UNIVERSITY OF PUNE

REVISED SYLLABUS FOR S.Y. B.Sc. CHEMISTRY FROM 2014-2015

(According to Semester system 2014-2015)

Course structure: There will be four theory papers of 50 Marks each, (40 marks external + 10 marks internal) and one practical course of 100 marks. (80 marks External + 20 marks Internal). The examination will be held semester-wise for theory papers whereas the examination for practical course CH-223 will be held at the end of **SEMETER-II**

SEMESTER	PAPER	COURSE TITLE	MARKS
I	CH-211	PHYSICAL & ANALYTICAL CHEMISTRY	50
I	CH-212	ORGANIC & INORGANIC CHEMISTRY	50
II	CH-221	PHYSICAL & ANALYTICAL CHEMISTRY	50
II	CH-222	ORGANIC & INORGANIC CHEMISTRY	50

Practical Course in Chemistry: CH-223 - 100 Marks

Equivalence of Previous Syllabus:

Semester	Old Course (2009-10)	New Course (2014-15)
I	CH-211 : Physical Chemistry	CH-211 : Physical & Analytical Chemistry
I	CH-212 : Organic Chemistry	CH-212 : Organic & Inorganic Chemistry
II	CH-221 : Inorganic Chemistry	CH-222 : Organic & Inorganic Chemistry
II	CH-222 : Analytical Chemistry	CH-221 : Physical & Analytical Chemistry
	CH- 223: Practical	CH- 223: Practical

S. Y. B. Sc. (Chemistry) Syllabus

Semester - I

Paper 1: CH-211: Physical and Analytical Chemistry

Paper 2: CH-212: Organic and Inorganic Chemistry

Semester - II

Paper 3: CH-221: Physical and Analytical Chemistry

Paper 4: CH-222: Organic and Inorganic Chemistry

Practical Course in Chemistry CH-223 (To be conducted during both semesters)

SEMESTER – I

Paper 1: CH-211

Section – I

Physical Chemistry

Chapter 1: Elementary Chemical Kinetics **[10]**

Introduction to Chemical kinetics, molecularity and order of reaction , reaction rates, rate laws, rate constant and its significance, Integrated rate law expression and its characteristics–first order, second order (single reactant, two reactants involved), examples of 1^{st} and 2^{nd} order reaction, pseudomolecular reactions, factors affecting rate of reaction, measurement of rate of reaction, numericals.

Aim: To introduce concept of kinetics at undergraduate level.

Objectives: Student should learn

i. Concept of kinetics , terms used , rate laws , types of order
ii. Discuss examples of first order and second order reaction
iii. Pseudo molecular reactions
iv. Factors affecting on rate of reaction
v. Techniques of measurement of rate of reaction
vi. To solve problems

Chapter 2: Photochemistry **[10]**

Introduction, thermal reactions and photochemical reactions, laws of photochemistry, quantum yield, measurement of quantum yield, types of photochemical reactions-photosynthesis, photolysis, photocatalysis, photosensitization, photophysical process–fluorescence, phosphorescence, quenching, chemiluminiscence, numericals.

Aim: To impart basic knowledge of photochemistry and its applications

Objectives: After studying the chapter student should be able to

i. Know about photochemistry
ii. Understand difference between thermal and photochemical reactions
iii. Understand laws of photochemistry
iv. Learn what is quantum yield and it's measurement
v. Know Types of photochemical reactions and photophysical process
vi. Know about quenching and chemiluminence
vii. To solve numericals

Chapter 3: Distribution law **[04]**

Nernst distribution law, Statement and thermodynamic proof for Nernst distribution law, association and dissociation of solute in solvent, application of distribution law, Numericals.

Aim: To understand Nernst Distribution Law and its applications

Objectives: Students should learn

i. Concept of distribution of solute amongst pair of immiscible solvents
ii. Distribution law and it's thermodynamic proof
iii. Distribution law and nature of solute in solution state
iv. Application – Solvent extraction
v. To solve numericals

Ref.1: Page no. 298 to 302 and 775-800

Section – II

Analytical Chemistry

Chapter 4: Introduction to Analytical Chemistry **[3]**

Introduction, Chemical analysis, applications of chemical analysis, sampling, types of analysis, Common techniques, Instrumental methods, other techniques, factors affecting on choice of method

Aim: To introduce basics of analytical chemistry

Objectives: Students should learn

i. What is Analytical Chemistry
ii. Chemical analysis and its applications
iii. Sampling
iv. Common techniques
v. Instrumental methods and other techniques
vi. Choice of method

Ref: Vogel chapter 1 (Page 1 - 11) up to section 1.9 except use of literature.

Chapter 5: Errors in Quantitative Analysis **[5]**

Introduction, Error, Accuracy, precision, methods of expressing accuracy and precision, classification of errors, significant figures and computations, distribution of random errors, mean and standard deviations, reliability of results, Numericals.

Aim: To understand errors and its interpretation

Objectives: Students should learn

i. Meaning of error and terms related to expression & estimation of errors
ii. Methods of expressing accuracy and precision
iii. Classification of errors
iv. Significant figures and computations
v. Distribution of errors
vi. Mean and standard deviations
vii. Reliability of results

Ref: Vogel, 5thedn chapter 4 (127-137 up to section 4.10) extended up to 4.13

Chapter 6: Inorganic Qualitative Analysis [8]

Basic principle, common ion effect, solubility, solubility product, preparation of original solution, classification of basic radicals in groups, separation of basic radicals, removal of interfering anions (phosphate and borate), detection of acid radicals.

Aim: To study the theory underlying Inorganic Qualitative analysis

Objectives: A student should know

i. Basic principles in qualitative analysis
ii. Meaning of common ion effect
iii. Role of common ion effect and solubility product
iv. Different groups for basic radicals
v. Group reagent and precipitating agents
vi. Interfering anions and its removal
vii. Separation for basic radicals
vii. Method of detection of acidic radicals

Chapter 7: Analysis of Organic Compounds (Qualitative & Quantitative) [8]

I. Qualitative

A. Types of organic compounds, Characteristic tests and classifications, reactions of different functional groups, analysis of binary mixtures.

II Quantitative

B. Analysis–estimation of C, H, (O) by combustion tube, detection of nitrogen, sulfur, halogen and phosphorous by Lassigen's test.
C. Estimation of nitrogen by Dumas's Kjeldahl's method, estimation of halogen, sulphur and phosphate by Carious method.
D. Determination of empirical and molecular formula, numerical problems.

Aim: To disseminate knowledge of qualitative & quantitative analysis of organic compounds

Objectives: A student should know-

i. Classification of compounds with different functional groups
ii. Different tests for detection of elements like C, H, (O), N, S & P.
iii. Characteristic tests for different functional groups
iv. Different colour tests and the reactions
v. Quantitative analysis of C, H by Liebig's method
vi. Kjeldahl's method with example
vii. Carius tube method with example
vii. Empirical and molecular formula
vii. To solve numericals.

Name of the reference book:

1. Analytical Chemistry by G.D. Christian, sixth edition. Pages: 1-10
2. Vogel's textbook of Quantitative Analysis, sixth edition
   J. Mendham, R.C. Denney, J.D. Barnes, MJK Thomas
3. A textbook of macro & semi micro qualitative analysis by
   A.J. Vogel, fifth edition
4. Quantitative Organic Analysis, fourth edition, A.J. Vogel, ELBS

Paper 2: CH-212

Section – I

Organic Chemistry

Chapter 1: Stereoisomerism **[12]**

Introduction to optical isomerism: Chirality, optical activity and polarimetry, enantiomers, absolute configuration, R/S system nomenclature with wedge and Fischer representation of two chiral centres, erythro, threo, meso-diastereomers with R/S configuration. Stereoisomerism Baeye'rs strain theory, heat of combustion, cycloalkanes, factors affecting the stability of conformation, Conformation of cyclohexane - equatorial and axial bonds, Monosubstituted cyclohexane stability with $-CH_3$ and $-C(CH_3)_3$ substitutes. Structures of geometrical isomers of dimetylcyclohexane only.

Ref. 3

Aims and Objectives

Students should be able to –

i) Identify chiral center in the given organic compounds.

ii) Define Erythro, threo, meso, diasteroisomers with suitable examples.

iii) Able to find R/S configuration in compounds containing two chiral centers.

iv) Explain Bayer's strain theory, Heat of combustion and relates stability of cycloalkanes.

v) Explain the stability of cyclohexanes.

vi) Draw the structure of boat and chair configuration of cyclohexane.

vii) Draw axial and equatorial bonds in cyclohexane.

viii) Draw structure of conformations of mono- & disubstituted cyclohexanes

ix) Explain the stability of axial and equatorial conformation of monosubstituted cyclohexanes.

Chapter 2: Organic reaction Mechanism **[12]**

Introduction, types of reagents–electrophile, nucleophile and free radical.

Types of organic reactions: Addition, Elimination (β-elimination and Hofmann elimination), substitution (aliphatic electrophilic and nucleophilic, aromatic electrophilic) and rearrangement.

Mechanism: (i) Aldol condensation (ii) Markovnikov and anti-Markovnikov addition reaction (iii) Saytzeff and Hoffmann elimination (iv) S_N^1 and S_N^2 reactions (v) Hofmann rearrangement.

Ref. 1 & 4

Aims and Objectives

Students should be able to –

i) Define and classify heterocyclic compounds.

ii) Use Huckel rule to predict aromaticity.

iii) Suggest synthetic route for preparation of various heterocyclic compounds.

iv) Write and complete various reactions of heterocyclic compounds.

v) Predict products.

Reference Books:

Ref. 1: Organic Chemistry-6h Ed. Morrison and Boyd Prentice Hall of India Prt Ltd,New Delhi-2001.

Ref. 2: Outline of Biochemistry 5h Ed., Conn, Stumpf Bruening and Roy Doi John Wiley 1987.

Ref. 3: Stereochemistry of carbon compounds - E. L. Eliel

Ref. 4: Reactions, rearrangements and reagents – S N Sanyal

Section – II

Inorganic Chemistry

Chapter 3: General Principles of Metallurgy: [6]

Introduction, occurrence of metals, ores and minerals, types of ores, operations involved in metallurgy, crushing, connotation, various methods of concentration such as hand picking, gravity separation, magnetic separation. Froth flotation, Calcinations, Roasting etc. Reduction, various methods of reduction such as smelting, Aluminothermic process and electrolytic reduction, Refining of metals, various methods of refining such as poling, liquation, electrolytic and vapour phase refining (Van Arkel Process).

Aims: To study principles and process of metallurgy.

Objectives: A student should be able -

i) To differentiate between ore and minerals.

ii) To differentiate between calcination and roasting and smelting.

iii) To know the different methods for separation of gangue or matrix from metallic compounds.

iv) To know the terms smelting, flux.

References:

i) Advanced Inorganic Chemistry, Satyaprakash, Tuli, Basu, pages 262-271.

ii) Text book of Inorganic Chemistry, P.L. Soni, pages 2.3-2.8, 2.13-2.17.

Chapter 4: Metallurgy of Aluminium (Electrometallurgy): [4]

Occurrence, Physiochemical principles, Extraction of Aluminium, Purification of bauxite by Baeyer's process, Electrolysis of alumina, application of aluminum and its alloys.

Aims: To study metallurgy of Aluminium.

Objectives: A student should be able -

i) To know physico-chemical principles involved in electrometallurgy.

ii) To understand electrolysis of alumina and its refining.

iii) To explain the uses of Aluminum and its alloys.

iv) To know purification of bauxite ore.

References:

i) Advanced Inorganic Chemistry, Satyaprakash, Tuli, Basu pages 458-463.

ii) Text book of Inorganic Chemistry, P.L. Soni pages 2.209 to 2.211

Chapter 5: Metallurgy of Iron and Steel (Pyrometallurgy) [8]

Occurrence, concentration, calcination, smelting physio-chemical principles, reactions in the blast furnace, wrought iron, manufacture of steel by Bessemer and L.D. process, its composition and applications.

Aims: To study metallurgy of Iron.

Objectives: A student should be able -

i) To explain the term pyrometallurgy and to explain the physico chemical principles involved in the reduction process by carbon monoxide.

ii) To know different reactions in the blast furnace.

iii) To differentiate between properties of pig iron and wrought iron.

iv) To explain the basic principles of different methods for preparation of steel.

v) To explain the merits and demerits of different methods.

Reference:

i) Advanced Inorganic Chemistry, Satyaprakash, Tuli, Basu pages 830-849.

Chapter 6: Corrosion and Passivity: [6]

(a) Corrosion : Definition of corrosion, Types of corrosion, Atmospheric, Immersed, Mechanism of electrochemical corrosion, Factors affecting corrosion - position of metal in E. C. S., purity effect of moisture, effect of oxygen, pH, physical state of metal, methods of protection of metal from corrosion- alloy formation, making metal cathodic, controlling

external condition. Coating-galvanising, Tinning, electroplating, metal cladding, organic coating.

(b) Passivity : Definition, Theories of passivity - (i) Oxide film theory (ii) Gaseous film theory (iii) Physical film theory, Valence theory, Catalytic theory, Allotropic theory, Electrochemical passivity.

A student should know -

i) Definition of corrosion.

ii) Types of corrosion.

iii) Mechanism of corrosion.

iv) Factors affecting corrosion.

v) Methods of prevention of metal from corrosion.

vi) Meaning of passivity.

vii) Different theories of passivity.

viii) Galvanising, Tinning, Electroplating from corrosion.

Reference:

i) Introduction to Electrochemistry by S. Glasstone, 2nd Ed. pages 491-503.

SEMESTER – II

Paper 3: CH-221

Section – I

Physical Chemistry

Chapter 1: Free Energy and Equilibrium **[12]**

Introduction, Helmholtz free energy, variation of Helmholtz free energy with volume and temperature, Helmholtz free change energy for chemical reaction,Gibb's free energy, Variation of Gibb's free energy with pressure and temperature, Gibb's free energy change for chemical reaction, Free energy change for physical transitions, Free energy change for an ideal gas; standard free energy change, Gibb's-Helmholtz equation, Properties and significance of Gibb's free change, Van't Hoff reaction isotherm, thermodynamic equilibrium constants, Relation between Kp and Kc for gaseous reactions, variation of equilibrium constant with temperature, Criteria for chemical equilibrium, Physical equilibrium, Clapeyron equation, Clausius–Clapeyron equation, Application of Clausius–Clapeyron equation, numericals.

Aim: To conceptualize phenomenon of free energy and equilibria.

Objectives: The student should able to know

i. Free energy concepts, types and its variation
ii. Free energy change for chemical reaction and physical transition
iii. Free energy change for ideal gases
iv. Gibb's Helmholtz equations and its properties & significance
v. van't Hoff reaction isotherm and thermodynamic equilibrium constants,
vi. Chemical and physical equilibrium
vii. Clausius –Clapeyron equation and its applications
vii. To solve numericals.

Ref. 1: Page no. 189 to 200, 206

Ref. 2: Relevant pages.

Chapter 2: Solutions of Liquids in Liquids **[12]**

Types of solutions, Ideal solutions, Raoult's law, ideal and non ideal solutions, Henry's law, Application of Henry's law with example CS_2 in acetone, problems based on Raoult's law and Henry's law, vapor pressure–composition diagram of ideal and non ideal solution, temperature composition diagram of miscible binary solutions, distillation from temperature–composition diagram, Azeotropes, Partially immiscible liquids.

Aim: To distinguish behavior of liquid phase solutions.

Objectives: The student should to know

i. Ideal and non ideal solutions and laws governing these solutions
ii. Interpretation of vapor pressure–composition diagram
iii. Interpretation of temperature composition diagram.
iv. Distillation from temperature – composition diagram,
v. Azeotropes
vi. Partially immiscible liquids.
vii. To solve numericals

Ref.2: Pages 229 to 247, 254 to 258

Reference books:

1. Principles of Physical Chemistry by S.H. Maron & C. Prutton 4th edition.
2. Physical Chemistry by W.J. Moore 5th edition.
3. Physical Chemistry by P.W. Atkin 4th edition
4. Physical Chemistry by D. Alberty 3rd edition.

Section – II

Analytical Chemistry

Chapter 3: Introduction to volumetric analysis [6]

Introduction, methods of expressing concentrations, primary and secondary standard solutions. Apparatus used and their calibration: burettes, microburettes, volumetric pipettes, graduated pipettes, volumetric flask, methods of calibration, Instrumental & non-instrumental analysis – principles & types.

Aim: To provide basic knowledge essential for volumetric analysis

Objectives: A student should be able to know

i. Meaning of equivalent weight, molecular weight, normality, molality, primary and secondary standards.
ii. Different way to express concentrations of the solution.
iii. Preparation of standard solution.
iv. To solve numerical problems.
v. Calibrate various apparatus such as burette, pipette, volumetric flask, barrel pipette etc.
vi. Types instrumental and non instrumental analysis

Chapter 4: Non Instrumental volumetric analysis [18]

Indicators–theory of indicators, acid base indicators, mixed and universal indicators [3]

Acid–Base titrations: Strong acid–Strong base, Weak acid–strong base, Weak acid-Weak base titration, Displacement titrations, polybasic acid titrations. (Discuss titration with respect to neutralization and equivalence point determination and limitations) [6]

Redox titrations: Principle of redox titration, detection of equivalence point using suitable indicators. [3]

Complexometric titrations: Principle, EDTA titrations, choice of indicators [6]

Iodometry and Iodimetry: Principle, detection of end point, difference between iodometry and iodimetry, Standardization of sodium thiosulphate solution using potassium dichromate and iodine method, Applications – estimation of Cu , estimation of Cl_2.

Aim: To learn and equip with non instrumental volumetric techniques

Objectives: The student should able to

i. Explain role of indicators.
ii. Know mixed and universal indicators.
iii. Know neutralization curves for various acid base titration
iv. Know principle of complexometric precipitation and redox titrations.
v. Know the definitions and difference between iodometry and iodimetry.
vi. To know standardization of sodium thiosulphate and EDTA.
vii. Reactions between $CuSO_4$ and Iodine and liberated I_2 and $Na_2S_2O_3$
viii. Choice of suitable indicator.
ix. Estimate copper from $CuSO_4$ and available chlorine in bleaching powder.
x. Prepare standard silver nitrate solution.
xi. Mohr’s and Fajan’s method.
xii. Determine the amount of halides separately and in presence of each other.

Paper 4: CH-222

Section – I

Organic Chemistry

Chapter 1: Reagents in Organic Synthesis [8]

Catalytic hydrogenation including liquid phase hydrogenation, Birch reduction, $NaBH_4$, $LiAlH_4$, Sn/HCl

Oxidation reagents: $KMnO_4$, $K_2Cr_2O_7$, Jones reagent, PCC, Per acids, OsO_4.

Student should understand:

i) Concept of different reagents used in the one type of conversion

ii) Merits & demerits of different reagents

iii) Reagent based mechanisms

iv) Use of different hydrogen donors for hydrogenation

Ref. 1 & 4

Chapter 2: Chemistry of heterocyclic compounds with one hetero atom. [6]

Definition and classification of heterocyclic compounds, nomenclature and aromatic character. Synthesis of Pyrrole, Furan, Thiophene, Pyridine and their reactions: Nitration, Sulphonation, Acylation and Catalytical reduction. Structure and synthesis of quinoline and Isoquinoline.

Student should know:

i) Define and classify heterocyclic compounds.

ii) Use Huckel rule to predict aromaticity.

iii) Suggest synthetic route for preparation of various heterocyclic compounds.

iv) Write and complete various reactions of heterocyclic compounds.

v) Predict products.

Ref. 1

Chapter 3: Introduction of Bio-molecules [10]

Carbohydrates: Definition, classification, reaction of monosaccharide (glucose)- oxidation, reduction, osazone and ester formation, isomerization, Killiani-Fischer synthesis and Ruff

degradation, Configuration of D/L configuration of (+) Glucose, Fischer-Haworth and chair formulae, Brief account of disaccharides: Sucrose, cellobiose, maltose and lactose.

Polysaccharides: Starch, cellulose and glycogen.

Amino acids: Fischer projection, relative configuration, classification, structures and reactions of amino acids, Properties and chemical reactions with amino and carboxylic group.

Proteins: Formation of Peptide linkage, α-helical conformation, β-plated structure, primary, secondary, tertiary and quaternary structure of proteins.

Ref. 2 & 3

Student should know

i) Know different biomolecules.

ii) Appreciate the role of biochemistry in the day to day life.

iii) Understand the importance of biochemistry.

iv) Define carbohydrates.

v) Classify carbohydrates giving suitable examples.

vi) Write and complete various reactions of glucose.

vii) Explain optical activity in carbohydrates.

viii) Write Fischer projection and perspective formula with glyceraldehydes as reference compound.

ix) Explain the principle in Killani Fischer synthesis.

x) Explain stereoisomerism in monosaccharide.

xi) Draw structure of some common aldoses and ketoses.

xii) Distinguish between diastereomers and epimers.

xiii) Write cyclic structure of glucose in Fischer, Haworth and chair form.

xiv) Know the phenomenon of mutaroatation.

xv) Draw the structure and bonding in maltose, lactose, cellobiose and sucrose.

xvi) Know about polysaccharide, structures of starch and cellulose.

xvii) Classify the naturally occurring amino acids.

xviii) Explains the amphoteric nature of amino acids.

xix) Know the important reactions of α-amino acids.

xx) Outline the formation of peptide bond.

xxi) Explain the hydrogen bonding in α-helical structure.

xxii) Relate the stability of α-helical chain and their R-groups.

xxiii) Define primary, secondary, tertiary and quaternary structure of proteins.

xxiv) Classify proteins.

Reference Books:

Ref. 1: Organic Chemistry-6h Ed. Morrison and Boyd Prentice Hall of India Prt Ltd, New Delhi-2001.

Ref. 2: Outline of Biochemistry 5h Ed., Conn, Stumpf Bruening and Roy Doi John Wiley 1987.

Ref. 3: Stereochemistry of carbon compounds - E. L. Eliel

Ref. 4: Reactions, rearrangements and reagents – S N Sanyal

Section – II

Inorganic Chemistry

Chapter 4: Chemistry of d-block elements [6]

Position of d-block in periodic table, electronic configuration, trends in properties of these elements w.r.t.(a) size of atoms & ions (b) reactivity (c) catalytic activity (d) oxidation state (e) complex formation ability (f) colour (g) magnetic properties (h) non-stoichiometry (i) density, melting & boiling points.

Student should know:

i) To know position of d-block elements in periodic table.

ii) To know the general electronic configuration & electronic configuration of elements.

iii) To know trends in periodic properties of these elements w.r.t. size of atom and ions, reactivity, catalytic activity, oxidation state, complex formation ablility, colour, magnetic properties, non-stoichiometry, density, melting point, boiling point.

Chapter 5: Organometallic Chemistry [6]

Definition of Organometallic compounds and Organometallic chemistry, CO as a π-acid donor ligand, binary metal carbonyls, methods of synthesis; (a) Direct reaction (b) Reductive carbonylation (c) Photolysis and thermolysis. Molecular and electronic structures (18 electron rule) of metal carbonyls. Homogenous catalysis-Hydroformylation (Oxo Process) and Wacker Process.

Aim: To study the metal carbonyl complexes and their uses in the homogenous catalysis.

Objectives:

Students should be able:

i) To understand M-C bond and to define organometallic compounds

ii) To define organometallic chemistry

iii) To understand the multiple bonding due to CO ligand.

iv) To know methods of synthesis of binary metal carbonyls.

v) To understand the structure and bonding using valence electron count (18 electron rule)

vi) To understand the catalytic properties of binary metal carbonyls.

vii) To understand the uses of organometallic compounds in the homogenous catalysis.

References:

1. Concise Inorganic Chemistry by J. D. Lee-relevant pages.

2. General Chemistry-Raymond Chang- relevant pages.

Chapter 6: Acids, Bases and Solvents [6]

Definition of acids and bases, Arrhenius theory, Lowry-Bronsted theory, Lewis concept, Lux-Flood theory, strength of acids and bases, trends in the strength of hydracids and oxyacids, Properties of solvents, M.P-B.P range, dipole moment, dielectric constant, Lewis acid-base character and types of solvents.

Ref: Basic Inorganic Chemistry – F. A. Cotton (Pages- 163-173)

(6) Acids, Bases, Solvents and reactions in non-aqueous solvents:

Aims: To study different solvents and to know the different theories of acids and bases.

Objectives: A student should be able -

i) To define acids and bases according to Arrhenius theory Lowery- Bronsted concept, Lewis concept.

ii) To explain the merits and demerits of different theories of acids and bases.

iii) To define the conjugate acid and base pairs.

iv) To explain the leveling effect of solvents.

v) To demonstrate the trends in the strength of hydracids, oxyacids.

vi) To define hard and soft acids.

vii) To know the trends in the strength of hydra and oxyacids.

viii) To know the rules governing the strength of oxyacids.

ix) To explain the properties of a solvent that determines their utility.

x) To know some useful solvents.

xi) To explain the reactions in non-aqueous solvents like HF and NH3.

Chapter 7: Chemical Toxicology [6]

Toxic chemicals in the environment, Impact of toxic chemistry on enzymes.

Biochemical effect of Arsenic, Cadmium, Lead, Mercury, Biological methylation.

A student should be able -

i) To know toxic chemical in the environment.

ii) To know the impact of toxic chemicals on enzyme.

iii) To know the biochemical effect of Arsenic, Cd, Pb, Hg.

iv) To explain biological methylation.

Reference:

i) Fundamental Chemistry by A. K. Dee. (3^{rd} Ed.)

Practical Course in Chemistry CH – 223

A) Physical Chemistry practicals (Any Five)

i. To determine critical solution temperature of phenol water system

ii. To determine molecular weight of given organic liquid by steam distillation

iii. Determination of solubility of benzoic acid at different temperature and to determine ΔH of dissociation process.

iv. To study neutralization of acid (HCl) base (NaOH) and CH_3COOH by NaOH and H_2SO_4 by NaOH.

v. To determine the rate constant (or to study kinetics) of acid catalyzed ester hydrolysis.

vi. To determine the rate constant of base catalyzed ester hydrolysis.

vii. Partition coefficient of iodine between water and carbon tetrachloride.

Aim: To equip students to correlate theoretical and experimental knowledge

Objectives: After completion of practical course student should be able to

i. Verify theoretical principles experimentally

ii. Interpret the experimental data

iii. Improve analytical skills

iv. Correlate the theory and experiments and understand their importance

B) Inorganic Qualitative Analysis (Minimum Five mixtures)

i. One simple mixture (without phosphate or borate)

ii. Two Mixtures containing PO_4^{3-} (With PO_4^{3-} removal)

iii. Two Mixtures containing BO_3^{3-} (With BO_3^{3-} removal)

Inorganic Qualitative Analysis of Binary Mixtures (including phosphate and borate removal).

Sodium carbonate extract is to be used wherever necessary for detecting acidic radicals.

C) Organic Chemistry Practical

a. Organic qualitative analysis of Binary Mixtures without ether separation (**Four only**)

Two: solid-solid, one: solid-liquid, one: liquid-liquid

b. Organic Preparation: (**Any two including Crystallization, MP, TLC**)

i) Pthalic anhydride to pthalamide

ii) Glucose to osazone

iii) Acetanilide to p-bromoactanilide

iv) Benzaldehyde to dibenzylidene acetone

After completion of practical course student should be able to –

i) Verify theoretical principles experimentally.

ii) Acquire skill of crystallisation, record correct m. p. / b. p.

iii) Perform the complete chemical analysis of the given organic compound and should be able to recognize the type of compound.

iv) Write balanced equation for all the reactions, they carry in the laboratory.

v) Perform the given organic preparation according to the given procedure.

vi) Follow the progress of the reaction by using TLC technique.

vii) Set up the apparatus properly for the given experiments.

viii) Perform all the activities in the laboratory with neatness and cleanness.

Ref. 1 Organic Qualitative Analysis: A. I. Vogel

D) Analytical Chemistry Practicals (Any Five)

i. Estimation of sodium carbonate content of washing soda.
(Vogel 5thEdition: 10.30 page 295).

ii. Determination of Ca in presence of Mg using EDTA.
Ref.2: Page 412

iii. a) Preparation of standard 0.05 N oxalic acid solution and standardization of approx. 0.05N $KMnO_4$ solution.
b) Determination of the strength of given H_2O_2 solution with standard 0.05 N $KMnO_4$solution.

iv. Estimation of Aspirin from a given tablet and find errors in quantitative analysis.

v. Estimation of Al (III) from the given aluminium salt solution by using Erichrome Black–T indicator (Back titration method)

vi. Iodometric estimation of copper.

vii. Report on one day industrial educational visit.

Reference books

1. Analytical Chemistry by G.D. Christian 6th edition.
2. Vogel's Textbook of Quantitative chemical analysis 6th edition R.C. Denney, J.D. Barnes, M.J.K. Thomas

Aim: To equip students to correlate theoretical and experimental knowledge

Objectives: After completion of practical course student should be able to

i. Verify theoretical principles experimentally

ii. Interpret the experimental data

iii. Improve analytical skills

iv. Correlate the theory and experiments and understand their importance

N.B. - Industrial visit during the academic year is compulsory.