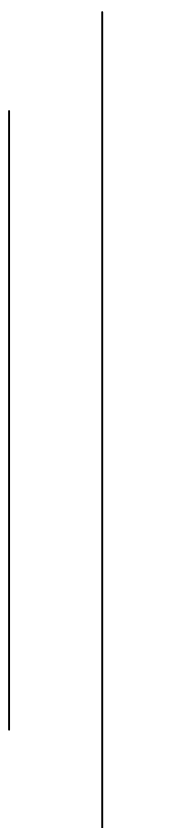


GOVERNMENT OF MANIPUR
MAYAI LAMBI COLLEGE

YUMNAM HUIDROM, IMPHAL WEST



BA / BSc Syllabus

DEPARTMENT OF CHEMISTRY

Syllabus for Undergraduate Programme

Bachelor of Science in Chemistry



Manipur University, Canchipur

Imphal-795003

Section B: ORGANIC CHEMISTRY

25 marks; 30 Hours

Unit 1 Structure and Bonding

5 Marks

Hybridization (sp , sp^2 and sp^3) bond lengths and bond angles, bond energy, localized and delocalized chemical bond, van der Waals interactions, inclusion compounds, clathrates, charge transfer complexes, resonance, hyperconjugation, inductive and field effects, hydrogen bonding.

Unit 2 Mechanism of organic reactions

6 Marks

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

Methods of determination of reaction mechanism (product analysis, intermediates, isotope effects, kinetically controlled and thermodynamically controlled reactions and stereochemical studies).

Unit 3 Cycloalkanes

5 Marks

Nomenclature: monocyclic, bicyclic, tricyclic cycloalkanes. Baeyer's strain theory and its limitations. Ring strain in small rings (cyclopropane and cyclobutane), theory of strainless rings. The ease of cyclopropane ring: banana bonds.

Unit 4 Alkenes, Cycloalkenes, Dienes and Alkynes

9 Marks

Methods of formation, mechanisms of dehydration of alcohols and dehydrohalogenation of alkyl halides, regioselectivity in alcohol dehydration. The Saytzeff rule, Hofmann elimination, physical properties and relative stabilities of alkenes.

Chemical reactions of alkenes – mechanisms involved in hydrogenation, electrophilic and free radical additions, Markownikoff's rule, hydroboration – oxidation, oxymercuration – reduction, Epoxidation, ozonolysis, hydration, hydroxylation and oxidation with $KMnO_4$. Polymerization of alkenes. Substitution at the allylic and vinylic positions of alkenes.

Nomenclature and classification of dienes: isolated, conjugated and cumulated dienes. Structure of allenes and butadiene, methods of formation, polymerisation. Chemical reactions 1, 2- and 1,4- additions, Diels-Alder reaction.

Methods of formation. Chemical reactions of alkynes, acidity of alkynes. Mechanism of electrophilic and nucleophilic additions reactions, hydroboration – oxidation, metal – ammonia reductions, oxidation and polymerisation.

Section C: PHYSICAL CHEMISTRY

25 marks; 30 Hours

Unit 1 Gaseous state – I 6 Marks

Kinetic molecular model of a gas: postulates and derivation of the kinetic gas equation; collision frequency; collision diameter; mean free path, including their temperature and pressure dependence. Barometric distribution and its use in evaluating molecular velocities (average, root mean square and most probable) and average kinetic energy, law of equipartition of energy.

Unit 2 Gaseous state-II 6 Marks

Deviations from ideal gas behaviour. Compressibility factor, Z , and its variation with pressure for different gases. Causes of deviation from ideal behaviour, van der Waals equation of state, its derivation and application in explaining real gas behaviour, mention of other equations of state (Berthelot, Dieterici); Boyle temperature. Continuity of states, critical state, relation between critical constants and van der Waals constants, law of corresponding states.

Unit 3 Liquid state 5 Marks

Nature of liquid state, intermolecular forces, Qualitative treatment of the structure of the liquid state; physical properties of liquids; vapour pressure, surface tension and coefficient of viscosity and their determination. Effect of addition of various solutes on surface tension and viscosity. Temperature variation of viscosity and surface tension of liquids.

Unit 4 Solid state 8 Marks

Nature of the solid state, laws of constancy of interfacial angles, law of rational indices, Miller indices, elementary ideas of symmetry, symmetry elements and symmetry operations, qualitative idea of point and space groups, seven crystal systems and fourteen Bravais lattices; X-ray diffraction, Bragg's law, a simple account of rotating crystal method and powder pattern method.

CH-101P: INORGANIC CHEMISTRY PRACTICAL

25 Marks; 45 Hours

I.Semimicro analysis (4 radicals)

Semimicro analysis of inorganic mixtures containing four radicals/ions from the following list: Silver, lead, mercury, bismuth, copper, cadmium, arsenic, manganese, cobalt, aluminium, iron, nickel, calcium, strontium, barium, magnesium, sodium, potassium, ammonium, chloride, bromide, iodide, fluoride, sulphate, sulphite, thiosulphate, chromate, phosphate, nitrate, nitrite, borate, arsenite and arsenate.

Unit 2: Arenes and aromaticity 7 Marks

Structure of benzene: molecular formula and Kekule structure, Stability and carbon-carbon bond lengths of benzene, resonance structure, MO picture.

Aromaticity-the Huckel rule, aromatic ions.

Aromatic electrophilic substitution – general pattern of the mechanism, role of σ - and π -complexes and energy profile diagram. Mechanism of nitration, halogenations, sulphonation, mercuration and Friedel – Crafts reaction. Activating and deactivating substituents, orientation and ortho/para ratio.

Unit 3 Alkyl halides and aryl halides 4 Marks

Mechanisms of nucleophilic substitution reactions of alkyl halides. S_N2 and S_N1 reactions with energy profile diagrams.

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 4 Alcohols 4 Marks

Synthesis from carbonyl compounds, dihydric alcohols - nomenclature, methods of formation, chemical reactions of vicinal glycols, oxidative cleavage [$Pb(OAc)_4$ and HIO_4].

Trihydric alcohols – nomenclature, chemical reactions, nitration, reaction with $KHSO_4$.

Section C: PHYSICAL CHEMISTRY

25 Marks; 30 Hours

Unit 1 Solutions 6 Marks

Solutions and mixtures, miscible and immiscible liquids, types of solutions, Raoult's law and Henry's law, ideal and non-ideal solution, deviation from ideal behaviour, vapour pressure of liquid and liquid mixtures, separation of completely miscible binary liquid solutions by distillation, azeotropic mixtures, solubility of partially miscible liquids (phenol-water, TEA-water and nicotine-water system), critical solution temperature, Nerst's distribution law and its limitations.

Unit 2 Dilute Solutions 6 Marks

Dilute solution; Colligative properties – lowering of vapour pressure. Clapeyron – Clausius equation, Thermodynamic derivation using chemical potential to derive relations between the four colligative properties: (i) relative lowering of vapour pressure, (ii) elevation of boiling point, (iii) Depression of freezing point, (iv) osmotic pressure and amount of

25 Marks; 30 Hours

- Unit 1 Metallurgy 6 Marks**
Minerals and ores, general principles of metallurgy, extraction of Li, K, Be, Sn, Sb, Bi, Cr and Mn.
- Unit 2 Chemistry of p-block elements 6 Marks**
Comparative studies diagonal relationships, salient features of hydrides, oxides, oxyacids and halides, basic properties of halogens, interhalogens and polyhalogens. Applications of p-block elements (Si, Ge, Se)
- Unit 3 General properties of d-block elements 6 Marks**
Definition, position in the periodic table, Characteristics properties of d-block elements, occurrence and abundance, variable oxidation states.
- Unit 4 Coordination Chemistry 7 Marks**
Werner's theory and its experimental verification, types of ligands, nomenclature of coordination compounds (IUPAC), coordination number and stereochemistry of coordination compounds, isomerism of coordination compounds.

SECTION B: ORGANIC CHEMISTRY

25 Marks; 30 Hours

- Unit 1 Phenols 5 Marks**
Acidic character, Comparative acidic strengths of alcohols and phenols, resonance stabilization of phenoxide ion, Reactions of phenols – electrophilic aromatic substitution, acylation and carboxylation, Mechanism of Fries rearrangement, Claisen rearrangement, Gatterman synthesis, Hauben – Hoesch reaction and Reimer – Tiemann reaction.
- Unit 2 Ethers and epoxides 5 Marks**
Ethers: Methods of their formation, physical properties, Chemical reactions – cleavage and autooxidation, Ziesel'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 3 Aldehydes and ketones 8 Marks**
Synthesis of aldehydes and ketones with particular reference to the synthesis of aldehydes from acid chlorides, synthesis of aldehydes and ketones using 1, 3 – dithianes, synthesis of ketones from nitriles and from carboxylic acids. Physical properties.
Mechanism of nucleophilic additions to carbonyl group with particular emphasis on benzoin, aldol, Perkin and Knoevenagel condensation, Condensation with ammonia and its derivatives. Wittig reaction, Mannich reaction.

order reactions and examples – half life period with examples, effect of temperature on the rate of reactions - Arrhenius equation and concept of energy of activation. Experimental methods of the determination of rate laws.

CH303P: PHYSICAL CHEMISTRY PRACTICAL

25 Marks; 45 Hours

1. Surface tension measurements (use of organic solvents excluded)

Determine the surface tension by (i) drop number (ii) drop weight method.

2. Viscosity measurement:

(a) Viscosity measurement of given liquids using Ostwald's viscometer (at room temperature)

(b) Study the effect of variation of viscosity of an aqueous solution with the concentration of solute.

3. pH measurements

(a) Measurements of pH of different solutions using pH-meter.

(b) Preparation of buffer solutions

(i) Sodium acetate-acetic acid

(ii) Ammonium chloride-ammonium hydroxide

Measurement of the pH of buffer solutions and comparison of the values with theoretical values.

(c) pH metric titrations of

(i) strong acid and strong base

(ii) weak acid and strong base

Any other experiment carried out in the class.

SEMESTER - IV

CH-404 Section A: INORGANIC CHEMISTRY

25 Marks; 30 Hours

Unit 1 Chemistry of lanthanides 6 Marks

Position in the periodic table, general properties of lanthanides, electronic structure, oxidation states, ionic radii and lanthanide contraction, consequences of lanthanide contraction, complex formation, uses of lanthanides and their compounds.

Unit 2 Chemistry of Actinides 6 Marks

Position of Actinides in the periodic table, general properties of actinides, identification and nuclear synthesis of trans-uranium elements, separation of Np, Pu and Am from U, similarities between the later actinides and later lanthanides.

Unit 3 Chemistry of noble gases 6 Marks

Position in the periodic table, principles of isolation, chemical properties, bonding and stereochemistry of xenon compounds, uses of noble gases.

Unit 4 Hard and soft acids and bases 7 Marks

Classification of acids and bases as hard and soft, Pearson's concept, acid-base strength and hardness and softness. Symbiosis, theoretical basis of hardness and softness.

Section B: ORGANIC CHEMISTRY

25 Marks; 30 Hours

Unit 1 Carboxylic acids 6 Marks

Acidity of carboxylic acids, effects of substituents on acid strength. Reactions of carboxylic acids. Hell-Volhard-Zelinsky reaction. Synthesis of acid chlorides, esters and amides. Reduction of carboxylic acids. mechanism of decarboxylation.

Hydroxyl acids: malic, tartaric and citric acids.

Unit 2 Carboxylic acid derivatives 6 Marks

Relative stability of acyl derivatives. Physical properties, interconversion of acid derivatives by nucleophilic acyl substitution.

Preparation of carboxylic acid derivatives, chemical reactions. Mechanisms of esterification and hydrolysis (acidic and basic).

Unit 3 Organometallic compounds**6 Marks**

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

Organozinc compounds: formation and chemical reactions.

Organolithium compounds: formation and chemical reactions.

Unit 4 Polymers**7 Marks**

Natural and synthetic, mechanism of polymerization, condensation and addition polymers, Synthetic plastics, thermosetting and thermoplastics. Urea-formaldehyde, phenol-formaldehyde plastics, Teflon, polystyrene and polyurethanes, natural and synthetic rubbers, synthetic fibres, acrylics, nylon-6 and nylon -66, terylene, elementary of fibremaking, blended fibres.

Section C: PHYSICAL CHEMISTRY**25 Marks; 30 Hours****Unit 1 Catalysis****6 Marks**

Types of catalyst, specificity and selectivity, mechanisms of catalyzed reactions at solid surfaces; effect of particle size and efficiency of the catalysts. Enzyme catalysis, Michaelis-Menten mechanism, acid-base catalysis, Theory of catalysis-adsorption and intermediate compound formation.

Unit 2 Ionic equilibria-I**7 Marks**

Electrolytes and non-electrolytes, strong, moderate and weak electrolytes, ionization and ionization constant, factors affecting degree of ionization, ionic product of water. Calculation of pH of dilute solutions of weak acids and bases, common ion effect, dissociation constants of mono- and di-protic acids. Salt hydrolysis and pH for different salts. Buffer solutions; derivation of Henderson equation and its applications; buffer capacity, buffer range, buffer action and applications of buffers in analytical chemistry and biochemical processes in the human body.

Unit 3 Ionic equilibria-II**6 Marks**

Solubility and solubility product of sparingly soluble salts – application of solubility product principle. Qualitative treatment of acid – base titration curves. Theory of acid – base indicators; selection of indicators and their limitations.

Unit 4 Phase equilibria-I**6 Marks**

Phases, components and degree of freedom, Gibbs phase Rule (no derivation) for non-reactive and reactive system; - Application to one component systems – water, carbon dioxide and sulphur with applications.

CH-404P ANALYTICAL CHEMISTRY PRACTICAL

25 Marks; 45 Hours

1. To determine Hardness of water using EDTA.
2. To estimate nickel using DMG.
3. To estimate calcium content in chalk as calcium oxalate by permanganometry.
4. To estimate reducing sugar by titration with standard Fehling solution/Benedict's solution.
5. To determine the equivalent weight of the given acid sample by direct titration method with alkali.
6. To determine the saponification value of the given fat or oil sample.
7. To estimate protein in the given sample by Folin Lowry method/Biuret method.
8. To estimate a reducing by colorimetric method.
9. To determine the concentration of a given sample by using Lambert-Beer's law.
10. To determine the amount of iodine from a given sample (salt) by titration method.

**SEMESTER V
INORGANIC CHEMISTRY**

CH-505

67 Marks; 90 Hours

Unit1 Nuclear chemistry and Radioactivity

7 Marks

Discovery of radioactivity, nature of radiations, separation of isotopes, binding energy, mass defect, half-life, group displacement law, artificial transmutation artificial radioactivity. Nuclear binding energy and packing fraction. Thermonuclear reactions, radioactive tracer techniques and their applications.

Unit 2 Chemistry of compounds of non-transition elements

8 Marks

Comparative studies of s- and p-block elements. Preparation and properties of bleaching powder, Portland cement and borazole. Study of solid CO₂ and carbonaceous fuel (solid, liquid and gaseous). Oxides and oxyacids of phosphorous, oxides and hydrides of halogens. Chemical reactivity of Chalcogens (halides, oxyacids and peroxyacids of sulphur).

Water pollution, nature of pollutants, treatment of water.

Toxic chemicals in environment, biochemical effects of mercury, cadmium, lead and pesticides, control and treatment of the above trace elements, solid waste pollution, treatment and disposal.

CH-506 ORGANIC CHEMISTRY

67 Marks; 90 Hours

Unit 1 Carbohydrates

11 Marks

Classification and nomenclature, Monosaccharides, mechanism of osazone formation, constitution of glucose and fructose, chain lengthening and chain shortening of aldoses. Configuration of monosaccharides. Formation of glycosides, ethers and esters. Determination of ring size of monosaccharides. Cyclic structure of D(+)-glucose. mechanism of mutarotation.

Structures of ribose and deoxyribose.

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

Unit 2 Amino acids, Peptides and Proteins

7 Marks

Classification, structure, stereochemistry of amino acids. Acid-base behaviour, isoelectric point and electrophoresis. Preparation and reactions of amino acids.

Classification of proteins, Peptide structure determination, classical levels of protein structure. Protein denaturation/renaturation.

Unit 3 Nucleic acids

5 Marks

Nucleic acids: Introduction, Constituents of nucleic acids. Ribonucleosides and ribonucleotides. The double helical structure of DNA.

Unit 4 Fats, Oils and detergents

6 Marks

Natural fats, edible and industrial oils of vegetable origin, common fatty acids, glycerides, hydrogenation and unsaturated oils. Saponification value, iodine value, acid value. Soaps, synthetic detergents, alkyl and aryl sulphonates.

Unit 5 Pericyclic reactions

9 Marks

Definition and classification, electrocyclic reactions (thermal and photochemical) involving 4 and 6 π - electrons and corresponding cyclo reversion reaction, cycloaddition reactions, FMO approach, Diels-Alder Reaction, photochemical [2+2] reactions.

Unit 6 Synthetic dyes

5 Marks

Colour and constitution (electronic concept). Classification of dyes, Chemistry and synthesis of Methyl orange, Congo red, Malachite green, Crystal violet, Phenolphthalein, Fluorescein, Alizarin and Indigo.

ionic conductance - Kohlrausch's law and its application – salt hydrolysis and pH of a salt, buffer action and explanation.

CH-508P INORGANIC AND PHYSICAL CHEMISTRY PRACTICAL
100 Marks (Inorganic: 67 marks; Physical: 33 marks)
135 Hours

Inorganic Laboratory:

I. Preparation of Inorganic complexes

- a. Preparation of sodium tris(oxalate)ferrate(III)
- b. Preparation of Nickel Dimethylglyoxime, $[\text{Ni}(\text{DMG})_2]$
- c. Preparation of copper tetraamine complex, $[\text{Cu}(\text{NH}_3)_4]\text{SO}_4$
- d. Preparation of cis and trans-bis(oxalate)diaqua chromate

II. Estimation of two constituents from a binary mixture (one volumetrically and one gravimetrically)

Estimation of the constituents from the following mixture: Iron and calcium, iron and copper, iron and manganese, copper and zinc, silver and copper, calcium and barium, calcium and lead, calcium and magnesium, copper and chloride, copper and sulphate.

III. Semimicro analysis

Semimicro analysis of five radicals containing at least one rare element (V, Mo, W, etc.) Silver, lead, mercury, bismuth, copper, cadmium, arsenic, manganese, cobalt, aluminium, iron, nickel, calcium, strontium, barium, magnesium, sodium, potassium, ammonium, chloride, bromide, iodide, fluoride, sulphate, sulphite, thiosulphate, chromate, phosphate, nitrate, nitrite, borate, arsenite and arsenate.

Physical Laboratory:

(I) Study of equilibrium of the following reactions by the distribution method:

- (i) I_2 in water –Kerosene/ CCl_4
- (ii) $\text{I}_2(\text{aq}) + \text{I}^- \rightarrow \text{I}_3^-(\text{aq})$
- (iii) $\text{Cu}^{2+}(\text{aq}) + n\text{NH}_3 \rightarrow \text{Cu}(\text{NH}_3)_n^{2+}$

(II) Perform the following potentiometric /pH- metric titrations:

Strong acid with strong base (ii) weak acid with strong base and (iii) dibasic acid with strong base

(III) Potentiometric /pH- metric titrations of Mohr's salt with potassium dichromate.

(IV) Determination of critical solution temperature and composition of the phenol-water system and to study the effect of impurities on it.

(V) Phase equilibria: Construction of the phase diagram of (i) simple eutectic and (ii) congruently melting systems, using cooling curves and ignition tube methods.
Any other experiment carried out in the class.

**CH-608: Semester VI
INORGANIC CHEMISTRY**

66 Marks; 90 Hours

Unit 1 Bonding in coordination compounds 14 Marks

Theory of coordination bond, Effective atomic number rule, Valence bond theory and its limitation. Crystal field theory. Splitting of d-orbitals in different stereochemistries octahedral, tetrahedral and square planar complexes. Factors that influence complex formation, stability constants.

Unit 2 Magnetic properties of transition metal complexes 8 Marks

Types of magnetic behaviour, methods of determining magnetic susceptibility, spin only formula, L-S coupling and application of magnetic moment data in 3d transition metal complexes.

Unit 3 Inorganic polymers 7 Marks

Silicates and their classification and structures, phosphazenes as inorganic polymers, structure and bonding in triphosphazenes, zeolites and molecular sieves.

Unit 4 Thermoanalytical methods 9 Marks

Thermogravimetric (TGA) and Differential Thermal Analysis (DTA), Differential Scanning Calorimetry (DSC) – Basic principles, Instrumentation, Factors affecting thermoanalytical techniques, Application in soils, organic and inorganic compounds, analytical chemistry.

Unit 5 Organometallic Chemistry 9 Marks

Definition, nomenclature and classification of organometallic compounds. 18 electron rule, counting of electrons in compounds; bonding and structure of CO, NO and N₂ compounds.

Unit 6 Bioinorganic Chemistry 9 Marks

synthesis, Skraup synthesis and Bischler-Napieralski synthesis. Mechanism of electrophilic substitution reactions of indole, quinoline and isoquinoline

Unit 5 Medicinal chemistry 7 Marks

Drugs and antibiotics – synthesis and structure of the following

Sulphadiazine - sulphaguanidine

Analgesics – aspirin, phenacetin

Antimalarials – Plasmoquin, chloroquine

Antibiotics - chloramphenicol

Unit 6 Chromatography 5 Marks

Principles and applications of chromatography – column, thin layer, paper, preparatory thin layer, gas chromatography, elementary ideas of instrumentation of gas chromatography.

Unit 7 Mass spectroscopy 7 Marks

Basic principle, basic compounds of double focussing instruments, molecular ions, fragmentation of molecular ions, basic rules of fragmentation, fragmentation by α -bond rupture in alkane groups, α -bond rupture near functional groups, study of the nature of fragmentation and presentation of mass spectra of 2-methylpentane, cyclohexane.

Unit 8 Nuclear Magnetic Resonance Spectroscopy, 8 Marks

Qualitative and conceptual treatment of the nmr phenomenon, precessional frequency, energy transition, theory of resonance, chemical shift, magnetically non-equivalent protons, shielding and deshielding, spin coupling, analysis of AX type spectra like, trans-cinnamic acid, 1, 1, 2-trichloro ethane, ethyl bromide, elementary ideas on instrumentation and sample handling.

Unit 9 Electron Paramagnetic Resonance Spectroscopy 5 Marks

Elementary principle of epr., g values hyperfine splitting, epr spectra of $C_6H_6(\cdot)$ and $CH_3CHOCH_2CH_3$ and their analysis.

Unit 10 Green Chemistry 5 Marks

Principles and applications of green chemistry. Introduction, advantages and disadvantages. Applications in organic synthesis, principles of ultrasound and microwave assisted organic reactions, reactions in ionic liquids.

CH-610 PHYSICAL CHEMISTRY

67 Marks; 90 Hours

Unit 1 Computer Applications in Chemistry 6 Marks

Introduction to computers and its application in chemistry: introduction to computers – characteristics of a computer – types of computers – block diagram of a digital computer. Algorithm - Flow chart - Application of computer in chemistry (only selected programs) determination of molarity, normality and molality of solutions – calculation of pH.

Unit 2 Quantum Chemistry – II 7 Marks

Schrodinger wave equation (in Cartesian co-ordinates) and its importance, wave function and its physical interpretations, Schrodinger equation for a free particle moving in one dimensional box and its solutions, probability distribution of electrons - radial probability distribution curves.

Unit 3 Spectroscopy 8 Marks

Rotational spectra of diatomic molecules:

Rigid rotor, moment of inertia, energy levels, selection rules, nature of spectrum, determination of bond length. Effect of isotope substitution on the rotational spectra.

Vibrational spectra of diatomic molecules:

Harmonic oscillator: energy levels, selection rules, nature of spectrum, determination of force constant. Anharmonic oscillator: energy levels, selection rules, nature of spectrum, fundamental band, overtones.

Raman spectroscopy: Raman effect, Raman scattering – Stokes lines and Anti-Stokes' lines. Raman shift.

Unit 4 Symmetry and Point groups 6 Marks

Symmetry operations – products of symmetry operations of various point groups with examples, group multiplication table (C_{2v} , C_{3v}).

Unit 5 Electrochemistry I 7 Marks

Chemical cells, reversible and irreversible cells with examples. Electromotive force of a cell and its measurement, Nernst equation, Standard electrode potential and its application to different kinds of half-cells. EMF in determination of (i) free energy, enthalpy and entropy of a cell reaction, (ii) equilibrium constants, and (iii) pH values, using hydrogen, quinone-hydroquinone, glass electrodes.

Unit 6 Electrochemistry II 6 Marks

Concentration cells with and without transference, liquid junction potential, decomposition potential, electrolytic polarization, overvoltage; determination of activity coefficients and transference numbers. Qualitative discussion of potentiometric titrations (acid-base, redox, precipitation).

Theory of strong electrolytes – Debye – Huckel - Onsager theory (without detail treatment) – verification of Onsager equation – Wien effect and Debye – Falkenhagen effect – ionic strength – activity and activity coefficients of strong electrolytes and the limiting equation.

Unit 7 Statistical Thermodynamics – II 6 Marks

Basic postulates of Maxwell-Boltzmann distribution law, derivation of Maxwell-Boltzmann distribution law, Maxwell-Boltzmann distribution law of velocities, Partition function and its physical significance, types of partition functions (derivation not included).

Unit 8 Surface Active Agents 6 Marks

Hydrophilic and hydrophobic groups, amphiphiles, classification of surfactants, surfactants in solution, micelles and micelles formation.

Unit 9 Chemical kinetics II 8 Marks

Collision theory and transition state theory of reaction rate, Lindemann mechanism, Steady state approximation and reaction mechanism, Kinetics of complex reactions: (i) Opposing reactions (ii) parallel reactions (iii) consecutive reactions and (iv) chain reactions.

Unit 10 Phase equilibria II 7 Marks

Phase equilibria of two component system: solid-liquid equilibria, simple eutectic-Bi, Cd, Pb-Ag system, desilverisation of lead.

Solid solutions: compound formation with congruent melting point (Mg-Zn) and incongruent melting point (NaCl-H₂O), (FeCl₃-H₂O) and (CuSO₄-H₂O) system. Freezing mixtures, acetone dry ice.

CH-611P ORGANIC AND PHYSICAL CHEMISTRY PRACTICAL

100 Marks (Organic: 67, Physical: 33)

Organic Laboratory:

A. Qualitative analysis:

Identification of Organic Compounds, Detection of extra elements (N, S and halogens) and functional groups – phenolic, carboxylic, carbonyl, esters, amines, nitro, anilide, alcohol, halogen derivative of hydrocarbons and hydrochloride in simple organic compounds.

Analysis should include detection of elements, functional group, and preparation of a solid derivative. A completely dried sample of the derivative should be submitted to the examiner.

B. Organic preparation:

- Acetylation of salicylic acid, aniline, glucose and hydroquinone. Benzoylation of aniline and phenol.
- Aliphatic electrophilic substitution: Preparation of iodoform from ethanol and acetone.

- (c) Electrophilic aromatic substitution:
Nitration: Preparation of m-dinitrobenzene, p-nitroacetanilide.
Halogenation: Preparation of p-bromoacetanilide, 2, 4, 6-tribromophenol.
- (d) Diazotisation/coupling: Preparation of methyl orange and methyl red.
- (e) Oxidation: Preparation of benzene from toluene.
- (f) Reduction: Preparation of aniline from nitrobenzene.

Physical Laboratory

1. To study changes in conductance in the following systems
 - (a) strong acid-strong base
 - (b) weak acid-strong base and
 - (c) mixture of strong acid and weak acid-strong base.
2. Study the kinetics of the following reactions
 - (a) Acid hydrolysis of methyl acetate with hydrochloric acid, volumetrically or conductometrically.
 - (b) Saponification of ethyl acetate.
3. Verification of Lambert-Beer's Law
4. Determination of pK (indicator) for phenolphthalein or methyl red.
5. Study the formation of a complex between ferric and thiocyanate (or salicylate) ions.

Any other experiment carried out in the class.

Reference Books:

Inorganic Chemistry

1. J.D. Lee, New Concise in Inorganic Chemistry.
2. J.E. Huheey, E.A. Keiter and R.L. Keiter, Principles of Structure and Reactivity, Harper Collins College Publishers, 1993.
3. F.A. Cotton and G. Wilkinson Advanced Inorganic Chemistry, Academic Press, 3rd Edition, 1976.
4. A Text Book of Inorganic Chemistry – Part I, R. L. Dutta.
5. A Text Book of Inorganic Chemistry, Satya Prakash
6. D.F. Shriver, P.W. Atkins and C.H. Langford, Inorganic Chemistry, Academic Press, 1991.
7. S. Sarkar, General and Inorganic Chemistry, Part II

8. G.L. Miessler and D.A. Tarr, Inorganic Chemistry, Pearson Education, Low price Edition
9. G. Pass and H. Sutcliffe, Practical Inorganic Chemistry, Chapman & Hill, 2nd Edition.
10. J.N.Gurtu and Kapoor, Advanced Experimental Inorganic Practical Chemistry, S.Chand and Company, N. Delhi.
11. J.Basset, R.C. Denney, G.H. Jeffery and J. Mendham, Vogel's Text Book of Quantitative Inorganic Analysis, ELBS.
12. J.Basset, R.C. Denney, G.H. Jeffery and J. Mendham, Vogel's Text Book of Qualitative Inorganic Analysis, ELBS.
13. H.H. Willard, L.L. Merrit and J.A.Dean, Instrumental Methods of Analysis, East-West Press, 4th Edition, 1974.
14. R.L.Dutta and A. Syamal, Elements of MagnetoChemistry, Affiliated East-West Press, 2nd Edition.
15. G. Friedlander, J.W. Kennedy and J.M. Mill, Nuclear and Radiochemistry, Wiley International, 2nd Edition.
16. K. Nakamoto, Infrared and Raman spectra of Inorganic and coordination Compounds, 4th Edition, John Wiley, 1986.
17. R.S. Drago, Physical Methods in chemistry, Saunders College Publishers, 1977.
18. C.N. Banwell, Fundamentals of Molecular Spectroscopy, Tata McGraw Hill.
19. Thermal Methods of Analysis, W.W. Wendlandt, Inter-Science.
20. J.W. Moore and E.A. Moore – Environmental Chemistry, Academic Press, London, 1976.
21. A.K. De, Environmental Chemistry, 3rd Edn., New Age International Ltd, Pub, New Delhi, 1994.
22. S.E. Manahan, Environmental Chemistry, Willard Grant Press, Boston, 1983.
23. S.S. Dara – A Text Book of Environmental Chemistry and Pollution Control, S. Chand and Co., New Delhi, 1995.
24. G.N. Mukherjee and A Das, Elements of Bio-inorganic Chemistry, 2001.
25. H.J. Arnikaar, Essentials of Nuclear Chemistry
26. H.J.E. Emeleus and A.G. Sharp, Modern Aspects of Inorganic Chemistry.
27. Day and Selvin, Concise Inorganic Chemistry
28. G.S. Manku, Basic concepts in Inorganic Chemistry.

Organic Chemistry

1. R.T. Morrison and R.N. Boyd, Organic Chemistry, Allyn and Bacon. Inc.
2. J.March, Advanced Organic Chemistry, Wiley Eastern Ltd.
3. S.M. Mukherjee, S.P. Singh and R.P. Kapoor, Organic Chemistry, Vol. I, II, III, Wiley Eastern Ltd.
4. F.A. Cotton, Chemical Applications of Group Theory, WILEY Eastern.
5. F.A. Carey and R.J. Sunberg, Advanced Organic Chemistry, Part A and B, Plenum Press.
6. R.K. Bansal, Organic reaction Mechanism, Wiley Eastern.
7. A.I. Vogel, Practical Organic Chemistry.

8. R.K. Bansal, Synthetic Approaches in Organic Chemistry, Narosha Publishing House.
9. W. Kemp and A. Bahl, Experimental Organic Chemistry, S. Chand and Co.
10. R.K. Bansal, Heterocyclic Chemistry, New Age International.
11. R.M. Silverstien, G.C. Bassler and T.C. Morrill, Spectroscopic Identification of Organic Compounds.
12. J.R. Dyer, Application of Spectroscopic of Organic Compounds, Prentice Hall.
13. J.M. Hollas, Modern Spectroscopy, John Wiley.
14. V.K. Alluwalla, M. Kidwai, New Trends in Green Chemistry, Anamaya Publishers.
15. D. Nashipuri, Stereochemistry of Organic Compounds, Wiley Eastern.
16. P.S. Khalsi, Stereochemistry, Conformation and Mechanism, New Age International.
17. T.L. Gilchrist and C.W. Rees, Carbon, Nitrenes, Aynes, Netson London Publication.
18. I.L. Finar, Organic Chemistry, Vol. I and II, ELBS Publication.

Physical Chemistry:

1. P.W. Atkins, The Elements of Physical Chemistry - (1996)2nd ed., Oxford University Press, Oxford
2. G.M. Barrow, Physical Chemistry - 6nd ed., Tata McGraw Hill Publishing Co. Ltd., New Delhi
3. K.J. Laidler and J.H. Meiser, Physical Chemistry -2nd ed. (First Indian ed. 1999) CBS Publishers and Distributors, New Delhi.
4. R.J. Silbey and R.A. Alberty, Physical Chemistry – John Wiley & Sons (Asia) Pvt. Ltd., (Singapore) 3rd ed. (2002).
5. Samuel Glasstone, Thermodynamics for Chemists – Affiliated East-West Press.
6. Samuel Glasstone, An introduction to Electrochemistry – Affiliated East-West Press.
7. P.L. Soni, Text book of Physical Chemistry – Sultan Chand.
8. A.S. Negi and S.C. Anand, Physical Chemistry - New Age International (P).
9. Kundu and Jam, Physical Chemistry – S. Chand.
10. K.L. Kapoor, Physical Chemistry – Macmillan – 4 volumes.
11. Glasstone and Lewis, Elements of Physical Chemistry – Macmillan.
12. S. Glasstone, Text book of Physical Chemistry – Macmillan.
13. Maron and Landor – Colier, Fundamentals of Physical Chemistry – Macmillan.
14. G.W. Castellan, Physical Chemistry - Narosha Publishing House.
15. Dogra & Dogra, Physical Chemistry through Problems
16. Walter J. Moore, Physical Chemistry – Orient Longman.
17. Gashal, Numerical Problems on Physical Chemistry – Books and Allied (P) Ltd.
18. C.N.R. Rao, Universal General Chemistry – Macmillan.
19. C.H. Hanman, Electrochemistry - John Wiley, 1998.
20. K.J. Laidler, Chemical Kinetics – 3rd ed., Elsevier Publishers.
21. Puri, Sharma, Pathania, Principles of Physical Chemistry – Vishal Publishing Co.
22. IraN Levine, Physical Chemistry – (1995) 4nd ed., McGraw Hill Inc.
23. C.N. Banwell, Fundamentals of Molecular Spectroscopy – 5th ed.

24. Rohatgi Mukherjee, S Fundamentals of Photochemistry –
25. M.C. Gupta, Statistical Thermodynamics -
26. D.A. McQuarrie, Mathematics for Physical Chemistry – University Science Books (2008)
27. R. Mortimer, Mathematics for Physical Chemistry - 3rd Ed. Elsevier (2005).
28. J.H. Noggle, Physical Chemistry on a Microcomputer – Little Brown & Co. (1985).
29. T.Engel & P.Reid, Thermodynamics, Statistical Thermodynamics & Kinetics – Pearson Education, Inc: New Delhi (2007).