“Education through self-help is our motto.”- Karmaveer

Rayat Shikshan Sanstha’s

Sadguru Gadage Maharaj College, Karad

Accredited by NAAC with ‘A^{+}’ Grade with CGPA 3.63

Syllabus Framing of An Autonomous College

Syllabus for Bachelor of Science

Part-I

Chemistry (Major)

(As Per NEP-2020)

Semester I and II

To be implemented from June, 2023 onwards.

1) Title of the course: B.Sc. Part – I (Chemistry Major)

2) 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**.**

3) Eligibility of course:

For admission into bachelor's Degree, one should pass higher secondary school certificate examination i.e., H.S.C. science or 12th science or equivalent examination from a recognized board.

4) Duration:

The duration for B.Sc. Degree course with semester pattern

• B.Sc.- Part-I: I & II Semester

5) Medium of Instruction: English

6) Structure of the (B.Sc.-I) course:

Duration – One year

• B.Sc.-I comprises of total two semesters. In each semester there will be two theory papers.

• **Paper I and II ----- Semester-I**

Paper I: Inorganic Chemistry

Paper II: Organic Chemistry

Practical -I

• **Paper III and IV----- Semester-II**

Paper III: Physical Chemistry

Paper IV: Analytical Chemistry

Practical II

- **Practical examination will be conducted annually.**

7) Examination Pattern:

Semester	Paper No.	Paper Code	Theory Exam. SEE	Internal Exam CCE	Practical Exam		Total Marks
					Exam	Journal	
Semester I	Paper I	MJ-BCT23-101	40	10	-	-	100
	Paper II	MJ-BCT23-102	40	10			
Semester II	Paper III	MJ-BCT23-201	40	10	45	05	150
	Paper IV	MJ-BCT23-202	40	10			
Total marks:							250

8) Credit System –

Semester	Paper No.	Paper Code	Name of Paper	Distribution of Marks		Total Marks	Credits
				SEE	CCE		
I	Paper I	MJ-BCT23-101	Inorganic Chemistry	40	10	50	2
	Paper II	MJ-BCT23-102	Organic Chemistry	40	10	50	2
II	Paper III	MJ-BCT23-201	Physical Chemistry	40	10	50	2
	Paper IV	MJ-BCT23-20	Analytical Chemistry	40	10	50	2
	Practical Examination	MJ-BCP23-103 & MJ-BCP23-203	Semester I and II	45	05	50	4
Total						250	12

B.Sc. I Semester I
Paper I- Inorganic Chemistry
Paper Code: MJ-BCT23-101

Marks: 50

Subject	Unit No.	Title	Periods	Credits
Inorganic Chemistry	I	Atomic structure and Periodicity of Elements	08	2
	II	Ionic Bonding	06	
	III	Chemical Bonding - Valence bond theory (VBT)	05	
	IV	Acids and Bases	04	
	V	P-block elements	07	
		Total	30	

Paper II- Organic Chemistry
Paper Code: - MJ-BCT23-102

Marks: 50

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	
		Total	36	

Semester II
Paper III: Physical Chemistry
Paper Code: MJ-BCT23-201

Marks: 50

Subject	Unit No.	Title	Periods	Credits
Physical Chemistry	**I**	Basic Mathematical Concepts	**03**	**2**
	II	Thermodynamics	**05**	
	III	Chemical Kinetics	**08**	
	IV	Physical properties of liquids	**06**	
	V	Electrochemistry	**08**	
		Total	**30**	

Paper IV: Analytical Chemistry
Paper Code: MJ-BCT23-202

Marks: 50

Subject	Unit No.	Title	Periods	Credits
Analytical Chemistry	**I**	Introduction to analytical Chemistry	**06**	**2**
	II	Fundamentals of Industrial Chemistry and IPR	**08**	
	III	Chromatography	**08**	
	IV	Theory of titrimetric Analysis	**08**	
		Total	**30**	

9) Nature of Question Paper for Semester Pattern

Time: - 2 hrs. **Total Marks-50**

Instructions:

1. All questions are compulsory.
2. Numbers in right indicate full marks.
3. Use of scientific calculator is allowed.

Q. No.1) Multiple choice questions. (1 x 08) … (08)

Q.No.2) Attempt any two out of three (2 x 08) … (16)

Q.No.3) Attempt any four out of six (4 x 08) **……** (16)

Internal Examination (Home Assignment)

CCE-I: Marks =10

CCE-II: Marks =10

10) Nature of Question Paper for Practical Examination

Time: - 6 hrs. **Total Marks-50**

Perform three experiments.

Ques. 1) Inorganic Chemistry Experiment 15 marks

Ques. 2) Organic Chemistry Experiment 15 marks

Ques. 3) Physical Chemistry Experiment 15 marks

Ques. 4) Journal …… 05 marks

Total = 50 marks.

Semester I
Paper I: Inorganic Chemistry
Paper Code: MJ-BCT23-101

Marks: 50
Credits: 2

Unit No.	Name of the topic	Expected learning outcomes
1.	Atomic structure and of Elements	• To learn and understand introductory inorganicChemistry. • To understand size, shape and electron distribution in shells and sub- shells of an atom.
2.	Ionic Bonding	• To learn different types of bonds and nature of bondingin inorganic compounds. Calculations of different • energies associated with ionic bonding.
3.	Chemical Bonding Valence bond theory(VBT)	• Knowledge of nature of bonding, geometry, stability, and magnetic characters of covalent compounds by applying VBT.
4.	Acids and Bases	• Understanding of role of acids and bases in chemistry. • The study is useful in all chemical areas.
5.	P-block elements	• To learn and understand the properties and uses of the • Compounds of p-block elements.

Unit I: Atomic Structure and Periodicity of Elements (8 hours)

1.1 Bohr's theory of hydrogen atom and its limitations

1.2 Wave particle duality

1.3 Heisenberg uncertainty principle

1.4 Quantum numbers and their significance

1.5 Shapes of s, p and d atomic orbitals

1.6 Electrons filling rules in various orbitals: a) Aufbau's principle b) Hunds rule ofmaximum multiplicity c) Pauli's exclusion principle.

1.7 Electronic configuration of elements. Stability of empty, half-filled and completelyfilled orbitals.

1.8 Periodicity of the elements: General discussion of the following properties of the elements with reference to s block elements: a) electronic configuration b) atomic radii c) ionic radii d) ionization energy e) electron affinity f) electronegativity g) metallic characters h) reactivity i) oxidation state j) melting and boiling points k) chemical properties.

Unit II: Chemical Bonding and Molecular Structure: Ionic Bonding (6 hours)

2.1 Types of Chemical Bonds: a) Ionic Bond b) Covalent Bond c) Co-ordinate bond d) metallic bond e) Hydrogen Bond f) Van-der walls force.

2.2 Definition and formation of ionic bond. General characteristics of ionic bonding

2.3 Energetic in Ionic bond formation.

2.4 Born-Haber cycle for NaCl and its applications.

2.5 Fajan's Rule, Applications of Fajan's rule for,

i) Polarizing power and polarizability

ii) Ionic character in covalent compounds

iii) Bond moment, dipole moment and percentage ionic character.

Unit III: Chemical Bonding and Molecular structure: Valence bond theory (VBT). (5 hours)

3.1 VSEPR Theory.

3.2 Concept of hybridization, different types of hybridization and geometry offollowing molecules,

i) Linear geometry- $BeCl_2$ (sp hybridization)

ii) Planer trigonal geometry- BF_3 (sp^2 hybridization)

iii) Tetrahedral geometry- $SiCl_4$ (sp^3 hybridization)

iv) Trigonal bipyramidal geometry- PCl_5 (sp^3d hybridization)

v)Octahedral geometry- SF_6 (sp^3d^2 hybridization)

vi) Pentagonal bipyramidal geometry –IF_7 (sp^3d^3 hybridization)

Unit IV: Acids and Bases (4 hours)

4.1 Theories of Acids and Bases – Arrhenius concept, Bronsted –Lowry concept, Lewis concept, Lux-Flood concept. (Definition and examples only).

4.2 Hard and Soft Acids and Bases (HSAB concept).

4.2.1 Classification of Acids and Bases as hard soft and borderline.

4.2.2 Pearson's HSAB concept.

4.2.3 Acid –Base strength and hardness-softness.

4.2.4 Application and limitations of HSAB concept.

Unit V: P-Block Elements (Group 13, 14, 15) (07 hours)

5.1 Position of elements in periodic table.

5.2 Characteristics of group 13^{th}, 14^{th} and 15^{th} elements with special reference to electronic configuration and periodic properties.

5.3 Compounds of group 13^{th}, 14^{th} and 15^{th} elements.

5.3.1 Boron –diborane (only structure).

5.3.2 Allotropes of carbon and phosphorus.

5.3.3 Oxyacids of Nitrogen (HNO_2, HNO_3).

Reference Books:

1) Lee, J. D. Concise Inorganic Chemistry ELBS, 1991.

2) Cotton, F.A., Wilkinson, G. & Gaus, P.L. Basic Inorganic Chemistry, 3rd ed., Wiley.

3) Douglas, B. E., McDaniel, D. H. & Alexander, J. J. Concepts and Models in Inorganic Chemistry, John Wiley & Sons.

4) Huheey, J. E., Keiter, E. A., Keiter, R. L. & Medhi, O. K. Inorganic Chemistry:

5) Principles of Structure and Reactivity, Pearson Education India, 2006.

6) Puri, Sharma, Kalia. Principles of Inorganic Chemistry

7) Madan R. L. Chemistry for Degree Students (B. Sc. First year), S. Chand

Semester –I
Paper II: Organic Chemistry
Paper Code: MJ-BCT23-102

Marks: 50
Credits: 2

Unit No.	Name of the topic	Expected learning outcomes
1.	Fundamentals of Organic Chemistry	• The students are expected to understand the fundamentals and basic principles involved in organic Chemistry. • The students should define reactive intermediates, types of reagents and reactions
2.	Stereochemistry	• Understanding the spatial arrangement of atoms of organic molecule and types of stereoisomers. • The students should define types of stereoisomerism enantiomerism, diasteromerism • The students should explain chirality of compounds,

		geometrical isomerism in aldoxime and ketoxime. Conformations with respect to ethane, butane and cyclohexane.
3.	Chemistry of Aliphatic hydrocarbons	• The students should learn basic idea of aliphatic hydrocarbons. • The students should define alkane alkene and alkynes, types of substitution reactions. • The students should explain preparations and reactions of alkane alkene and alkynes.
5.	Chemistry of Aromatic hydrocarbons	• The students should learn basic idea of aromatic hydrocarbons. • The students should define electrophilic and nucleophilic substitution reaction. • The students should explain electrophilic substitution reactions with respect to effect of substitution groups and mechanism.

Unit I: Fundamentals of Organic Chemistry [12 L]

Introduction: inductive, electromeric, resonance and hyperconjugation effect. Cleavage of bonds-homolysis, heterolysis. Types of reagents and organic reactions. Introduction of reactive intermediates, carbocation, carbanion, carbon free radical, carbene, nitrene, arynes with their generation, structure, stability.

Unit II: Stereochemistry [10L]

Concept of stereochemistry, types of stereoisomerism, chiral and achiral compounds, optical isomerism in lactic acid, tartaric acid, 2,3-dihydoxybutanoic acids, enantiomerism and diastereomerism, Geometrical isomerism. Introduction, configuration and geometrical isomerism in aldoxime & ketomixes. Nomenclature of stereoisomerisms CIP rules, R/S, E and Z (cis & trans).

Unit III: Chemistry of Aliphatic Hydrocarbons [07]

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

Unit IV: Chemistry of Aromatic Hydrocarbons [07]

Introduction to homocyclic and polycyclic aromatic hydrocarbons benzene, naphthalene, anthracene, Meaning of important terms; aromatic, non-aromatic, anti-aromatic, Huckel's rules and its applications. Aromatic electrophilic substitution reactions, General mechanism, effect of substitution groups. Mechanism of nitration, sulfonation, halogenation, fridel-crafts alkylation & acylation reactions of benzene.

Theory References:

1) Organic Chemistry by Morrison & Boyd, 7thEdn

2) A Guidebook to Mechanism in Organic Chemistry, by Peter Sykes, 6th Edn.

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, 9th Edn .

6) A Text books of Organic Chemistry by Raj. K. Bansal

7) Organic Reaction Mechanism by V. K. Ahluwalia, 4thEdn.

Semester –II
Paper III: Physical Chemistry
Paper Code: MJ-BCT23-201

Marks: 50
Credits: 2

Unit No.	Name of the Topic	Expected Learning Outcome
1.	Basic MathematicalConcepts	• Learning and coherent understanding of basic concepts and rules of logarithms, graphs, derivative and integrations.
2.	Thermodynamics	• Knowledge and coherent understanding of basic concepts in thermodynamics will be gained by the student.
3.	Chemical Kinetics	• Learning and understanding the knowledge about basic concepts in kinetics and first order, second order reactionswith characteristics and suitable examples.
4.	Physical properties of liquids	• Learning and coherent understanding of surface tension, viscosity and refractive index with suitable examples.
5.	Electrochemistry	• Learning and coherent understanding of basic concepts in electrochemistry, conductors and conductivity cells, measurement of conductance with suitable examples and numerical problems.

Unit 1: Basic Mathematical Concepts (3 hours)

1.1 Logarithm: Basic rules and calculations.

1.2 Graph - Quadrants, drawing of linear graph, Slopes and Intercept.

1.3 Derivative and Integration: Basic rules.

Unit 2: Thermodynamics (5 hours)

2.1 Introduction, Basic terms used in thermodynamics, Zeroth law of thermodynamics.

2.2 First law of thermodynamics: Mathematical equation, sign conventions, statements of first law and its limitations.

2.3 Spontaneous and non-spontaneous processes, Second law of thermodynamics.

2.4 Heat engine, Carnot's Cycle and efficiency of heat engine.

2.5 Numerical Problems.

Unit 3: Chemical Kinetics (8 hours)

3.1 Introduction, rate of reaction, definition, and units of rate constant.

3.2 Factors affecting rate of reaction.

3.3 Order and Molecularity of reaction.

3.4 First order reaction: Derivation of rate constant. Characteristics of the firstorder reaction.

3.5 Pseudo- first order reactions –i) Hydrolysis of methyl acetate in presence ofacid, ii) Inversion of cane sugar.

3.6 Second order reaction: Derivation of rate constant for equal and unequal concentration of the reactants.

3.7 Examples of Second order reaction: i) Reaction between $K_2S_2O_8$ and KI and ii) Saponification of ethyl acetate.

3.8 Characteristics of Second order reactions.

3.9 Numerical problems.

Unit4: Physical properties of liquids (6 hours)

4.1 Introduction to states of matter, qualitative description of intermolecular forces in liquids, structure of liquids, classification of physical properties.

4.2 Surface tension and its determination using stalagmometer and differential risemethod.

4.3 Viscosity and its determination using Ostwald's viscometer.

4.4 Refractive index (Snell's law) specific and molecular refractivities and its determination using Abbe's refractometer.

4.5 Numerical Problems.

Unit 5: Electrochemistry (8 hours)

5.1 Introduction, types of cell, phenomenon of electrolysis, Faradays Laws ofelectrolysis.

5.2 Types of conductors.

5.3 Explanations of Conductance, specific conductance, equivalence and molecular conductance.

5.4 Variation of specific conductance, equivalence and molecular conductance with dilution, equivalent conductance at infinite dilution.

5.5 Dipping type of conductivity cell, modifications in the technique used before measurement of conductance w.r.to use of alternating current, use of conductivity water, conductivity cell and temperature control.

5.6 Measurement of conductance by Wheatstone bridge.

5.7 Cell constant and its determination.

5.8 Numerical problems.

Reference Books:

1) Barrow, G.M. Physical Chemistry Tata McGraw-Hill (2007).
2) Castellan G.W. Physical Chemistry 4 th Ed. Narosa(2004).
3) Kotz, J.C. Treichel, P.M.&Townsend,J.R.General Chemistry, Cengage Learning India Pvt Ltd: New Delhi (2009).
4) Mahan, B.H. University Chemistry, 3rd Ed. Narosa(1998).
5) Petrucci, R.H. General Chemistry, 5th Ed., Macmillan Publishing Co,: NewYork(1985).
6) Elements of Physical Chemistry S., Glasstone, D.Lewis.(2010)
7) Principles of physical Chemistry Marron and Prutton. (2007).
8) Elements of Physical Chemistry P.W.Atkins(2017-18)
9) Essentials of Physical Chemistry Bahl and Tuli. S. Chand,2010.
10) Physical Chemistry Danials and Alberty (2016)
11) University General Chemistry C. N. R.Rao(2016)
12) Priniples of Physical Chemistry, Puri, Sharma and Pathania 47th Edison, Vishal Publishing Co.
13) Physical Chemistry, A. J.Mee
14) Advanced Physical Chemistry, GurudeepRaj
15) Physical Chemistry, R. A.Alberty
16) General Chemistry, 5th Edition, Macmillan Publishing Co., New York (1985)

Paper IV: Analytical Chemistry

Paper Code: MJ-BCT23-202

Marks: 50

Credits: 2

Unit No.	Name of the topic	Expected learning Outcomes
1.	Introduction to analytical Chemistry	• Learning various analytical procedures and importance also sampling, accuracy and precision
2.	Fundamentals of Industrial Chemistry and IPR	• Distinguish between classical and industrial chemistry Learning and understanding basic concepts and concentration terms. Knowledge of IPR
3.	Chromatography	• Knowledge of chromatographic separation technique and terms involved in it. Learning paper chromatography andthin layer chromatography
4.	Theory of titrimetric Analysis	• Knowledge of various type of titrations, neutralization curves, indicators used in various titrations

1. Introduction to analytical Chemistry (6 hours)

1.1 Introduction

1.2 Importance of analysis

1.3 Analytical processes (Qualitative and Quantitative)

1.4 Methods of analysis (Only classification)

1.5 Sampling of solids, liquids and gases

1.6 Errors, types of errors (determinate and indeterminate), methods of expressingaccuracy (Absolute and relative error)

1.7 Significant figures, mean, median, standard deviation (Numerical problemsexpected)

2. Fundamentals of Industrial Chemistry and IPR (7 hours)

2.1 Difference between classical and industrial chemistry, Raw materials for chemicalindustry, Material safety data sheets (MSDS)

2.2 Definition and Explanation of terms - Molecular weight, Equivalent weight, Molarity, Normality, Molality, Molarity of mixed solution, Acidity of base, Basicity of acid, ppt, ppm, ppb solutions, Mole Fraction, Weight fraction, Percentage compositionby W/W, W/V, V/V, Problems based on Normality, Molarity, mole fraction, mixed solution, etc.

2.3 IPR- Introduction to IPR and its significance in presence scenario

3. Chromatography (6 hours)

3.1 Introduction, Basic Principle of Chromatography, Basic terms, Classification of Chromatography

3.2 Paper Chromatography- Principle, Methodology-types of papers and treatment, sample loading, choice of solvent, development-ascending, descending, circular, location of spots, determination of Rf value, Applications, advantages and disadvantages

3.3 Thin layer chromatography- Principle, Solvent system, stationary phases, preparation of TLC plate, Detecting reagents, methodology-sample loading, development, detection of spot, Rf value, Applications, advantages and disadvantages

3.4 Comparison of paper chromatography and TLC

4. Theory of titrimetric Analysis (6 hours)

4.1 Introduction

4.2 Acid-base indicators

4.3 Theory of indicators w.r.t. Ostwald's ionization theory and quinoid theory

4.4 Neutralization curves and choice of indicators for

a. Strong acid-strong base

b. Strong acid-weak base

c. Strong base-weak acid

4.5 Complexometric titrations

a. Introduction

b. Types EDTA titrations

c. Metallochromic indicators-Eriochrome black- T

d. Indicator Action of Eriochrome black- T

Reference Books:

1. Principles of Physical Chemistry by Puri, Sharma and Pathania, Vishal Publishing company Jalindhar
2. Essential of Physical Chemistry by Bahl B.S., Tuli G.D. and BahlArun, S.Chand and Company Ltd.New Delhi
3. Modern Analytical Chemistry by David Harvey, McGRAW-Hill International Edition, 2000
4. Industrial chemistry by B. K. Sharma, Goel Publishing Housing, 16th edition2011
5. Advanced Inorganic Chemistry, Vol.No.1, by Gurudeep Raj, Krishna

Prakashan Media Ltd, Goel Publication, Meerut

6. Analytical chemistry by B.K. Sharma, Krishna Prakashan Media Ltd, Meerut, edition 3rd 2011
7. Principles of electroplating and electroforming by Blum and Hogaboom Chemical Process Industries by Shreve and Brink.
8. Industrial Chemistry by Loutfy Madkor and Helen Njenga Elementary Principles of Chemical Processes by Richard Felder and RonaldRousseau, John Wiley and Sons

Practical's- I and II
(Paper Code: MJ-BCP23-103 & MJ-BCP23-203)
Physical Chemistry

1.Chemical Kinetics:

i) To investigate the reaction between K2S2O8 and KI with equal initial concentration of reactants. (Plotting of graph).

ii) Chemical Kinetics: To study the hydrolysis of methyl acetate.

2. Equivalent weight:

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

3. pH metry:

To prepare following buffer solutions and determine their buffer capacity

i) Sodium Acetate –Acetic Acid

ii) Ammonium chloride – Ammonium hydroxide

4. Thermochemistry:

Determination of Enthalpy of neutralization of hydrochloric acid with sodium hydroxide.

Organic Chemistry

1. Estimations (any two):

a) Estimation of aniline. (by bromination method)

b) Estimation of acetamide.

c) Estimation of Aspirin

2. Organic Qualitative analysis of organic compounds (at least eight) (four containing at least one extra element- N, S, Cl. Br, I)

a) Acids: Benzoic acid, Oxalic acid, cinnamic acid

b) Phenols: Beta-Naphthol, Resorcinol

c) Base: Aniline, p-Nitroaniline,

d) Neutral: Acetone, Acetanilide, urea, thiourea

3. Preparations of derivatives of organic compounds

a) Nitration of nitrobenzene

b) Oximes of aldehydes & ketones

c) 2,4-dinitropherylhydrazone of aldehydes & ketones

d) Picrate derivative of Beta-Naphthol

e) Oxalate derivative of urea

4. Purification of compounds by crystallization using suitable solvents.

5. Purification of compounds by sublimation.

Inorganic chemistry

1. To prepare standard 0.1 N KMnO4 solution and to determine the strength of given oxalic acid solution.
2. To determine quantity of Fe (II) ions from the given solutions by titrating it with 0.1 N $K_2Cr_2O_7$ solution by using internal indicator
3. To estimate amount of Cu (II) ions by iodometric titration by using $Na_2S_2O_3$ solution.
4. To standardize supplied EDTA solution by titrating with 0.01 M $ZnSO_4$ solution and to estimate amount of calcium from given solution by using Erio-T as an indicator.
5. Quality control-To determines percentage purity of the given sample of soda ash Na_2CO_3 by titrimetric method.
6. Estimation of amount of Acetic acid from the given vinegar sample by titrimetric method
7. Chromatography: Separation and identification of cations by Paper Chromatographic technique from the following mixtures:

a) Ni^{2++} Cu^{2+}

b) Ni^{2++} Co^{2+}

c) Cu^{2+} + 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. Sounders
6. Comprehensive Practical Organic Chemistry Qualitative Analysis by V. K. Ahluwali.

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.

10. Chromatography-H. Kaur

11. Chemistry for Degree students (B.Sc. First Year): R. L. Madan (S. Chand and company)

Practical Learning Outcomes:

Students will be able to explore theoretical knowledge in understanding and analysis.

Physical Chemistry

Chemical Kinetics:

1. The concepts of rate, order of reactions, rate constants and their units.
2. The reaction between K2S2O8 and KI and its mechanism with equation for rate constant.
3. The rate constant calculation from from experimental data as well as by graphical method..

Equivalent weight:

1. The concept of equivalent weight, atomic weight.
2. The measurement of volume of gas and height of solution by using eudiometer.
3. Calculation of equivalent weight from experimental data.

pH metry:

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.

Thermochemistry

Student should understand thermodynamic parameters like enthalpy of neutralization.

Organic Chemistry

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 summarize different tests and represent result.

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.

Estimation of Vitamin C/ Aspirin

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 standardize given NaOH solution and determine its normality.

4. Student should determine amount of Vitamin C /aspirin by calculation.

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

1. Students define paper chromatography, Rf 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 Rf value and identify components of given mixture.

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

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

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.

Inorganic Chemistry

Quantitative Analysis:

1. The concept of quantitative analysis, its types.
2. Weighing techniques.
3. Calculation of exact strength of given composition.

Volumetric Analysis:

1. The concept of primary and secondary standard, volumetric analysis.
2. Preparation of standard solutions
3. Determination of strength of solutions

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Accredited by NAAC with ‘A+’ Grade with CGPA 3.63

Syllabus Framing of An Autonomous College

Department of Chemistry

Syllabus

Choice Based Credit System (CBCS)

Class – B.Sc.-I Chemistry (Minor)

Semester I and II

(Syllabus to be implemented from June, 2023 onwards.)

Regulations in accordance with National Education Policy (NEP-2020) to be implemented from Academic Year 2023-24

1) Title of the course: B.Sc. Part – I (Chemistry Minor)

2) 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**.**

3) Eligibility of course:

For admission into bachelor's Degree, one should pass higher secondary school certificate examination i.e., H.S.C. science or 12th science or equivalent examination from a recognized board.

4) Duration:

The duration for B.Sc. Degree course with semester pattern

• B.Sc.- Part-I: I & II Semester

5) Medium of Instruction: English

6) Structure of the (B.Sc.-I) course:

Duration – One year

• B.Sc.-I comprises of total two semesters. In each semester there will be two theory papers.

• **Paper I and II ----- Semester-I**

Paper I: Inorganic Chemistry

Paper II: Organic Chemistry

Practical -I

• **Paper III and IV----- Semester-II**

Paper III: Physical Chemistry

Paper IV: Analytical Chemistry

Practical II

- **Practical examination will be conducted annually.**

7) Examination Pattern:

Semester	Paper No.	Paper code	Theory Exam. ESE	Internal Exam CCE	Practical Exam		Total Marks
					Exam	Journal	
Semester I	Paper I	MN-BCT23-101	40	10	-	-	100
	Paper II	MN-BCT23-102	40	10			
Semester II	Paper III	MN-BCT23-201	40	10	45	05	150
	Paper IV	MN-BCT23-202	40	10			
Total marks:							250

8) Credit System –

Sem	Paper No.	Paper Code	Name of Paper	Distribution of Marks		Total Marks	Credits
				SEE	CCE		
I	Paper I	MN-BCT23-101	Inorganic Chemistry	40	10	50	2
	Paper II	MN-BCT23-102	Organic Chemistry	40	10	50	2
II	Paper III	MN-BCT23-201	Physical Chemistry	40	10	50	2
	Paper IV	MN-BCT23-202	Analytical Chemistry	40	10	50	2
	Practical Examination	MN-BCP23-103 & MN-BCP23-203	Semester I and II	45	05	50	4
					Total	250	12

B.Sc. I Semester I

Paper I- Inorganic chemistry

Paper Code:- MN-BCT23-101

Marks: 50

Subject	Unit No.	Title	Periods	Credits
Inorganic Chemistry	I	Atomic structure and Periodicity of Elements	08	2
	II	Ionic Bonding	06	
	III	Chemical Bonding - Valence bond theory (VBT)	05	
	IV	Acids and Bases	04	
	V	P-block elements	07	
		Total	30	

Paper II- Organic Chemistry

Paper Code :- MN-BCT23-102

Marks: 50

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	
		Total	36	

Semester II

Paper III: Physical Chemistry

Paper Code :- MN-BCT23-201

Marks: 50

Subject	Unit No.	Title	Periods	Credits
Physical Chemistry	I	Basic Mathematical Concepts	03	2
	II	Thermodynamics	05	
	III	Chemical Kinetics	08	
	IV	Physical properties of liquids	06	
	V	Electrochemistry	08	
		Total	30	

Paper IV: Analytical Chemistry

Paper Code: - MN-BCT23-202

Marks: 50

Subject	Unit No.	Title	Periods	Credits
Analytical Chemistry	I	Introduction to analytical Chemistry	06	2
	II	Fundamentals of Industrial Chemistry and IPR	08	
	III	Chromatography	08	
	IV	Theory of titrimetric Analysis	08	
		Total	30	

9) Nature of Question Paper for Semester Pattern

Time: - 2 hrs. **Total Marks-50**

Instructions:

1. All questions are compulsory.
2. Numbers in right indicate full marks.
3. Use of scientific calculator is allowed.

Q. No.1) Multiple choice questions. (1 x 08) … (08)

Q.No.2) Attempt any two out of three (2 x 08) … (16)

Q.No.3) Attempt any four out of six (4 x 08) **……** (16)

Internal Examination (Home Assignment)

CCE-I: Marks =10

CCE-II: Marks =10

10) Nature of Question Paper for Practical Examination

Time: - 6 hrs. **Total Marks-50**

Perform three experiments.

Ques. 1) Inorganic Chemistry Experiment 15 marks

Ques. 2) Organic Chemistry Experiment 15 marks

Ques. 3) Physical Chemistry Experiment 15 marks

Ques. 4) Journal …… 05 marks

Total = 50 marks.

Semester I

Paper I: Inorganic Chemistry

Paper Code: MN-BCT23-101

Marks: 50

Credits: 2

Name of the topic	Expected learning outcomes
1. Atomic structure and Periodicity of Elements	• To learn and understand introductory inorganic chemistry. To understand size, shape and electron distribution in shells and sub- shells of an atom.
2. Ionic Bonding	• To learn different types of bonds and nature of bondingin inorganic compounds. Calculations of different • energies associated with ionic bonding.
3. Chemical Bonding - Valence bond theory(VBT)	• Knowledge of nature of bonding, geometry, stability, • and magnetic characters of covalent compounds by applying VBT.
4. Acids and Bases	• Understanding of role of acids and bases in chemistry. • The study is useful in all chemical areas.
5. P-block elements	• To learn and understand the properties and uses of the • compounds of p-block elements.

Unit I: Atomic Structure and Periodicity of Elements (8 hours)

1.1 Bohr's theory of hydrogen atom and its limitations

1.2 Wave particle duality

1.3 Heisenberg uncertainty principle

1.4 Quantum numbers and their significance

1.5 Shapes of s, p and d atomic orbitals

1.6 Electrons filling rules in various orbitals: a) Aufbau's principle b) Hunds rule of maximum multiplicity c) Pauli's exclusion principle.

1.7 Electronic configuration of elements. Stability of empty, half-filled and completely filled orbitals.

1.8 Periodicity of the elements: General discussion of the following properties of the elements with reference to s block elements: a) electronic configuration b) atomic radii c) ionic radii d) ionization energy e) electron affinity f) electronegativity g) metallic characters h) reactivity i) oxidation state j) melting and boiling points k) chemical properties.

Unit II: Chemical Bonding and Molecular Structure: Ionic Bonding (6 hours)

2.1 Types of Chemical Bonds: a) Ionic Bond b) Covalent Bond c) Co-ordinate bond d) metallic bond e) Hydrogen Bond f) Van-der walls force.

2.2 Definition and formation of ionic bond. General characteristics of ionic bonding

2.3 Energetic in Ionic bond formation.

2.4 Born-Haber cycle for NaCl and its applications.

2.5 Fajan's Rule, Applications of Fajan's rule for,

i) Polarizing power and polarizability

ii) Ionic character in covalent compounds

iii) Bond moment, dipole moment and percentage ionic character.

Unit III: Chemical Bonding and Molecular structure : Valence bond theory (VBT). (5 hours)

3.1 VSEPR Theory.

3.2 Concept of hybridization, different types of hybridization and geometry of following molecules,

i) Linear geometry- $BeCl_2$ (sp hybridization)

ii) Planer trigonal geometry- BF_3 (sp^2 hybridization)

iii) Tetrahedral geometry- $SiCl_4$ (sp^3 hybridization)

iv) Trigonal bipyramidal geometry- PCl5 (sp^3d hybridization)

v)Octahedral geometry- SF_6 (sp^3d^2 hybridization)

vi) Pentagonal bipyramidal geometry –IF_7 (sp^3d^3 hybridization)

Unit IV: Acids and Bases **(4 hours)**

4.1 Theories of Acids and Bases – Arrhenius concept, Bronsted –Lowry concept, Lewis concept, Lux-Flood concept. (Definition and examples only).

4.2 Hard and Soft Acids and Bases (HSAB concept).

- 4.2.1 Classification of Acids and Bases as hard soft and borderline.
- 4.2.2 Pearson's HSAB concept.
- 4.2.3 Acid –Base strength and hardness-softness.
- 4.2.4 Application and limitations of HSAB concept.

Unit V: P-Block Elements (Group 13, 14, 15) **(07 hours)**

5.1 Position of elements in periodic table.

5.2 Characteristics of group 13^{th}, 14^{th} and 15^{th} elements with special reference to electronic configuration and periodic properties.

5.3 Compounds of group13^{th}, 14^{th} and 15^{th} elements.

- 5.3.1 Boron –diborane (only structure).
- 5.3.2 Allotropes of carbon and phosphorus.
- 5.3.3 Oxyacids of Nitrogen (HNO_2, HNO_3).

Reference Books:

1) Lee, J. D. Concise Inorganic Chemistry ELBS, 1991.

2) Cotton, F.A., Wilkinson, G. & Gaus, P.L. Basic Inorganic Chemistry, 3rd ed., Wiley.

3) Douglas, B. E., McDaniel, D. H. & Alexander, J. J. Concepts and Models in InorganicChemistry, John Wiley & Sons.

4) Huheey, J. E., Keiter, E. A., Keiter, R. L. & Medhi, O. K. Inorganic Chemistry:

5) Principles of Structure and Reactivity, Pearson Education India, 2006.

6) Puri, Sharma, Kalia. Principles of Inorganic Chemistry

7) Madan R. L. Chemistry for Degree Students (B. Sc. First year), S. Chand

Semester –I

Paper II: Organic Chemistry

Paper Code: MN-BCT23-102

Marks: 50
Credits: 2

Name of the topic	Expected learning outcomes
1. Fundamentals of Organic Chemistry	• The students are expected to understand the fundamentals and basic principles involved in organic • chemistry.
2. Stereochemistry	• Understanding the spatial arrangement of atoms of • organic molecule and types of stereoisomers.
3. Chemistry of Aliphatic hydrocarbons	• To understand basic Knowledge of aliphatic hydrocarbons and • synthetic reaction of aliphatic hydrocarbons
4. Chemistry of Aromatic hydrocarbons	• To understand basic concepts of aromaticity and application of huckels rule

Unit I: Fundamentals of Organic Chemistry [12 L]

Introduction: inductive, electromeric, resonance and hyperconjugation effect. Cleavage of bonds-homolysis, heterolysis. Types of reagents and organic reactions. Introduction of reactive intermediates, carbocation, carbanion, carbon free radical, carbene, nitrene, arynes with their generation, structure, stability.

Unit II: Stereochemistry [10L]

Concept of stereochemistry, types of stereoisomerism, chiral and achiral compounds,optical isomerism in lactic acid, tartaric acid, 2,3-dihydoxybutanoic acids, enantiomerism and diastereomerism,Geometrical isomerism. Introduction, configuration and geometrical isomerism in aldoxime & ketomixes. Nomenclature of stereoisomerisms CIP rules, R/S, E and Z (cis & trans).

Unit III: Chemistry of Aliphatic Hydrocarbons [07]

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

Unit IV: Chemistry of Aromatic Hydrocarbons [07]

Introduction to homocyclic and polycyclic aromatic hydrocarbons benzene, naphthalene, anthracene, Meaning of important terms; aromatic, non-aromatic, anti-aromatic,Huckel's rules and its applications.Aromatic electrophilic substitution reactions, General mechanism, effect of substitution groups. Mechanism of nitration, sulfonation, halogenation, fridel-crafts alkylation & acylation reactions of benzene.

Theory References:

1) Organic Chemistry by Morrison & Boyd, 7thEdn

2) A Guidebook to Mechanism in Organic Chemistry, by Peter Sykes, 6th Edn.

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, 9th Edn .

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 , diasteromerism

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.

Semester –II

Paper III: Physical Chemistry

Paper Code: - MN-BCT23-201

Marks: 50
Credits: 2

Name of the Topic	Expected Learning Outcome
1. Basic Mathematical Concepts	• Learning and coherent understanding of basic concepts and rules of logarithms, graphs, derivative and integrations.
2. Thermodynamics	• Knowledge and coherent understanding of basic concepts in thermodynamics will be gained by the student.
3. Chemical Kinetics	• Learning and understanding the knowledge about basic • concepts in kinetics and first order, second order reactions with characteristics and suitable examples.
4. Physical properties of liquids	• Learning and coherent understanding of surface tension, viscosity and refractive index with suitable examples.
5. Electrochemistry	• Learning and coherent understanding of basic concepts in electrochemistry, conductors and conductivity cells, measurement of conductance with suitable examples and • numerical problems.

Unit 1: Basic Mathematical Concepts (3 hours)

1.1 Logarithm: Basic rules and calculations.

1.2 Graph - Quadrants, drawing of linear graph, Slopes and Intercept.

1.3 Derivative and Integration: Basic rules.

Unit 2: Thermodynamics (5 hours)

2.1 Introduction, Basic terms used in thermodynamics, Zeroth law of thermodynamics.

2.2 First law of thermodynamics: Mathematical equation, sign conventions, statements of first law and its limitations.

2.3 Spontaneous and non-spontaneous processes, Second law of thermodynamics.

2.4 Heat engine, Carnot's Cycle and efficiency of heat engine.

2.5 Numerical Problems.

Unit 3: Chemical Kinetics (8 hours)

3.1 Introduction, rate of reaction, definition, and units of rate constant.

3.2 Factors affecting rate of reaction.

3.3 Order and Molecularity of reaction.

3.4 First order reaction: Derivation of rate constant. Characteristics of the first order reaction.

3.5 Pseudo- first order reactions –i) Hydrolysis of methyl acetate in presence of acid, ii) Inversion of cane sugar.

3.6 Second order reaction: Derivation of rate constant for equal and unequal concentration of the reactants.

3.7 Examples of Second order reaction: i) Reaction between $K_2S_2O_8$ and KI and ii) Saponification of ethyl acetate.

3.8 Characteristics of Second order reactions.

3.9 Numerical problems.

Unit4: Physical properties of liquids (6 hours)

4.1 Introduction to states of matter, qualitative description of intermolecular forces in liquids, structure of liquids, classification of physical properties.

4.2 Surface tension and its determination using stalagmometer and differential rise method.

4.3 Viscosity and its determination using Ostwald's viscometer.

4.4 Refractive index (Snell's law) specific and molecular refractivities and its determination using Abbe's refractometer.

4.5 Numerical Problems.

Unit 5: Electrochemistry (8 hours)

5.1 Introduction, types of cell, phenomenon of electrolysis, Faradays Laws of

electrolysis.

5.2 Types of conductors.

5.3 Explanations of Conductance, specific conductance, equivalence and molecular conductance.

5.4 Variation of specific conductance, equivalence and molecular conductance with dilution, equivalent conductance at infinite dilution.

5.5 Dipping type of conductivity cell, modifications in the technique used before measurement of conductance w.r.to use of alternating current, use of conductivity water, conductivity cell and temperature control.

5.6 Measurement of conductance by Wheatstone bridge.

5.7 Cell constant and its determination.

5.8 Numerical problems.

Reference Books:

1) Barrow, G.M. Physical Chemistry Tata McGraw-Hill(2007).

2) Castellan G.W. Physical Chemistry 4 th Ed. Narosa(2004).

3) Kotz, J.C. Treichel, P.M.&Townsend,J.R.General Chemistry, Cengage Learning IndiaPvt Ltd: New Delhi(2009).

4) Mahan ,B.H. University Chemistry, 3rd Ed. Narosa(1998).

5) Petrucci, R.H. General Chemistry, 5th Ed., Macmillan Publishing Co,: New York(1985).

6) Elements of Physical Chemistry S., Glasstone, D.Lewis.(2010)

7) Principles of physical Chemistry Marron and Prutton. (2007).

8) Elements of Physical Chemistry P.W.Atkins(2017-18)

9) Essentials of Physical Chemistry Bahl and Tuli. S. Chand,2010.

10) Physical Chemistry Danials and Alberty (2016)

11) University General Chemistry C. N. R.Rao(2016)

12) Priniples of Physical Chemistry, Puri, Sharma and Pathania 47th Edison, Vishal Publishing Co.

13) Physical Chemistry , A. J.Mee

14) Advanced Physical Chemistry, GurudeepRaj

15) Physical Chemistry , R. A.Alberty

16) General Chemistry, 5th Edition, Macmillan Publishing Co. , New York (1985)

Paper IV: Analytical Chemistry
Paper Code: MN-BCT23-202

Marks: 50

Credits: 2

Name of the topic	Expected learning Outcomes
1. Introduction to analytical Chemistry	• Learning various analytical procedures and importance also sampling, accuracy and precision
2. Fundamentals of Industrial Chemistry and IPR	• Distinguish between classical and industrial Chemistry Learning and understanding basic concepts andconcentration terms. Knowledge of IPR
3. Chromatography	• Knowledge of chromatographic separation technique and terms involved in it. Learning paper chromatography andthin layer chromatography
4. Theory of titrimetric Analysis	• Knowledge of various type of titrations, neutralization curves, indicators used in various titrations

1. Introduction to analytical Chemistry (6 hours)

1.1 Introduction

1.2 Importance of analysis

1.3 Analytical processes (Qualitative and Quantitative)

1.4 Methods of analysis (Only classification)

1.5 Sampling of solids, liquids and gases

1.6 Errors, types of errors (determinate and indeterminate), methods of expressingaccuracy (Absolute and relative error)

1.7 Significant figures, mean, median, standard deviation (Numerical problemsexpected)

2. Fundamentals of Industrial Chemistry and IPR (7 hours)

2.1 Difference between classical and industrial chemistry, Raw materials for chemicalindustry, Material safety data sheets (MSDS)

2.2 Definition and Explanation of terms - Molecular weight, Equivalent weight, Molarity, Normality, Molality, Molarity of mixed solution, Acidity of base, Basicity of acid, ppt, ppm, ppb solutions, Mole Fraction, Weight fraction, Percentage compositionby W/W, W/V, V/V, Problems based on Normality, Molarity, mole fraction, mixed solution, etc.

2.3 IPR- Introduction to IPR and its significance in presence scenario

3. Chromatography (6 hours)

3.1 Introduction, Basic Principle of Chromatography, Basic terms, Classification of Chromatography

3.2 Paper Chromatography- Principle, Methodology-types of papers and treatment, sample loading, choice of solvent, development-ascending, descending, circular, location of spots, determination of Rf value, Applications, advantages and disadvantages

3.3 Thin layer chromatography- Principle, Solvent system, stationary phases, preparation of TLC plate, Detecting reagents, methodology-sample loading, development, detection of spot, Rf value, Applications, advantages and disadvantages

3.4 Comparison of paper chromatography and TLC

4. Theory of titrimetric Analysis (6 hours)

4.1 Introduction

4.2 Acid-base indicators

4.3 Theory of indicators w.r.t. Ostwald's ionization theory and quinoid theory

4.4 Neutralization curves and choice of indicators for

a. Strong acid-strong base

b. Strong acid-weak base

c. Strong base-weak acid

4.5 Complexometric titrations

a. Introduction

b. Types EDTA titrations

c. Metallochromic indicators-Eriochrome black- T

d. Indicator Action of Eriochrome black- T

Reference Books:

1) Principles of Physical Chemistry by Puri, Sharma and Pathania, Vishal Publishingcompany Jalindhar

2) Essential of Physical Chemistry by Bahl B.S., Tuli G.D. and BahlArun, S.Chand andCompany Ltd.New Delhi

3) Modern Analytical Chemistry by David Harvey, McGRAW-Hill International Edition, 2000

4) Industrial chemistry by B. K. Sharma, Goel Publishing Housing, 16th edition2011

5) Advanced Inorganic Chemistry, Vol.No.1, by Gurudeep Raj, Krishna PrakashanMedia Ltd, Goel Publication, Meerut.

6) Analytical chemistry by B.K. Sharma, Krishna Prakashan Media Ltd, Meerut, edition3rd 2011

7)Principles of electroplating and electroforming by Blum and Hogaboom

8)Chemical Process Industries by Shreve and Brink

9) Industrial Chemistry by Loutfy Madkor and Helen Njenga Elementary Principles of Chemical Processes by Richard Felder and RonaldRousseau, John Wiley and Sons

Practical's- I and II (MN-BCP23-103 & MN-BCP23-203)

Physical Chemistry

1.Chemical Kinetics:

i) To investigate the reaction between K2S2O8 and KI with equal initial concentration of reactants. (Plotting of graph).

ii) Chemical Kinetics: To study the hydrolysis of methyl acetate.

2. Equivalent weight:

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

3. pH metry:

To prepare following buffer solutions and determine their buffer capacity

i) Sodium Acetate –Acetic Acid

ii) Ammonium chloride – Ammonium hydroxide

4. Thermochemistry:

Determination of Enthalpy of neutralization of hydrochloric acid with sodium hydroxide.

Organic Chemistry

1. Estimations (any two):

a) Estimation of aniline. (by bromination method)

b) Estimation of acetamide.

c) Estimation of Aspirin

2. Organic Qualitative analysis of organic compounds (at least eight) (four containing at least one extra element- N, S, Cl. Br, I)

a) Acids: Benzoic acid, Oxalic acid, cinnamic acid

b) Phenols: Beta-Naphthol, Resorcinol

c) Base: Aniline, p-Nitroaniline,

d) Neutral: Acetone, Acetanilide, urea, thiourea

3. Preparations of derivatives of organic compounds

a) Nitration of nitrobenzene

b) Oximes of aldehydes & ketones

c) 2,4 dinitropherylhydrazone of aldehydes & ketones

d) Picrate derivative of Beta-Naphthol

e) Oxalate derivative of urea

4. Purification of compounds by crystallization using suitable solvents.

5. Purification of compounds by sublimation.

Inorganic chemistry

1. To prepare standard 0.1 N KMnO4 solution and to determine the strength of given oxalic acid solution.

2. To determine quantity of Fe (II) ions from the given solutions by titrating it with 0.1 N K2Cr2O7 solution by using internal indicator

3. To estimate amount of Cu(II) ions by iodometric titration by using Na2S2O3 solution.

4. To standardize supplied EDTA solution by titrating with 0.01 M ZnSO4 solution and to estimate amount of calcium from given solution by using Erio-T as an indicator.

5. Quality control-To determines percentage purity of the given sample of soda ash

Na2CO3 by titrimetric method.

6. Estimation of amount of Acetic acid from the given vinegar sample by titrimetric method

7. Chromatography: Separation and identification of cations by Paper Chromatographic technique from the following mixtures:

a) Ni2++ Cu2+

b) Ni2++ Co2+

c) Cu2+ + Co2+.

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. Sounders

6. Comprehensive Practical Organic Chemistry Qualitative Analysis by V. K. Ahluwali.

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.

10. Chromatography-H. Kaur

11. Chemistry for Degree students (B.Sc. First Year): R. L. Madan (S. Chand and company)

Practical Learning Outcomes:

Students will be able to explore theoretical knowledge in understanding and analysis.

Physical Chemistry

Chemical Kinetics:

1. The concepts of rate, order of reactions, rate constants and their units.

2. The reaction between K2S2O8 and KI and its mechanism with equation for rate constant.

3. The rate constant calculation from from experimental data as well as by graphical method..

Equivalent weight:

1. The concept of equivalent weight, atomic weight.

2. The measurement of volume of gas and height of solution by using eudiometer.

3. Calculation of equivalent weight from experimental data.

pH metry:

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.

Thermochemistry

Student should understand thermodynamic parameters like enthalpy of neutralization.

Organic Chemistry

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 summarize different tests and represent result.

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.

Estimation of Vitamin C/ Aspirin

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 standardize given NaOH solution and determine its normality.
4. Student should determine amount of Vitamin C /aspirin by calculation.

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

1. Students define paper chromatography, Rf 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 Rf value and identify components of given mixture.

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

1. Students define purification, crystallization, saturated solution.

2. Students learn different crystallization techniques using different solvent systems.

3. Students learn to prepare saturated solution and crystallize sample.

4. Students determine physical constants of purified samples.

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.

Inorganic Chemistry

Quantitative Analysis:

1. The concept of quantitative analysis, its types.

2. Weighing techniques.

3. Calculation of exact strength of given composition.

Volumetric Analysis:

1. The concept of primary and secondary standard, volumetric analysis.

2. Preparation of standard solutions

3. Determination of strength of solutions

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Accredited by NAAC with ‘A+’ Grade with CGPA 3.63

Syllabus Framing of An Autonomous College

Department of Chemistry

Syllabus

Choice Based Credit System (CBCS)

B.Sc.-I Chemistry

(Open /Generic Elective)

Semester I and II

(Syllabus to be implemented from June, 2023 onwards.)

Regulations in accordance with National Education Policy (NEP-2020) to be implemented from Academic Year 2023-24

1) Title of the course: B.Sc. Part – I (Chemistry Open / Generic Elective)

2) 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**.**

3) Eligibility of course:

For admission into bachelor's Degree, one should pass higher secondary school certificate examination i.e., H.S.C. science or 12th science or equivalent examination from a recognized board.

4) Duration:

The duration for B.Sc. Degree course with semester pattern.

• B.Sc.- Part-I: I & II Semester

5) Medium of Instruction: English

6) Structure of the (B.Sc.-I) course:

Duration – One year

• B.Sc.-I comprises of total two semesters. In each semester there will be two theory papers.

• Paper I and II ----- Semester-I

Paper I: Fundamental of Inorganic Chemistry

Paper II: Fundamental of Organic Chemistry

Practical -I

• Paper III and IV----- Semester-II

Paper III: Fundamental of Physical Chemistry

Paper IV: Fundamental of Analytical Chemistry

Practical II

- **Practical examination will be conducted annually.**

7) Examination Pattern:

Semester	Paper No.	Paper Code	Theory Exam. SEE	Internal Exam CCE	Practical Exam		Total Marks
					Exam	Journal	
Semester I	Paper I	GE- BCT23-101	40	10	-	-	100
	Paper II	GE-BCT23-102	40	10			
Semester II	Paper III	GE-BCT23-201	40	10	45	05	150
	Paper IV	GE-BCT23-202	40	10			
Total marks:							250

8) Credit System –

Sem	Paper No.	Paper code	Name of Paper	Distribution of Marks		Total Marks	Credits
				SEE	CCE		
I	Paper I	GE- BCT23-101	Fundamental of Inorganic Chemistry	40	10	50	2
	Paper II	GE-BCT23-102	Fundamental of Organic Chemistry	40	10	50	2
II	Paper III	GE- BCT23-201	Fundamental of Physical Chemistry	40	10	50	2
	Paper IV	GE- BCT23-202	Fundamental of Analytical Chemistry	40	10	50	2
	Practical Examination (OE)	GE-BCP23-103	Semester I and II	45	05	50	4
Total						250	12

B.Sc. I Semester I

Paper I- Fundamental of Inorganic chemistry

Paper Code : GE- BCT23-101

Marks: 50

Subject	Unit No.	Title	Periods	Credits
Fundamental of Inorganic Chemistry	I	Atomic structure and Periodicity of Elements	08	2
	II	Ionic Bonding	06	
	III	Chemical Bonding - Valence bond theory (VBT)	05	
	IV	Acids and Bases	04	
	V	P-block elements	07	
		Total	30	

Paper II- Fundamental of Organic chemistry

Paper Code : GE- BCT23-102

Marks: 50

Subject	Unit No.	Title	Periods	Credits
Fundamental of Organic Chemistry	I	Fundamentals of organic Chemistry	10	2
	II	Stereochemistry	08	
	III	Chemistry of Aliphatic Hydrocarbon	06	
	IV	Chemistry of Aromatic Hydrocarbons	06	
		Total	30	

Semester II

Paper III: Fundamental of Physical Chemistry

Paper Code : GE- BCT23-201

Marks: 50

Subject	Unit No.	Title	Periods	Credits
Fundamental of Physical Chemistry	**I**	Basic Mathematical Concepts	**03**	**2**
	II	Thermodynamics	**05**	
	III	Chemical Kinetics	**08**	
	IV	Physical properties of liquids	**06**	
	V	Electrochemistry	**08**	
		Total	**30**	

Paper IV: Fundamental of Analytical Chemistry

Paper Code: - GE-BCT23-202

Marks: 50

Subject	Unit No.	Title	Periods	Credits
Analytical Chemistry	**I**	Introduction to analytical Chemistry	**06**	**2**
	II	Fundamentals of Industrial Chemistry and IPR	**08**	
	III	Chromatography	**08**	
	IV	Theory of titrimetric Analysis	**08**	
		Total	**30**	

9) Nature of Question Paper for Semester Pattern

Time: - 2 hrs.

Total Marks-40

Instructions:

1. All questions are compulsory.
2. Numbers in right indicate full marks.
3. Use of scientific calculator is allowed.

Q. No.1) Multiple choice questions. (1 x 08) … (08)

Q.No.2) Attempt any two out of three (2 x 08) … (16)

Q.No.3) Attempt any four out of six (4 x 08) …… (16)

Internal Examination (Home Assignment)

CCE-I: Marks =10

CCE-II: Marks =10

10) Nature of Question Paper for Practical Examination

Time: - 6 hrs. **Total Marks-50**

Perform three experiments.

Ques. 1) Inorganic Chemistry Experiment 15 marks

Ques. 2) Organic Chemistry Experiment 15 marks

Ques. 3) Physical Chemistry Experiment 15 marks

Ques. 4) Journal …… 05 marks

Total = 50 marks.

Semester I

Paper I: Fundamental of Inorganic Chemistry

Paper Code: GE- BCT23-101

Marks: 40
Credits: 2

Unit No.	Name of the topic	Expected learning outcomes
1.	Atomic structure and Periodicity of Elements	• To learn and understand introductory inorganicchemistry. To understand size, shape and electron • distribution in shells and sub- shells of an atom.
2.	Ionic Bonding	• To learn different types of bonds and nature of bondingin inorganic compounds. Calculations of different energies associated with ionic bonding.
3.	Chemical Bonding - Valence bond theory(VBT)	• Knowledge of nature of bonding, geometry, stability, and magnetic characters of covalent compounds by applying VBT.
4.	Acids and Bases	• Understanding of role of acids and bases in chemistry. • The study is useful in all chemical areas.
5	P-block elements	• To learn and understand the properties and uses of the • compounds of p-block elements.

Unit I: Atomic Structure and Periodicity of Elements (8 hours)

1.1 Bohr's theory of hydrogen atom and its limitations

1.2 Wave particle duality

1.3 Heisenberg uncertainty principle

1.4 Quantum numbers and their significance

1.5 Shapes of s, p and d atomic orbitals

1.6 Electrons filling rules in various orbitals: a) Aufbau's principle b) Hunds rule of maximum multiplicity c) Pauli's exclusion principle.

1.7 Electronic configuration of elements. Stability of empty, half-filled and completely filled orbitals.

1.8 Periodicity of the elements: General discussion of the following properties of the elements with reference to s block elements: a) electronic configuration b) atomic radii c) ionic radii d) ionization energy e) electron affinity f) electronegativity g) metallic

characters h) reactivity i) oxidation state j) melting and boiling points k) chemical properties.

Unit II: Chemical Bonding and Molecular Structure: Ionic Bonding (6 hours)

2.1 Types of Chemical Bonds: a) Ionic Bond b) Covalent Bond c) Co-ordinate bond d) metallic bond e) Hydrogen Bond f) Van-der walls force.

2.2 Definition and formation of ionic bond. General characteristics of ionic bonding

2.3 Energetic in Ionic bond formation.

2.4 Born-Haber cycle for NaCl and its applications.

2.5 Fajan's Rule, Applications of Fajan's rule for,

i) Polarizing power and polarizability

ii) Ionic character in covalent compounds

iii) Bond moment, dipole moment and percentage ionic character.

Unit III: Chemical Bonding and Molecular structure: Valence bond theory (VBT). (5 hours)

3.1 VSEPR Theory.

3.2 Concept of hybridization, different types of hybridization and geometry of following molecules,

i) Linear geometry- $BeCl_2$ (sp hybridization)

ii) Planer trigonal geometry- BF_3 (sp^2 hybridization)

iii) Tetrahedral geometry- $SiCl_4$ (sp^3 hybridization)

iv) Trigonal bipyramidal geometry- PCl5 (sp^3d hybridization)

v)Octahedral geometry- SF_6 (sp^3d^2 hybridization)

vi) Pentagonal bipyramidal geometry –IF_7 (sp^3d^3 hybridization)

Unit IV: Acids and Bases (4 hours)

4.1 Theories of Acids and Bases – Arrhenius concept, Bronsted –Lowry concept, Lewis concept, Lux-Flood concept. (Definition and examples only).

4.2 Hard and Soft Acids and Bases (HSAB concept).

4.2.1 Classification of Acids and Bases as hard soft and borderline.

4.2.2 Pearson's HSAB concept.

4.2.3 Acid –Base strength and hardness-softness.

4.2.4 Application and limitations of HSAB concept.

Unit V: P-Block Elements (Group 13, 14, 15) (07 hours)

5.1 Position of elements in periodic table.

5.2 Characteristics of group 13th, 14th and 15th elements with special reference to electronic configuration and periodic properties.

5.3 Compounds of group13th, 14th and 15th elements.

5.3.1 Boron –diborane (only structure).

5.3.2 Allotropes of carbon and phosphorus.

5.3.3 Oxyacids of Nitrogen (HNO_2, HNO_3).

Reference Books:

1) Lee, J. D. Concise Inorganic Chemistry ELBS, 1991.

2) Cotton, F.A., Wilkinson, G. & Gaus, P.L. Basic Inorganic Chemistry, 3rd ed., Wiley.

3) Douglas, B. E., McDaniel, D. H. & Alexander, J. J. Concepts and Models in InorganicChemistry, John Wiley & Sons.

4) Huheey, J. E., Keiter, E. A., Keiter, R. L. & Medhi, O. K. Inorganic Chemistry:

5) Principles of Structure and Reactivity, Pearson Education India, 2006.

6) Puri, Sharma, Kalia. Principles of Inorganic Chemistry

7) Madan R. L. Chemistry for Degree Students (B. Sc. First year), S. Chand

Semester –I

Paper II: Fundamental of Organic Chemistry
Paper Code: GE- BCT23-102

Marks: 50
Credits: 2

Unit No.	Name of the topic	Expected learning outcomes
1.	Fundamentals of OrganicChemistry	• The students are expected to understand the fundamentals and basic principles involved in organic Chemistry.
2.	Stereochemistry	• Understanding the spatial arrangement of atoms of organic molecule and types of stereoisomers.
3.	Chemistry of Aliphatic hydrocarbons	• To understand basic Knowledge of aliphatic hydrocarbons and synthetic reaction of aliphatic hydrocarbons
4.	Chemistry of Aromatic hydrocarbons	• To understand basic concepts of aromaticity and application of huckels rule

Unit I: Fundamentals of Organic Chemistry [10 L]

Introduction: inductive, electromeric, resonance and hyperconjugation effect. Cleavage of bonds-homolysis, heterolysis. Types of reagents and organic reactions. Introduction of reactive intermediates, carbocation, carbanion, carbon free radical, carbene, nitrene, arynes with their generation, structure, stability.

Unit II: Stereochemistry [08L]

Concept of stereochemistry, types of stereoisomerism, chiral and achiral compounds,optical isomerism in lactic acid, tartaric acid, 2,3-dihydoxybutanoic acids, enantiomerism and diastereomerism,Geometrical isomerism. Introduction, configuration and geometrical isomerism in aldoxime & ketomixes. Nomenclature of stereoisomerisms CIP rules, R/S, E and Z (cis & trans).

Unit III: Chemistry of Aliphatic Hydrocarbons [06]

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

Unit IV: Chemistry of Aromatic Hydrocarbons [06]

Introduction to homocyclic and polycyclic aromatic hydrocarbons benzene, naphthalene, anthracene, Meaning of important terms; aromatic, non-aromatic, anti-aromatic,Huckel's rules and its applications.Aromatic electrophilic substitution reactions, General mechanism, effect of substitution groups. Mechanism of nitration, sulfonation, halogenation, fridel-crafts alkylation & acylation reactions of benzene.

Theory References:

1) Organic Chemistry by Morrison & Boyd, 7thEdn

2) A Guidebook to Mechanism in Organic Chemistry, by Peter Sykes, 6th Edn.

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, 9th Edn .

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 , diasteromerism

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.

Semester –II
Paper III: Fundamental of Physical Chemistry
Paper Code: GE- BCT23-201

Marks: 50
Credits: 2

Unit-No.	Name of the Topic	Expected Learning Outcome
1.	Basic Mathematical Concepts	• Learning and coherent understanding of basic concepts And rules of logarithms, graphs, derivativeand integrations.
2.	Thermodynamics	• Knowledge and coherent understanding of basic concepts in thermodynamics will be gained by the student.
3.	Chemical Kinetics	• Learning and understanding the knowledge about basic concepts in kinetics and first order, second order reactions with characteristics and suitable examples.
4.	Physical properties of liquids	• Learning and coherent understanding of surface tension, viscosity and refractive index with suitable examples.

5.	Electrochemistry	• Learning and coherent understanding of basic concepts in electrochemistry, conductors and conductivity cells, measurement of conductance with suitable examples and numerical problems.

Unit 1: Basic Mathematical Concepts (3 hours)

1.1 Logarithm: Basic rules and calculations.

1.2 Graph - Quadrants, drawing of linear graph, Slopes and Intercept.

1.3 Derivative and Integration: Basic rules.

Unit 2: Thermodynamics (5 hours)

2.1 Introduction, Basic terms used in thermodynamics, Zeroth law of thermodynamics.

2.2 First law of thermodynamics: Mathematical equation, sign conventions,statements of first law and its limitations.

2.3 Spontaneous and non-spontaneous processes, Second law of thermodynamics.

2.4 Heat engine, Carnot's Cycle and efficiency of heat engine.

2.5 Numerical Problems.

Unit 3: Chemical Kinetics (8 hours)

3.1 Introduction, rate of reaction, definition, and units of rate constant.

3.2 Factors affecting rate of reaction.

3.3 Order and Molecularity of reaction.

3.4 First order reaction: Derivation of rate constant. Characteristics of the firstorder reaction.

3.5 Pseudo- first order reactions –i) Hydrolysis of methyl acetate in presence ofacid, ii) Inversion of cane sugar.

3.6 Second order reaction: Derivation of rate constant for equal and unequalconcentration of the reactants.

3.7 Examples of Second order reaction: i) Reaction between K2S2O8 and KI and ii) Saponification of ethyl acetate.

3.8 Characteristics of Second order reactions.

3.9 Numerical problems.

Unit4: Physical properties of liquids (6 hours)

4.1 Introduction to states of matter, qualitative description of intermolecular forces inliquids,

structure of liquids, classification of physical properties.

4.2 Surface tension and its determination using stalagmometer and differential risemethod.

4.3 Viscosity and its determination using Ostwald's viscometer.

4.4 Refractive index (Snell's law) specific and molecular refractivities and its determination using Abbe's refractometer.

4.5 Numerical Problems.

Unit 5: Electrochemistry **(8 hours)**

5.1 Introduction, types of cell, phenomenon of electrolysis, Faradays Laws ofelectrolysis.

5.2 Types of conductors.

5.3 Explanations of Conductance, specific conductance, equivalence and molecular conductance.

5.4 Variation of specific conductance, equivalence and molecular conductance with dilution, equivalent conductance at infinite dilution.

5.5 Dipping type of conductivity cell, modifications in the technique used before measurement of conductance w.r.to use of alternating current, use of conductivity water, conductivity cell and temperature control.

5.6 Measurement of conductance by Wheatstone bridge.

5.7 Cell constant and its determination.

5.8 Numerical problems.

Reference Books:

1) Barrow, G.M. Physical Chemistry Tata McGraw-Hill (2007).

2) Castellan G.W. Physical Chemistry 4 th Ed. Narosa(2004).

3) Kotz, J.C. Treichel, P.M.&Townsend,J.R.General Chemistry, Cengage Learning IndiaPvt Ltd: New Delhi(2009).

4) Mahan ,B.H. University Chemistry, 3rd Ed. Narosa(1998).

5) Petrucci, R.H. General Chemistry, 5th Ed., Macmillan Publishing Co,: New York(1985).

6) Elements of Physical Chemistry S., Glasstone, D.Lewis.(2010)

7) Principles of physical Chemistry Marron and Prutton. (2007).

8) Elements of Physical Chemistry P.W.Atkins(2017-18)

9) Essentials of Physical Chemistry Bahl and Tuli. S. Chand,2010.

10) Physical Chemistry Danials and Alberty (2016)

11) University General Chemistry C. N. R.Rao(2016)

12) Priniples of Physical Chemistry, Puri, Sharma and Pathania 47th Edison, Vishal Publishing Co.

13) Physical Chemistry , A. J.Mee

14) Advanced Physical Chemistry, GurudeepRaj

15) Physical Chemistry , R. A.Alberty

16) General Chemistry, 5th Edition, Macmillan Publishing Co. , New York (1985)

Semester –II

Paper IV: Fundamental of Analytical Chemistry

Paper Code: GE- BCT23-202

Marks: 50

Credits: 2

Unit No.	Name of the topic	Expected learning Outcomes
1.	Introduction to analytical Chemistry	• Learning various analytical procedures and importance also sampling, accuracy and precision
2.	Fundamentals ofIndustrial Chemistry and IPR	• Distinguish between classical and industrial chemistry Learning and understanding basic concepts and concentration terms c. Knowledge of IPR
3.	Chromatography	• Knowledge of chromatographic separation technique and terms involved in it. Learning paper chromatography andthin layer chromatography
4.	Theory of titrimetric Analysis	• Knowledge of various type of titrations, neutralization curves, indicators used in various titrations

1. Introduction to analytical Chemistry (6 hours)

1.1 Introduction

1.2 Importance of analysis

1.3 Analytical processes (Qualitative and Quantitative)

1.4 Methods of analysis (Only classification)

1.5 Sampling of solids, liquids and gases

1.6 Errors, types of errors (determinate and indeterminate), methods of expressingaccuracy

(Absolute and relative error)

1.7 Significant figures, mean, median, standard deviation (Numerical problemsexpected)

2. Fundamentals of Industrial Chemistry and IPR (8 hours)

2.1 Difference between classical and industrial chemistry, Raw materials for chemicalindustry, Material safety data sheets (MSDS)

2.2 Definition and Explanation of terms - Molecular weight, Equivalent weight, Molarity, Normality, Molality, Molarity of mixed solution, Acidity of base, Basicity of acid, ppt, ppm, ppb solutions, Mole Fraction, Weight fraction, Percentage compositionby W/W, W/V, V/V, Problems based on Normality, Molarity, mole fraction, mixed solution, etc.

2.3 IPR- Introduction to IPR and its significance in presence scenario

3. Chromatography (8 hours)

3.1 Introduction, Basic Principle of Chromatography, Basic terms, Classification of Chromatography

3.2 Paper Chromatography- Principle, Methodology-types of papers and treatment, sample loading, choice of solvent, development-ascending, descending, circular, location of spots, determination of Rf value, Applications, advantages and disadvantages

3.3 Thin layer chromatography- Principle, Solvent system, stationary phases, preparation of TLC plate, Detecting reagents, methodology-sample loading, development, detection of spot, Rf value, Applications, advantages and disadvantages

3.4 Comparison of paper chromatography and TLC

4. Theory of titrimetric Analysis (8 hours)

4.1 Introduction

4.2 Acid-base indicators

4.3 Theory of indicators w.r.t. Ostwald's ionization theory and quinoid theory

4.4 Neutralization curves and choice of indicators for

a. Strong acid-strong base

b. Strong acid-weak base

c. Strong base-weak acid

4.5 Complexometric titrations

a. Introduction

b. Types EDTA titrations

c. Metallochromic indicators-Eriochrome black- T

d. Indicator Action of Eriochrome black- T

Reference Books:

1) Principles of Physical Chemistry by Puri, Sharma and Pathania, Vishal Publishingcompany Jalindhar

2) Essential of Physical Chemistry by Bahl B.S., Tuli G.D. and BahlArun, S.Chand andCompany Ltd.New Delhi

3) Modern Analytical Chemistry by David Harvey, McGRAW-Hill International Edition, 2000

4) Industrial chemistry by B. K. Sharma, Goel Publishing Housing, 16th edition2011

5) Advanced Inorganic Chemistry, Vol.No.1, by Gurudeep Raj, Krishna PrakashanMedia Ltd, Goel Publication, Meerut

6) Analytical chemistry by B.K. Sharma, Krishna Prakashan Media Ltd, Meerut, edition3rd 2011

7)Principles of electroplating and electroforming by Blum and Hogaboom8)Chemical Process Industries by Shreve and Brink

9) Industrial Chemistry by Loutfy Madkor and Helen Njenga Elementary Principles of Chemical Processes by Richard Felder and RonaldRousseau, John Wiley and Sons

Practical's- OE-I and OE-II (GE- BCP23-103 & GE- BCT23-203)

Physical Chemistry

1.Chemical Kinetics:

i) To investigate the reaction between K2S2O8 and KI with equal initial concentration of reactants. (Plotting of graph).

ii) Chemical Kinetics: To study the hydrolysis of methyl acetate.

2. Equivalent weight:

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

3. pH metry:

To prepare following buffer solutions and determine their buffer capacity

i) Sodium Acetate –Acetic Acid

ii) Ammonium chloride – Ammonium hydroxide

4. Thermochemistry:

Determination of Enthalpy of neutralization of hydrochloric acid with sodium hydroxide.

Organic Chemistry

1. Estimations (any two):

a) Estimation of aniline. (by bromination method)

b) Estimation of acetamide.

c) Estimation of Aspirin

2. Organic Qualitative analysis of organic compounds (at least eight) (four containing at least one extra element- N, S, Cl. Br, I)

a) Acids: Benzoic acid, Oxalic acid, cinnamic acid

b) Phenols: Beta-Naphthol, Resorcinol

c) Base: Aniline, p-Nitroaniline,

d) Neutral: Acetone, Acetanilide, urea, thiourea

3. Preparations of derivatives of organic compounds

a) Nitration of nitrobenzene

b) Oximes of aldehydes & ketones

c) 2,4 dinitropherylhydrazone of aldehydes & ketones

d) Picrate derivative of Beta-Naphthol

e) Oxalate derivative of urea

4. Purification of compounds by crystallization using suitable solvents.

5. Purification of compounds by sublimation.

Inorganic chemistry

1. To prepare standard 0.1 N KMnO4 solution and to determine the strength of given oxalic acid solution.
2. To determine quantity of Fe (II) ions from the given solutions by titrating it with 0.1 N $K_2Cr_2O_7$ solution by using internal indicator
3. To estimate amount of Cu (II) ions by iodometric titration by using $Na_2S_2O_3$ solution.
4. To standardize supplied EDTA solution by titrating with 0.01 M $ZnSO_4$ solution and to estimate amount of calcium from given solution by using Erio-T as an indicator.
5. Quality control-To determines percentage purity of the given sample of soda ash Na_2CO_3 by titrimetric method.
6. Estimation of amount of Acetic acid from the given vinegar sample by titrimetric method
7. Chromatography: Separation and identification of cations by Paper Chromatographic technique from the following mixtures:

a) Ni^{2++} Cu^{2+}

b) Ni^{2++} Co^{2+}

c) Cu^{2++} 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. Sounders

6. Comprehensive Practical Organic Chemistry Qualitative Analysis by V. K. Ahluwali.

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.

10. Chromatography-H. Kaur

11. Chemistry for Degree students (B.Sc. First Year): R. L. Madan (S. Chand and company)

Practical Learning Outcomes:

Students will be able to explore theoretical knowledge in understanding and analysis.

Physical Chemistry

Chemical Kinetics:

1. The concepts of rate, order of reactions, rate constants and their units.

2. The reaction between K2S2O8 and KI and its mechanism with equation for rate constant.

3. The rate constant calculation from from experimental data as well as by graphical method..

Equivalent weight:

1. The concept of equivalent weight, atomic weight.

2. The measurement of volume of gas and height of solution by using eudiometer.

3. Calculation of equivalent weight from experimental data.

pH metry:

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.

Thermochemistry

Student should understand thermodynamic parameters like enthalpy of neutralization.

Organic Chemistry

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 summarize different tests and represent result.

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.

Estimation of Vitamin C/ Aspirin

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 standardize given NaOH solution and determine its normality.

4. Student should determine amount of Vitamin C /aspirin by calculation.

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

1. Students define paper chromatography, Rf 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 Rf value and identify components of given mixture.

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

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

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.

Inorganic Chemistry

Quantitative Analysis:

1. The concept of quantitative analysis, its types.
2. Weighing techniques.
3. Calculation of exact strength of given composition.

Volumetric Analysis:

1. The concept of primary and secondary standard, volumetric analysis.
2. Preparation of standard solutions
3. Determination of strength of solutions

Rayat Shikshan Sanstha's
Sadguru Gadage Maharaj College, Karad
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Syllabus for Bachelor of Science Part – I (B.Sc. - I -Chemistry Major)
As Per NEP
(w.e.f. June, 2023)

B.Sc. Part – I (Chemistry Major)

B.Sc.-I Semester-I Indian Knowledge System

Name of Paper- Ancient Indian Chemistry

(Paper code :- IKSC23-101)

Unit-I: Introduction to Ancient Indian Chemistry [06]

Contribution of Ancient Indian Chemistry in metallurgy, Ayurveda, constructor, evidences of Indian ancient Chemistry, Rasshala (Chemistry laboratory) and Apparatus (Yantra), Study of different used in ancient India. textile, dying, paper, ink, glass Cosmetics and equipment's used.

Unit-II: Ancient Indian chemists and their works [8]

Introduction of all chemist and their work in the period

- Nagarjuna
- Vagbhata
- Govindacharya
- Yashodhara
- Ramachandra
- Somdeve
- P.C. Roy

Unit-III: introduction to Rasa shastra [7]

Physical and chemical Properties and uses of

- Maharasa
- Uprasa
- General rasa.(Shadharan rasa)
- Others-gems, metals, poisons, alkali, acids, salts….etc.

Unit-IV: Metallurgy [8]

Introduction of metallurgy, ancient technique utilize in metallurgy. Study of copper age, iron age, tin age

Rayat Shikshan Sanstha's
Sadguru Gadage Maharaj College, Karad
(Autonomous)
Syllabus for Bachelor of Science Part – I (B.Sc. - I -Chemistry Major)
As Per NEP
(w.e.f. June, 2023)

B.Sc. Part – I (Chemistry Major)

B.Sc.-I Sem-II Skill Enhancement Course

SEC-I Laboratory Safety Management

(Paper Code:- SECC23-201)

Unit-I: Introduction to Laboratory Chemicals & its Management [8]

- Introduction
- General Laboratory Protocols,
- Types of hazardous chemicals: Corrosives, Oxidisers, Flammables, Water Reactives, Pyrophorics, Peroxide forming chemicals; toxics: acute effect, chronic effect, prevention of toxic exposures, LD_{50}, LC50, Threshold limit values
- Routes of Entry: Inhalation, Skin absorption, Gastrointestinal introduction of toxins
- Receipt of chemicals; Labeling of chemicals; Storage of chemicals.

Unit-II: MSDS & Laboratory Safety Pictograms (Symbols) [7]

- Introduction,
- MSDS, CASRN
- Safety symbols of various reactive chemicals.

Unit-III: Prevention of Accidents and First Aid Measures [8]

- Introduction
- First Aid measures for cuts/bleeding, burns, flammable liquid spill, Fire accidents: Fire on the cloth, Eye accidents, Chemical spill on skin, Inhalation of chemical vapours, spilling of unknown and neutral compounds, poisons, inhalation of poisonous gases.
- Universal antidote for any poison
- Materials in First Aid Kit.

Unit-IV: General Safety & Safe Handling of Chemicals [7]

- General Safety and Operational Rules: Electrical Safety, Vacuum operations, Handling glassware, Fume Hood Safety and Ventilation
- Handling and transportation of chemicals, Chemical Spills on surface, Guidelines for handling of acids, alkalis, phenols and reactive chemicals, Compressed Gas Safety, Safe Handling of Cryogenic liquids, Handling of Dry Ice.
- Waste Management & Disposal
- Housekeeping