CHE 101 Chemistry-I B.Sc.-B.Ed. Semester-I Credit: 4 (3-0-1)

Objectives:

(a) To understand the atomic structure and wave-like behaviour of electrons
(b) To develop an understanding of chemical bonding and molecular structure
(c) To develop an understanding of the basic characteristics of the gaseous, liquid and solid states .
(d) To learn about the electronic effects in organic molecules and the reaction mechanisms involved thereof

Unit I: Atomic Structure & Periodic Properties [5]

Idea of de Broglie matter waves, Heisenberg uncertainty principle, atomic orbitals, Schrödinger wave equation, significance of ψ and ψ^2, quantum numbers, radial and angular wave functions and probability distribution curves, shapes of s, p, and d orbitals. Aufbau and Pauli exclusion principles, Hund's multiplicity rules. Electronic configurations of the elements, effective nuclear charge.

Atomic and ionic radii, ionization energy, electron Affinity and electronegativity: definition, method of determination, trends in periodic table and applications.

Unit II: Chemical Bonding [7]

Covalent Bond – Valence bond theory and its limitations, various types of hybridization and shapes of simple inorganic molecules and ions. Valence shell electron pair repulsion (VSEPR) theory to NH_3, H_3O^+, SF_4, CIF_3, ICI_2 and H_2O. MO theory, homonuclear diatomic molecules, multicenter bonding in electron deficient molecules, bond strength and bond energy, percentage ionic character from dipole moment and electronegativity difference. Weak Interactions – Hydrogen bonding, Van der Waals forces.

Unit III: Gaseous & Liquid States of Matter [8]

Postulates of kinetic theory of gases, deviation from ideal behavior, van der waals equation of state.Law of corresponding states. Molecular velocities: Root mean square, average and most probable velocities. Qualitative discussion of the Maxwell's distribution of molecular velocities, collision number, mean free path and collision diameter. Liquification of gases (based on Joule Thomson- effect) Intermolecular forces, structure of liquid. Structural differences between solids, liquids and gases. Liquid crystals: Difference between liquid crystal, solid and liquid . Classification, structure of nematic and cholestric phases. Thermography and seven segment cell.

Unit IV: Introductory Organic Chemistry [7]

IUPAC nomenclature: Alkanes, cyclo-alkanes, alkenes, alkynes, halogen compounds, alcohols, ethers, aldehydes, ketones, carboxylic acids, nitro compounds. Hybridization and Geometry of Molecules: methane, ethane, ethylene, acetylene. Electronic Effects: Inductive, resonance, hyper conjugation and steric effect. Cleavage of bonds: homolytic and heterolytic C-C bond fission. Reaction Intermediates and their stability: carbocations, carbanions and free radicals.

Unit V: Basic Organic Synthesis and Principles [8]

Alkanes: preparation by reduction of alkyl halides, Wurtz reaction and Kolbe's electrolytic methods with mechanism; Alkenes: preparation by dehydration of alcohols, dehydrohalogenation of alkylhalides, dehalogenation of vic-dihalides and by Kolbe's electrolytic method. Alkynes: Preparation by dehydrohalogenation of vic-dihalides and gem-dihalides, dehalogenation of tetrahalides and Kolbe's electrolytic method. Reactions:addition reactions with hydrogen, halogens, hydrogen halide (markownikoffs rule, peroxide effect), hydroboration, ozonolysis, hydroxylation with KMnO4, allylic substitution by NBS. Conjugated Dienes; Electrophilic addition of dienes: 1,2, & 1,4 addition, Diels . Alder reaction

Books Recommended:

1. Organic Chemistry, Morrison and Boyd, Prentice Hall.
2. Advanced Organic Chemistry, Bahl, B S, Bahl A.
3. Physical Chemistry by **P. W. Atkins,** Elbs
4. Basic Inorganic Chemistry by **F. A. Cotton & Wilkinson**, John Wiley
5. Inorganic Chemistry by **J. E. Huhey**, Harpes & Row

CHEMISTRY PRACTICAL

Examination duration: 3 hrs
Two experiments to be set.
Objectives:
To become familiar with techniques of volumetric estimation of common species by common methods and to get acquaintance with common chemistry softwares

COURSE CONTENT:

1) Stoichiometry of neutralization reactions of sulfuric, hydrochloric and nitric acids with sodium hydroxide.

2) Estimation of sodium carbonate with sodium bicarbonate in a mixture.

3) Estimation of ammonia in ammonium salt by back titration

4) Estimation of ferrous ions using potassium permanganate

5) Estimation of oxalic acid using potassium permanganate

6) Estimation of ferrous ions using potassium dichromate with internal and external indicators

7) Standardization of sodium thiosulfate using potassium dichromate and estimation of iodine

8) Estimation of copper in copper salt by iodimetry

9) Standardization of EDTA solution using zinc sulfate and determination of Mg++ or Ca++ in solution

10) Estimation of hardness of water by EDTA.

11) Estimation of alkali content of an antacid.
12) Using chemistry related softwares (such as ChemOffice/ChemDraw) for basic applications.

References:
1) A Text Book of Quantitative Inorganic Analysis: A I Vogel

2) ChemOffice/ChemDraw Softwares

CHE 151 Chemistry II B.Sc.-B.Ed. Semester-II Credit: 4 (3-0-1)

Objectives:

(a) To know about the features of s- & p-block elements
(b) To understand the various concepts of Acids and Bases
(c) To develop an understanding of colloidal state, its properties and applications
(d) To develop an understanding of chemical kinetics and catalysis

Unit I: s- and p- Block Elements [5]

Comparataive study, diagonal relationships, salient features of hydrides, solvation and complexation tendencies, an introduction to alkyls & aryls. Comparative study (including diagonal relationship) of groups 13-17 elements, compounds like hydrides, oxides, oxyacids and halides of groups 13-16. Chemical properties of the noble gases, role of Mg, Na, K, Ca ions in biology.

Unit II: Acids and Bases [4]

Arrhenius, Bronsted-Lowry, solvent system, Lewis and HSAB concept of acids and bases.

Unit III: Colloidal State [5]

Definition of colloid, classification of colloids. Solids in liquids (sols): properties – kinetic, optical and electrical: stability of colloids, protective action Hardy-Schulze law, gold number. Liquids in solids (gels): classification, preparation and properties, inhibition, general application of colloids.

Unit IV : Chemical kinetics and Catalysis [6]

Introduction to chemical kinetics Theories of chemical kinetics: effect of temperature on rate of reaction, Arrhenius equation, concept of activation energy, Simple collision theory based on hard sphere model transition state theory (equilibrium hypothesis) Expression for the rate constant based on equilibrium constant and thermodynamic aspects. Catalysis, characteristics of catalysed reactions, classification of catalysis, miscellaneous examples.

Unit V: Aromatic Compounds & Aromaticity [5]

Aromatic hydro carbons and aromaticity, resonance in benzene, Huckel's (4n+2) rule and its simple applications. Acidic character of phenols - explanation on the basis of resonance stabilization. Electrophilic substitution reactions in aromatic compounds. General mechanisms of nitration, halogenation, sulphonation, Friedel-Craft's acylation and alkylation, ortho/para/meta directive influence with examples.

Unit VI Elimination & Substitutions Reactions [5]

SN1 and, SN2 reaction mechanism: effects of structure, substrate, solvent, nucleophile and leaving groups. Mechanisms of E1 and E2 reactions, Hoffmann and Sayetzeffs rules cis and trans eliminations, Elimination Vs substitution.

Unit VII Stereochemistry [6]

Introduction, Concept of Isomerism, Classification of Stereoisomers, Optical isomerism, Chirality & Elements of symmetry, Wedge formula, Fischer projection, Newmann projection.

Relative and absolute configurations, sequence rules, D & L, R & S systems of nomenclature. Understanding with examples for Enantiomers, mesoform, erythro/threo forms, diastereoisomers, inversion, retention, and racemization. Conformational understanding with an example of ethane, n-butane, Cyclohexane and Decalin**.**

Books Recommended:

1. Fundamentals of Organic Chemistry Solomons, John Wilev
2. Introduction to Organic Chemistry, Streitwiesser, Hathcock and Kosover, Macmillan.
3. Physical Chemistry Vol. 1-5, by K.L Kapoor
4. Physical Chemistry: A Molecular Approach by McQuarrie & Simon Viva
5. Concise Inorganic Chemistry by **J D Lee,** Amazon.
6. Comprehensive Co-ordination Chemistry by G. Wilkinson, R. D. Gillars & J. A. Mccleverty, Pergamon
7. Chemistry of the Elements by N. N. Greenwood & Earnshow, Pergamon

CHEMISTRY PRACTICAL

Examination duration: 3 hrs
Two experiments to be set (Question 1 being compulsory).

COURSE CONTENTS:

1) To evolve a scheme of analysis of a given sample for anions and cations applying the concepts of solubility product and common ion effect:
a. Classification of anions and cations

b. Qualitative inorganic analysis of mixtures containing four radicals (may or may not include PO_4^{3-})
2) Determination of density of liquids using specific gravity bottle.

3) Determination of viscosity of the given liquid using Ostwald's viscometer.

4) Measurement of the surface tension of the given liquid using stalagmometer.

5) Vapour pressure measurement of pure liquid and a solution involving it.

6) Determination of the enthalpy of vapurisation of water

7) Determination of the refractive index of a pure liquid

8) Determination of concentration of a given substance by colorimetry

9) Preparation of simple sol-gels using processes like precipitation/stirring (e.g. mixture of metal citrates from nitrates)

References:

1) A Text Book of Qualitative Inorganic Analysis: A I Vogel

2) Practical Physical Chemistry: A Findlay

CHE 201 Chemistry III B.Sc.-B.Ed. Semester-III Credit: 4(3-0-1)

Objectives:

(a) To learn the concepts of thermodynamics and chemical equilibrium
(b) To know about the features of d- and f- block elements
(c) To develop an understanding of oxidation and reduction
(d) To develop an understanding of the chemical properties of organic compounds having hydroxyl, carbonyl and nitro groups

Unit I Thermodynamics [6]

Thermodynamic terms, State and path functions and their differentials. Thermodynamic process. Concept of heat and work. First Law of thermodynamics, energy and enthalpy. Heat capacity, heat capacities at constant volume and pressure and their relationship. Joule's law – Joule – Thomson coefficient and inversion temperature. Calculation of w, q, dU & dH for the expansion of ideal gases under isothermal and adiabatic condition for reversible process. Introduction to Thermo chemistry, Kirchhoff's equation. Second law of thermodynamics

Unit IV Chemical Equilibrium [6]

Equilibrium Constant and free energy. Thermodynamic derivation of law of mass action. Le Chatelier's principle. Reaction isotherm and reaction isochore, Clausius – Clapeyron equation and applications.

Unit II Chemistry of d and f block Elements [6]

Characteristic properties of d- and f- block elements. Properties of the elements, their binary compounds and complexes illustrating relative stability of their oxidation states, coordination number and geometry. lanthanide contraction, complex formation

Unit V Oxidation and Reduction [5]

Nernst Equation, Electrochemical series, Use of redox potential data – analysis of redox cycle,. Principles involved in the extraction of the elements.

Unit III Hydroxy and Carbonyl Compounds [7]

Preparation of monohydric alcohols from carbonyl compounds using Grignard reagents, Methods to distinguish between Primary, secondary and tertiary alcohols (Lucas, Victor Meyer's and oxidation method) Preparation of aldehydes and ketones by Rosenmund's reduction, Oppeanauer oxidation. Reactions of aldehydes and ketones (Reduction using $LiA1H_4$, Clemensen and Wolf-Kishner reduction, reaction with alcohols) Mechanism of Aldol condensation, Cannizzaro's reaction, Reimer – Tiemann reaction, Perkin's reaction, Benzoin condensation.

Unit VI Organic Compounds of Nitrogen [6]

Preparation of nitroalkanes and nitroarenes, Separation of primary, secondary and tertiary amines using Hinsberg and Hoffmann method, Structural & basicity relation of amines, Amine salts as phase transfer catalyst, Reduction of nitro compounds, Reductive amination of aldehyde and ketones, Gabriel-phthalimide reaction, Synthetic transformation of aryl diazonium salts, azo coupling.

Books Recommended:

1. Chemistry of the Elements by N. N. Greenwood & Earnshow, Pergamon
2. Metalo-organic Chemistry by A. J. Pearson, Wiley
3. Physical Chemistry by Samuel Glasstone
4. Physical Chemistry by IRA. N. Levine TMH

5. Organic Chemistry by Morrison Boyd
6. Organic Chemistry by Finar
7. Fundamentals of Organic Chemistry Solomons, John Wilev

CHEMISTRY PRACTICAL

Examination duration: 3 hrs
Two experiments to be set.

COURSE CONTENT:
Objective:
To develop basic skills in organic synthesis and purification of organic compounds

A) LABORATORY TECHNIQUES

1. Calibration of thermometer using naphthalene/acetanilide/urea

2. Determination of melting point of benzoic acid/cinnamic acid/m-dinitrobenzene/p-dichlorobenzene.

3. Determination of boiling point of aniline/nitrobenzene/chlorobenzene

4. Distillation of water-alcohol mixture using water condenser, distillation of chlorobenzene-nitrobenzene mixture using air-condenser.

5. Crystallization: Benzoic acid from hot water, naphthalene from ethanol.

6. Sublimation of camphor/phthalic acid/succinic acid.

B) ELECTROPHILIC SUBSTITUTION REACTIONS

1. Preparation of iodoform from ethanol/acetone
2. Preparation of *m*-dinitrobenzene from nitrobenzene by nitration
3. Preparation of *p*-bromoacetanilide from acetanilide by bromination
4. Preparation of 2,4,6-tribromophenol from phenol/2,4,6-tribromoaniline from aniline.
5. Preparation of acetanilide from aniline by acetylation

Reference:

Practical Organic Chemistry: A I Vogel

CHE 251 Chemistry IV B.Sc.-B.Ed. Semester-IV Credit: 4 (3-0-1)

Objectives:

(a) To learn about the basic concepts of phase equilibrium and electrochemistry
(b) To develop an understanding of transition metal complexes and its properties
(c) To know about the nuclear stability and nuclear reactions
(d) To understand the salient features of biomolecules
(e) To learn about the spectroscopy characterization of Organic molecules

Unit I Phase Equilibrium [6]

Statement and meaning of the terms – phase, component and degree of freedom, phase equilibria of one component system – water, phase equilibria of two component system – solid equilibria, simple eutectic – Pb-Ag system, desilverisation of lead.

Unit II Coordination Compounds [6]

Werner's coordination theory and its experimental verification, effective atomic number concept, chelates, nomenclature of coordination compounds, isomerism in coordination compounds, valence bond theory of transition metal complexes.

Unit III Carboxylic Acids & its derivatives [5]

Acidity of Carboxylic Acids, Effects of Substituent's on Acid Strength. Preparation and reactions of carboxylic acids. Hell-Volhard-Zelinsky reaction. Synthesis of acid chlorides, esters and amides. Reduction of carboxylic acids. Mechanism of decarboxylation, effect of heat and dehydrating agents, Mechanisms of esterification and hydrolysis (acidic and basic).

Unit IV Electrochemistry [6]

Electrical transport, Migration of ions and kohlrausch law, Arrhenius theory of electrolytic dissociation, Application of conductivity measurements, conductometric titrations. Types of reversible electrodes Electrode reactions, Nernst equation, derivation of cell E. M. F. and single electrode potential, standard hydrogen electrode – reference electrodes, electrochemical series and its significance. Electrolytic and Galvanic cells – reversible and irreversible cells. EMF of a cell and its measurement. Potentiometric titrations.

Unit V Nuclear chemistry [5]

Radioactivity: Characteristics of radioactive decay, Decay kinetics, types of decay, α, β, γ- emissions, artificial radioactivity. Nuclear fission and fusion; Nuclear Reactors: Classification of reactors, reactor power, and application of radioactivity, nuclear waste Management.

Unit VI Spectroscopic Characterization of Organic Molecules [4]

Basic principles of UV-VIS and, FTIR, spectroscopy. Brief application of spectroscopic characterization of organic molecules.

Unit VII Biomolecules [4]

Classifications and nomenclature of monosaccharides, Mechanism of osazone formation, Interconversion of glucose and fructose, formation of glycosides, Cyclic structure of D(+)-glucose, Mechanism of mutarotation, Classification, structure and stereochemistry of amino acids, isoelectric point, Brief introduction to peptide and proteins, Classical peptide synthesis, introduction and constituents of nucleic acids, the double helical structure of DNA.

Books Recommended :

1. Modern Electrochemistry – Vol – I & II, by **J. O. M. Bockris & A. K. N. Reddy,** Plenum.
2. Organic Chemistry, F.A. Carey, McGraw-Hill Inc.
3. Organic Chemistry, Morrison and Boyd, Prentice Hall.
4. Concise Inorganic Chemistry by **J D Lee,** Amazon.
5. Comprehensive Co-ordination Chemistry by G. Wilkinson, R. D. Gillars & J. A. Mccleverty, Pergamon
6. Principles of Bio-inorganic Chemistry by S. J. Lippard & J. M. Berg, University Science Books.

CHEMISTRY PRACTICAL

Examination duration: 3 hrs
One experiment to be set.

COURSE CONTENTS:

1. Determination of the heat of neutralization of acids and bases.
2. Verification of Hess' Law of constant heat summation.
3. Determination of solubility of sparingly soluble salt at various temperature and calculation of the enthalpy of solution.
4. pH titration (acid-base: observation of the change in pH).
5. Construction of phase diagram for a two component system (solid-solid, liquid-liquid).
6. Determination of the equivalent constant of hydrolysis of an ester.
7. Determination of the dissociation constant of a weak acid.
8. A comparative study on methods of finding universal indicator, pH paper strips (both, wide and narrow range), use of pH meter.
9. Determination of the solubility product values of a sparingly soluble salt.
10. Determination of dissociation constant involving phenolphthalein/methyl orange by colorimetry.
11. Determination of the molecular weight of a given liquid by steam distillation.
12. Determination of the percentage composition of NaCl by critical solution temperature method (phenol-water system).
13. Determination of the distribution coefficient of benzoic acid between water and toluene or that of acetic acid between water and 1-butanol.
14. Determination of the transition temperature of a given salt hydrate.
15. Determination of the molecular weight of a given substance by Rast's method

References:

1) Practical Physical Chemistry: A Findlay

CHE 301 Physical Chemistry-I B.Sc.-B.Ed. Semester-V Credit: 3 (3-0-0)

Objectives:

(a) To learn about phase equilibria of one and two component systems
(b) To develop an understanding of ideal/non-ideal solutions and colligative properties
(c) To understand the Nernst distribution law, potentiometric titrations and corrosion
(d) To understand the concept of residual entropy, Gibbs and Helmholtz functions

Unit I: Phase Equilibria

Derivation of Gibbs Phase Rule , Phase equilibria of one component system of CO2 & Sulfur,two component system of Bi –Cd. Solid solutions – compound formation with congruent m.pt. Mg- Zn & incongruent m.pt. (NaCl- H2O, Ferric chloride – water & copper sulfate water), Freezing mixtures, acetone-dry ice.

Liquid-liquid mixtures: ideal liquid mixtures, Raoult's and Henry's Law, Non Ideal systems, azeotropes, HCl-Water and ethanol-water systems. Partially miscible liquids-Phenol-water.

Unit II: Solutions, Dilute Solutions and Colligative Properties

Ideal and non-ideal solutions, methods of expressing concentrations of solutions of solutions, activity and activity coefficient. Dilute solution, colligative properties, Raoult's law, relative lowering of vapour pressure, molecular 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 and association of solutes.

Unit III: Electrochemistry

Nernst distribution law – thermodynamic derivation, applications. Concentration cell, with and without transport, liquid junction potential, application of concentration cells, solubility product and activity coefficient, potentiometric titrations, definition of pH and pka, determination of pH using Hydrogen, quin hydrone and glass electrodes by potentiometric methods. Buffers: Mechnism of buffer action, Henderson –hazel equation, hydrolysis of salts, corrosion: types, theories and methods of control.

Unit IV: Thermodynamics

Third law, Nernst Heat theorem, statement and concept of residual entropy, evaluation absolute entropy from heat capacity data, Gibbs and Helmholtz functions, G & A functions as themodyanamic quantities, , A& G as criteria for thermodynamic equilibrium and spontaneity, their advantage over entropy change, variation of G & A with P, V & T.

Books recommended:

1. The Elements of Physical Chemistry, P. W. Atkins, Oxford
2. Physical Chemistry, G. M.. Barrow, McGraw Hill
3. Physical Chemistry through problems: S. K. Dogra & S. Dogra, Wiley Eastern Ltd.

CHE 302 Inorganic Chemistry-I B.Sc.-B.Ed. Semester-V Credit: 3 (3-0-0)

Objectives:

(a) To learn about the spectroscopic term symbols and spin-orbit coupling
(b) To develop an understanding of transition metal chemistry and its magnetic and catalytic properties
(c) To learn about Frost-Ebsworth, Latimer and Pourbaix diagrams and its applications of redox reactions to the extraction of elements from their ores
(d) To understand the reactions that occur in non-aqueous solvents, ionic liquids, supercritical fluids

Unit I: spin-orbit coupling and spectroscopic term symbols
Multielectron systems: Quantum numbers and vectors, mutual inclination of electron orbits and resultant vectors, Russel-Saunders coupling, J-J coupling, ground states term symbols, microstates and derivation of Russell-Saunders terms: p^2, d^2 and pd configuration,

Unit III: Transition elements
General group trends with special reference to electronic configuration, colour, variable valency, ability to form complexes, magnetic and catalytic properties, Difference between the first, second and third transition series. Chemistry of Ti, V, Cr Mn, Fe and Co in various oxidation states (excluding their metallurgy)

UnitIV : Advance Electrochemistry
Standard reduction potentials, E^o, relatioanship between E^o, ΔG^0 and K, Formal Potential and its application: Effect of pH**,** complexation, solubility; Disproportionation and comproportionation reaction Redox stability in water: Frost-Ebsworth, Latimer and Pourbaix diagrams, applications of redox reactions to the extraction of elements from their ores: Ellingham diagrams.

Unit V: Chemistry of Non-aqueous Solvents
Reactions in non-aqueous solvents with reference to liquid NH_3, H_2SO_4, liquid HF, HSO_3F, liquid SO_2. N_2O_4, PCl_5, BrF_3 superacids, ionic liquid: molten salts solvent systems, ionic liquid at ambient temperature; supercritical fluids: properties of supercritical fluids and their uses as solvents,

Books Recommended:

1. Basic Inorganic Chemistry by **F. A. Cotton & Wilkinson**, John Wiley
2. Inorganic Chemistry by **J. E. Huhey**, Harpes & Row
3. Comprehensive Co-ordination Chemistry by **G. Wilkinson, R. D. Gillars & J. A. Mccleverty**, Pergamon
4. Concise Inorganic Chemistry by **J D Lee.**.

Course Code- CHE-303 B.Sc.-B.Ed. Semester-V

Credits: 2(02P) Contact hours per week: 2

CHEMISTRY PRACTICAL

Examination duration: 3 hrs Two experiments to be set.

COURSE CONTENTS:

Chemical Kinetics

1) Iodination of acetone by titration and colorimetry

2) Acid hydrolysis of ester

3) Reaction between potassium peroxidisulfate and potassium iodide

4) Base hydrolysis of ester by titration and conductometry

5) Iodine clock reaction

6) Solvolysis of tertiary butyl chloride by titrimetry, conductometry and pH-metry.

7) Inversion of cane sugar.

Coordination Complexes

Preparation of cobalt and chromium complexes and their analysis using titrations.

References:

1) Practical Physical Chemistry: A Findlay

2) Quantitative Inorganic Analysis: A I Vogel

CHE 351 Organic Chemistry-I B.Sc.-B.Ed. Semester-VI Credit: 3 (3-0-0)

Objectives:

(a) To learn about the chemical properties of alkanes, cycloalkanes, alkenes
(b) To develop an understanding of aromatic compounds, alcohols and phenols

Unit I Alkanes and Cyclolkanes

Corey House reactions and decaroxylation of carboxylic acids, Mechanism of free radical halogination of alkanes, Cycloalkanes: Nomenclature, methods of preparations, chemical reactions, Bayer's strain theory and its limitations, Ring strain in cyclopropane and cyclobutanes, Theory of stainless rings. The case of cyclopropane ring: banana bonds.

Unit II Alkenes, Cycloalkenes, Dienes and Alkynes

Regio-selectivity: Saytzeff rule, Hoffmann elimination, physical properties and relative stabilities of alkenes. Chemical reactions of alkenes: hydroboration-oxidation, oxymercuration-reduction, Epoxidation, hydration, polymerization of alkenes, Substitution at the allylic and vinylic positions of alkenes. Cycloalkenes: conformation, synthesis, and chemical reactions. Dienes: nomenclature, isolated, conjugated and cumulated dienes: structure, method of formation, polymerization, chemical reaction-1,2 and 1,4 additions, diels-alder reaction. Alkynes: hydroboration-oxidation, metal-ammonia reductions, oxidation and polymerization

Unit-III Aryl compounds

The aryl group, Aromatic nucleus and side chain, Side chain reactions of benzene derivatives, Birch reduction, Methods of formation and chemical reactions of alkylbenzenes, alkynylbenzenes and biphenyl.

Unit-IV Alkyl and Aryl Halides

Methods of formation alkyl halide, Mechanisms of nucleophilic substitution reactions of alkyl halides, substitution at the allylic and vinylic positions of alkenes, Mechanisms of elimination reactions of alkyl halides. Methods of formation of aryl halides, nuclear and side chain reactions. The addition-elimination and the elimination-addition, mechanisms of nucleophilic aromatic substitution reactions.

Unit-V Alcohols

Monohydric alcohols: methods of formation (Grignard reagent), reduction of aldehydes, ketones, carboxylic acids and esters. Hydrogen bonding, Acidic nature, Reactions of alcohols. Dihydric alcohols: methods of formation, chemical reactions of vicinal glycols, oxidative cleavage [Pb(OAc)4 and HIO4] and pinacol-pinacolone rearrangement. Trihydric alcohols: methods of formation, chemical reactions of glycerol.

Unit-VI 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 - electrophillic aromatic substitution, acylation and carboxylation, Mechanisms of Fries rearrangement, Claisen rearrangement, Gatterman synthesis, Hauben-Hoesch, Lederer-Manasse and Reimer-Tiemann reaction.

Suggested Books:

1. **Organic Chemistry**", I. L. Finar, Vol. I & II, 5th Edition (1975), Longman Ltd., New Delhi.
2. **Organic Chemistry**, Morrison and Boyd, Prentice Hall.
3. **Organic reaction and mechanism-structure and reactivity** by Jerry March
4. **Introduction to Organic Chemistry**, Streitwiesser, Hathcock and Kosover, Macmillan.
5. ***A Guide Book to Mechanism in Organic Chemistry****",* **P. Sykes,** Orient Longman Ltd.
6. **Fundamentals of Organic Chemistry**, Solomons, John Wilev.

CHE 352 Inorganic Chemistry-II B.Sc.-B.Ed. Semester-VI Credit: 3 (3-0-0)

Objectives:

(a) To learn about the inorganic rings, chains and cages
(b) To develop an understanding of bonding theories in coordination chemistry
(c) To learn about reaction kinetics and mechanism in coordination chemistry
(d) To understand the isomerism and electronic spectra of coordination complexes

Unit I: Inorganic Rings, chains and cages
Catenation and Heterocatenation, Heterocyclic Ring System- Borazines, Phosphazines- Monomer and Polymer, S-N ring compounds, Homocyclic rings of S, Se and Te. Silicates minerals, Isopolyanions, Boranes: boron cage compounds-closo, nido, arachno, carboranes; cage compounds of S and P.

Unit II : Coordination Chemistry
Bonding theories: 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 effecting the magnitude of 10 Dq (Δo, Δt). Octahedral vs. tetrahedral coordination, tetragonal distortions from octahedral geometry Jahn-Teller theorem, square planar coordination. Ligand field and MO Theories (Elementary idea only Chelate effect, polynuclear complexes.

Unit III: Isomerism in coordination compounds
Stereoisomerism: geometrical and optical, Structural isomerism: coordination, ionization, hydrate, linkage.

Unit IV Electronic spectra of coordination complexes
Types of electronic transitions, selection rule for d-d transitions, spectroscopic ground states. Explanation of electronic spectra on the basis of Orgel energy level diagrams. Spectrochemical series, nepheleuxatic effect,

Unit V: Reaction kinetics and mechanism
The trans effect, theories of trans effect, mechanism of trans effect, kinetics of substitution reactions in square planar complexes. Thermodynamic and kinetic stability including factors affecting them. Labile and inert complexes**.** Electron transfer reactions, Inner sphere, outer sphere, without breaking M-L bond.

Books Recommended:

1. Basic Inorganic Chemistry by **F. A. Cotton & Wilkinson**, John Wiley
2. Inorganic Chemistry by **J. E. Huhey**, Harpes & Row
3. Comprehensive Co-ordination Chemistry by **G. Wilkinson, R. D. Gillars & J. A. Mccleverty**, Pergamon
4. Concise Inorganic Chemistry by **J D Lee.**

Course Code- CHE-353
Credits: 2(02P)
Contact hours per week: 2
CHEMISTRY PRACTICAL
Examination duration: 3 hrs Two experiments to be set.
COURSE CONTENTS:
Objectives:
To develop basic skills of separation of organic compounds and to evolve a scheme of analysis of organic compounds based on properties of functional groups for identification.

COURSE CONTENT:

1) Qualitative Organic Analysis

(i) Separation of organic mixtures containing two solid components using water, $NaHCO_3$, NaOH.

(ii) Analysis of an organic compound: Detection of the extra elements(N, S and X)and the functional groups (phenolic, carboxylic, carbonyl, ester, carbohydrate, alcohol, amine, amide, nitro and anilide)in simple organic compounds. Identification of organic compound based on functional group analysis, determination of physical constant (mp/bp).

2) Chromatographic techniques

(i) Thin layer chromatography:

Determination of R_f –values and identification of organic compounds:
a. Separation of green leaf pigments (spinach leaves may be used)

b. Preparation and separation of 2,4-dinitrophenylhydrazones of acetone/2-butanone using toluene:light petroleum (2:3 ratio)

c. Separation of mixtures of dyes.

(ii) Paper chromatography:

Determination of R_f –values and identification of organic compounds:
a. Separation of mixtures of amino acids

b. Separation of mixture of D-galactose and D-fructose using butanol: acetic acid:water (4:5:1); spray reagent: anilinhydrogenphthalate

(iii)Column chromatography: Separation of ortho and para nitroanilines.

References:
1. A Text Book of Qualitative Organic Analysis: A. I. Vogel

2. A Text Book of Quantitative Organic Analysis: A. I. Vogel

CHE 401 Physical Chemistry-II B.Sc.-B.Ed. Semester-VII Credit: 3 (3-0-0)

Objectives:

(a) To understand the basic concepts of quantum mechanics
(b) To develop an understanding of various spectroscopic techniques namely, electronic spectroscopy, rotational and vibrational spectroscopy
(c) To learn about the fundamentals of photochemistry

I Elementary Quantum Mechanics

Black – body radiation, Planck's radiation law, photoelectric effect, heat capacity of solids, Bohr's model of hydrogen atom (no derivation) and its defects, Compton effect. De Broglie hypothesis, the Heisenberg's uncertainty principle, Sinusoidal wave equation, Hamiltonian operator, Schrodinger wave equation and its importance, physical interpretation of the wave function, postulates of quantum mechanics, particle in a one dimensional box.Schrodinger wave equation for H-atom, separation into three equations (without derivation), quantum numbers and their importance, hydrogen like wave functions, radial wave functions, angular wave functions. Molecular orbital theory, basic ideas- criteria for forming M .O, from A.O, construction of M.O's by LCAO – H_2^+ ion, calculation of energy levels from wave functions, physical picture of bonding and antibonding wave functions, concept of σ, σ^*, π, π^* orbitals and their characteristics. Hybrid orbitals – sp, sp^2. sp^3, calculation of coefficients of A.O.'s used in these hybrid orbitals.Introduction to valence bond model of H_2, comparison of M.O. and V.B. models.

II Spectroscopy

Introduction: electromagnetic radiation, regions of the spectrum, basic features of different spectrometers, statement of the Born- Oppenheimer approximation, degrees of freedom.

Electronic Spectrum

Concept to potential energy curves for bonding and antibonding Molecular orbital, qualitative description of selection rules and Frank-Condon principle. Qualitative description of a, SIGMA, PI and n M O., their energy levels and the respective transitions.

Rotational Spectrum

Diatomic molecules. Energy levels of a rigid rotor (semi- classical principles), selection rules, spectral intensity, distribution using population distribution (Maxell- Boltzmann distribution) determination of bond length, qualitative description of non- rigid rotor, isotope effect.

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, effect of anharmonic motion and isotope on the spectrum, idea of vibrational frequencies of different functional groups.

Raman Spectrum: concept of polarizability, pure rotational and pure vibrational Raman spectra of diatomic molecules, selection rules.

Unit III : Photochemistry

Interaction of radiation with matter, difference between thermal and photochemical process. Laws of photochemistry: Grothus – Drapper law, Stark – Einstein law, Jablonski diagram depicting various processes occurring in the exited state, qualitative description of fluorescence, phosphorescence, non –

radiative processes (internal conversion, intersystem crossing), quantum yield, photosensitized reaction – energy transfer processes (simple examples.)

Books Recommended:

1. The Elements of Physical Chemistry, P. W. Atkins, Oxford
2. Physical Chemistry, G. M.. Barrow, McGraw Hill
3. Physical Chemistry through problems: S. K. Dogra & S. Dogra, Wiley Eastern Ltd.

CHE 402 Organic Chemistry-II B.Sc.-B.Ed. Semester-VII Credit: 3 (3-0-0)

Objectives:

(a) To learn about the nomenclature, synthesis and reaction of ethers, epoxides, aldehydes and ketones
(b) To understand the carboxylic acid and its derivatives
(c) To learn about reaction kinetics and mechanism in coordination chemistry
(d) To develop an understanding of the properties of organometallic and organosulphur compounds

Unit I Ethers and Epoxides

Nomenclature and methods of formation, physical properties, Chemical reactions: cleavage and autoxidation, Zeisel's method. 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 Aldehydes and Ketones:

Synthesis of aldehydes and ketones from acid chlorides, 1,3-dithianes, nitriles and carboxylic acids, Physical properties. Mechanism of nucleophilic additions to carbonyl group: Perkin and Knoevengel condensations, Condensation with ammonia and its derivatives. Wittig reaction. Mannich reaction, Use of acetals as protecting group. Baeyer-Villiger oxidation, Meerwein-Pondorof Verley, Clemmensen, and $NaBH_4$ reductions, Halogenation of enolizable ketones, An introduction to α, β unsaturated aldehydes and ketones.

Unit III Carboxylic acid and Derivatives

Preparation and Reactions of carboxylic acids, Hell-Volhard-Zelinsky reaction, Mechanisms of esterification and hydrolysis (acidic and basic). Reduction of carboxylic acids, Mechanism of decarboxylation, effect of heat and dehydrating agents, methods of formation and chemical reactions of unsaturated monocarboxylic acids, Dicarboxylic acids, haloacids, hydroxy acids- Malic, tartaric & citric acid and acid anhydrides. Physical properties, interconversion of acid derivatives by nucleophilic acyl substitution.

Unit IV Nitrogen Compounds

Preparation and Chemical reactions of nitroalkanes and nitroarenes, Mechanisms of nucleophilic Substitution in nitroarenes and their reductions in acidic, neutral and alkaline media. Picric acid. Halonitroarenes: reactivity, structure and nomenclature, physical properties, Stereochemistry of amines. Preparation of alkyl and aryl amines (reduction of nitro compounds, nitriles), reductive amination of aldehydic and ketonic compounds, Gabriel-Phthalamide reaction, Hoffmann bromamide reaction, Reactions of amines, electrophilic aromatic substitution in aryl amines, reactions of amines with nitrous acid.

Unit V Organometallic Compounds

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

Unit VIOrganosulphur Compounds

Nomenclature, structural features, Methods of formation and chemical reactions of thiols, thioethers, sulphonic acids, sulphonamides and sulphaguanidine

Suggested Books:

1. **Organic Chemistry**", I. L. Finar, Vol. I & II, Longman Ltd., New Delhi.
2. **Organic Chemistry**, Morrison and Boyd, Prentice Hall.
3. **Organic reaction and mechanism-structure and reactivity** by Jerry March
4. **Introduction to Organic Chemistry**, Streitwiesser, Hathcock and Kosover, Macmillan.
5. ***A Guide Book to Mechanism in Organic Chemistry****",* **P. Sykes,** Orient Longman Ltd.
6. **Fundamentals of Organic Chemistry**, Solomons, John Wilev. **Organic Chemistry,** Jonathan Clayden, Nick Greeves, Stuart Warren, Peter Wothers, Oxford University Press, USA
7. **Organic Chemistry**, L.G. Wade Jr. Prentice Hall.
8. **Organic Chemistry,** Jonathan Clayden, Nick Greeves, Stuart Warren, Peter Wothers, Oxford University Press, USA
9. **Organic Chemistry**, L.G. Wade Jr. Prentice Hall.

Course Code- CHE-403 Credits: 2(02P)

Contact hours per week: 2

CHEMISTRY PRACTICAL

Examination duration: 3 hrs One experiment to be set.

COURSE CONTENTS:

Objectives:

To learn to perform basic experiments of electrochemistry including conductance measurements and conductometric and potentiometric titrations.

COURSE CONTENTS:

1. To study the effect of dilution on Molar Conductivity on weak and strong electrolytes.
2. Conductometric titrations.
3. Construction and measurement of EMF of Cells.
4. Potentiometric titrations.

References:

1) Practical Physical Chemistry: A Findlay

CHE 451 Organic Chemistry-III B.Sc.-B.Ed. Semester-VIII Credit: 3 (3-0-0)

Objectives:

(a) To learn about NMR spectroscopy and its use in structure determination of organic compounds
(b) To understand the photochemical reactions of carbonyl compounds and olefins
(c) To develop an understanding of chemistry of pericyclic and heterocyclic compounds
(d) To learn about the basic features of hormones and vitamins

Unit I NMR Spectroscopy and Structure Determination

Nuclear magnetic resonance (NMR) spectroscopy:
Proton magnetic resonance (1H NMR) spectroscopy, nuclear shielding and deshielding, chemical shift and molecular structure, spin-spin splitting and coupling constants, areas of signals, interpretation of PMR spectra of simple organic molecules such as ethyl bromide, ethanol, acetaldehyde, 1,1,2-tribromoethane, ethyl acetate, toluene and acetophenone, Brief introduction to ^{13}C NMR, Problems pertaining to the structure elucidation of simple organic compounds using UV, IR and NMR spectroscopic techniques. Gas Chromatography: Basic concepts

Unit II Photochemistry

Principles of photochemistry, photochemical reactions of carbonyl compounds and olefins, Patterno-Buchi Reaction, Norrish type-I and Norrish type-II reactions.

Unit III Heterocyclic Compounds

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. Introduction to condensed five and sixmembered heteroeycies. Preparation and reactions of Indole, quinoline and isoquinolme with special reference to Fischer indole synthesis, Skraup synthesis and Bischler-Napieralski synthesis. Mechanism of electrophilic substitution reactions of indole, quinoline and isoquinoline.

Unit IVOrganic synthesis via enolates

Acidity of α-hydrogens, alkylation of diethyl malonate and ethyl acetoacetate. Synthesis using diethyl manlonate and ethyl acetoacetate, Claisen condensation. Keto-enol tautomerism of ethyl acetoacetate, Alkylaticn of 1,3-dithianes. Alkylation and acylation of enamines

Unit V - Introductory Pericyclic Chemistry

Concerted reaction, Molecular orbital theory, LCAO methods, bonding and anti-bonding orbitals, orbital symmetry, correlation diagram for electrocyclic reactions, Diels-Alder reaction.

Unit VI Alkaloids & Terpenes

Occurrence, importance, general structural features, Hofmann exhaustive methylation, structure and synthesis of nicotine and piperine. Terpenes: Occurrence, isolation, classification, Isoprene rule, structure and synthesis of citral, geraniol and α-terpineol.

Unit VII Vitamins and Hormones

Chemical constitution and physiological functions of vitamins A, B2 (Riboflavin), C (Ascorbic acid); Thyroxin and estrone.

Suggested Books:

1. **Organic Chemistry**", I. L. Finar, Vol. I & II, Longman Ltd., New Delhi.
2. **Organic Chemistry**, Morrison and Boyd, Prentice Hall.
3. **Organic reaction and mechanism-structure and reactivity** by Jerry March
4. **Introduction to Organic Chemistry**, Streitwiesser, Hathcock and Kosover, Macmillan.
5. ***A Guide Book to Mechanism in Organic Chemistry****",* **P. Sykes,** Orient Longman Ltd.

CHE 452 Inorganic Chemistry-III B.Sc.-B.Ed. Semester-VIII Credit: 3 (3-0-0)

Objectives:

(a) To learn about the oxidation states, magnetic and spectral properties of lanthanides and actinides
(b) To understand the basic concepts of magnetochemistry and its application to coordination complexes
(c) To develop an understanding of bioinorganic chemistry and organometallic chemistry

Unit I: Lanthanides and actinides

Electronic configuration, oxidation states, colour, spectral and magnetic properties, lanthanide contraction, separation of lanthanides (ion-exchange method only). General features and chemistry of actinides, principles of separation of Np, Pu and Am from U. Trans-Uranium elements.

Unit II: Magnetochemistry of coordination complexes

Definition of magnetic properties, types of magnetic bodies, two sources of paramagnetism: orbital and spin effects, Diamagnetism and Pascals's constant, methods of determining magnetic susceptibility, orbital contribution to magnetic moments, magnetic properties based on crystal field models: octahedral, tetrahedral, trigonal bipyramidal, square pyramidal, tetragonally distorted octahedral complexes, spin state equilibrium in octahedral stereochemistry: crossover region, Valance bond and crystal field interpretation of magnetic moments. Correlation of magnetic moment data and stereochemistry; anomalous magnetic moments.

Unit III: Organometallic Chemistry

Definition and classification of organometallic compounds, EAN rule (18e and 16e), Preparation, properties, bonding and applications of alkyl and aryls of Li, Al, Hg, Sn, Ti. A brief account of metal-ethylenic complexes and homogeneous hydrogenation

Unit IV: Metal carbonyls

Preparation, properties, structure and bonding of mononuclear carbonyls. π- acceptor behaviour of carbon monoxide, synergic effect (Mo diagram of CO be refer for synergic effect refer to I R frequencies) Carbonylate anions, ferrocene and its reactions.

Unit V : Bioinorganic Chemistry

Metal ions present in biological systems : classification of elements according to their action in biological system. Geochemical effect on the distribution of metals. Sodium / K-pump. Biochemistry of Mg and Ca Metalloenzyme oxaloacetate decarboxylase and carboxypeptidase. Excess and deficiency of some trace metals. Toxicity of metal ions (Hg, Pb and As) reasons for toxicity, Use of chelating agents in medicine. Iron and its application in bio-systems, Storage and transfers of iron.

Books Recommended:

1. Basic Inorganic Chemistry by **F. A. Cotton & Wilkinson**, John Wiley
2. Inorganic Chemistry by **J. E. Huhey**, Harpes & Row
3. Comprehensive Co-ordination Chemistry by **G. Wilkinson, R. D. Gillars & J. A. Mccleverty**, Pergamon
4. Concise Inorganic Chemistry by **J D Lee,** Amazon.

Course Code- CHE-453

Credits: 2(02P)
Contact hours per week: 2

CHEMISTRY PRACTICAL
Examination duration: 3 hrs
Objectives:

 To develop skills of synthesis and estimation of organic compounds.

COURSE CONTENT:

1. **Two step organic synthesis**

a. Synthesis of p-bromoaniline from acetanilide.

b. Preparation of o-iodobenzoic acid from anthranilic acid.

c. Preparation of m-nitrobenzoic acid from methyl benzoate.

d. Preparation of paracetamol.

e. Synthesis of quinoline.

2. **Quantitative organic analysis**

a. Estimation of aniline by bromated-bromide method.

b. Estimation of glucose by Fehlings method

c. Determination of iodine value of an oil by Vij's method.

References:

1. Practical Organic Chemistry: A I Vogel