

Rayat Shikshan Sanstha's
Yashwantrao Chavan Institute of Science, Satara
(Autonomous)

Syllabus for Bachelor of Science Part – I (B.Sc. - I -Chemistry)

1. TITLE: B.Sc. Chemistry
2. YEAR OF IMPLEMENTATION: 2018-2019
3. PREAMBLE: This updated syllabus is prepared for first year undergraduate students. At this level, to develop their interest towards chemistry as basic science and also to prepare them for the academic and industrial exposure simultaneously. Introduction of instrumental techniques with the regular chemistry exercises will help to enhance analytical thinking of the students. The interdisciplinary approach with vigor and depth is compatible to the syllabi of other universities, at the same time is not rigid for the students at first year of their graduation. The units in the syllabus are well defined with scope and the number of lectures. The references are mentioned with relevance.
4. GENERAL OBJECTIVES OF THE COURSE:
 1. The content of the syllabus have been framed as per the UGC norms.
 2. The students are expected to understand the fundamentals, principles, mathematical concepts and recent developments in the subject area.
 3. The practical course is in relevance to the theory courses to improve the understanding of the concepts.
5. DURATION: one year
6. PATTERN: Semester
7. MEDIUM OF INSTRUCTION: English
8. STRUCTURE OF COURSE:
 - 1) FIRST SEMESTER ----- (NO. OF PAPERS 2)

Paper I: Physical Chemistry (BCT 101)

Paper II: Inorganic Chemistry (BCT 102)

Practical I: (BCP 103) (Practical examination is semester wise)
 - 2) SECOND SEMESTER ----- (NO. OF PAPERS 2)

Paper III: Organic Chemistry (BCT 201)

Paper IV: Analytical Chemistry(BCT 202)

Practical II: (BCP 203) (Practical examination is semester wise)

2) Structure and Titles of Papers of B.Sc. Course:

B.Sc. I Semester I

Paper I Physical Chemistry (BCT 101)

Marks: 40

Subject	Unit No.	Title	Periods	Credits
Physical Chemistry	I	Chemical Mathematics	06	2
	II	Chemical Energetics	18	
	III	Chemical Equilibria	06	
	IV	Chemical kinetics	06	
Grand total			36	

Paper II- Inorganic chemistry (BCT 102)

Marks: 40

Subject	Unit No.	Title	Periods	Credits
Inorganic Chemistry	I	Quantum chemistry and atomic structure	13	2
	II	Ionic Bonding	07	
	III	Covalent Bonding	06	
	IV	Molecular Orbital Theory (MOT)	10	
Grand Total			36	

Semester II

Paper III- Organic chemistry (BCT 201)

Marks: 40

Subject	Unit No.	Title	Periods	Credits
Organic Chemistry	I	Fundamentals of organic chemistry	12	2
	II	Stereochemistry	10	
	III	Chemistry of Aliphatic Hydrocarbon	07	
	IV	Chemistry of Aromatic Hydrocarbons	07	
Grand Total			36	

B.Sc. I Semester II

Paper IV: Analytical Chemistry (BCT 202)

Marks: 40

Subject	Unit No.	Title	Periods	Credits
Analytical Chemistry	I	Basic concepts in Analytical Chemistry	12	2
	II	Purification and separation methods	06	
	III	Chromatography	06	
	IV	Water Analysis	06	
	V	Fertilizer Analysis	06	
Grand Total			36	

3) OTHER FEATURES:

A) LIBRARY: Reference and Textbooks, Journals and Periodicals, Reference Books for Advanced Books for chemistry Advanced studies. –List Attached

B) SPECIFIC EQUIPMENTS: Necessary to run the Course, Computer, LCD, Projector, Visualizer, Smart board

C) Laboratory Equipment's: Apparatus&equipment's and chemicals required.

1. Viscometer
2. Stop watch
3. Eudiometer
4. Digital balance with 1 mg accuracy
5. Burette, pipette and conical flask
6. 1/10⁰C thermometer
7. Polythene bottles
8. Measuring cylinder
9. Stopper bottle
10. Test tube, Beaker
11. Thile's tube
12. Capillary tube
13. Evaporating dish
14. Glass rod
15. Wire gauze
16. Burner
17. Water bath
18. Chromatography paper
19. Glass jar
20. Watch glass
21. Tripod stand
22. Burette stand
23. Iron stand
24. Test tube holder
25. Test tube stand
26. Spot tile
27. Dropper
28. Drye

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Syllabus Introduced from June, 2018

B.Sc. Part I: Chemistry

Semester I

Theory: Paper I: Physical Chemistry

Paper Code: BCT 101

Marks: 40

Credits: 2

Learning Objectives:

1. To enable the students to learn the concept of energy.
2. To make student familiar about chemical processes, reactions, energy changes during the reaction
3. To understand thermodynamic and thermochemical concepts and importance of functions of state.
4. To train students to calculate different equilibrium constants.
5. To clear the concept of dissociation of electrolytes, the concept of pH, pOH and solubility product.
6. To empower the students with the tools of mathematics to solve different chemical problems.

Unit I : Chemical Mathematics:

[06 L]

Graph: Cartesian co-ordinates, Plotting of graph from experimental data, equation of straight line, slope, Intercept & its characteristics. Derivative: Definition, Simple rules of differentiation partial differentiation, examples related to chemistry. Integration: Definition, Simple rules of Integration, Integration between limits, examples related to chemistry,

Ref. -1 Page No. 7-33 *Ref. 2* Page No. 4-11

Unit II: Chemical Energetics:

A: Thermochemistry:

[07 L]

Introduction: Enthalpy of reaction, Standard enthalpy change. Types of enthalpy changes viz: enthalpy of neutralization, enthalpy of ionization, enthalpy of formation, enthalpy of solution, enthalpy of hydration, enthalpy of phase transition. Calculation of bond energy, bond

dissociation energy and resonance energy from thermo chemical data, Variation of enthalpy of reaction with temperature – Kirchhoff's equation. Numerical problems

B: Thermodynamics:

[07 L]

Introduction, Spontaneous and non-spontaneous process with examples, Statements Second law of Thermodynamics, Carnot's cycle, its efficiency, Carnot's Theorem (Heat engine), Concept of entropy, physical significance of entropy, Entropy as a function of volume and temperature, pressure and temperature, entropy of mixing of gases, entropy change accompanying phase transition. Third law of thermodynamics and determination of absolute entropy. Numerical problems

Ref. 2 Page No. 517-521 Ref. 3 Page No. 1.547-1.556, Ref.3 Page No. 1.568-1.577

Unit III: Chemical Equilibria

[06]

Concept of free energy, Free energy change in chemical reaction, Thermodynamic derivation of law of chemical equilibrium. Distinction between ΔG and ΔG^0 , Le Chatelier's principle, conditions for maximum yield in industrial processes like manufacture of ammonia and sulphuric acid. Relationship between K_p , K_c and K_x for reactions involving ideal gases.

Ref 5 page no. 621-672

Unit IV: Chemical Kinetics

[10L]

Introduction, Rate of reaction, Definition and units of rate constant, Factors affecting rate of reaction. (Nature of reactant, Concentration, pressure, temperature and catalyst.) Order and Molecularity of reaction, Zero order reaction, first order reaction, Characteristics of first order reaction. Examples, Pseudo-unimolecular reactions, examples. Second order reaction: Derivation of rate constant for equal and unequal concentration of the reactants. Characteristics of Second order reaction., Determination of order of reaction by i) integration method ii) graphical method iii) Half-life method, Effect of temperature on rate of reaction, Arrhenius equation, Concept of energy of activation.

Theories of Reaction Rates: Collision theory and Activated Complex theory of bimolecular reactions. Comparison of the two theories (qualitative treatment only). Numerical problem

Ref. 5 Page No.731-770

Learning Outcomes:

Unit I : Chemical Mathematics

1. The student understands the graphical representation and processing.
2. Students understands and uses the rules and differentiation and integration in chemical derivations

Unit II: Chemical Energetics

1. Student learns the concept enthalpy and understands enthalpy changes in various chemical processes. Defines effect temperature on enthalpy of reaction
2. Determines Bond energies from thermochemical data

Student defines second law of thermodynamics and explains the concept of entropy

Student derives equation for efficiency of heat engine and third law entropy

Unit III: Chemical Equilibria

1. Student understands the free energy concept and chemical equilibrium.
2. Defines Le Chatelier's principle and learns its application to industrial processes

Unit IV: Chemical kinetics

1. Student distinguishes between first , second and zero order reaction
2. Gains knowledge about molecularity of reaction, Arrhenius equation, pseudo unimolecular reactions
3. Solves numerical problems on equation of first order reaction, second order reaction , life time etc

Theory References:

1. Under graduate physical chemistry, UGC curriculum Vol. I – Guria-GurtuPragati Prakashan
2. Principles of physical chemistry- Puri,Sharma,Pathania 44th publication and Vishal publication
3. Text book of physical chemistry – P. L. Soni, O. P. Dharmatma, U. N. Dash Sultan Chand and Sons
4. University general chemistry -An introduction to chemical science-C.N.R.Rao-Macmillan
5. A) Essentials of physical chemistry – ArunBahl, B.S.Bahl, G.D.Tuli S. Chand and company Ltd
B) Chemical kinetics 3rd eddition Keith J. Laidler Pearson publication

6. University General Chemistry: An Introduction to Chemical Sciences, C.N.R.Rao, MacMillon Publishers.
7. Barrow G.M., Physical Chemistry, Tata McGraw Hill (2007)
8. Atkins P.W., Paula J.De, Atkins Physical Chemistry, Oxford University Press

Paper II: Inorganic Chemistry

Paper Code: BCT 102

Marks: 40

Credits: 2

Learning Objectives:

1. To develop interdisciplinary approach of the subjects for students opting for specialization in other subjects at latter stages of graduation
2. To expose the students to various emerging new areas of Chemistry and apprise them with their prevalent in their future studies and their applications in various spheres of chemical sciences.

Unit I: Introduction to Quantum Chemistry & Atomic Structure [11 L]

Black Body radiation, Photoelectric effect, Compton Effect, Plank's theory, De-Broglie's relationship, Experimental verification of wave nature of electron,

Bohrs theory of hydrogen atom, Quantization of energy, Hydrogen spectrum, Wave theory, Heisenberg's uncertainty principal, Atomic orbitals & Quantum numbers, Pauli's exclusion principle, Hunds multiplicity rule, Aufbau principle, Electronic configuration of elements.

R1: Page 1-16, Page 35-40, Page 45, Page 50-52;

R2: Page 34;

R3: Page 1-7, Page 31, Page 66-86;

R4: Page 3-39.

Unit II: Ionic Bonding

[10 L]

Definition, General Characteristics of ionic bonding, Formation of ionic bonds, Energetics of ionic bond formation statement of Born-Lande equation for calculation of lattice energy, Born-Haber cycle & it's applications, Fajan's rules, Radius ratio, Radius ratio effects & calculation of radius ratio for octahedral geometry, Structure of NaCl, Zinc Blende (ZnS), Rutile (TiO₂).

R1: Page 137-140;

R3: Page 175-194;

R6: Page 422-437;

R7: Page 43-58.

Unit III: Covalent Bonding

[05 L]

VBT approach, Valence shell electron pair repulsion theory (VSEPR), VSEPR approach, assumptions, examples and limitations

R1: Page 141-149,

R3: Page 200-223;

R6: Page 437-479;

R7: Page 33-41.

Unit IV: Molecular orbital theory (MOT)

[10 L]

Introduction to LCAO method, Formation of bonding, anti-bonding & nonbonding molecular orbitals, Conditions for successful overlaps, Types of overlaps, Energy level sequence for molecular orbitals when $n = 1$ & $n = 2$, Bond order & its significance, Molecular orbital diagrams for –

- Homonuclear diatomic molecules – N_2^+ , N_2 , N_2^- , O_2^+ , O_2^-
- Heteronuclear diatomic molecules – CO, NO, NO^+
- Comparison between VBT & MOT

Ref.1: Page 160-179;

Ref.2: Page 134-138;

Ref.4: Page 368-433;

Ref.5: Page 129-140, Page 146-148;

Ref.4: Page 576-591;

Ref.7: Page 89-112.

Theory References

- Principles of Inorganic Chemistry; By Puri, Sharma & Kalia, 3rd and 4th Edition.
- Inorganic Chemistry; By Gary L. Miessler & Donald A. Tarr; 3rd edition
- Atomic structure and chemical bonding; By Manas Chanda; 2nd edition
- Quantum Chemistry; By R. K. Prasad,
- Inorganic chemistry- Principles of Structure and Reactivity; By James H. Huheey, Keiter, Medhi; 4th edition
- Modern Inorganic Chemistry; By R. D. Madan,
- Concise Inorganic Chemistry; By J. D Lee; 5th edition.

Learning outcomes:

Unit I: Introduction to Quantum Chemistry & Atomic Structure

- 1) Student should understand difference between classical chemistry and modern chemistry.
- 2) Student must explore conceptual fact of atom and molecule.
- 3) Understanding formation of atomic orbital through quantum approach.
- 4) They should know energy level in atom using modern classical quantum mechanics.
- 5) They should understand behavior of electron in atom.

Unit II: Ionic Bonding

- 1) Student should understand formation of various types of bonds.
- 2) Student should compare formation of solids through various types of bonds.
- 3) Student should know formation and energetics of ionic bond.
- 4) They should explain the formation statement of Born-Lande equation, Born–Haber cycle, Fajans rule and various aspects of lattice points in ionic solids.
- 5) Student must explain geometry, structure of ionic solids.

Unit III: Covalent Bonding

- 1) Student must explain formation of covalent bond.
- 2) Student must state approach of molecule formation through VBT.
- 3) They should demonstrate VSEPR theory and comparison between linear and nonlinear molecule.

Unit IV: Molecular orbital theory (MOT)

- 1) They must explain the formation of molecule from atomic orbitals.
- 2) They should explain LCAO method, bonding, antibonding and nonbonding molecular orbitals.
- 3) They should understand axial and lateral overlapping of atomic orbitals.
- 4) They should explain various diatomic molecules through VBT and MOT.
- 5) They should know comparison between VBT and MOT.
- 6) They should explain molecular orbital diagram of homonuclear and heteronuclear molecules.

Practical-I (BCP- 103)

1. Determination of Enthalpy of neutralization of hydrochloric acid with sodium hydroxide
2. Determination of heat of ionization of weak acid by using polythene bottle.
3. Preparation of Buffer solutions
 - I) Sodium Acetate –Acetic Acid and Ammonium chloride – Ammonium hydroxide
 - II) Measurement of pH of buffer solution & comparison of values with theoretical values
4. Measurement of pH of different solutions like aerated drinks, fruit juices, shampoos & soaps using pHmeter.
5. Chemical Kinetics: To investigate the reaction between $K_2S_2O_8$ and KI with equal initial concentration of reactants. . (Plotting of graph)
6. Equivalent weight: To determine equivalent weight of metal (Mg) by hydrogen displacement method using Eudiometer
7. **Quantitative analysis:**
 - i) Gravimetric Analysis (volatilization gravimetric analysis)

Binary Mixture	1) $NH_4Cl + BaSO_4$
	2) $ZnO + ZnCO_3$
8. **Volumetric analysis:**
 - i) Preparation of standard 0.1 N $KMnO_4$ solution and determine the strength of given oxalic acid solution.
 - ii) Determine quantity of Fe (II) ions from the given solutions by titrating with 0.1 N $K_2Cr_2O_7$ solutions by using internal indicator.
 - iii) Estimation of amount of Acetic acid from the given vinegar sample by titrimetric method.

Practical References:

1. Practical in physical chemistry- P.S.Sindhu Macmillan publication
2. Senior practical physical chemistry- Khosala Garge, R Chand and Co-Delhi
3. Experiments in chemistry- D.V.Jahagirdar Himalya publishing house
4. Experimental physical chemistry-V.D.Athawale , Parul Mathur, New age international publishers
5. Findlay's practical physical chemistry-Longman

6. Vogel's text book of Qualitative Chemical Analysis (Longman ELBS Edition)
7. Vogel's text book of Quantitative Analysis (Longman ELBS Edition)
8. Practical book of Physical Chemistry: Nadkarni, Kothari & Lawande
9. Experimental Physical Chemistry: A. Findlay.
10. Systematic Experimental Physical Chemistry: S. W. Rajbhoj, Chondhekar.
(Anjali Publication.)
11. Experiments in Physical Chemistry: R. C. Das and B. Behra. (Tata Mc Graw Hill)
12. Advanced Practical Physical Chemistry: J. B. Yadav (Goel Publishing House.)
13. Practical Physical Chemistry: B. D. Khosala. (R. Chand & Sons)
14. Experiments in Chemistry: D. V. Jahagirdar.
15. A Text Book of Quantitative Inorganic Analysis Including Elementary Instrumental Analysis: A.I. Vogel (Third Ed.) (ELBS)

Practical Course learning Outcomes:

1,2. Determination of Enthalpy of neutralization of hydrochloric acid with sodium Hydroxide and Determination of heat of ionization of weak acid

1. Students should define enthalpy, neutralization, heat of ionization
2. Students learn to measure temperatures of solutions and mixtures.
3. Student calculate enthalpy of neutralisation.

3. Preparation and measurement of pH of Buffer solutions.

1. Students should define buffer solution and explain types of buffer solution.
2. Students should learn to prepare different buffer solutions.
3. Students calculate pH of buffer solutions.
4. Students compare pH of buffer with theoretical values.

4. Measurement of pH of different solutions like aerated drinks, fruit juices, shampoos & soaps using pHmeter.

1. Student define pH.
2. Student learn to standardise and operate pH meter.
3. Student learn to measure pH of different solutions by pHmeter.
4. Students compare pH of commercial samples.

5. Chemical Kinetics: To investigate the reaction between $K_2S_2O_8$ and KI with equal initial concentration of reactants (Plotting of graph).

1. Students should define concepts in chemical kinetics: rate, order of reactions, rate constants

and their units.

2. Students learn the reaction between $K_2S_2O_8$ and KI and its mechanism with equation for rate constant.

3. Students determine rate constant from experimental data.

4. Students learn to plot graph and determines rate constant from graph.

6. Equivalent weight: To determine equivalent weight of metal (Mg) by hydrogen displacement method using Eudiometer.

1. Students define equivalent weight, atomic weight.

2. Students learn to measure volume of gas and height of solution by using eudiometer.

3. Students learn to calculate equivalent weight from experimental data.

7. Quantitative analysis:

1. Students should define quantitative analysis, gravimetric analysis, binary mixture, volatilization etc.

2. Students should understand weighing techniques.

3. Students should calculate exact strength of given composition.

8. Volumetric analysis:

1. Students should define primary and secondary standard, volumetric analysis.

2. Students should prepare standard solution of $KMnO_4$, oxalic acid and $K_2Cr_2O_7$.

3. Students should calculate normality by titration method and determine strength.

4. Students should know different commercial samples of vinegar.

5. Students should estimate amount of acetic acid from vinegar sample.

Semester –II

Paper III: Organic Chemistry

Paper Code: BCT 201

Marks: 40

Credits: 2

Learning Objectives:

1. To expose the students to various emerging new areas of Chemistry and apprise them with their prevalent in their future studies and their applications in various spheres of chemical sciences.
2. To enhance student sense of enthusiasm for chemistry and to involve them in an intellectually stimulating experience of learning in a supportive environment.

Unit I Fundamentals of Organic Chemistry

[12 L]

Introduction: inductive, electromeric, resonance and hyperconjugation effect. Cleavage of bonds. Types of reagents and organic reactions. Introduction of Reactive intermediaries, carbocation, carbanion, carbon free radical carbene, nitrene, arynes; applications of structural effects : strength of organic acids and bases, p_Ka and p_Kb values of common organic acids and bases .

Ref.1: Pages 55 – 59, 64 – 87

Ref. 2: Pages 20 – 22, 53-76, 101 -119, 122, 174 -176,251, 270 -298.

Ref. 3: Pages 75 – 163 Ref. 6: Pages 110 – 125 Ref. 7: Pages 78 – 120

Unit II Stereochemistry

[10L]

Concept of stereochemistry, types of stereoisomerism, chiral and achiral compounds, optical isomerism in tartaric acid 2.3, dihydroxybutanoic acids, enantiomerism and diastereomerism, Geometrical isomerism Introduction, geometrical isomerism in aldoxime, & ketoximes, configuration of aldoximes & ketoximes nomenclature of stereoisomerisms D L, CIP rules: R/S, E and Z (cis trans), erythro and threo

Ref.1: Pages 43 – 52, 194 – 200 Ref. 4: Pages 4 -11, 16-58, 318 - 321

Ref. 5: Pages 1 – 187 Ref. 6: Pages 67 – 104

Unit III Chemistry of Aliphatic Hydrocarbons

[07 L]

Introduction, Alkanes: preparation, catalytic hydrogenation, Wurtz reaction, Kolbe's synthesis from Grignard reagent. Alkenes: addition reaction Saytzeff's rule Alkynes: preparation of acetylene from calcium carbide, preparation of higher alkynes by dehalogenation of tetra halides, addition reaction and cycloalkanes preparation and reactions

Introduction, types of substitution reactions, aliphatic nucleophile substitutions: Introduction, nucleophiles, leaving groups, mechanism of nucleophilic substitution. The S_N1 , S_N2 reaction, kinetics, mechanism

Ref.1: Pages 134– 150, 234 -253, 302, 415, 416. **Ref. 3:** Pages 260 – 309, 343 – 515.

Ref. 6: Pages 328 -374

Unit IV Chemistry of Aromatic Hydrocarbons

[07]

Introduction to monocyclic and polycyclic aromatic hydrocarbons benzene, naphthalene, anthracene, Meaning of important terms; aromatic, non aromatic, anti aromatic, aromatic Huckel's rules and its applications

Aromatic electrophilic substitution reactions General mechanism, effect of substitution groups. Mechanism of nitration, sulfonation, halogenation, Friedel-Crafts alkylation & acylation reactions, Aromatic nucleophilic substitution (addition –elimination); orientation, activating & deactivating groups

Ref.1: Pages, 262 -283, 426 -474, 479–497

Ref. 2: Pages 131 - 173. **Ref. 3:** Pages 517 -548. **Ref. 7:** 10 -26.

Theory References:

- 1) Organic Chemistry by Morrison & Boyd, 7thEdⁿ.
- 2) A Guidebook to Mechanism in Organic Chemistry, by Peter Sykes, 6thEdⁿ.
- 3) Organic Chemistry, Vol. I, by S.M. Mukharji, S. P. Singh
- 4) Stereochemistry of Carbon compounds, by E. L. Eliel
- 5) Stereochemistry Conformation & Mechanism by P.S. Kalsi, 9thEdⁿ.
- 6) A Text books of Organic Chemistry by Raj. K. Bansal
- 7) Organic Reaction Mechanism by V. K. Ahluwalia, 4thEdⁿ.

Learning Outcomes:

Unit I Fundamentals of Organic Chemistry

1. The students should learn fundamentals of organic chemistry.
2. The students should define reactive intermediates, types of reagents and reactions
3. The students should explain preparations and reactions of reactive intermediates, strength of acids and bases

Unit II Stereochemistry

1. The students should learn basic concepts of stereochemistry.
2. The students should define types of stereoisomerism enantiomerism , diastereomerism
3. The students should explain chirality of compounds, geometrical isomerism in aldoxime and ketoxime. Conformations with respect to ethane, butane and cyclohexane.

Unit III Chemistry of aliphatic hydrocarbons

1. The students should learn basic idea of aliphatic hydrocarbons
2. The students should define alkane alkene and alkynes, types of substitution reactions
3. The students should explain preparations and reactions of alkane alkene and alkynes.

Unit IV Chemistry of aromatic hydrocarbon

1. The students should learn basic idea of aromatic hydrocarbons
2. The students should define electrophilic and nucleophilic substitution reaction
3. The students should explain electrophilic substitution reactions with respect to effect of substitution groups and mechanism.

Paper IV: Analytical Chemistry

Paper Code: BCT 202

Marks: 40

Credits: 2

Learning Objectives:

1. Development of analytical skills of the students.
2. To inspire and boost interest of the students towards chemistry as the main subject.
Development of analytical skills of the students.
3. To inspire and boost interest of the students towards chemistry as the main subject.
4. To develop interdisciplinary approach of the subjects for students opting for specialization in other subjects at latter stages of graduation
5. To expose the students to various emerging new areas of Chemistry and apprise them with their prevalent in their future studies and their applications in various spheres of chemical sciences

Unit I Basic Concepts in Analytical Chemistry

[05L]

A) Introduction, Definition and Explanation of following terms- Solute, Solvent, Solution, Polar solvent, Non-Polar solvent, Saturated solution, Unsaturated solution, Super saturated solution, Normality, Equivalent weight, Molecular weight, Molarity, Acidity of base, Basicity of acid, Percentage solution, ppt, ppm, ppb solutions, Mole Fraction, Weight fraction, Percentage composition by W/W, W/V, V/V Problems based on Normality, Molarity, mole fraction, mixed solution, etc. Errors, Precession

Ref. 4: Pages 20 -44; 144 – 172 Ref. 5: Pages 444 – 479.

Ref. 6: Pages 151-268.

B) Ionic Equilibria:

[07L]

Strong and weak electrolytes, Degree of Ionization, Factors affecting degree of ionization, Ionization constant and ionic product of water. Ionization of weak acids&bases, Common Ion effect, pH scale, Buffers, types of buffer. Solubility& solubility product of sparingly soluble salt, Numerical problems

Ref. 12 Page No.370-377, Ref. 13 Page No. 2.484-2.49, 2.434-2.407

Unit II Purification and Separation Method

[06 L]

Distillation techniques, Distillation of liquid mixtures, Types of distillation , Types of columns and packing, Condensers, Vacuum distillation, Spinning-band distillation, Steam distillation, Kiigelrohr distillation, Isopiestic or isothermal distillation Recrystallization

techniques Filtration, Choice of solvents, Petroleum ethers, Mixed solvents Sublimation. Solvent extraction: Classification principal and efficiency of technique mechanism of extraction salvation and chelation.

Ref. 9: Pages 05-12. Ref. 10: Pages 141 – 163; 165-218.

Unit III Chromatography [06 L]

Introduction, Basic Principle of Chromatography, Basic terms, Classification of Chromatography Paper Chromatography- Principle, Methodology-types of papers and treatment, sample loading, choice of solvent, development-ascending, descending, circular, location of spots, determination of R_f value, Applications, advantages and disadvantages Thin layer chromatography; Principle, Solvent system, stationary phases, preparation of TLC plate, Detecting reagents, methodology-sample loading, development, detection of spot, R_f value, Applications, advantages and disadvantages, Comparison of paper chromatography and TLC

Ref. 11 page no. 585-596

Unit IV Water Analysis [06L]

Introduction, hardness (Temporary and permanent) Sterilization and disinfection of water; Chemical methods (Aeration, use of $KMnO_4$, ionization, bleaching powder) and physical methods of sterilization (Boiling, exposure to sunlight and UV light, Irradiation with ultrasound) Measurement of water quality by chemical and physical examination: Colour Taste, Turbidity, Alkalinity, Suspended solids, Hydrogen ion concentration, Acidity, Biological oxygen demand(BOD), Chemical oxygen demand(COD), Dissolved oxygen(DO).

Ref. 1: Pages 01-24; Ref. 7: Pages 218 – 257.

Ref. 5: Pages 420-443.

Unit V Fertilizer Analysis [06 L]

Introduction, Micronutrients, Types of Fertilizer, Needs and Essential requirements of fertilizer Fertility and pH Value of soil Classification of fertilizer and Action of urea as a fertilizer Mixed fertilizer(NPK fertilizer), Complex fertilizer Phosphoric fertilizer Manufacture of triple Super-phosphate Pollution caused by the fertilizer Effect of fertilizer

Ref. 8: Pages 1079-1084 Ref. 1: Pages 173-198

Learning Outcomes:

Unit I: Basic concepts in analytical chemistry

1. The student understands the basic concepts. solvent types, molarity, etc
2. Students understands electrolytes, solubility, mole fraction, buffers, pH, weak and strong acid etc
3. Student should solve numerical problems.

Unit II: Purification and separation methods

1. Student learns the concept of purification techniques, separation techniques etc
2. Defines vacuum distillation, steam distillation etc

Unit III: Chromatography

1. Students should define chromatography, types of chromatography, paper
2. Chromatography, mobile phase, stationary phase, RF value, internal indicator.
3. Students should prepare chromatographic strip with spotting of given sample solution.
4. Students should calculate RF value and identification of cations
5. Students should identify basic radicals by taking different tests for particular cation.

Unit IV: Water analysis

1. Students understand water analysis techniques, its purification etc
2. Gains knowledge of hardness, BOD, COD,

Unit V: Fertilizer analysis

1. Student understand fertilizer techniques , classification etc
2. Gains knowledge fertilizer analysis, manufacturing processing etc

References:

- 1) Industrial chemistry by B.K.Sharma, Goel Publishing Housing, 1st edition.
- 2) Chemistry, Richard Harwood Cambridge University Press.
- 3) Handbook of Lubricant Greases and Petrochemicals, Small Industry Research Institute.
- 4) Analytical Chemistry, VIth Ed. Gary D. Christian.
- 5) Chemical Principles, 3rd Ed. Robert S. Boikess Edward Edelson, Harper International Ed.
- 6) Calculation in Chemistry, Donald J. Dahm Eric A. Nelson W. W. Norton & Company.
- 7) Principles of Environmental Chemistry, 2nd Ed. James E. Girard Jones and Bartlett.

- 8) Advanced Inorganic Chemistry Vol. 1 Satya Prakash, G. D. Tuli, S. K. Basu. Publisher S. Chand
- 9) Systematic Experiment in Chemistry Arun Sethi New Age International Publisher.
- 10) Vogel's Textbook of Quantitative Inorganic Analysis J. Bassett, R. C. Denney, G. H. Jeffery J. Medha
- 11) Instrumentation methods of chemical analysis, Chawla – Anand, Himalaya Publishing House
- 12) University general chemistry - An introduction to chemical science - C.N.R. Rao - Macmillan
- 13) Text book of physical chemistry – P. L. Soni, O. P. Dharmatma, U. N. Dash Sultan Chand and Son

Practical-II (BCP- 203)

1. Volumetric analysis:

i) Estimation of Vitamin C/ Aspirine

2. Organic Qualitative analysis of organic compounds like Benzoic acid, alpha naphthol, aniline, acetone, ethyl acetate, acetanilide, urea, thiourea etc

3. Preparations of derivatives of organic compounds

i) Nitration

ii) Oximes of aldehydes & ketones

iii) 2,4-dinitrophenylhydrazone of aldehydes & ketones

iv) Picrate

v) Oxalate

4. Estimation of Acetamide/Aniline

5. Identify & separate mixture of amino acids / sugar by paper chromatography.

6. Purification of compounds by crystallization using suitable solvents

7. Purification of compounds by sublimation

8. Separation and identification of cation by paper chromatographic technique

from the following mixture i) $\text{Ni}^{2+} + \text{Cu}^{2+}$, ii) $\text{Ni}^{2+} + \text{Co}^{2+}$, iii) $\text{Cu}^{2+} + \text{Co}^{2+}$

Practical References:

1. Vogel's text book of Qualitative Chemical Analysis (Longman ELBS Edition)
2. Vogel's text book of Quantitative Analysis (Longman ELBS Edition)
3. Practical Organic Chemistry by A.I. Vogel
4. Practical Organic Chemistry by O.P. Agrawal.

5. Practical Organic Chemistry by F. G. Mann & B. C. Saunders
6. Comprehensive Practical Organic Chemistry Qualitative Analysis by V. K. Ahluwalia
7. A Text Book of Quantitative Inorganic Analysis Including Elementary Instrumental Analysis: A.I. Vogel (Third Ed.).
8. Mikes O. Laboratory Hand book of Chromatographic and Allied Methods Elles Harwoods series on analytical chemistry John Wiley and sons 1979.
9. Skoog D. A. Holler F. J. and Nieman T. A. Principle of Instrument analysis Cengage Learning Indian Indian Ed.

Practical Learning Outcomes:

1) Organic Qualitative analysis

1. Students should define physical constants, elemental analysis, and functional group.
2. Students should prepare sodium extract for determination of elements.
3. Students should find out aromatic and aliphatic nature, type, elements and functional group in the given compound.
4. Students should confirm the compound by taking special test.
5. Students should summarise different tests and represent result.

2) Preparations of derivatives of organic compounds

1. Students should define meaning of derivate, role of derivative preparation.
2. Students should know different reactions for preparation of derivatives of organic Compounds.
3. Students should prepare derivative of organic compounds.
4. Students should confirm by taking physical constant of derivative.

3) Estimation of Vitamin C/Aspirine

1. Students should understand structure of Vitamin C /aspirin and its applications.
2. Students should know different sources of Vitamin C/ aspirin
3. Students should standardise given NaOH solution and determine its normality.
4. Student should determine amount of Vitamin C /aspirin by calculation.

4) Identify & separate mixture of amino acids/ sugar by paper chromatography.

1. Students define paper chromatography, R_F value.
2. Students should know different types of amino acids and sugars.
3. Students learn to prepare chromatographic strip with spotting of given sample solution.
4. Students calculate R_f value and identify components of given mixture.

5) Purification of compounds by crystallization using solvents such as water, alcohol, alcohol-water.

1. Students define purification, crystallization, saturated solution.
2. Students learn different crystallisation techniques using different solvent systems.
3. Students learn to prepare saturated solution and crystalize sample.
4. Students determine physical constants of purified samples.

6) Purification of compounds by sublimation

1. Students define sublimation.
2. Students learn to carry out sublimation method.
3. Students determine physical constants of purified samples.

Nature of Question Paper:

1. CCE-I : Marks =10: Unit 1 : Descriptive short questions (2 x 5)
2. CCE-II: Marks =10: Unit 2 &3: Multiple Choice questions :
Online Examination: (1x10)
3. ESE: Marks =50: Unit 1 to 4:
Q.1. Multiple Choice questions (1 x 10)
Q.2. Attempt any two out of three (2 x 10=20)
Q.3. Attempt any four out of six(4 x5=20)

A(CCE- Comprehensive Continuous Evaluation, ESE – End Semester Examination)