemistry, Puri, Sharma, Pathania [Publisher: VPC]
5. Physical Chemistry, Ira Levine, [Publisher: Pearson]

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B.Sc. (PCM) I Year (II Semester)

Schedule per week Practical: 6
Examination Time : 4 Hrs **Maximum Marks: 50 (20+30)**
Subject : Chemistry Lab-II **Paper Code : CH-108**

UNIT-I (Inorganic)

Volumetric Analysis

Complexometric titrations: Determination of Hardness of Water by EDTA

Paper Chromatography

Qualitative Analysis of the any one of the following Inorganic cations and anions by paper chromatography (Pb^{+2} , Cu^{+2} , Ca^{+2} , Ni^{+2} , Cl^{-} , Br^{-} , I^{-}, PO_4^{-3} and NO_3^{-}).

UNIT-II (Physical)

1. To determine the surface tension of a given liquid by drop number method.
2. To determine the viscosity of a given liquid.
3. To determine the specific refractivity of a given liquid

UNIT-III (Organic)

To study the process of sublimation of camphor and phthalic acid.

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B.Sc. (PCM) II Year (III Semester)

Schedule per week Practical: 6
Examination Time : 3 Hrs **Maximum Marks: 50(20+30)**
Subject : Inorganic Chemistry **Paper Code : CH-201**

Note: *Examiner will set nine questions in all and the students will be required to attempt only five questions selecting one question from each unit which will be of 6 marks each.* ***Question number one is compulsory containing six short answer type*** *questions covering the entire syllabus and will be of 1 mark.*

UNIT–I

Chemistry of Elements of I transition series: Definition of transition elements, position in the periodic table, General characteristics & properties of I transition elements, Structures & properties of some compounds of transition elements-TiO_2, $VOCl_2$, $FeCl_3$, $CuCl_2$ and $Ni(CO)_4$

UNIT-II

Chemistry of Elements of IInd & IIIrd transition series: General characteristics and properties of the IInd and IIIrd transition elements Comparison of properties of 3d elements with 4d & 5d elements with reference only to ionic radii, oxidation state, magnetic and Spectral properties and stereochemistry.

UNIT-III

Coordination Compounds: Werner's coordination theory, effective atomic number concept, chelates, nomenclature of coordination compounds, isomerism in coordination compounds, valence bond theory of transition metal complexes

UNIT-IV

Non-aqueous Solvents: Physical properties of a solvent, types of solvents and their general characteristics, reactions in non-aqueous solvents with reference to liquid NH_3 and liquid SO_2

Acids and Bases, HSAB Concept: Arrhenius, Bronsted-Lowry, the Lux-Flood, Solvent system and Lewis concepts of acids & bases, relative strength of acids & bases, Concept of Hard and Soft Acids &Bases. Symbiosis, electronegativity and hardness and softness

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B.Sc. (PCM) II Year (III Semester)

Schedule per week Practical: 6
Examination Time : 3 Hrs **Maximum Marks: 50(20+30)**
Subject : Organic Chemistry **Paper Code : CH-203**

Note: *Examiner will set nine questions in all and the students will be required to attempt only five questions selecting one question from each unit which will be of 6 marks each.* ***Question number one is compulsory containing six short answer type*** *questions covering the entire syllabus and will be of 1 mark.*

UNIT–I

Alcohols: Monohydric alcohols nomenclature, methods of formation by reduction of aldehydes, ketones, carboxylic acids and esters. Hydrogen bonding. Acidic nature. Reactions of alcohols. Dihydric alcohols — nomenclature, methods of formation, chemical reactions of vicinal glycols, oxidative cleavage [$Pb(OAc)_4$ and HIO_4] and pinacol-pinacolone rearrangement.
Epoxides: Synthesis of epoxides. Acid and base-catalyzed ring opening of epoxides, orientation of epoxide ring opening, reactions of Grignard and organolithium reagents with epoxides

UNIT-II

Phenols: Nomenclature, structure and bonding. Preparation of phenols, physical properties and acidic character. Comparative acidic strengths of alcohols and phenols, resonance stabilization of phenoxide ion. Reactions of phenols — electrophilic aromatic substitution, Mechanisms of Fries rearrangement, Claisen rearrangement, Reimer-Tiemann reaction, Kolbe's reaction and Schotten and Baumann reactions.

UNIT-III

Ultraviolet (UV) absorption spectroscopy: Absorption laws (Beer-Lambert law), molar absorptivity, presentation and analysis of UV spectra, types of electronic transitions, effect of conjugation. Concept of chromophore and auxochrome. Bathochromic, hypsochromic, hyperchromic and hypochromic shifts. UV spectra of conjugated enes and enones, Woodward- Fieser rules, calculation of λmax of simple conjugated dienes and -unsaturated ketones. Applications of UV Spectroscopy in structure elucidation of simple organic compounds.

UNIT-IV

Carboxylic Acids & Acid Derivatives: Nomenclature of Carboxylic acids, structure and bonding, physical properties, acidity of carboxylic acids, effects of substituents on acid strength. Preparation of carboxylic acids. Reactions of carboxylic acids. Hell-Volhard Zelinsky reaction. Reduction of carboxylic acids. Mechanism of decarboxylation. Structure, nomenclature and preparation of acid chlorides, esters, amides and acid anhydrides. Relative stability of acyl derivatives. Physical properties, interconversion of acid derivatives by nucleophilic acyl substitution. Mechanisms of esterification and hydrolysis (acidic and basic)

OR

Schedule per week Practical: 6

Examination Time	**: 3 Hrs**	**Maximum Marks:**	**50(20+30)**
Subject	**: Polymer Chemistry (Elective)**	**Paper Code**	**: CH-203**

Note: *Examiner will set nine questions in all and the students will be required to attempt only five questions selecting one question from each unit which will be of 6 marks each.* ***Question number one is compulsory containing six short answer type*** *questions covering the entire syllabus and will be of 1 mark.*

UNIT-I

Introduction and history of polymeric materials: Different schemes of classification of polymers, Polymer nomenclature, Molecular forces and chemical bonding in polymers, Texture of Polymers.

Functionality and its importance: Criteria for synthetic polymer formation, classification of polymerization processes, Relationships between functionality, extent of reaction and degree of polymerization. Bifunctional systems, Poly-functional systems.

UNIT-II

Kinetics of Polymerization: Mechanism and kinetics of step growth, radical chain growth, ionic chain (both cationic and anionic) and coordination polymerizations, Mechanism and kinetics of copolymerization, polymerization techniques. **Crystallization and crystallinity:** Determination of crystalline melting point and degree of crystallinity, Morphology of crystalline polymers, Factors affecting crystalline melting point. **Nature and structure of polymers-**Structure, Property relationships.

UNIT-III

Determination of molecular weight of polymers (Mn, Mw, etc) by end group analysis, viscometry, light scattering and osmotic pressure methods. Molecular weight distribution and its significance. Polydispersity index.

Glass transition temperature (Tg) and determination of Tg, Free volume theory, WLF equation, Factors affecting glass transition temperature (Tg).

UNIT-IV

Polymer Solution – Criteria for polymer solubility, Solubility parameter, Thermodynamics of polymer solutions, entropy, enthalpy, and free energy change of mixing of polymers solutions, Flory- Huggins theory, Lower and Upper critical solution temperatures.

Properties of Polymers (Physical, thermal, Flow & Mechanical Properties). Brief introduction to preparation, structure, properties and application of the following polymers: polyolefins, polystyrene and styrene copolymers, poly(vinyl chloride) and related polymers, poly(vinyl acetate) and related polymers, acrylic polymers, fluoro polymers, polyamides and related polymers. Phenol formaldehyde resins (Bakelite, Novalac), polyurethanes, silicone polymers, polydienes, Polycarbonates, Conducting Polymers, [polyacetylene, polyaniline, poly(p-phenylene sulphide polypyrrole, polythiophene)].

Reference Books:

1. Seymour's Polymer Chemistry, Marcel Dekker, Inc.
2. G. Odian: Principles of Polymerization, John Wiley.
3. F.W. Billmeyer: Text Book of Polymer Science, John Wiley.
4. P. Ghosh: Polymer Science& Technology, Tata Mcgraw-Hill.
5. R.W. Lenz: Organic Chemistry of Synthetic High Polymers.

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B.Sc. (PCM) II Year (III Semester)

Schedule per week Practical: 6
Examination Time : 3 Hrs **Maximum Marks: 50(20+30)**
Subject : Physical Chemistry **Paper Code : CH-205**

Note: *Examiner will set nine questions in all and the students will be required to attempt only five questions selecting one question from each unit which will be of 6 marks each.* ***Question number one is compulsory containing six short answer type*** *questions covering the entire syllabus and will be of 1 mark.*

UNIT-I

Thermodynamics-I: Definition of thermodynamic terms: system, surrounding etc. Types of systems, intensive and extensive properties. State and path functions and their differentials. Thermodynamic process. Concept of heat and work. Zeroth Law of thermodynamics, First law of thermodynamics: statement, definition of internal energy and enthalpy. Heat capacity, heat capacities at constant volume and pressure and their relationship.

UNIT-II

Thermodynamics-II: Joule's law, Joule Thomson coefficient for ideal gas and real gas: and inversion temperature. Calculation of w q dU & dH for the expansion of ideal gases under isothermal and adiabatic conditions for reversible process, Temperature dependence of enthalpy, Kirchoffs equation. Bond energies and applications of bond energies.

UNIT-III

Chemical Equilibrium: Equilibrium constant and free energy, concept of chemical potential, Thermodynamic derivation of law of chemical equilibrium. Temperature dependence of equilibrium constant; Van't Hoff reaction isochore, Van't Hoff reaction isotherm. Le-Chatetier's principle and Clausius-Clapeyron equation its applications.

UNIT-IV

Distribution Law: Nernst distribution law – its thermodynamic derivation, Modification of distribution law when solute undergoes dissociation, association and chemical combination. Applications of distribution law: (i) Determination of degree of hydrolysis and hydrolysis constant of aniline hydrochloride. (ii) Determination of equilibrium constant of potassium triiodide complex and process of extraction.

RAFFLES UNIVERSITY

SCHOOL OF BASIC AND APPLIED SCIENCES
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B.Sc. (PCM) II Year (III Semester)

Schedule per week Practical: 6

Examination Time : 4 Hrs **Maximum Marks: 50 (20+30)**
Subject : Chemistry Lab-III **Paper Code : CH-207**

UNIT-I (Inorganic)

1. Gravimetric Analysis

Quantitative estimations of, Cu^{2+} as copper thiocyanate and Ni^{2+} as Ni – dimethylglyoxime.

2. Colorimetry:

To verify Beer - Lambert law for $KMnO_4/K_2Cr_2O_7$ and determine the concentration of the given $KMnO_4/K_2Cr_2O_7$ solution.

UNIT-II (Physical)

1. To determine the CST of phenol – water system.
2. To determine the solubility of benzoic acid at various temperatures and to determine the H of the dissolution process.

UNIT-III (Organic)

Laboratory Techniques

(a) Steam distillation (non evaluative) Naphthalene from its suspension in water
Separation of *o*-and *p*-nitrophenols

(b) Column chromatography (non evaluative) Separation of fluorescein and methyleneblue
Separation of leaf pigments from spinach leaves

Distribution of marks

1. UNIT-I	10 (6+4) marks
2. UNIT-II	10 (6+4) marks
3. UNIT-III	10 (6+4) marks
4. Viva-voce	10 (6+4) marks
5. Lab Record	10 (6+4) marks

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B.Sc. (PCM) II Year (IV Semester)

Schedule per week Practical: 6
Examination Time : 3 Hrs **Maximum Marks: 50(20+30)**
Subject : Inorganic Chemistry **Paper Code : CH-202**

Note: *Examiner will set nine questions in all and the students will be required to attempt only five questions selecting one question from each unit which will be of 6 marks each.* ***Question number one is compulsory containing six short answer type*** *questions covering the entire syllabus and will be of 1 mark.*

UNIT-I

Chemistry of f -block elements:
Lanthanides: Electronic structure, oxidation states and ionic radii and lanthanide contraction, complex formation, occurrence and isolation, lanthanide compounds.

UNIT-II

Chemistry of f -block elements
Actinides: General features and chemistry of actinides, chemistry of separation of Np, Pu and Am from U, Comparison of properties of Lanthanides and Actinides and with transition elements.

UNIT-III

Theory of Qualitative and Quantitative Inorganic Analysis-I:
Chemistry of analysis of various acidic radicals, Chemistry of identification of acid radicals in typical combinations, Chemistry of interference of acid radicals including their removal in the analysis of basic radicals.

UNIT-IV

Theory of Qualitative and Quantitative Inorganic Analysis-II:
Chemistry of analysis of various groups of basic radicals, Theory of precipitation, co- precipitation, Post-precipitation, purification of precipitates.

OR

Schedule per week Lectures: 2
Examination Time : 3 Hrs Maximum Marks: 50(20+30)
Subject : Coordination Chemistry (Elective) Paper Code : CH-202

Note: *Examiner will set nine questions in all and the students will be required to attempt only five questions selecting one question from each unit which will be of 6 marks each.* ***Question number one is compulsory containing six short answer type*** *questions covering the entire syllabus and will be of 1 mark.*

UNIT-I

Werner's theory, valence bond theory (inner and outer orbital complexes), electroneutrality principle and back bonding. Crystal field theory, measurement of 10 Dq (Δo), CFSE in weak and strong fields, pairing energies, factors affecting the magnitude of 10 Dq (Δo, Δt). Octahedral vs. tetrahedral coordination, tetragonal distortions from octahedral geometry Jahn-Teller theorem, square planar geometry. Qualitative aspect of Ligand field and MO Theory.

IUPAC nomenclature of coordination compounds, isomerism in coordination compounds. Stereochemistry of complexes with 4 and 6 coordination numbers. Chelate effect, polynuclear complexes, Labile and inert complexes.

UNIT-II

Transition Elements: General group trends with special reference to electronic configuration, colour, variable valency, magnetic and catalytic properties, ability to form complexes. Stability of various oxidation states and e.m.f. (Latimer diagrams) Different between the first, second and third transition series. Chemistry of Cr, Mn, Fe and Co in various oxidation states with special reference to the following compounds: peroxo compounds of chromium, potassium dichromate, potassium permanganate, potassium ferrocyanide, potassium ferricyanide, sodium nitroprusside and sodium cobaltinitrite.

UNIT-III

Lanthanoids and Actinoids: Electronic configuration, oxidation states, colour, spectral and magnetic properties, lanthanide contraction, separation of lanthanides (ion-exchange method only).

UNIT-IV

Inorganic Reaction Mechanism : Introduction to inorganic reaction mechanisms. Substitution reactions in square planar complexes, Trans- effect, theories of trans effect. Thermodynamic and Kinetic stability.

Reference Books:

1. Purcell, K.F & Kotz, J.C., Inorganic Chemistry W.B. Saunders Co, 1977.
2. Huheey, J.E., Inorganic Chemistry, Prentice Hall, 1993.
3. Cotton, F.A. & Wilkinson, G., Advanced Inorganic Chemistry Wiley-VCH, 1999
4. Basolo, F, and Pearson, R.C., Mechanisms of Inorganic Chemistry, John Wiley & Sons, NY, 1967.
5. Greenwood, N.N. & Earnshaw A., Chemistry of the Elements, ButterworthHeinemann, 1997.
6. Miessler, G. L. &. Tarr, Donald A. Inorganic Chemistry 3rd Ed.(adapted), Pearson, 2009

OR

Schedule per week Lectures: 2

Examination Time : 3 Hrs **Maximum Marks: 50(20+30)**

Subject : Novel Inorganic Solids (Elective) **Paper Code : CH-202**

Note: *Examiner will set nine questions in all and the students will be required to attempt only five questions selecting one question from each unit which will be of 6 marks each.* ***Question number one is compulsory containing six short answer type*** *questions covering the entire syllabus and will be of 1 mark.*

UNIT-I

Synthesis and modification of inorganic solids: Conventional heat and beat methods, Co-precipitation method, Sol-gel methods, Hydrothermal method, Ion-exchange and Intercalation methods.

Inorganic solids of technological importance: Solid electrolytes – Cationic, anionic, mixed Inorganic pigments – coloured solids, white and black pigments.

One-dimensional metals, molecular magnets, inorganic liquid crystals.

UNIT-II

Nanomaterials: Overview of nanostructures and nanomaterials: classification. Preparation of gold and silver metallic nanoparticles, self-assembled nanostructures-control of nanoarchitecture onedimensional control. Carbon nanotubes and inorganic nanowires. Bioinorganic nanomaterials, DNA and nanomaterials, natural and antisical nanomaterials, bionano composites. Introduction to engineering materials for mechanical construction:

Composition, mechanical and fabricating characteristics and applications of various types of cast irons, plain carbon and alloy steels, copper, aluminum and their alloys like duralumin, brasses and bronzes cutting tool materials, super alloys thermoplastics, thermosets and composite materials.

UNIT-III

Composite materials:

Introduction, limitations of conventional engineering materials, role of matrix in composites, classification, matrix materials, reinforcements, metal-matrix composites, polymer-matrix composites, fibre-reinforced composites, environmental effects on composites, applications of composites.

UNIT-IV

Speciality polymers: Conducting polymers - Introduction, conduction mechanism, polyacetylene, polyparaphenylene and polypyrole, applications of conducting polymers, Ion-exchange resins and their applications. Ceramic & Refractory: Introduction, classification, properties, raw materials, manufacturing and applications.

Reference Books:

1. Atkins, Peter, Overton, Tina, Rourke, Jonathan, Weller, Mark and Armstrong, Fraser Shriver& Atkins' Inorganic Chemistry, 5 th Edition, Oxford University Press 2011- 2012
2. Adam, D.M. Inorganic Solids: An introduction to concepts in solid-state structural chemistry, John Wiley and Sons, London, New York, Sydney, Toronto, 1974
3. Poole Jr., Charles P., Owens, Frank J., Introduction to Nanotechnology John Wiley and Sons, 2003.

SCHOOL OF BASIC AND APPLIED SCIENCES
Department of Chemistry
(Syllabus and Scheme of Studies w. e. f. 2022-25 onwards)
B.Sc. (PCM) II Year (IV Semester)

Schedule per week Practical: 6
Examination Time : 3 Hrs **Maximum Marks: 50(20+30)**
Subject : Organic Chemistry **Paper Code : CH-204**

Note: *Examiner will set nine questions in all and the students will be required to attempt only five questions selecting one question from each unit which will be of 6 marks each.* ***Question number one is compulsory containing six short answer type*** *questions covering the entire syllabus and will be of 1 mark.*

UNIT-I

Infrared (IR) absorption spectroscopy: Molecular vibrations, Hooke's law, selection rules, intensity and position of IR bands, measurement of IR spectrum, fingerprint region, characteristic absorptions of various functional groups and interpretation of IR spectra of simple organic compounds. Applications of IR spectroscopy in structure elucidation of simple organic compounds.

UNIT-II

Amines: Structure and nomenclature of amines, physical properties. Separation of a mixture of primary, secondary and tertiary amines. Structural features affecting basicity of amines. Preparation of alkyl and aryl amines (reduction of nitro compounds, nitriles, reductive amination of aldehydic and ketonic compounds. Gabriel phthalimide reaction, Hofmann bromamide reaction. electrophilic aromatic substitution in aryl amines, reactions of amines with nitrous acid.

UNIT-III

Diazonium Salts: Mechanism of diazotization, structure of benzene diazonium chloride, Replacement of diazo group by H, OH, F, Cl, Br, I, NO2 and CN groups, reduction of diazonium salts to hyrazines, coupling reaction and its synthetic application.

Nitro Compounds: Preparation of nitro alkanes and nitro arenes and their chemical reactions. Mechanism of electrophilic substitution reactions in nitro arenes and their reductions in acidic, neutral and alkaline medium.

UNIT-IV

Aldehydes and Ketones: Nomenclature and structure of the carbonyl group. Synthesis of aldehydes and ketones with particular reference to the synthesis of aldehydes from acid chlorides, advantage of oxidation of alcohols with chromium trioxide (Sarett reagent) pyridinium chlorochromate (PCC) and pyridinium dichromate, Physical properties. Comparison of reactivities of aldehydes and ketones. Mechanism of nucleophilic additions to carbonyl group with particular emphasis on benzoin, aldol, Perkin and Knoevenagel condensations. Condensation with ammonia and its derivatives. Wittig reaction. Mannich reaction. Oxidation of aldehydes, Baeyer–Villiger oxidation of ketones, Cannizaro reaction. MPV, Clemmensen, Wolff- Kishner, $LiAlH_4$ and $NaBH_4$ reductions.

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B.Sc. (PCM) II Year (IV Semester)

Schedule per week Practical: 6
Examination Time : 3 Hrs **Maximum Marks: 50(20+30)**
Subject : Physical Chemistry **Paper Code : CH-206**

Note: *Examiner will set nine questions in all and the students will be required to attempt only five questions selecting one question from each unit which will be of 6 marks each.* ***Question number one is compulsory containing six short answer type*** *questions covering the entire syllabus and will be of 1 mark.*

UNIT-I

Thermodynamics-III: Second law of thermodynamics, need for the law, different statements of the law, Carnot's cycles and its efficiency, Carnot's theorem, Thermodynamics scale of temperature. Concept of entropy– entropy as a state function, entropy as a function of V & T, entropy as a function of P & T, entropy change in physical change, entropy as a criteria of spontaneity and equilibrium. Entropy change in ideal gases and mixing of gases.

UNIT-II

Thermodynamics-IV: Third law of thermodynamics: Nernst heat theorem, statement of concept of residual entropy, evaluation of absolute entropy from heat capacity data. Gibbs and Helmholtz functions; Gibbs function(G) and Helmholtz function (A) as thermodynamic quantities, A & G as criteria for thermodynamic equilibrium and spontaneity, their advantage over entropy change. Variation of G and A with P, V and T.

UNIT-III

Electrochemistry-III: Electrolytic and Galvanic cells, reversible & Irreversible cells, conventional representation of electrochemical cells, EMF of cell and its measurement, Wes ton standard cell, activity and activity coefficients, Calculation of thermodynamic quantities of cell reaction (G, H& K).Types of reversible electrodes metal-metal ion gas electrode, metal–insoluble salt anion and redox electrodes. Electrode reactions, Nernst equations, derivation of cell EMF and single electrode potential. Standard Hydrogen electrode, reference electrodes, standard electrodes potential, sign conventions, electrochemical series and its applications.

UNIT-IV

Electrochemistry-IV: Concentration cells with and without transference, liquid junction potential, application of EMF measurement i.e. valency of ions, solubility product activity coefficient, potentiometric titration (acid- base and redox). Determination of pH using Hydrogen electrode, Quinhydrone electrode and glass electrode by potentiometric methods.

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B.Sc. (PCM) II Year (IV Semester)

Schedule per week Practical: 6
Examination Time : 4 Hrs **Maximum Marks: 50(20+30)**
Subject : Chemistry Lab-IV **Paper Code : CH-208**

UNIT-I (Inorganic)

Preparations: Preparation of Cuprous chloride, prussion blue from iron fillings, tetraammine cupric sulphate, chrome alum, potassium trioxalatochromate (III).

UNIT-II (Physical)

1. To determine the enthalpy of neutralisation of a weak acid/weak base vs. strong base/strong acid and determine the enthalpy of ionisation of the weak acid/weakbase.
2. To determine the enthalpy of solution of solid calcium chloride
3. To study the distribution of iodine between water and CCl4.

UNIT-III (Organic)

Systematic identification (detection of extra elements, functional groups, determination of melting point or boiling point and preparation of at least one pure solid derivative) of the following simple mono and bifunctional organic compounds: Naphthalene, anthracene, acenaphthene, benzyl chloride, *p*-dichlorobenzene, *m*-dinitrobenzene, *p*-nitrotoluene, resorcinol , hydroquinone, α-naphthol, β-naphthol, benzophenone, ethyl methyl ketone, benzaldehyde, vanillin, oxalic acid, succinic acid, benzoic acid, salicyclic acid, aspirin, phthalic acid, cinnamic acid, benzamide, urea, acetanilide, benzanilide, aniline hydrochloride, p- toluidine, phenyl salicylate (salol), glucose, fructose, sucrose, *o-*, *m-*, *p* nitroanilines, thiourea.

Distribution of marks

1. UNIT-I	10 (6+4) marks
2. UNIT-II	10 (6+4) marks
3. UNIT-III	10 (6+4) marks
4. Viva-voce	10 (6+4) marks
5. Lab Record	10 (6+4) marks

SCHOOL OF BASIC AND APPLIED SCIENCES
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B.Sc. (PCM) III Year (V Semester)

Schedule per week Lectures : 2 Hrs
Examination Time : 3 Hrs **Maximum Marks: 50(20+30)**
Subject : Inorganic Chemistry **Paper Code : CH-301**

Note: *Examiner will set nine questions in all and the students will be required to attempt only five questions selecting one question from each unit which will be of 6 marks each.* ***Question number one is compulsory containing six short answer type*** *questions covering the entire syllabus and will be of 1 mark.*

UNIT-I

Metal-ligand bonding in Transition Metal Complexes: Limitations of valence bond theory, an elementary idea of crystal-field theory, spectrochemical series, crystal field splitting in octahedral, tetrahedral and square planar complexes, factors affecting the crystal-field parameters.

UNIT-II

Thermodynamic and Kinetic Aspects of Metal Complexes: Jahn-Teller effect of the transition metal complexes, A brief outline of thermodynamic stability of metal complexes and factors affecting the stability, substitution reactions of square planar complexes of Pt (II).

UNIT-III

Magnetic Properties of Transition Metal Complexes: Types of magnetic behavior, spin-only formula, orbital contribution to magnetic moments, L-S coupling, spectroscopic ground states, application of magnetic moment data for 3d metal complexes.

UNIT-IV

Electron Spectra of Transition Metal Complexes: Types of electronic transitions, selection rules for d-d transitions, appearance of colour in transition metal complexes, Orgel-energy level diagram for d^1 and d^9 states, discussion of the electronic spectrum of $[Ti(H_2O)_6]^{+3}$ complex ion.

Suggested books:

1. Advanced Inorganic Chemistry, F.A. Cotton and Wilkinson, John Wiley.
2. Inorganic Chemistry, J.E. Huheey, HarperCollins.
3. Magnetochemistry, R.L. Carlin, Springer Verlog.
4. Magnetochemistry, A. Earnshaw.
5. Introduction to ligand fields, B.N. Figgis, Wiley Eastern-IIed.
6. Inorganic Chemistry, by Malik, Tuli Madan, S. Chand . & company.
7. Inorganic Chemistry B.Sc. -V, by Ramesh Kapoor and R S Chopra, R. Chand. & company.

SCHOOL OF BASIC AND APPLIED SCIENCES
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B.Sc. (PCM) III Year (V Semester)

Schedule per week Lectures : 2 Hrs
Examination Time : 3 Hrs **Maximum Marks: 50(20+30)**
Subject : Organic Chemistry **Paper Code : CH-303**

Note: *Examiner will set nine questions in all and the students will be required to attempt only five questions selecting one question from each unit which will be of 6 marks each.* ***Question number one is compulsory containing six short answer type*** *questions covering the entire syllabus and will be of 1 mark.*

UNIT-I

NMR Spectroscopy-I: Principle of nuclear magnetic resonance, introduction to proton NMR, number of signals, peak areas and integration, equivalent and nonequivalent protons positions of signals and chemical shift, shielding and de-shielding of protons, proton counting, splitting of signals and coupling constants.

UNIT-II

NMR Spectroscopy-II: Factors affecting chemical shift, Discuss ion of proton NMR spectra of the molecules: ethyl bromide, n-propylbromide, isopropyl bromide, 1,1-dibromoethane, 1,1,2-tribromoethane, ethanol, acetaldehyde, ethyl acetate, toluene, benzaldehyde and acetophenone. Brief introduction and chemical shift values of carbon NMR. Simple problems on NMR spectroscopy for structure determination of organic compounds.

UNIT-III

Carbohydrates-I: Classification and nomenclature. Monosaccharides, mechanism of osazone formation, inter-conversion of glucose and fructose, chain lengthening and chain shortening of aldoses. Configuration of monosaccharides. Erythro and threo diastereomers. Conversion of glucose into mannose. Formation of glycosides, ethers and esters. Determination of ring size of glucose and fructose. Open chain and cyclic structure of D (+)-glucose &D (-) fructose. Mechanism of mutarotation. Structures of ribose and deoxyribose.

UNIT-IV

Carbohydrates-II: An introduction to disaccharides (maltose, sucrose and lactose) and polysaccharides (starch and cellulose) without involving structure determination.

Organometallic Compounds:

Organomagnesium compounds: the Grignard reagents-formation, structure and chemical reactions. Organozinc compounds: formation and chemical reactions. Organolithium compounds: formation and chemical reactions.

Suggested Books:

1. Principles of Biochemistry, A. L. Lehninger, Worth Publishers.
2. Biochemistry, L.Stryer, W.H.Freeman.
3. Biochemistry, J. David Rawn, Neil Patterson.
4. Biochemistry, Voet and Voet, John Wiley.
5. Organic chemistry For B. Sc. III Year By P Bhagchandani, Sahitayabhawan Publications.

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B.Sc. (PCM) III Year (V Semester)

Schedule per week Lectures : 2 Hrs
Examination Time : 3 Hrs **Maximum Marks: 50(20+30)**
Subject : Physical Chemistry **Paper Code : CH-305**

Note: *Examiner will set nine questions in all and the students will be required to attempt only five questions selecting one question from each unit which will be of 6 marks each.* ***Question number one is compulsory containing six short answer type*** *questions covering the entire syllabus and will be of 1 mark.*

UNIT-I

Quantum Mechanic s-I: Black-body radiation, Plank's radiation law, photoelectric effect, heat capacity of solids, Compton effect, wave function and its significance of Postulates of quantum mechanics , quantum mechanical operator, commutation relations, Hamiltonian operator, Hermitian operator, average value of square of Hermitian as a positive quantity, Role of operators in quantum mechanics, To show quantum mechanically that position and momentum cannot be predicated simultaneously, Determination of wave function & energy of a particle in one dimensional box, Pictorial representation and its significance,

UNIT-II

Physical Properties and Molecular Structure: Optical activity, polarization-(clausius-Mossottiequation). Orientation of dipoles in an electric field, dipole moment, measurement of dipole moment-temperature method and refractivity method, dipole moment and structure of molecules, Magnetic permeability, magnetic susceptibility and its determination. Application of magnetic susceptibility, magnetic properties-paramagnetism, diamagnetism and ferromagnetics.

UNIT-III

Spectroscopy-I: Electromagnetic radiation, regions of spectrum, basic features of spectroscopy, statement of Born-Oppenheimer approximation, Degrees of freedom.
Rotational Spectrum: Diatomic molecules. Energy levels of rigid rotator (semi-classical principles), selection rules, spectral intensity distribution using population distribution (Maxwell-Boltzmann distribution), determination of bond length, qualitative description of non-rigid rotor, isotope effect.

UNIT–IV

Spectroscopy-II, Vibrational spectrum: Infrared spectrum: Energy levels of simple harmonic oscillator, selection rules, pure vibrational spectrum, intensity, determination of force constant and qualitative relation of force constant and bond energies, effects of an harmonic motion and isotopic effect on the spectra, idea of vibrational frequencies of different functional groups.
Raman Spectrum: Concept of polarizibility, pure rotational and pure vibrational Raman spectra of diatomic molecules, selection rules, Quantum theory of Raman spectra

Text Books:

1. Physical Chemistry for B.Sc. Students by S C Khetarpal, R. Chand & Co, New Delhi
2. Principles of Physical Chemistry for B. sc. Students by Puri, Sharma & Pathania

Books Suggested

1. Physical Chemistry, P.W. Atkins, Oxford University Press.
2. Physical Chemistry, G.W. Castellan, Narosa. Publishers, New Delhi
3. Principles of Physical Chemistry, Puri, Sharma &Pathania, Vishal Pub.
4. Introductory Quantum Chemistry, A.K. Chandra, Tata McGraw Hill.
5. Quantum Chemistry, I.M. Levine, Prentice Hall.
6. Quantum Mechanics, M.L. Strause, Prentice – Hall
7. Quantum Chemistry, J. P. Lowe & K. Peterson, Academic Press (2005).
8. Theoretical Chemistry, Samual Glasstone Affiliated East-West Press.
9. Molecular Quantum Mechanics, P.W. Atkins & R.S. Friedman, 3rd Ed. Oxford University Press (1997).
10. Modern Spectroscopy, J.M. Hollas, John Wiley.
11. Chemical Applications of Group Theory, F.A. Cotton.
12. Introduction to Molecular Spectroscopy, G.M. Barrow, McGraw Hill.
13. Basic Principles of Spectroscopy, G.M. Barrow, McGraw Hill.
14. Fundamentals of molecular spectroscopy, C. N. Banwell, Tata Macgraw Hill.
15. Physical Methods in Chemistry, R.S. Drago, Saunders College.
16. Modern Spectroscopy, J.M. Hollas, John Wiley.
17. Applied Electron Spectroscopy for Chemical Analysis Ed. H. Windawi and F.L. Ho, Wiley Interscience.
18. NMR, NQR, EPR and Mossbauer Spectroscopy in Inorganic Chemistry, R.V. Parish, Ellis Harwood.

RAFFLES UNIVERSITY

SCHOOL OF BASIC AND APPLIED SCIENCES
Department of Chemistry
(Syllabus and Scheme of Studies w. e. f. 2022-25 onwards)
B.Sc. (PCM) III Year (V Semester)

Schedule per week Practical : 6 Hrs
Examination Time : 4 Hrs **Maximum Marks: 50(30+20)**
Subject : Chemistry Lab-V **Paper Code : CH-307**

UNIT-I (Inorganic)

Semimicro qualitative analysis of mixture containing not more than four radicals (including interfering, Combinations and excluding insolubles):
Pb^{2+}, Hg^{2+}, Hg_2^{2+}, Ag^{+}, Bi^{3+}, Cu^{2+}, Cd^{2+}, As^{3+}, Sb^{3+}, Sn^{2+}, Fe^{3+}, Cr^{3+}, Al^{3+}, Co^{2+}, Ni^{2+}, Mn^{2+}, Zn^{2+}, Ba^{2+}, Sr^{2+}, Ca^{2+}, Mg^{2+},

UNIT-II (Physical)

1. To determine the strength of the given acid solution (mono and dibasic acid) conductometrically.
2. To determine the solubility and solubility product of a sparingly soluble electrolyte conductometrically

UNIT-III (Organic)

Chromatography Method

Determination of Rf values and identification of organic compounds
(a) Separation of green leaf pigments (spinach leaves may be used)by paper chromatographic method
(b) Separation of a mixture of colored organic compounds using common organic solvents by TLC.

Distribution of marks

1. UNIT-I	10 (6+4) Marks
2. UNIT-II	10 (6+4) Marks
3. UNIT-III	10 (6+4) Marks
4. Viva-voce	10 (6+4) Marks
5. Lab Record	10 (6+4) Marks

Suggested Books:

1. Experiments and Techniques in Organic Chemistry, D. Pasto, C. Johnson and M. Miller,Prentice Hall.
2. Macroscale and Microscale Organic Experiments, K.L. Williamson, D.C. Heath.
3. Systematic Qualitative Organic Analysis, H. Middleton, Adward Arnold.
4. Handbook of Organic Analysis-Qualitative and Quantitative, H. Clark, Adward Arnold.
5. Vogel's Textbook of Practical Organic Chemistry, A.R. Tatchell, John Wiley.
6. Advanced practical chemistry, Jagdamba, Yadav and shrivastava, PragatiPrakasan
7. Advanced organic practical chemistry, J.N.Gurtu and R. Kappor, S. Chand

SCHOOL OF BASIC AND APPLIED SCIENCES
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B.Sc. (PCM) III Year (VI Semester)

Schedule per week Lectures : 2 Hrs
Examination Time : 3 Hrs **Maximum Marks: 50(20+30)**
Subject : Inorganic Chemistry **Paper Code : CH-302**

Note: *Examiner will set nine questions in all and the students will be required to attempt only five questions selecting one question from each unit which will be of 6 marks each.* ***Question number one is compulsory containing six short answer type*** *questions covering the entire syllabus and will be of 1 mark.*

UNIT–I

Molecular Orbital Theory: Drawbacks of VBT and introduction of LCAO method, Simple MO diagrams of homonuclear molecules - C_2, N_2, O_2, Calculation of Bond order, MO diagrams of halogens and correlation of color of complexes. Non-crossing rule and MO of heteronuclear molecules – CO and HX.

UNIT-II

Organometallic Chemistry: Definition, nomenclature and classification of organometallic compounds. π-acidity of ligands and its effect on stretching frequencies, 18 electron rule, Preparation, properties, and bonding of alkyls of Li, Al, Hg, Brief account of metal-ethylenic complexes – Zeises salt, Organometallic catalysis – Oxidative addition and Reductive elimination, Hydrogenation of olefins.

UNIT-III

Bioinorganic Chemistry: Essential and trace elements in biological processes, metalloporphyrins with special reference to haemoglobin and myoglobin. Biological role of alkali and alkaline earth metal ions with special reference to Ca^{+2}. Nitrogen fixation.

UNIT-IV

Silicones and Phosphazenes: Silicones and phosphazenes, their preparation, properties, structure and uses

Suggested Books:

1. Principles of Bioinorganic Chemistry, S.J. Lippard and J.M. Berg, University Science Books.
2. The Organometallic Chemistry of the Transition Metals, R.H. Crabtree, John Wiley.
3. Organometallics, A. Salzer, Ch. Elschenbrioch.VCH Publications.
4. Inorganic Chemistry, by Malik, Tuli Madan, S. Chand . & company.
5. Inorganic Chemistry, by James E. Huheey, E.A. Keiter, R. L. Keiter, O. K. Medhi
6. Inorganic Chemistry B.Sc. -I, by Ramesh Kapoor and R S Chopra, R. Chand & company.

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B.Sc. (PCM) III Year (VI Semester)

Schedule per week Lectures : 2 Hrs
Examination Time : 3 Hrs **Maximum Marks: 50(20+30)**
Subject : Organic Chemistry **Paper Code : CH-304**

Note: *Examiner will set nine questions in all and the students will be required to attempt only five questions selecting one question from each unit which will be of 6 marks each.* ***Question number one is compulsory containing six short answer type*** *questions covering the entire syllabus and will be of 1 mark.*

UNIT-I

Heterocyclic Compounds-I: Introduction, Molecular orbital picture and aromatic characteristics of pyrrole, furan, thiophene and pyridine. Methods of synthesis and chemical reactions with particular emphasis on the mechanism of electrophilic substitution. Mechanism of nucleophilic substitution reactions in pyridine derivatives. Comparison of basicity of pyridine, piperidine and pyrrole

UNIT-II

Heterocyclic Compounds-II: Introduction to condensed five and six- membered heterocycles. Prepration and reactions of indole, quinoline and isoquinoline with special reference to Fisher indole synthesis, Skraup synthesis and Bischler-Napieralski synthesis. Mechanism of electrophilic substitution reactions of, quinoline and isoquinoline**. Organosulphur Compounds:** Nomenclature, structural features, Methods of formation and chemical reactions of thiols, thioethers, sulphonic acids, sulphonamides and sulphaguanidine. Synthetic detergents alkyland aryl sulphonates.

UNIT-III

Organic Synthesis *via* Enolates: Acidity of hydrogens, alkylation of diethyl malonate and ethylacetoacetate. Synthesis of ethyl acetoacetate: the Claisen condensation. Keto-enol tautomerism of ethyl acetoacetate.

Synthetic Polymers: Addition or chain-growth polymerization. Free radical vinyl polymerization, ionic vinyl polymerization, and Ziegler-Natta polymerization and vinyl polymers. Condensation or step growth polymerization. Polyesters, polyamides, phenol formaldehyde resins. Natural and synthetic rubbers.

UNIT-IV

Amino Acids, Peptides& Proteins: Classification, of amino acids. Acid-base behavior, isoelectric point and electrophoresis. Preparation of α-amino acids. Structure and nomenclature of peptides and proteins. Classification of proteins. Peptide structure determination, end group analysis, selective hydrolysis of peptides. Classical peptide synthesis, solid–phase peptide synthesis. Structures of peptides and proteins: Primary & Secondary structure.

Suggested Books:

1. Sykes, P. A Guidebook to Mechanism in Organic Chemistry 6th Ed., Prentice-Hall (1996).
2. Finar, I. L. &Finar, A. L. Organic Chemistry Vol. 2, Addison-Wesley (1998).
3. Finar, I. L. Organic Chemistry Vol. 1, Longman (1998).
4. Natural Products, their chemistry and biological significance. J. Mann, R. S. Davidson

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B.Sc. (PCM) III Year (VI Semester)

Schedule per week Lectures : 2 Hrs
Examination Time : 3 Hrs **Maximum Marks: 50(20+30)**
Subject : Physical Chemistry **Paper Code : CH-306**

Note: *Examiner will set nine questions in all and the students will be required to attempt only five questions selecting one question from each unit which will be of 6 marks each.* ***Question number one is compulsory containing six short answer type*** *questions covering the entire syllabus and will be of 1 mark.*

UNIT-I

Spectroscopy-III: -Electronic Spectrum: Concept of potential energy curves for bonding and antibonding molecular orbitals, qualitative description of selection rules and Franck- Condon principle. Qualitative description of sigma and pie and n molecular orbital (MO) their energy level and respective transitions.

UNIT-II

Photochemistry: Interaction of radiation with matter, difference between thermal and photochemical processes. Laws of photochemistry: Grotthus-Drapper law, Stark-Einstein law (law of photochemical equivalence) Jablonski diagram depiciting various processes occurring in the excited state, qualitative description of fluorescence, phosphorescence, non-radiative processes (internal conversion, intersystem crossing), quantum yield, photosensitized reactions-energy transfer processes (simple examples).

UNIT-III

Solutions: -Dilute Solutions and Colligative Properties: Ideal and non-ideal solutions, methods of expressing concentrations of solutions, activity and activity coefficient. Dilute solution, Colligative properties, Raoult'slaw, relative lowering of vapour pressure, molelcular weight determination, Osmosis law of osmotic pressure and its measurement, determination of molecular weight from osmotic pressure. Elevation of boiling point and depression of freezing point, Thermodynamic derivation of relation between molecular weight and elevation in boiling point and depression in freezing point. Experimental methods for determining various colligative properties. Abnormal molar mass, degree of dissociation and association of solutes.

UNIT-IV

Phase Equillibrium: Statement and meaning of the terms- phase component and degree of freedom, thermodynamic derivation of Gibbs phase rule, phase equilibria of one component System, water and Sulpher systems. Phase equilibria of two component systems, solid-liquid equilibria, simple eutectic, Pb- Ag system, desilverisation of lead

Text Books:

Physical Chemistry for B.c. Students by S C Khetarpal, R. Chand & Co, New Delhi
Principles ofPhysical Chemistry for B.Sc. Students by Puri, Sharma & Pathania

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B.Sc. (PCM) III Year (VI Semester)

Schedule per week Lectures : 6 Hrs
Examination Time : 4 Hrs **Maximum Marks: 50(30+20)**
Subject : Chemistry Lab-VI **Paper Code : CH-308**

UNIT-I (Inorganic Chemistry)

Semi micro qualitative analysis of mixture containing not more than four radicals (including interfering, Combinations and excluding insoluble's) NH_4^+, CO_3^{2-}, S^{2-}, SO_3^{2-}, $S_2O_3^{2-}$, NO_2^-, CH_3COO^-, Cl^-, Br^-, I^-, NO_3^-, SO_4^{2-},$C_2O_4^{2-}$, PO_4^{3-}, BO_3^{3-}

UNIT-II (Physical Chemistry)

1. To determine the strength of given acid solution (mono and dibasic acid)/$KMnO_4$ – Mohr salt potentiometrically.
2. To determine the molecular weight of a non-volatile solute by Rast method.
3. To standardize the given acid solution (mono and dibasic acid) pH metrically.

UNIT-III (Organic Chemistry)

Synthesis of the following organic compounds:

(a) To prepare o-chlorobenzoic acid from anthranilic acid.
(b) To prepare p-bromoaniline from p-bromoacetanilide.
(c) To prepare m-nitroaniline from m-dinitrobenzene.
(d) To prepare S-Benzyl-iso-thiouronium chloride from thiourea

Distribution of marks

1. UNIT-I	10 (6+4) Marks
2. UNIT-II	10 (6+4) Marks
3. UNIT-III	10 (6+4) Marks
4. Viva-voce	10 (6+4) Marks
5. Lab Record	10 (6+4) Marks

Suggested Books:

1. Experiments and Techniques in Organic Chemistry, D. Pasto, C. Johnson and M. Miller, Prentice Hall.
2. Macroscale and Microscale Organic Experiments, K.L. Williamson, D.C. Heath.
3. Systematic Qualitative Organic Analysis, H. Middleton, Adward Arnold.
4. Handbook of Organic Analysis-Qualitative and Quantitative, H. Clark, Adward Arnold.
5. Vogel's Textbook of Practical Organic Chemistry, A.R. Tatchell, John Wiley.