Address : UNIREG
Telephone No. : 2419677/2419361
Fax : 0821-2419363/2419301

e-mail : registrar@uni-mysore.ac.in
www.uni-mysore.ac.in

UNIVERSITY OF MYSORE

Estd. 1916

VISHWAVIDYANILAYA KARYA SOUDHA
CRAWFORD HALL, POST BOX NO. 406
MYSORE-570 005

No.AC.2(S)/401/13-14

Dated: 24-05-2014

NOTIFICATION

Sub: Modification in the existing syllabus of Chemistry (UG) to be effective from 2014-15

Ref: 1. Proceedings of Faculty of Science & Technology Meeting held on14-02-2014.
2. Proceedings of the Meeting of Academic Council held on 29-03-2014.

The Board of Studies in **Chemistry (UG)** at its meeting held on 03-12-2013 and 12-12-2013 has resolved to Modify the existing syllabus of Chemistry (UG) to be effective from the academic year 2014-15 onwards.

The Faculty of Science and Technology and the Academic Council at their meetings held on 14-02-2014.and 29-03-2014 respectively approved the above proposals and the same is hereby notified.

The copy of the Modify existing syllabus of Chemistry (UG) is annexed herewith.

for S. Sampathkumar
REGISTRAR. 24/5/2014
University of Mysore
MYSORE.

To

1. The Registrar (Evaluation), University of Mysore, Mysore.
2. The Chairperson, BOS/DOS in Chemistry, MGM.
3. The Dean, Faculty of Science & Technology, DOS in Zoology, MGM.
4. The Principals of the Affiliated Science Colleges.
5. The Deputy/Assistant Registrar (Evaluation), University of Mysore, Mysore.
6. Sri Narasimha Murthy, Statistician, E.B. UOM, Mysore.
7. The Supdt AC.1 & AC.2, A.B., Academic Section / PMEB, UOM., Mysore.
8. The P.A. to the Vice-Chancellor/Registrar/Registrar(Evaluation), UOM., Mysore.
9. The Case Worker, AC.7, Academic Section, University of Mysore, Mysore.
10. The Section Guard File(Supdt.AC.2), A.B., A.C., UOM.
11. The Schedule File.

UNIVERSITY OF MYSORE

SUBJECT: CHEMISTRY

REVISED SYLLABUS FOR B.Sc. COURSE UNDER SEMESTER SCHEME

DURATION OF THE COURSE – THREE YEARS – SIX SEMESTER

FROM THE ACADEMIC YEAR 2014-15

I SEMESTER

CHEMISTRY PAPER – I

CLASS DURATION – 03 HOURS PER WEEK

MARKS: Theory – 60 + Internal Assessment – 10 = 70

INORGANIC CHEMISTRY

14 Hours

UNIT-I

Elements of quantum mechanics: Wave mechanical concept of the atom, dual nature of electron, derivation of de-Broglie's equation. Heisenberg's uncertainty principle and its significance. Schrodinger wave equation-explanation of the terms therein (no derivation) Eigen values and functions, significance of ψ and ψ^2. Quantum numbers and their significance. Shapes of s, p and d orbitals. Effective nuclear charge, screening effect-based on Slater's rules (problems to be worked out). General energy level diagram of multi electron atom (up to n=4). Pauli's exclusion principle, Hund's rule, (n+1) rule, Aufbau principle. Electronic configuration of elements (up to At. No. 40), stability of completely filled and half filled orbitals based on the concepts of pairing energy, promotional energy and symmetric charge distribution.

[7 Hours]

UNIT-II

Periodic Table and Periodicity: Classification of elements into s, p, d, and f-blocks, cause of periodicity. Detailed discussion of the following periodic properties of elements with examples.

1) Atomic radius: Covalent, ionic, Vanderwaal's and crystal radii. Additive nature of covalent radii. Determination of ionic radii by Lande's method. Variation of covalent radii in a group and in a period- explanation for the observed trends. Comparison of the size of the atoms with the corresponding anions and cations, Variation of ionic radii in isoelectronic ions.

2) Ionization enthalpy: Successive ionization enthalpy, factors affecting ionization enthalpy, applications of ionization enthalpy. Variation in a group and in a period – explanation for the observed trends.

3) Electron gain enthalpy: Successive electron gain enthalpy variation of electron gain enthalpy in period and in a group- explanation for the observed trends.

4) Electronegativity: Variation of electronegativity in a group and in a period- explanation for the observed trends. Factors determining electro negativity (charge on the atom and hybridization). Pauling, Mulliken and Allred-Rochow scale of electronegativity. Applications of electronegativity. [**7 Hours]**

ORGANIC CHEMISTRY

14 Hours

UNIT-I

Introduction to organic chemistry- Definition and importance of organic compounds to life and applications in food, fuels, textiles, dyes, drugs and cosmetics with examples. Nomenclature (IUPAC) of bifunctional, aliphatic and aromatic compounds. **[3 Hours]**

UNIT-II

Basic Concepts in Organic Chemistry: Generation, stability and reactions involving carbocations, carbanions, free radicals, nitrene and carbenes.

Types of organic reactions: Definition with examples of addition, substitution, elimination, isomerisation, condensation and rearrangement reactions.

Hybridization: Tetravalency of carbon, sp^3, sp^2 and sp – hybridization (in brief). Bond length, bond angle, bond energy, localized and delocalized chemical bonds – resonance and hyperconjugation effects. **[4 Hours]**

UNIT-III

Alkanes: Preparation by Corey-House reaction, conversion of alkanes to aromatic compounds via alkenes and alkynes- aromatization and pyrolysis.

Alkenes: Preparation of alkenes by Witting's reaction, Hoffmann's elimination, Stereoselectivity. Mechanism of electrophillic addition, oxymercuration, reduction, hydroboration – oxidation and epoxidation. Mechanism of oxidation with $KMnO_4$ and OsO_4, ozonolysis. industrial applications of ethene and propene.

Dienes: Types, relative stabilities of dienes, conjugated dienes – 1,3 butadiene-structure, 1,2 and 1,4-addition reactions with H_2 and halogens, Diel's Alder reaction with an example.

Alkynes: Methods of preparation – dehydrohalogenation, vicinal and gem dihalides, reactions of alkynes – Electrophillic additions with HCN, CH_3COOH and H_2O polymerization.

[7 Hours]

PHYSICAL CHEMISTRY

14 Hours

NOTES:

- SI Units to be used
- Problems to be worked out and diagrams to be drawn whenever necessary

UNIT I

Gases: Maxwell-Boltzmann distribution of molecular velocities (no derivation – assume equation) explanation. Effect of temperature on distribution of molecular velocities using distribution curve (graph). Boltzmann factor (significance and equation). Energy distribution as a function of temperature. Types of molecular velocities – average (u_{av}) - root mean square

velocity (u_{rms}) - most probable velocity (u_{mp}) – their definition and equations (no derivation). Relation between u_{av}, u_{rms} and u_{mp} velocities of molecules and their calculations (based on temperature dependence). **[4 Hours]**

UNIT II

The critical phenomena – Andrew's experiments on CO_2, critical constants – T_c, P_c and V_c. definitions-experimental determination of Critical temperature and Critical pressure by using Cagniard delaTour's apparatus. critical volume by Cailletes and Mathias method – Vander Waal's equation – relation between Vander Waal's Constants 'a' and 'b' and critical constants T_c, P_c and V_c to be derived using isotherms of CO_2. Law of corresponding states and reduced equation of state (to be derived)

Liquefaction of gases – Principle underlying liquefaction of gases – Joule Thomson effect, Joule Thomson experiment – Show that Joule Thomson effect is an isoenthalphic process ($\Delta H = 0$). Joule Thomson coefficient, Inversion temperature, definitions and its relation between Vander Waal's constants ('a' and 'b'). **[4 Hours]**

UNIT III

Indicator – Definitions, types (acid-base, redox, adsorption indicators), examples for each type. Theory of indicators – Oswald's theory and Quinonoid theory – indicator constant – action of phenolphthalein and methyl orange in acid-base solutions – pH titration curves for strong acid vs strong base, weak acid vs strong base, weak base vs strong acid, choice of indicators in these types of titrations – color change and pH range. Universal indicator – definition.

Adsorption: Introduction, principle involved. Sorption, absorption and adsorption (statement, differences and examples) physical and chemical adsorption – definition and differences. Adsorption of gases on solids – factors which influence. Adsorption isotherms (definition) – mathematical expression for Freundlich's and Langmuir's adsorption isotherms. Applications of adsorption. **[6 Hours]**

II SEMESTER

CHEMISTRY PAPER – II

CLASS DURATION – 03 HOURS PER WEEK

MARKS: Theory – 60 + Internal Assessment – 10 = 70

INORGANIC CHEMISTRY

14 Hours

UNIT-I

Chemical bonding-I: Ionic bond: Factors that favor the formation of ionic bonds, Lattice energy, Born-Lande's equation (no derivation), Born-Haber cycle, setting up of Born-Haber cycle for 1:1 ionic solids. Numerical calculations of LE and EA based on Born-Haber cycle for 1:1 ionic solids, uses of Born-Haber cycle. Role of lattice energy and hydration energy and their importance in the context of stability and solubility of ionic solids.

Covalent bond: Factors favouring the formation of covalent bond (ionization energy, electron affinity, electronegativity, nuclear charge, inter nuclear distance and number of valence electrons). Valence bond approach – explanation with examples (H_2, F_2, HF, O_2 and N_2) to illustrate valence bond approach. Sigma and Pi bonds – explanation by taking H_2, O_2 and N_2 as examples.

Fajan's rules of polarization and their explanation. Bond length, bond order, bond energy and their significance, polarity of covalent bonds, polar and non-polar molecules, Dipole moment and polarity of molecules to be explained by taking HCl, CO_2, CCl_4 and H_2O as examples.

[6 Hours]

UNIT-II

Chemical bonding-II: Hybridization-directional property and geometry of sp, sp^2, sp^3, sp^3d and sp^3d^2 hybrid orbitals taking $BeCl_2$, BF_3, $SiCl_4$, PCl_5 and SF_6 as examples respectively. VSEPR theory with SO_2, NH_3, H_2O, SF_4 and ClF_3 as examples.

Coordinate bond: Explanation with examples H_3O^+, NH_4^+, NH_3-BF_3 molecule.

Molecular Orbital Theory: An elementary account of MOT, linear combination of atomic orbitals (no mathematical approach). Bonding and antibonding molecular orbitals, conditions for the combination, energy levels of molecular orbitals, Molecular orbital structures and bond orders of species like H_2, He_2, He_2^+, N_2, O_2, HF, LiH, and CO, Prediction of magnetic properties of these species. [**6 Hours]**

Statistical treatment of results of quantitative analysis: Classification of errors, accuracy, precision, minimization of errors (calibration of apparatus, running of blank determination, running parallel determination to be mentioned), significant figures and computation, mean and standard deviation (explanation with an example), distribution of random errors (explanation with the help of curve), reliability of results (F-test and t-test). **[2 Hours]**

ORGANIC CHEMISTRY

14 Hours

UNIT-I

Organic Reagents: One method of preparation and applications of acetic anhydride, benzoyl chloride, dimethyl sulphate, raney nickel and sodium ethoxide. **[2 Hours]**

UNIT-II

Cycloalkanes: Definition, examples, relative stability Bayer's strain theory and its limitations. Sachse-Mohr's theory of strainless rings. Chair and boat conformations of cyclohexane and their stability. Conformations of cyclopentane. **[3 Hours]**

UNIT-III

Aromatic hydrocarbons: Nomenclature of benzene derivatives, Huckel's rule with respect to benzenoids, (benzene, naphthalene, anthracene and phenanthracene) and non-benzenoid compounds (cyclopentadienyl anion, cycloheptadienyl cation) anti-aromaticity.

Aromatic electrophillic substitution – General mechanism, electronic interpretation of orientating influence of electron donating groups (-CH_3, -Cl, -NH_2 and -OH groups) and electron

withdrawing groups (-NO_2, -CHO, -COOH and –SO_3H groups) on electrophillic substitution reactions.

Hydrogenation of aromatic compounds: Birch reduction, side chain oxidation of toluene to benzaldehyde and benzoic acid. Resonating structures of benzene, naphthalene and anthracene. Diel's Alder reactions of anthracene with maleic anhydride.

Biphenyls: Preparation – Ullmann reaction.

Alkenyl Benzenes: Cis and Trans stilbene and their preparation (any one method). **[9 Hours]**

PHYSICAL CHEMISTRY

14 Hours

NOTES:

- SI Units to be used
- Problems to be worked out and diagrams to be drawn whenever necessary

UNIT 1

Liquid mixtures: Classification of binary mixtures – partially miscible, completely miscible and completely immiscible pairs of liquids (explanation with examples for each type). Raoult's law, definition of ideal and non-ideal solutions based on Raoult's law.

Partially miscible liquids: Critical solution temperature (CST) – types – phenol-water system, triethylamine-water system, nicotine-water system (mutual solubility temperature (MST) vs composition curves to be drawn). Effect of addition of non-volatile solute on CST. Binary mixtures of completely miscible liquids.

Vapour pressure – definition, vapor pressure – composition diagrams and boiling point – composite diagrams. Classification into the types – obeying Raoult's law (type I), showing positive deviation from Raoult's Law (type II) and showing negative deviation from Raoult's Law (type III) – examples for each type.

Principles of fractional distillation: Fractional distillation of type I, type II and type III liquid mixtures (with examples). Azeotropic mixtures (definition).

Binary mixtures of completely immiscible liquids (with examples), weight fraction of distillates (no derivation), principle of distillation, applications (numerical problem on weight fractions of components). **[5 Hours]**

UNIT II

Colligative Properties: Concept of vapour pressure, variation of vapour pressure with temperature. Definition of boiling point and freezing point, effect of dissolution of solute on the vapour pressure of the solvent. Lowering of vapour pressure. Raoult's law – relation between relative lowering of vapour pressure and molar mass (to be derived). Determination of relative molar mass of solute by dynamic method. Elevation of boiling point and its relation to lowering of vapour pressure and molar mass (to be derived). Ebullioscopic constant of the solvent and its relation to the boiling point (only equation). Determination of molar mass of the solute by Walker-Lumsden method. Depression in freezing point and its relation to lowering of vapour pressure and molar mass (to be derived). Cryoscopic constant and its relation to the melting point (equation). Determination of molar mass of a non-volatile solute by Beckmann's method (problems to be worked out). **[5 Hours]**

UNIT III

Semi permeable membrane – natural and artificial, preparation of copper ferrocyanide membrane by Morse-Frazer method. Definition of osmosis, osmotic pressure (mention application), determination of osmotic pressure by Berkley-Hartley's method, laws of osmotic pressure analogy with gas laws, determination of molar mass from osmotic pressure measurements (relation to be derived), isotonic solutions, plasmolysis. **[4 Hours]**

III SEMESTER

CHEMISTRY PAPER – III

CLASS DURATION – 03 HOURS PER WEEK

MARKS: Theory – 60 + Internal Assessment – 10 = 70

INORGANIC CHEMISTRY

14 Hours

UNIT-I

Metallic bond: Definition, factors favouring the formation of metallic bond, Band theory, explanation of electrical conductance of metals, semiconductors (n- and p-type), Insulators and Superconductors (explanation and applications with suitable examples).

Hydrogen bonding: Types of hydrogen bonding, conditions for the formation of H-bond. Hydrogen bonding in HF, H_2O, NH_3, alcohols, carboxylic acids and nitrophenols. Appropriate anomalous properties like physical state, boiling point and solubility. Structure of ice. Theories (or nature) of hydrogen bond (electrostatic approach, VBT and MOT treatments) [**5 Hours]**

UNIT-II

Metal carbonyls: Definition, classification with examples, nature of M-CO bonding in carbonyls. Preparation, properties and structures of mono nuclear and binuclear metal carbonyls- $Ni(CO)_4$, $Cr(CO)_6$, $Fe(CO)_5$, $Mn_2(CO)_{10}$, $Co_2(CO)_8$. Applications of EAN rule to mononuclear metalcarbonyls. **[3 Hours]**

UNIT-III

Boron: Boron hydrates – diborane, preparation, structure and uses.

Carbon: Fullerenes – production, structure of C_{60} and C_{70}. Diamond, graphite – properties and structure.

Silicon: Structure of silica. Silicates – types and structure with one example for each type.

Nitrogen: Preparation, properties, structure and applications of hydrazine, hydroxyl amine and nitrogen trichloride.

Sulphur: Preparation, properties, structures and applications of thionyl chloride, sulphuryl chloride and SF_6.

Halogens: Bleaching powder – preparation, properties and structure.

Pseudo halogens: Preparation, properties and structure of cyanogen and thiocyanogen (any one method of preparation and any three properties to be discussed). **[6 Hours]**

ORGANIC CHEMISTRY

14 Hours

UNIT-I

Organic halides: Alkyl halides: isomerism and classification, elimination reaction: dehydrohalogenation. Saytzeff and Hoffmann elimination with mechanism. Nucleophilic substitution reaction. S_N1 and S_N2 with energy profile diagram. Effect of nature of alkyl groups, nature of leaving groups, nucleophiles and solvents. **[3 Hours]**

UNIT-II

Aryl halides: Relative reactivity of alkyl, allyl, vinyl and aryl halides towards nucleophilic substitution reactions. Generation of benzyne-trapping with dienes (furan and anthracene). **[4 Hours]**

Organometallic compounds: Definition with example, organo zinc compounds – preparation of diethyl zinc and its applications.

Organolithium Compounds: Preparation and synthetic applications. **[3 Hours]**

UNIT-III

Alcohols: Definition and classification.

Monohydric alcohols: Preparation of alcohols by hydroboration and oxidation method. Hydration of alkenes. Distinction tests between 1°, 2°, and 3° alcohols by Victor Meyer

oxidation method. Conversion of 1° to 2°, 2° to 3° and 1° to 3° alcohols. Dehydration of 1°, 2°, 3° alcohols and comparison of their rates.

Dihydric alcohols: Glycol – preparation from vicinal dihalides and uses. Pinacoles – synthesis, mechanism of pinacol-pinacolone rearrangement

Trihydric alcohols: Glycerol, synthesis from propene, reactions with HNO_3, H_2SO_4, oxalic acid and HI. Uses of glycerol. **[4 Hours]**

UNIT-IV

Phenols: Definition, classification with examples, acidity of phenols, effect of substituents on acidity of phenols. Mechanism of Reimer-Tiemann reaction and Kolbe reaction. **[3 Hours]**

PHYSICAL CHEMISTRY

14 Hours

NOTES:

- SI Units to be used
- Problems to be worked out and diagrams to be drawn whenever necessary

UNIT I

Polymers: Introduction, monomer, repeating units, types (linear, branches and network) with examples, degree of polymerization, classification (arrangement and shape) with examples, polymerization reaction (addition and condensation), molar masses of polymers – types (number average and mass average), determination of molar mass (viscosity and osmotic pressure method) (Numerical problems). **[5 Hours]**

UNIT II

Ionic equilibria: Ionic equilibria in aqueous solutions, strong and weak electrolytes – definition and examples. Ostwald's dilution law (to be derived) and its limitations (numerical problems). Activity and activity coefficients – definition and their relation. Mean ionic activity coefficients

– ionic strength – determination and its calculation. Debye-Huckel theory of strong electrolytes (relaxation time effect, electrophoretic effect and viscous effect). Debye-Huckel-Onsagar equation (no derivation), Debye-Huckel Limiting equation for activity coefficients (no derivation). Solvent system concept of acids and bases. Role of solvents in altering strengths of acids and bases. Hydrolysis of salts – derivation of hydrolysis constant and degree of hydrolysis of the salt of weak acid and weak base (ammonium acetate), effect of temperature on degree of hydrolysis. **[5 Hours]**

UNIT III

Distribution Law: Nernst distribution law in liquid-liquid systems, distribution coefficient, statement of Nernst distribution law – verification of distribution law taking distribution of I_2 in H_2O and CCl_4 – limitations of the law, conditions for the validity of distribution law, association of the solute in one of the solvents, dissociation of the solute in one of the solvents, application of distribution law with respect to solvent extraction process (numerical problems) **[4 Hours]**

IV SEMESTER

CHEMISTRY PAPER – IV

CLASS DURATION – 03 HOURS PER WEEK

MARKS: Theory – 60 + Internal Assessment – 10 = 70

INORGANIC CHEMISTRY

14 Hours

UNIT-I

Noble gases: Isolation from air by Rayleigh's method, preparation, separation of Noble gases-Dewar's method. Preparation, Structure and applications of compounds of Xenon and Krypton (XeF_2, $XeOF_2$, XeO_3, KrF_2, KrF_4, KrO_3 XH_2O-one method of preparation for each), Clathrates (explanation with suitable examples, essential conditions for the formation and uses).

Non-aqueous solvents: Liquid ammonia-reasons for the solvent properties, typical reactions-solubility of alkali metals; acid-base, precipitation, ammonolysis, Ionization of weak acids,

advantages and disadvantages. Liquid SO_2-reasons for the solvent properties, typical reactions-acid-base, solvolysis, precipitation, amphoteric and redox

HSAB: Classification of acids and bases as Hard and Soft. Pearson's HSAB concept, acid-base strength, hardness and softness, symbiosis. [**7 Hours]**

UNIT-II

Nuclear chemistry: Fundamental particles of nucleus- nucleons, isotopes, isobars and isotones (definition with suitable examples), Nuclear forces (brief explanation), nuclear stability-n/p ratio, Mass defect, Binding energy, Inner structure of nucleus- Liquid drop model, Nuclear fission-(definition with suitable examples), Calculation of energy release in nuclear fission, modes of release of fission energy (uncontrolled and controlled).

Plutonium as a fissionable material (Plutonium bomb), nuclear fusion and its advantages over nuclear fission reactions, hydrogen bomb, nuclear transmutation-artificial radioactivity. Detection and measurement of radioactivity – G. M. counter. Cyclotron, Nuclear reactor, Breeder reactor, Q values of nuclear reactions. Uses of radio isotopes – tracer technique, agriculture, medicine, food preservation and dating (explanation). Separation of uranium isotopes – Laser irradiation method (atomic and molecular routes). [**7 Hours]**

ORGANIC CHEMISTRY

14 Hours

UNIT-I

Ethers: Nomenclature, Williamson ether synthesis, reactions – cleavage and auto-oxidation-Ziesel's method.

Epoxides: Synthesis by Darzen's method. Acid and base catalyzed opening of epoxides.

Crown ethers: Introduction with examples. **[3 Hours]**

UNIT-II

Carbonyl Compounds: Distinction between aldehydes and ketones – oxidation and reduction method. Addition of alcohols- formation of hemiacetal and acetal. Condensation with NH_2OH and 2,4-DNP. Mechanism of aldol condensation, Perkins reaction, Cannizzaro reaction, Claisen condensation, Knovenagel reaction. **[4 Hours]**

UNIT-III

Carboxylic acids: Definition, classification with examples. Synthesis by Arndt-Eistert reaction, resonance structure of carboxylate ion and its stability. Effect of substituents on acidity of aliphatic and aromatic carboxylic acids.

Hydroxy acids: Synthesis of lactic, citric and tartaric acids. One method each and their importance. Effect of heat on α, β, γ-hydroxy acids. **[3 Hours]**

UNIT-IV

Amines: Definition, classification with example. Separation of amine mixture by Hinsberg's method using toluene sulphonyl chloride. Distinction tests for 1°, 2°, 3° amines (acetylation and Hoffmann's exhaustive methylation. Action of nitric acid on different amines. Both aliphatic and aromatic 1°, 2°, 3° amines, basicity of amines, effect of substituents on basicity of aliphatic and aromatic amines. Hoffmann-Martius rearrangement.

Diazonium Compounds: preparation, mechanism of preparation and synthetic applications of benzene diazonium chloride. Conversion to phenol, halobenzene, phenyl hydrazine and coupling reaction. **[4 Hours]**

PHYSICAL CHEMISTRY

14 Hours

NOTES:

- SI Units to be used
- Problems to be worked out and diagrams to be drawn whenever necessary

UNIT I

Second law of thermodynamics: Limitations of First Law of Thermodynamics – need for II Law of thermodynamics, spontaneous, non-spontaneous and equilibrium processes (definitions and examples for each), different ways of stating II Law, heat engine (example) Carnot cycle, efficiency of Carnot cycle (derivation), concept of entropy – definition and physical significances of entropy – criteria of spontaneity in terms of entropy change, statements of II law in terms of entropy (numerical problems to be worked out on entropy and efficiency of Carnot engine)

Free energy: Helmholtz and Gibb's free energy – their definitions and their relationship, Gibb's – Helmholtz equation at constant pressure and volume (derivations), thermodynamic criteria of equilibrium and spontaneity, variation of free energy with temperature and pressure, Claussius – Clappeyron equation (differential form to be derived), integrated form of Claussius – Clappeyron equation (to be assumed) and its applications (enthalpy of vapourization, boiling point and freezing point at different temperatures), (numerical problems on these applications), Van't Hoff's reaction isotherms and isochore equations (to be derived). **[5 Hours]**

UNIT II

Elementary Quantum Mechanics: black body radiation – Planck's Law, Photoelectric effect, Compton effect, Schrodinger's wave equation (no derivation) and its importance, physical interpretation of wave function, particle in one dimensional box (no derivation), Hamiltonian operator. **[5 Hours]**

UNIT III

Physical Properties and chemical constitution: Additive and constitutive properties, properties of liquids – viscosity, definition of coefficient of viscosity, factors affecting viscosity – temperature, size, weight, shape of molecules, intermolecular forces, determination of viscosity of liquids by Ostwald's method.

Surface tension: Definition, effect of temperature on surface tension, effect of solute on surface tension, determination of surface tension of liquids using stalgmometer.

Parachor: Definition – Sugden equation, calculation of parachor and its application with respect to structural elucidation of benzene and quinone, numerical problems based on surface tension, viscosity and parachor applications. **[4 Hours]**

V SEMESTER

CHEMISTRY PAPER – V

INORGANIC CHEMISTRY

CLASS DURATION – 02 HOURS PER WEEK

MARKS: Theory – 60 + Internal Assessment – 10 = 70

28 Hours

UNIT I

Chemistry of transition elements: Position in the periodic table, electronic configuration, general characteristics- atomic and ionic radii, ionization energy, variable oxidation states, spectral properties, redox potentials, colour and magnetic properties, catalytic activity, complex formation and interstitial compounds formation (3d, 4d and 5d series).

Chemistry of inner transition elements: Electronic configuration and position in the periodic table, oxidation states, spectral properties, colour and magnetic properties, complex formation and ionic radii, lanthanide contraction – cause and its consequences. General survey of actinides – comparison with lanthanides, transuranic elements. [**5 Hours]**

Ion-exchange: Introduction, action of ion exchange resins – cation exchange and anion exchange resins, exchange of inorganic ions, ion exchange capacity, separation of lanthanides by ion- exchange method. [**2 Hours]**

UNIT II

Gravimetry: Introduction to gravimetric analysis – precipitation methods (various steps involved to be discussed), advantages of gravimetric analysis, purity of the precipitates, co-precipitation and post-precipitation, conditions of precipitation, precipitation from homogeneous solution (hydroxides and sulphates), washing and ignition of precipitate (general discussion only). Electro-gravimetric analysis-estimation of copper.

Organic precipitants: Advantages of organic precipitants over inorganic precipitants, DMG, 8-hydroxy quinoline (Oxine), 1,10-phenanthroline and EDTA. Structure of Ni^{2+}-DMG and Mg^{2+}-oxine complexes. [**5 Hours]**

UNIT III

Coordination Chemistry: Ligands, classification of ligands and chelation, nomenclature of co-ordination compounds, physical methods in the study of complexes – change in conductance, colour and pH. Stability of complexes – stability constant, a brief outline of thermodynamic stability of metal complexes, factors affecting the stability of complexes. Polynuclear complexes, inner metallic complexes.

Isomerism in co-ordination complexes: Stereo-isomerism – Geometrical and optical isomerism exhibited by co-ordination compounds of co-ordination number 4 and 6. **[6 Hours]**

UNIT IV

Metal-ligand bonding in transition metal complexes:

Valence bond theory: Salient features, formation of octahedral complexes on the basis of VBT, outer and inner orbital octahedral complexes- $[Fe(CN)_6]^{4-}$, $[Fe(CN)_6]^{3-}$, $[Co(CN)_6]^{3-}$, $[CoF_6]^{3-}$ $[Cr(H_2O)_6]^{3+}$ and $[Fe(H_2O)_6]^{2+}$. Formation of tetrahedral and square planner complexes on the basis of VBT – $[Ni(CN)_4]^{2-}$, $[Cu(NH_3)]^{2+}$, $[Zn(NH_3)_4]^{2+}$and $[Ni(CO)_4]$, limitations of VBT.

[5 Hours]

Crystal field theory: Important features of crystal field theory, crystal field splitting of d-orbitals in tetrahedral, octahedral and square planar complexes, crystal field stabilization energy (CFSE), factors affecting the magnitude of Δ_o, (nature of ligand, oxidation state of the metal ion, size of the orbitals, geometry of the complex), high spin (HS) and low spin (LS) complexes, magnetic properties of metal complexes based on crystal field theory-$[Co(NH_3)_6]^{3+}$, $[CoF_6]^{3-}$, $[Fe(CN)_6]^{4-}$, $[Fe(CN)_6]^{3-}$ and $[Ni(CN)_4]^{2-}$. Magnetic susceptibility, measurement of magnetic moment by Gouy's method. Limitations of CFT.

Ligand field theory: Evidences for metal ligand covalent bonding in complexes. **[8 Hours]**

UNIT V

Bio-inorganic chemistry: Essential and trace elements in biological process, metalloporphyrins with special reference to haemoglobin and myoglobin, biological role of alkali and alkaline earth metal ions with respect to Na^+ and Ca^{2+} ions. [**2 Hours]**

V SEMESTER

CHEMISTRY PAPER – VI

ORGANIC CHEMISTRY

CLASS DURATION – 02 HOURS PER WEEK

MARKS: Theory – 60 + Internal Assessment – 10 = 70

28 Hours

UNIT-I

Carbohydrates: Definition and importance, classification based on composition with examples-reducing and non-reducing sugars.

Monosaccharides: Glucose: reactions of glucose (with H_2N-OH, HCN, $C_6H_5NHNH_2$, Br_2 water, Conc. HNO_3, reductions with HI/red P , methanols, (dry HCl), acetic anhydride and reduction reactions.

Structural elucidation of glucose: Open chain structure, configuration, drawbacks of open chain structure, ring structure – Fisher and Haworth structure. Determination of ring size by methylation method. Fischer and Haworth structures of fructose, galactose and mannose.

Conversion reactions – 1. Ascending (Kiliani's synthesis) 2. Descending (Wohl's degradation) 3. Aldose to ketose 4. Ketose to Aldose 5. Epimerisation

Disaccharides: Structural elucidation of sucrose, structural formulae of maltose and lactose (Haworth structure).

Polysaccharides: Partial structural formulae of starch, cellulose, glycogen and their uses.

[5 Hours]

UNIT-II

Stereochemistry: Introduction, definition, elements of symmetry (plane, centre, simple axes and alternative axes), asymmetry and dissymmetry, Chirality, designation of configuration – R-S notation. Optical activity – explanation – cause of optical activity (non-super impossibility). Enantiomers and diastereomers optical isomerism in tartaric acid and biphenyls, racemisation, resolution, methods of resolution (Chemical and biochemical methods) Walden inversion, asymmetric synthesis (partial and absolute).

Geometrical isomerism: Definition with example, designation of cis-trans and E-Z notations with examples. Geometrical isomerization of aldoximes and ketoximes, Beckmann rearrangement. **[5 Hours]**

UNIT-III

Green Chemistry: Purpose, principles to be followed for green chemistry. Synthesis of acetamide, ibuprofen, benzoin, benzylic acid and para-bromo acetanilide. **[2 Hours]**

UNIT-IV

Active methylene compounds: Definition, ethyl acetoacetate, preparation and keto-enol tautomerism in ethyl acetoacetate-its evidence.

Synthetic applications: Acid hydrolysis, ketonic hydrolysis, mono carboxylic acids, dicarboxylic acids-succinic acid, adipic acid, antipyrine, uracil, acetyl acetone, crotonic acid and cinnamic acid. **[3 Hours]**

UNIT-V

Synthetic Polymers: Definition, vehicle, fixative, odorous substances. Classification, synthesis of 1. Methyl anthranilate 2. Phenyl alcohol 3. Linalool 4. Mask ketone 5. α and β-Ionones, Vanillin. **[2 Hours]**

UNIT-VI

Dyes: Colour and constitution, chromophore - oxochrome theory, classification of dyes based on applications with examples, synthesis of indigo and malachite green, structural elucidation of alizarin and its synthesis. **[2 Hours]**

Terpenes: Definition, isoprene rule, classification, isolation (solvent extraction and steam distillation) structural elucidation of citral and its synthesis, structural formulae of α-terpeniols, camphor and menthol. **[3 Hours]**

Natural Pigments: Introduction to antho cyanines, structural formulae and their importance of antho cyanins, β-carotene and haemoglobin. **[2 Hours]**

UNIT-VII

Chromatography: Paper: introduction to ascending, descending and circular, R_f value and it's applications

TLC: Introduction and applications

Column Chromatography: Introduction, principle and experimental details and applications

Gas Chromatography: Introduction, apparatus, programmed temperature gas chromatography, quantitative analysis of GLC

HPLC: Introduction, schematic diagram of instrumentation and application. **[4 Hours]**

V SEMESTER

CHEMISTRY PAPER – VII

PHYSICAL CHEMISTRY

CLASS DURATION – 02 HOURS PER WEEK

MARKS: Theory – 60 + Internal Assessment – 10 = 70

28 Hours

Class duration: 2 Hours per week

Marks: Theory = 60 + Internal Assessment = 10 (Total = 70)

NOTES:

- SI Units to be used
- Problems to be worked out and diagrams to be drawn whenever necessary

UNIT I

Crystallography: Elements of symmetry – plane, axis and centre, elements of symmetry in cubic crystals, law of rational indices – Weiss and Miller indices, lattice planes in cubic crystals. Crystal lattice and unit cell, types of Lattice – Bravais lattices, X-Ray diffraction and Bragg's Law (to be derived), determination of crystal structure of rock salt by rotating crystal method using Bragg's spectrometer, application of X-ray studies – distance between lattice planes, density of crystals, determination of Avogadro Number (numerical problems on applications).

Liquid Crystals: Defination, classification of thermotropic liquid crystals into smectic and nematic with examples-molecular arrangement of these and their uses. **[8 Hours]**

UNIT II

Spectrophotometry and photochemistry: Lambert – Beer's law – statement and mathematical form (to be derived). Molar extinction coefficient – definition – spectrophotometer – construction and working, its application.

Laws of photochemistry – Grotthus-Draper law of photochemical activation and Einstein's law of photochemical equivalence, quantum efficiency, reasons for low quantum yield (HBr

formation as example) and high quantum yield (HCl formation as example), actinometry – Uranyl oxalate actinometer.

Photophysical processes: Definition with examples – photosensitization (eg. photosynthesis in plants), photo inhibition, fluorescence, phosphorescence, chemiluminescence and bioluminescence with examples. Determination of absorbed intensity – schematic diagram of apparatus used. Detectors – thermopile, photoelectric cell and actinometer (Uranyl oxalate).

Radiation Chemistry: Definition, primary and secondary stages in radiochemical reactions, ionic yield, energy yield, comparison with photochemistry, units of radiation – rad, gray and roentgen, Dosimeter – Fricke dosimeter, theories of radiolysis – Lind's and EHT theories. Radiolysis of water vapour, benzene and acetic acid. **[8 Hours]**

UNIT III

Molecular Spectroscopy: Regions of spectra, types of spectra, microwave spectra – rotational spectra of diatomic molecules, moment of inertia (expression to be derived). Expression for rotational energy, selection rule and transition, calculation of bond length, IR Spectra – vibrational spectra of diatomic molecules – force constant (no derivation), expression for vibrational energy, zero point energy, selection rule and transitions. Vibrational modes of polyatomic molecules taking H_2O and CO_2 molecules as examples. Applications of IR spectroscopy (mention).

NMR Spectroscopy: Introduction – spin number, chemical shift, instrumentation, NMR spectra of ethyl alcohol – low and high resolution, applications (mention). **[8 Hours]**

UNIT IV

Raman Spectra: Concept of polarizability, pure rotation, vibration (qualitative study) stoke's and antistoke's lines, selection rule, applications (mention)

Electronic Spectra: Potential energy curves for bonding and antibonding molecular orbitals, band theory, electronic transitions, qualitative description of non-bonding orbitals and transition between them. Selection rule and Franck Condon principle. **[4 Hours]**

VI SEMESTER

CHEMISTRY PAPER – VIII

INORGANIC CHEMISTRY

CLASS DURATION – 02 HOURS PER WEEK

MARKS: Theory – 60 + Internal Assessment – 10 = 70

28 Hours

UNIT I

Inorganic polymers: Definition – examples, general properties, comparison with organic polymers, glass transition temperature

Silicones: Definition, nomenclature, preparation (linear, cross-linked and cyclic). Factors affecting the nature of silicon polymers, properties (chemical and thermal stabilities, chemical properties) uses of silicon polymers, silicon fluids/oils – uses, silicon elastomers – rubbers, silicon resins (preparation and uses)

Phosphazenes: Definition, types, structures, preparation, properties and uses. Crystalline polymetaphosphates – Maddrell's and Kuroll's salts – properties and uses. Nature of bonding in phosphazenes.

Fluorocarbons: Definition, examples, preparation, properties and uses of Freon-12, Freon-22, PTFE and poly per fluorovinyl chloride. **[6 Hours]**

UNIT II

Abrasives: Definition, classification with examples – hardness, manufacture and applications of carborundum, alundum and tungsten carbide.

Refractories: Definition, properties, classification with examples. Different steps involved in the manufacture of refractories. Applications of refractories.

Explosives: Definition, classification with examples, characteristics of explosives. Preparation and uses of dynamite, cordite and RDX.

Paints: Constituents and their functions, manufacture of lithopone and titanium dioxide.

[5 Hours]

UNIT III

Fuels: Definition, classification with examples – characteristics, calorific value, determination of calorific value of a solid or liquid fuel. Applications of gaseous fuels. Compressed natural gas, water gas, producer gas and LPG – their production, composition and applications

Propellants: Definition, characteristics, classification and applications. [**4 Hours]**

UNIT IV

Fertilizers: Definition and classification, manufacture of nitrogeneous fertilizers – CAN and urea. Phosphatic fertilizers – calcium dihydrogen phosphate, NPK type fertilizers. [**2 Hours]**

UNIT V

Metallurgy: Types of metallurgy: Pyrometallurgy: Extraction of Nickel from sulphide ore – general metallurgy followed by Mond's process (purification), manganese from oxide ores – reduction by the Aluminothermite process – refining by electrolytic process.

Hydrometallurgy: Extraction of gold from native ore by cyanide process and refining by quartation process.

Electrometallurgy: Extraction of lithium by fusion method followed by electrolysis of lithium chloride.

Powder metallurgy: Importance, metal powder production and applications, production of tungsten powder. Extraction of (1) Thorium from monazite sand – purification by iodine method, (2) uranium from pitch blende – production of U_3O_8 by carbonate method, U_3O_8 to UO_2 by reduction, UO_2 to U by fluoride method. [**8 Hours]**

UNIT-VI

Nanotechnology: Definition, uses and nature of nanotechnology, **Nanomaterials**-definition, properties and applications, **Carbon nanotubes**- definition, types, methods of preparation (mention), properties and industrial applications of carbon nanotubes, **Nanowires**-definition,

types, production of crystalline nanowires by vapour-liquid-solid synthesis method, applications of nanowires. **[3 Hours]**

VI SEMESTER

CHEMISTRY PAPER – IX

ORGANIC CHEMISTRY

CLASS DURATION – 02 HOURS PER WEEK

MARKS: Theory – 60 + Internal Assessment – 10 = 70

28 Hours

UNIT-I

Hetrocyclic Compounds: Definition, classification with examples, synthesis of furan, thiophene, pyrrole, pyridine, indole (Fischer method) quinoline (Skrup's synthesis with mechanism), isoquinoline, pyrimidine (one method each), aromaticity and basicity of pyrrole and pyridine. Electrophillic substitution reactions of pyrrole and pyridine.

Uric acid: Elucidation of structure and synthesis by Fischer's method, conversion of uric acid to purine and caffeine

Alkaloids: Definition, classification based on heterocyclic rings-isolation, synthesis and structural elucidation of nicotine and morphine, physiological importance of alkaloids.

[8 Hours]

UNIT-II

Vitamins: Definition, classification, structural elucidation and synthesis of Vit-A, Synthesis of Vit-C, structural formulae of Vit B_1, B_2, B_6, calciferol, E and K and their importance.

Hormones: Definition, classification, synthesis of adrenaline, thyroxine, structural formulae of estradiol, progesterone and testosterone and their importance.

Drugs: Chemotherapy and chemotherapeutic agents, definition of drugs, types of drugs, antipyretics, analgesics, anesthetics, sedatives, narcotics, antiseptics, antibacterials, antibiotics,

antimalarials and sulpha drugs with examples. Synthesis of paracetamol, sulphanilamide, sulphaguanidine. **[8 Hours]**

UNIT-III

Special techniques in organic synthesis:

a) Polymer supported reagents – introduction, properties of polymer support-advantages of polymer support reagents, choice of polymers, types and applications.
b) Phase transfer catalysis – introduction, definition, types, preparation, mechanism and advantages.
c) Microwave induced organic synthesis – introduction, reaction vessel, reaction medium, advantages, limitations, precaution and applications.
d) Sonochemistry – use of ultra sound in organic synthesis, introduction, instrumentation, physical aspects, types and applications. **[4 Hours]**

UNIT-IV

Amino acids: Structure of α-amino acids, peptide bond, protecting groups-Boc, Z, F-moc groups, use of HOBt and HOAt. **[2 Hours]**

UNIT-V

Spectroscopy of organic compounds:

UV-visible spectroscopy: Introduction, chromophores and auxo chrome, blue shift and red shift, graphical representation of spectra of 1,3-butadiene, benzene and lycopene. Influence of conjugation on UV absorption-comparison of UV spectra of acetone and methylvinyl ketone

IR-Spectroscopy: Introduction, stretching frequency of –OH (free and H-bonded), alkyl –C-H, C=C, C=C, C-C, C=O and C-O groups (by taking suitable examples). Graphical representation of IR spectra of benzoic acid and methyl benzoate

NMR Spectroscopy: Basic principles of proton magnetic resonance , nuclear magnetic spin quantum number I, influence of the magnetic field on the spin of nuclei, spin population,

saturation using radio frequency, nuclear magnetic resonance-chemical shift (δ value), uses of TMS reference, nuclear shielding effects, equivalent and non-equivalent protons, spin-spin splitting and coupling.

Applications of NMR spectroscopy to simple organic molecules (like ethyl alcohol, ethane, propane, ethylene, methylamine, aniline, benzene, toluene, acetone, acetophenone, methyl cyanide and other simple molecules. **[6 Hours]**

VI SEMESTER

CHEMISTRY PAPER – X

PHYSICAL CHEMISTRY

CLASS DURATION – 02 HOURS PER WEEK

MARKS: Theory – 60 + Internal Assessment – 10 = 70

28 Hours

NOTES:

- SI Units to be used
- Problems to be worked out and diagrams to be drawn whenever necessary

UNIT I

Electrochemistry-I: Introduction, conductance – specific conductance, equivalent conductance and molar conductance – their definitions and SI units. Conductance cell and cell constant. Determination of equivalent conductance by meter – bridge method, ionic mobility, ionic conductance, Kohlrausch's law and its significance – determination of equivalent conductance at infinite dilution for weak electrolyte.

Transport number: Definition and explanation, anomalous transport number – explanation with examples – relationship between ionic conductance and transport number (to be derived), determination of transport number by moving boundary method – transport number of H^+ using $CdCl_2$ as supporting electrolyte (numerical problems on equivalent conductance, transport numbers and kohlrausch's law).

[6 Hours]

Application of conductance measurements – (a) solubility and solubility product of sparingly soluble salt, (b) ionic product of water, (c) degree of ionization of weak electrolyte. Numerical problems for the applications of a, b and c to be worked out.

Conductometric titration: strong acid vs strong base, weak acid vs strong base, strong acid vs weak base, weak acid vs weak base, with suitable examples for each. **[4 Hours]**

UNIT II

Electromotive force-I: Electrolytic and electrochemical cells, electrode reaction of Daniel cell, single electrode potential, sign of electrode potential-convention (reduction potential to be adopted), convention of representing a cell, EMF and standard EMF of a cell, cell reaction, reversible and irreversible cells, Nernst equation (to be derived) and calculation of electrode potential, standard hydrogen gas electrode, reference electrodes-calomel and Ag-AgCl electrode-construction and working, electrochemical series and its significance, equilibrium constant and free energy of cell reaction, spontaneity of a cell reaction, concentration cells.

EMF of concentration cells: Definition with explanation – with transference and without transference, concentration cells – with examples. Liquid junction potential and salt bridge. (Numerical problems on Nernst equation and EMF calculations).

Fuel cells: Working of H_2-O_2 fuel cell and its importance. **[6 Hours]**

UNIT III

Electromotive force-II

Application of EMF measurements: (a) Determination of pH of a solution using quinhydrone electrode and glass electrode (using dip type Calomel electrode) – Explanation with principle and procedure. (b) Potentiometric titration – principle, location of end points in - (1) Neutralization reactions [NaOH Vs HCl] (2) Oxidation-reduction reactions [$K_2Cr_2O_7$ Vs FAS] (3) Precipitation reaction [KCl Vs $AgNO_3$] and (4) Complexometric reactions ($ZnSO_4$ Vs $K_3[Fe(CN)_6]$) **[3 Hours]**

UNIT IV

Chemical Kinetics: Introduction – differential and integrated rate equations for second order kinetics, derivation of second order rate equation when a=b and a≠b, unit of rate constant, half-life period, experimental verification of second order reactions – study of kinetics of saponificaiton of an ester, determination of the order of reaction – differential, time for half-change method and isolation method. Experimental methods of chemical kinetics, conductometric – example - saponification of esters. Potentiometric - example – kinetics of bromination of N,N-di-methyl aniline and spectrophotometric – example – colorimetric study of kinetics of oxidation of Indigocarmine by chloramine-T.

Application of kinetic studies: Arriving at the mechanism of urea formation from ammonium cyanate. **[5 Hours]**

UNIT V

Phase equilibria: Gibb's phase rule – definition of the terms with examples, application to one component system (water system), reduced phase rule – statement, reduced systems, two component system – simple eutectic type KI-water system, freezing mixtures, Pb-Ag system (desilverization of argentiferrous lead) **[4 Hours]**

Chemistry Syllabus for Practical for B.Sc. Course

Note: Students should be trained to use electronic balances (three digits)
SI units to be used.

I Semester: Practical – I

3 Hours per week

1. Calibration of : (i) Pipette (ii) Burette (iii) Volumetric flask
2. Preparation of 2N solutions of H_2SO_4,HCL, HNO_3,CH_3COOH and NH_3
3. Preparation of standard sodium carbonate solution and standardization of hydrochloric acid solution (methyl orange indicator). Estimation of sodium hydroxide present in the solution using phenolphthalein indicator.
4. Preparation of standard oxalic acid solution and standardization of sodium hydroxide solution. Estimation of sulphuric acid present in the solution
5. Preparation of standard potassium biphthalate solution and standardization of sodium hydroxide solution. Estimation of oxalic acid present in the solution.
6. Preparation of standard oxalic acid solution and standardization of potassium permanganate solution. Estimation of ferrous ammonium sulphate present in the solution
7. Preparation of standard oxalic acid solution and standardization of potassium permanganate solution. Estimation of hydrogen peroxide present in the solution.
8. Estimation of sulphuric acid and oxalic acid in a mixture using standard sodium hydroxide and standard potassium permanganate solutions.
9. Determination of the percentage of available chlorine in the given sample of bleaching powder.
10. Estimation of ferrous and ferric iron in a given mixture using standard potassium dichromate solution.
11. Preparation of standard zinc sulphate solution and standardization of EDTA. Estimation of total hardness of water.
12. Estimation of ammonium chloride using standard sodium hydroxide and standard hydrochloric acid solutions (back titration).

II Semester: Practical – II

3 Hours per week

Part 1: Qualitative analysis of mono functional organic compounds through functional group analysis. Determination of physical constant. Preparation of suitable derivative of the following class.

1. Acids
2. Alcohols
3. Aldehydes
4. Amides
5. Amines
6. Halogenated hydrocarbons
7. Hydrocarbons
8. Ketones
9. Nitro compounds
10. Phenols

Part 2: Organic preparations: Recrystallisation and determination of melting point and its importance may be mentioned

1. Acetylation : Preparation of acetanilide from aniline
2. Oxidation: Preparation of benzoin acid from benzaldehyde
3. Nitration : Preparation of m-dinitrobenzene from benzene
4. Hydrolysis : preparation of benzoic acid from ethyl benzoate

III Semester: Practical – III

3 Hours per week

1. Give reason and problems related to inorganic analysis.
2. Systematic semi-micro qualitative analysis of a mixture of two simple salts (with no interfering radicals). Including ionic reactions.

The constituent ions in the mixture to be restricted to the following.

Anions: HCO_3^-, CO_3^{2-}, SO_3^-, Cl^-, Br^-, NO_3^-, BO_3^{3-}, SO_4^{2-} and PO_4^{3-}

Cations: Pb^{2+}, Bi^{3+}, Cd^{2+}, Al^3+, Fe^{3+}, Fe^{2+}, Mn^{2+}, Zn^{2+}, Ba^{2+}, Sr^{2+}, Ca^{2+}, Mg^{2+}, K^+, Na^+ and NH_4^+

Note:

1. Mixtures requiring elimination of phosphate and borate should not be given.
2. Combination of anions in 2^{nd} group shall be avoided.
3. Salts that yield double decomposition shall be avoided (like $BaSO_4$).
4. The combination of two cations in the mixture should belong to different groups. However combinations like Mg^{2+} and NH_4^+ and Na^+ and NH_4^+ can be given.

IV Semester: Practical - IV

3 Hours per week

Part 1:

1. Determination of the density using specific gravity bottle and viscosity of a liquid using Ostwald's viscometer.
2. Determination of the density using specific gravity bottle and surface tension of a liquid using stalagmometer.
3. Determination of molecular mass of a non-volatile solute by Walker-Lumsden method.
4. Determination of rate constant of the decomposition of hydrogen peroxide catalyzed by $FeCl_3$.
5. Determination of transition temperature of the salt hydrates.
6. Determination of rate constant of saponification of ethyl acetate titrimetrically.
7. Determination of percentage composition of sodium chloride solution by determining the miscibility temperature of phenol - water system.
8. Determination of the mass present in the given solution of a strong acid using strong base by thermometric titration method.
9. Determination of molecular weight of a polymer material by viscosity measurements (cellulose acetate/methyl acrylate).
10. Study of kinetics of reaction between $K_2S_2O_8$ and KI, second order, determination of rate constant.
11. Determination of distribution coefficient of iodine in water and carbon tetra chloride.

V Semester: Practical – V and VI

6 Hours (2 practical per week of 3 Hours each)

Practical - V:

Gravimetric Estimations:

1. Gravimetric estimation of barium as barium sulphate.
2. Gravimetric estimation of iron as iron (III) oxide.
3. Gravimetric estimation of copper as copper (I) thiocyanate.
4. Gravimetric estimation of nickel as nickel dimethylglyoximate.
5. Gravimetric estimation of magnesium as magnesium -8-hydroxy oxinate.
6. Gravimetric estimation of sulphate as barium sulphate.
7. Gravimetric estimation of aluminum as aluminum oxide.
8. Gravimetric estimation of zinc as zinc oxide.
9. Gravimetric estimation of calcium as calcium oxide.
10. Paper chromatographic separation of Fe^{3+} and Ni^{2+} ions.
11. Paper chromatographic separation of Na^{+} and K^{+} ions

PRACTICAL - VI:

Ore and Alloy Estimations:

1. Preparation of standard potassium dichromate solution and estimation of iron in the given sample of hematite by dichromate method.
2. Estimation of percentage of calcium in limestone by oxalate method.
3. Estimation of manganese in the given sample of pyrolusite.
4. Estimation of magnesium in the given sample of dolomite by EDTA method.
5. Estimation of copper in bronze by iodometric method.
6. Estimation of tin in solder using EDTA.

Preparation of Inorganic Complexes

1. Preparation of mercurytetrathiocyanatocobaltate(II).
2. Prparation of potassiumtrisoxalatoferrate(III).
3. Preparation of ferrousoxalate.
4. Preparation of potassiumbisoxalatodiaquachromate(III).
5. Preparation of chloropentaminecobalt(III)chloride.
6. Preparation of manganese (III)acetylacetonate.

VI Semester – Practical VII and VIII

6 Hours (2 practical per week of 3 Hours)

Practical VII:

1. Determination of equivalent conductance of the given electrolyte (strong and weak) by using Meter Bridge.
2. Determination of solubility of sparingly soluble salt (like $BaSO_4$) by conductometric method.
3. Determination of K_a (dissociation constant of a weak acid) by conductometric method.
4. Determination of rate constant of saponification of ethyl acetate by conductivity measurements.
5. Conductometric titration of strong acid and strong base and weak acid and strong base.
6. Determination of percentage composition of a given mixture containing two miscible liquids by Abbe's refractometer.
7. Potentiometric titration of ferrous ammonium sulphate against potassium dichromate.
8. pH titration of strong acid against strong base (by observing change in pH).
9. Potentiometric titration of mixture of HCl and CH_3COOH using NaOH solution.
10. Colorimeteric estimation of Fe^{3+} ion using ammonium thiocyanate as complexing agent.
11. Colorimeteric estimation of Cu^{2+} ion using NH_4OH as complexing agent.
12. Colorimeteric study of kinetics of oxidation of indigocarmine by chloramine-T.

Practical-VIII

Organic Estimations:

1. Separation of p- and o-nitroaniline by TLC method (Solvent extraction).
2. Separation of p- and o-nitroaniline by column chromatography.
3. Estimation of glucose by Fehling solution method.
4. Estimation of Phenol by acetylation method.
5. Estimation of ascorbic acid by iodometric method.
6. Determination of Iodine value of oils by chloromine-T.
7. Isolation of Caffeine from tea powder.

8. Isolation of Castor oil from Castor seeds.
9. Estimation of neutral amino acids by titrametric method.
10. Estimation of carboxylic acid by titrametric method.
11. Estimation of $-NH_2$ group by acetylation method.
12. Determination of saponification value of oils.

Recommended Books

INORGANIC CHEMISTRY

Sl. No.	Title of the book	Author	Publisher
1	A Text book of Inorganic Chemistry	P. L. Soni	Sultan Chand & Sons
2	A Text book of Inorganic Chemistry	B. R. Puri & L. Sharma	Shobhanlal Nagin Chand Co.
3	Principles of Inorganic Chemistry	Puri, Sharma & Kalia	Shobhanlal Nagin Chand Co.
4	A Text book of Inorganic Chemistry	Gurudeep Raj	
5	Concise Inorganic Chemistry	J. D. Lee	B-Block Well Science Ltd.
6	A Text book of Inorganic Chemistry	Sathya Prakash & others	
7	Basic concepts of Analytical Chemistry	S. M. Khopkar	New Age International
8	Selected Topics in Inorganic Chemistry	Madan, Malik, Tuli	S. Chand & Company
9	A Text book of Inorganic Chemistry	A. K. De	New Age International
10	Comprehensive Inorganic Chemistry	O. P. Agarwal	
11	Inorganic Chemistry	Kapoor & Chopra	
12	Engineering Chemistry	B. K. Sharma	
13	Industrial Chemistry	B. K. Sharma	
14	Engineering Chemistry	Jayaprakash & Venugopal	
15	Engineering Chemistry	Jain and Jain	
16	Hand book of Industrial Chemistry	Riegel's James A. Kent	B. S. Publishers & Distributors
17	Instrumental methods of Chemical analysis	B. K. Sharma	Goel Publishing House
18	Elements of Nuclear Chemistry	R. Gopalan	Vikas Publishing

			House
19	Industrial Chemistry	B. N. Chakarbathy	Oxford & IBH Publishers
20	Instrumental methods of Chemical analysis	Gurdeep R. Chatwal & Sham Anand	Himalaya Publishing House
21	A Textbook Quantitative analysis	A. I. Vogel	ELBS
22	A Textbook Quantitative analysis	A. I. Vogel	ELBS
23	Management of Water Resources in Agriculture	V. S. Shreramulu	
24	Inorganic Polymers	C. R. Chatwal	Himalaya Publishing House
25	Theoretical Principles of Inorganic Chemistry	Manku	Tata McGraw Hills
26	Advanced Practical Inorganic Chemistry	Gurudeep Raj	Goel Publishing House
27	Experimental Inorganic/Physical Chemistry	Mounir A. Malati	Horward Series in Chemical science
28	University Chemistry	C. N. R. Rao	Mac Millan Company
29	A Text book of Inorganic Chemistry	Robinson & Heslop	New Age Publications
30	A Text book of Inorganic Chemistry	Emeleus & Anderson	New Age Publications
31	A Text book of Inorganic Chemistry	F. A. Cotton & G. Wilkinson	Wiley Interscience
32	Analytical Chemistry	Willard, Meritind & Dean	New Age Publications
33	Advanced Chemistry	Philip Mathews	Cambridge University Press
34	Instrumental methods of Chemical analysis	H. H.Willard, L. L. Merrite, K. A. Dean & F. A. Skettle	CBS Publishers
35	A Text book of Inorganic Chemistry	Emelius H. J., Sharpe A. G.	University Book Stall New Delhi

36	Theoretical Inorganic Chemistry	Dey & Selbin	University Book Stall New Delhi
37	Analytical Chemistry	John.H. Chenady	Saunders College, Publishing New York Tokyo
38	Introduction to nanoscience & nanotechnology	Chattopadhyay	PHI
39	Nanotechnology fundamentals & applications	Manasi Karkare	IKI NTPC
40	Nanotechnology	Richard Brooker , Earl boyson	Wiley Dream Tech India
41	Advances in nanoscience & nanotechnology	Dr. Shuthosh Sharma & Dr. Bellari	CSIR Publications

ORGANIC CHEMISTRY

Sl. No.	Title of the book	Author	Publisher
1	A Text book of Organic Chemistry	M. K. Jain	S. Chand & Company
2	A Text book of Organic Chemistry	Bhal & Bhal	S. Chand & Company
3	A Text book of Organic Chemistry	P. L. Soni	S. Chand & Company
4	Laboratory Manual of Organic Chemistry	Raj K. Bansal	New Age Publications
5	Laboratory Manual of Organic Chemistry	Jayaraman	S. Chand & Company
6	Chemistry of Natural products	Aggarwal	Goel Publishing House Meerut
7	Organic Chemistry	K. K. Sharma	Shobhanlal & Nagan Company
8	Organic Chemistry	Puri & Sharma	Shobhanlal & Nagan Company
9	Medicinal Chemistry	Ashuthosh Kar	Tata Mcgraw Hill

			Publications
10	Organic Chemistry	Handrickson	Tata Mcgraw Hill Publications
11	Organic Synthesis special techniques	V. K. Ahluwalia & Renu Aggarwal	Narosa publishing House
12	Organic Chemistry Vol. I & II	I. L. Finar	ELBS
13	Stereo Chemistry	Eliel	John Wiley Eastern Publications
14	Text Book of Qualitative & Quantitative Organic Analysis	Arthur Vogel	ELBS
15	Heterocyclic Chemistry	Raj K. Bansal	Tata Mcgraw Hill Publications
16	Laboratory Manual of Organic Chemistry	Skoog & West	Prentice-Hall of India Pvt. India
17	Manual of organic Chemistry	Dey & Seetharamanssss	
18	A text book of practical organic chemistry	A. I. Vogel Volume-III	
19	Practical Organic chemistry	Mann & Saunders	

PHYSICAL CHEMISTRY

Sl. No.	Title of the book	Author	Publisher
1	Physical Chemistry	R. P. Verma	Pradeep Publication
2	Kinetics of Chemical Reactions	S. K. Jain	Vishal publications, Jalandhar New Delhi
3	Physical Chemistry	M. Kundan & S. K. Jain	S. Chand & Company
4	Text book of Physical Chemistry	K. K. Sharma & C. K. Sharma	Vani Educational Books
5	Biophysical Chemistry	Upadhyaya & Upadhyaya	Himalaya Publishing Homes

6	Principles of physical chemistry	Puri, Sharma &Pathania	
7	Essentials of physical chemistry	B. S. Bahl, Arun Bahl & G. D. Tuli	
8	Polymer Science	V. R. Gowriker, N. V. Vishwanathan & J. Sreedhar	
9	Quantum Chemistry (2nd edition)	A.K. Chandra	
10	Quantum Chemistry	R.K. Prasad	
11	Colloidal Chemistry	D. K. Sharma	Goel Prakashan. Meerut
12	Physical Chemistry	R. L. Madan & G. D. Tuli	S. Chand & Company
13	Text book of advanced Physical Chemistry	Gurudeep Raj	Goel Prakashan. Meerut
14	Principles and Applications of Catalysis	B. Vishwanath	Narosa Publishing House
15	Engineering Chemistry	Jain & Jain	Dhanpal & Sons, New Delhi
16	Text Book of Physical Chemistry	B. D. Khosla	R. Chand & Publications
17	Fundamentals of Molecular Spectroscopy	Colin N. Banwell & Elleine M. Meeash	Himalaya Publishing Group
18	Physical Chemistry	Colin N. Banwell	Himalaya Publishing Group
19	Physical Chemistry	Glasstone	ELBS
20	Text book of Chemical Kinetics	Laidier	New Age Publication
21	Text book of Photochemistry	W. Bansal	S. Chand & Company
22	Text book of Thermodynamics	Glasstone	East-West Press Pvt. Ltd.
23	Text book of Electrochemistry	Glasstone	East-West Press Pvt. Ltd.
24	Physical Chemistry	Rakshit	
25	Physical Chemistry	Pathania & Sharma	Vishal Publications Jalandhar & Delhi