

Rayat Shikshan Sanstha's
Sadguru Gadage Maharaj College, Karad
(Autonomous)

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

1. TITLE: B.Sc. Chemistry
2. YEAR OF IMPLEMENTATION: 2023-24
3. PREAMBLE:

This updated syllabus is prepared for second year undergraduate students, to develop their interest towards chemistry and 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 vigour 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:

I) THIRD SEMESTER----- (NO. OF PAPERS 2)

Paper V: Organic Chemistry (BCT22-301)

Paper VI: Analytical and Industrial Chemistry (BCT22-302)

Practical III: (BCP22- 403)

II) FOURTH SEMESTER----- (NO. OF PAPERS 2)

Paper VII: Physical Chemistry (BCT22-401)

Paper VIII: Inorganic Chemistry (BCT22-402)

Practical IV: (BCP22-403) (Practical examination is Annual)

9) 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.

7) Examination Pattern:

Semester	Paper No.	Theory Exam. SEE	Internal Exam CCE	Total Marks
Semester III	Paper V (BCT22-301)	40	10	100
	Paper VI (BCT22-302)	40	10	
Semester IV	Paper VII (BCT22-401)	40	10	100
	Paper VIII (BCT22-402)	40	10	
Semester IV	Practical III & IV BCP22-403	100		100
Total marks:				300

8) Credit System –

Semester	Paper No.	Name of Paper	Distribution of Marks		Total Marks	Credits
			SEE	CCE		
Semester III	Paper V (BCT22 301)	Organic Chemistry	40	10	50	2
	Paper VI (BCT22-302)	Analytical and Industrial Chemistry	40	10	50	2
Semester IV	Paper VII (BCT22-401)	Physical Chemistry	40	10	50	2
	Paper VIII (BCT22-402)	Inorganic Chemistry	40	10	50	2
	Practical Examination III & IV (BCP22-403)	Semester III and IV	100		100	8
Total					300	16

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

CCE-I: Marks =10

CCE-II: Marks =10

10) Practical Examination

No. of Days-2

Total Marks-100

1) Physical Chemistry Experiment 25 marks

2) Organic Chemistry Experiment 25 marks

3) Inorganic Chemistry Experiment 35 marks

4) Journal & Oral 15 marks

Total = 100 marks.

B.Sc. II Semester III

Paper V: Organic Chemistry**(BCT22-301)**

Marks: 50

Subject	Unit No.	Title	Periods	Credits
Organic Chemistry	I	Amines	05	2
	II	Carbohydrates	10	
	III	Heterocyclic Compounds	08	
	IV	Organic Name Reactions and synthetic Reagents	09	
	V	Stereochemistry	06	
Grand total			38	

Paper VI: Analytical and Industrial Chemistry**(BCT22-302)**

Marks: 50

Subject	Unit No.	Title	Periods	Credits
Analytical Chemistry	I	Optical methods of analysis	08	2
	II	Electro analytical methods	10	
	III	Qualitative Analysis	08	
	IV	Gravimetric analysis	05	
	V	Basic concept in industrial chemistry Soaps and detergent	07	
Grand Total			38	

Semester IV**Paper VII- Physical chemistry****(BCT22- 401)****Marks: 50**

Subject	Unit No.	Title	Periods	Credits
Physical Chemistry	I	Electrochemistry	16	2
	II	Physical properties of liquids	08	
	III	Nuclear Chemistry	08	
	IV	Chemical Kinetics	06	
Grand Total			38	

Paper VIII: Inorganic chemistry**(BCT22- 402)****Marks: 50**

Subject	Unit No.	Title	Periods	Credits
Inorganic Chemistry	I	p-Block Elements	06	2
	II	Chemistry of elements of first transition series	06	
	III	Co-ordination chemistry	12	
	IV	Chelation	06	
	V	Acids, bases and non-aqueous solvents	08	
Grand Total			38	

B.Sc. Part II: Chemistry

Semester III

Theory: Paper V: Organic Chemistry

Paper Code: BCT22- 301

Marks: 50

Credits: 2

Expected Learning Outcomes:

Unit No.	Name of the Topic	Expected Learning Outcomes
I	Amines	Knowledge about Classification, Preparation and applications of amines and diazonium salts.
II	Carbohydrates	Understanding the classification, configuration and structure of carbohydrates
III	Heterocyclic Compounds	To Impart the Knowledge of structure, synthesis and reactivity of heterocyclic compounds.
IV	Organic Name Reactions and synthetic Reagents	Student will learn some organic reactions with mechanisms and applications of some reagents.
V	Stereochemistry	Student will learn the basic knowledge of conformational analysis of some organic compounds

Unit I: Amines

(05L)

Amines (Aliphatic and Aromatic): (Upto 5 carbons) Preparation: from alkyl halides, Gabriel's Phthalimide synthesis, Hofmann Bromide reaction. Reactions: Hofmann elimination, Carbylamine test, Hinsberg test, with HNO₂, Schotten – Baumann Reaction.

Unit II: Carbohydrates

(10L)

Classification based on chemical constitution with suitable example- Sources – open chain and ring structure of carbohydrate containing five and six carbon atom, determination of configuration of glucose and fructose, Mutarotation, reaction of glucose and fructose, acetylation, osazone, methylation, reduction and oxidation, chain lengthening and shortening reaction.

Unit III: Heterocyclic Compounds

(08L)

Introduction, Classification, Pyrrole - method of synthesis, aromatic character, molecular orbital structure,

resonance, reactivity, electrophilic substitution with mechanism, chemical reaction- reduction Nitration, sulphonation, Halogenation, friedal craft reaction, coupling reaction. Comparative study of pyrrol, furan and thiophene.

Unit IV: Organic Name Reactions and Synthetic Reagents (09L)

Perkin reaction, Reformatsky Reaction, Knoevenagel Condensation, Claisen condensation, Mannich Reaction, Pinacole – Pinacolone Reaction, Clammensen Reduction, Reimer – Tiemann reaction. Synthetic Reagent- Aceto Acetic ester (Ethyl aceto acetate)and Grignard Reagent.

Unit V: Stereochemistry (06L)

Nomenclature of Conformational isomers, Conformational analysis of Ethane and Butane, threo and erythro isomerism

Reference Books: -

- 1) Chemistry for Degree student by R.L. Madan. Unit-I,II,III.
- 2) Organic chemistry by T.W. Graham Solman& Craig B. Fryhle – 9th Edition. Unit-I,II,III.
- 3) Organic Chemistry by Morrison & Boyd – 6th Edition. Unit-I,II,III,V,.
- 4) Organic Chemistry by Clayden, Greeves& Warren – 2nd Edition. Unit-I
- 5) Organic reaction mechanism - V. K. Ahluwalia, Rakesh Paruskar – 4th Edition. Unit-IV
- 6) Stereochemistry - P.S. Kalsi, D.Nasipuri,alien. Unit-V.
- 7) Stereochemistry of organic compounds – Elile. Unit-V.
- 8) Stereochemistry – Nasipuri. Unit-V.

Paper VI: Analytical and Industrial Chemistry

Paper Code: BCT22- 302

Marks: 50

Credits: 2

Expected Learning Outcomes:

Unit No.	Name of the Topic	Expected Learning Outcomes
I	Optical methods of analysis	Learning and understanding different optical methods of analysis.
II	Electro analytical methods	Learning and understanding different Electroanalytical methods of analysis.
III	Qualitative Analysis	Learning and understanding basic principles of qualitative analysis.
IV	Gravimetric analysis	Learning and understanding basic concepts in gravimetric analysis.

V	Basic concept in industrial chemistry Soaps and detergent	Learning and understanding basic concepts in industrial chemistry and soaps.
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Unit I: Optical methods of analysis & Corrosion**[08L]**

Origin of spectra, interaction of radiation with matter, fundamental laws of spectroscopy and selection rules, validity of Beer-Lambert's law.

UV-Visible Spectrometry: Basic principles of instrumentation (choice of source, monochromator and detector) for single and double beam instrument

Corrosion and Electroplating: Introduction of corrosion, Electrochemical theory of corrosion, Factors affecting on corrosion -i. Position of metals in the electrochemical series on the basis of standard reduction potential ii. Purity of metal iii. Effect of moisture iv. Effect of oxygen (differential aeration principle) v. Hydrogen overvoltage, Methods of protections of metals from corrosion, Electroplating: Electrolysis, Faraday's laws, Cathode current Efficiency, Basic principles of electroplating, Cleaning of articles, Electroplating of chromium, Anodizing

Unit II: Electro analytical methods**[10L]**

Classification of electro analytical methods, Basic principle of i) pH metric, ii) Potentiometric and iii) Conductometric titrations. Techniques used for the determination of equivalence points, Techniques used for the determination of pKa values.

Conductometric Titrations

Introduction, Instrumentation (Conductance measurement- Direct reading conductivity bridge, conductivity cell and cell constant), Types of conductometric Titrations, Advantages and disadvantages of conductometric Titrations.

Unit III: Qualitative analysis**[08L]**

Principal of qualitative and quantitative analysis, Classification of organic and inorganic qualitative analysis, Identification of compounds, the functional group analysis, Application of solubility product and common ion effect, separation of cation into groups, Application of complex formation, Application of oxidation – reduction in inorganic qualitative analysis, Choice of groups reagents & group analysis, Interfering anions (fluorate, borate, oxalate & phosphate).

Unit IV: Gravimetric analysis**[05L]**

i) Definition & types of gravimetric analysis ii) Precipitation technique with respect to theory iii)

Solubility consideration; Common ion effect; diverse Ion effect; PH; Temperature and nature of solubility. iv) Digestion v) Nucleation vi) Co & post precipitation vii) Filtration & washing viii) Drying & Ignition.

Unit V: a) Basic concept in Industrial Chemistry [04 L]

Unit operation - Filtration, centrifugation, floatation, Evaporation, crystallisation, adsorption, Unit processes- Reduction, sulphonation, halogenation, nitration, polymerisation

b) Soap and detergents [03 L]

Introduction, soap, manufacture of soap, Detergent or syndets, comparison between soap and detergents

Reference Books:

1. Jeffery, G.H., Bassett, J., Mendham, J. & Denney, R.C. Vogel's Textbook of Quantitative Chemical Analysis, John Wiley & Sons, 1989. Unit-V
2. Willard, H.H., Merritt, L.L., Dean, J. & Settoe, F.A. Instrumental Methods of Analysis, 7th Ed. Wadsworth Publishing Company Ltd., Belmont, California, USA,1988. 27. Unit-II, III.
3. Christian, G.D; Analytical Chemistry, 6th Ed. John Wiley & Sons, New York, 2004. Unit-I
4. Harris, D. C. Exploring Chemical Analysis, Ed. New York, W.H. Freeman, 2001.
5. Khopkar, S.M. Basic Concepts of Analytical Chemistry. New Age, International Publisher, 2009. Additional Reading. Unit-V, IV
6. Skoog, D.A. Holler F.J. & Nieman, T.A. Principles of Instrumental Analysis, Cengage Learning India Ed. Unit-I
7. Mikes, O. Laboratory Hand Book of Chromatographic & Allied Methods, Elles Harwood Series on Analytical Chemistry, John Wiley & Sons, 1979. Unit- I
8. Ditts, R.V. Analytical Chemistry; Methods of Separation, van Nostrand, 1974.
9. Shreves chemical processes industries. Unit-V
10. Industrial chemistry by B. K. Sharma. Unit-V
11. J. Mendham, Vogels A Text books of Quantitative Chemical Analysis. Unit-V
12. Walter. E. Haris, An Introduction to Chemical Analysis. Unit-V
13. Douglas A. Skoog, Fundamentals of Analytical Chemistry. Unit-V, V(a)
14. G. Svehla, Vogels Qualitative Inorganic Analysis, Pearson. Unit- IV
15. R. M. Verma, Analytical Chemistry Theory & Practice. Unit-IV
16. W. Bernagrd King, Experiments in General Chemistry. Unit-IV

Practical Course III BCP22: 403

Learning Objectives:

1. To study the analytical technique for structure determination of organic compound. .
2. To find the amount of different compound.
3. To study chromatographic techniques for separation and purification of compound.
4. To analyse the compounds by using different instrumental methods.

1) Organic qualitative analysis: (Minimum 8 compounds)

Acids: Salicylic acid, phthalic acid, aspirin, cinnamic acid, Succinic acid, Oxalic acid,

Phenol: β naphthol, P Nitro phenol, P Nitro phenol.

Base: P nitro aniline, O Nitro aniline, M Nitro aniline, diphenyl amine.

Neutrals: Acetamide, ethyl methyl Ketone , Acetophenone, Benzophenone, Benzaldehyde, methyl acetate, Chloro benzene, bromo benzene, Nitrobenzene, M- dinitrobenzene, naphthalene, thiourea.

2) Organic Estimation:

- a) Estimation of Acetone
- b) Estimation of glycine
- c) Estimation of Vitamin C

3) Organic Preparations: (any three)

- a) Preparation of Benzoic acid
- b) Preparation of P – nitro acetanilide
- c) Preparation of Benzamide
- d) Preparation of Dihydropyrimidone
- e) Preparation of Dibenzalacetone (Green synthesis)

4) Colorimetry:

- a) Determination of unknown concentration of potassium permanganate solution.

5) Conductometry:

- a) Determination of strength of strong acid by titrating against strong alkali

6) PH Metry:

- a) Determination of PH of given soil samples

7) Determination of percentage purity of boric acid using supplied sodium hydroxide

8) Determination of titrable acidity in the given sample of milk or lassi of alkali content of antacid tablet using HCl

9) Determination of percentage of nitrogen present in the given sample of nitrogenous fertilizer

- 10) Preparation of azo dye
- 12) Estimation of ester
- 12) Determination COD in water samples

Learning Outcomes:

1. Students learn qualitative analysis of organic compounds
2. Students Learn to standardise and to estimate quantity of acetone, glycine etc
3. Determines normality by titrations of strong acid Vs strong base
4. Students learn organic preparation and practical yield .Calculations of various organic compounds

Practical references:

1. Vogel's text book of Qualitative Chemical Analysis (Longman ELBS Edition)
2. Basic concepts in Analytical chemistry by S.M.Khopkar
3. Advanced experimental Chemistry Vol. I. Physical by J. N.Gurtu&R. Kapoor. (S. Chand &Co.)
4. Systematic Experimental Physical Chemistry – by S. W. Rajbhoj, Chondhekar. (Anjali Publ.)
5. College Practical Chemistry by H. N. Patel, S. R. Jakali, H. P. Subhedar, Miss. S.P. Turakhia.
(Himalaya Publishing House, Mumbai.)

Semester –IV

Paper VII: Physical Chemistry

Paper Code: BCT22- 401

Marks: 50

Credits: 2

Expected Learning Outcomes:

Unit No.	Name of the Topic	Expected Learning Outcomes
I	Electrochemistry	Learning and understanding conductivity and transport number of the aqueous solutions with different applications.
II	Physical properties of liquids	Knowledge about surface tension, viscosity and refractive index will be gained by students .
III	Nuclear Chemistry	Learning the various nuclear phenomena and measurement of nuclear radiations.
IV	Chemical Kinetics	Learning and understanding the knowledge about third order reaction and theories of reaction rates .

Unit- I Electrochemistry

(16L)

Introduction, Types of conductors, Conductivity, Equivalent and Molar conductivity and their variation with dilution for weak and strong electrolytes in aqueous solution. Equivalent conductivity at infinite dilution, Measurement of conductance by using Wheatstone bridge. Kohlrausch law of independent migration of ions and its applications such as Ionic mobility, determination of degree of ionization of weak electrolyte, solubility and solubility products of sparingly soluble salts. Transference number, Hittorf's rule, determination of transport number using Moving boundary method, factors affecting transport numbers. Numerical problems.

Unit- II Physical Properties of Liquids

(8L)

Introduction, Classification of physical properties, Surface tension and its determination using Stalagmometry and differential capillary rise methods, Viscosity and its determination using Ostwald's viscometer, Refractive index (Snell's law), Specific and Molecular refractivities and its determination using Abbe's refractometer.

Unit – III Nuclear Chemistry

(8L)

Introduction, Types of Nuclear radiation, properties of α , β and γ radiations, Detection and measurement of nuclear radiations by Scintillation and Geiger muller counter methods, radioactive equilibrium and range of α -particles, Geiger Nuttal relations, determination of radioactive constant (decay constant)

Unit - IV Chemical Kinetics

(6L)

Introduction, Third order reactions: derivation of rate constant, characteristics and examples of third order reaction. Theories of reaction rates as Collision theory and Transition state theory (only quantitative aspect, derivation not expected).

References:

1. Principles of Chemistry by Puri and Sharma (Vishal Publishing Company, 4th edition). Unit-I,II,III,IV
2. Essentials of Physical Chemistry by B. S. Bahl and G. D. Tuli. (S.Chand.). Unit-I,II,III,IV
3. Text Book of Physical Chemistry by Soni-Dharmarha. Unit-I,IV.

Additional Reading:

1. Physical Chemistry by R. A. Alberty (Wiley Eastern Ltd.)
2. University General Chemistry by C. N. R. Rao(Mac-Millan.)
3. Elements of Physical Chemistry by P. W. Atkins. (Oxford University Press.)
4. Physical Chemistry through problems by S. K. Dogra, D. Dogra(Wiley Eastern Ltd.)
5. Physical Chemistry by A. J. Mee. ELBS & Heinemann Educational Books Ltd.)
6. A Text Book Physical Chemistry by S. Glasstone, (Mac Millan.)
7. Advanced Chemistry by Philip Mathews, (Cambridge University.)
8. An introduction to electrochemistry by S. Glasstone. (Mac Millan.)
9. A Text Book of physical Chemistry , by A.S.Negi and S.C. Anand.New Age International

publ,2nd Ed.

10. Advanced Physical Chemistry ByGurdeep Raj

11. Text Book Of Physical Chemistry by K.L. Kapoor

Paper VIII: Inorganic Chemistry

Paper Code: BCT22- 402

Marks: 50

Credits: 2

Expected learning Outcomes:

Unit No.	Name of the Unit	Learning Outcomes
I	P- Block elements	Understanding the properties, compounds of p-block elements
II	Chemistry of elements of first transition series	Students know the properties of elements of 3d series
III	Co-ordination chemistry	Learning and understanding basic concepts about coordination complexes
IV	Chelation	Knowledge of chelate compounds and their applications
V	Acids, Bases and Non-aqueous solvents	Learning of concepts of acids and bases, types of non-aqueous solvents

Unit I: p-Block Elements

[06 L]

1.1 Position of elements in periodic table

1.2. Characteristics of p-block elements with special reference to Electronic configuration and Periodic properties

1.3. Compounds of group 13,14 and 15

Boron: Diborane - Method of preparation and nature of bonding (structure)

Borazine: Method of preparation and nature of bonding (structure)

Allotropes of carbon and phosphorus

Oxyacids of nitrogen: HNO₂, HNO₃.

Unit II: Chemistry of elements of first transition series

[06 L]

2.1 Position of elements in periodic table

2.2 Characteristics of d-block elements with special reference to

i) Electronic structure

ii) Oxidation states

- iii) Magnetic character
- iv) Colored ions
- v) Complex formation.

Unit III: Co-ordination Chemistry

[12L]

3.1 Introduction, Types of salts

3.2 Distinction between double salt and complex salt

3.3 Definition and formation of co-ordinate covalent bond in $\text{BF}_3 \cdot \text{NH}_3$, $[\text{NH}_4]^+$

3.4 Werner's theory: Postulates

The theory as applied to cobalt ammines viz. $\text{CoCl}_3 \cdot 6\text{NH}_3$, $\text{CoCl}_3 \cdot 5\text{NH}_3$, $\text{CoCl}_3 \cdot 4\text{NH}_3$, $\text{CoCl}_3 \cdot 3\text{NH}_3$.

3.5 Description of the terms: ligand, co-ordination number, co-ordination sphere

3.6 Effective atomic number

3.7 IUPAC nomenclature of coordination compounds.

3.8 Isomerism in complexes with C.N. 4 and 6

- a) Geometrical Isomerism
- b) Optical Isomerism,
- c) Structural Isomerism: Ionisation Isomerism, Hydrate Isomerism, Coordination Isomerism, Linkage Isomerism and Co-ordination position Isomerism

3.9 Valance bond theory of transition metal complex with respect to

- a) C.N. 4: complexes of Cu and Ni
- b) C.N. 6 complexes of Fe and Co

Unit IV: Chelation

[06]

4.1 A brief introduction with respect to ligands, chelating agent, chelation and metal chelates.

4.2 Structural requirements of chelate formation

4.3 Difference between metal chelate and metal complex

4.4 Classification of chelating agents (with specific illustration of bidentate chelating agents)

4.5 Application of chelation with respect to chelating agents: EDTA and DMG

Unit V: Acids, Bases and Non aqueous Solvents

[08]

5.1 Introduction to theories of Acids and Bases: Arrhenius concept, Bronsted-Lowry concept, Lewis Concept, Lux-Flood Concept (definition and examples)

5.2 Hard and Soft Acids and Bases. (HSAB Concept)

- a) Classification of acids and bases as hard, soft and borderline.
- b) Pearson's HSAB concept.
- c) Acid–Base strength and hardness-softness.
- d) Applications and limitations of HSAB principle.

5.3 Chemistry of Non aqueous Solvents.

- a) Introduction, definition and characteristics of solvents.
- b) Classification of solvents.
- c) Physical properties and Acid-Base reactions in Liquid Ammonia (NH₃) and Liquid Sulphur Dioxide (SO₂).

Reference Books:

1. Petrucci, R.H. *General Chemistry* 5th Ed. Macmillan Publishing Co.: New York (1985). Unit-I,II
2. Cotton, F.A.& Wilkinson, G. *Basic Inorganic Chemistry*, Wiley. Unit-I,II,III,IV
3. Puri, Sharma, Kalia. *Inorganic Chemistry*. Unit-I,II,III,IV, V
4. *Concise inorganic chemistry* J.D.Lee. Unit-III,IV, V
5. *Instrumental methods of chemical analysis* H. Kaur. Unit-V
6. *Chemistry for engineers* by S.K.Jain, R.S. Thakure. Unit-V
7. *Industrial chemistry* by B. K. Sharma. 5th Ed. Unit -V

Additional Reading:

1. Kotz, J.C., Treichel, P.M. & Townsend, J.R. *General Chemistry* Cengage Learning India Pvt. Ltd., New Delhi (2009).
2. Mahan, B.H. *University Chemistry* 3rd Ed. Narosa (1998).
3. Shriver, D.F. & Atkins, P.W. *Inorganic Chemistry*, Oxford University Press.
4. Wulfsberg, G. *Inorganic Chemistry*, Viva Books Pvt. Ltd.
5. Rodgers, G.E. *Inorganic & Solid State Chemistry* Cengage Learning India Ltd 2008.
6. Puri & Sharma. *Principles of Physical chemistry*.

Practical Course IV

Code: BCP22-403

Learning Objectives:

1. To study different instruments.
2. To study the gravimetric analysis technique.
3. To find the purity of different inorganic samples.
4. To study semi-micro Qualitative Analysis.

Note :1. Use of Electronic / Analytical Balance is allowed.

2. Use of scientific calculator is allowed.

Part[A] :Instrumental

1. Viscosity :

To determine the percentage composition of a given liquid mixture by viscosity method. (Density data to be given).

2. Refractometry :

To determine the specific and molar refractions of benzene, toluene and xylene by Abbe's refractometer and hence determination of the refraction of -CH₂- group (Methylene group). (Densities should be determined by students.)

3. Conductometry:

- 1) Determination of cell constant of a conductivity cell using standard KCl (N/10 or N/50) solutions
- 2) To determine degree of dissociation and dissociation constant of acetic acid avarious dilutions and to verify Ostwald's dilution law conductometrically.
- 3) To determine the normality of the given strong acid by titrating it againststrong alkali conductometrically.
- 4) To determine the normality of the given weak acid by titrating it againststrong alkali conductometrically.

Part [B]: Non - Instrumental

4. Chemical Kinetics

- 1) To study the hydrolysis of methyl acetate in presence of HCl and H₂SO₄ and todetermine the relative strength of acids.
- 2) To study the effect of acid strength (0.5 M and 0.25 M HCl) on hydrolysis of an ester.
- 3) To study the kinetics of the reaction between K₂S₂O₈ and KI in solution with unequal initial concentration of the reactants
- 4) To study the reaction between potassium bromated and potassium iodide (KBrO₃ KI) in solution and hence to determine the order of the reaction.

5. Gravimetric Analysis:

- a) Gravimetric estimation of iron as ferric oxide from the given solution of ferrous ammonium sulphate and free sulphuric acid
- b) Gravimetric estimation of barium as barium sulphate from the given solution containing barium chloride and free hydrochloric acid

6. Inorganic Preparations:

- a) Preparation of ferrous ammonium sulphate (Mohr's salt)
- b) Preparation of tetrammonium copper (II) sulphate
- c) Preparation of chloropentammine cobalt (III) chloride

7. Titrimetric Estimations:

- a) Determination of percentage purity of given sample of soda ash
- b) Determination of total hardness of water using 0.01M EDTA solution
- c) Determination on Percentage purity of tetramine copper (II) sulphate

8. Inorganic Semi-micro Qualitative Analysis :

Analysis of Inorganic binary mixture :

Anions: Cl^- , Br^- , NO_3^- , NO_2^- , SO_4^{2-} , CO_3^{2-}

Cations: Cd^{++} , Fe^{++} , Al^{+++} , Cr^{+++} , Zn^{++} , Mn^{++} , Co^{++} , Mg^{++} , K^+ , NH_4^+ , Ba^{++} , Cu^{++}

Learning Outcomes:

1. Students learn Gravimetric analysis.
2. Learn to standardise and to titrimetric estimations.
3. Students learn inorganic semi- micro qualitative analysis.
4. Students learn to operate viscometer and measure time of flow for liquids.
5. Measurement of refractive index and calculation of specific and molar refractivities.

Practical References:

1. Experiments in chemistry- D.V.Jahagirdar Himalya publishing house
2. Vogel's text book of Qualitative Chemical Analysis (Longman ELBS Edition)
3. Vogel's text book of Quantitative Analysis (Longman ELBS Edition)
4. A Text Book of Quantitative Inorganic Analysis Including Elementary Instrumental Analysis: A.I. Vogel (Third Ed.) (ELBS)
5. Practical manual in water analysis by Goyal and Trivedi
6. Basic concepts in Analytical chemistry by S.M.Khopkar
7. Practical Inorganic chemistry by Pass G.
8. Experimental Physical Chemistry by A. Findlay. (Longman.)

9. Advanced Practical Physical Chemistry by J.B. Yadav. (*Goel Publishing house, Meerut.*)
10. Experiments in Physical Chemistry by R. C. Das and B. Behra.(*Tata McGraw Hill.*)
11. Advanced experimental Chemistry Vol. I. Physical by J. N.Gurtu&R. Kapoor. (*S. Chand &Co.*)
12. Experiments in Physical Chemistry by J. C. Ghosh, (*BharatiBhavan.*)
13. Systematic Experimental Physical Chemistry – by S. W. Rajbhoj, Chondhekar. (*Anjali Publ.*)
14. Practical Physical Chemisty – by B. D. Khosala& V. C. Garg. R.(*S.Chand& Sons.*)
Experiments in Chemistry by D. V. Jahagirdar.
15. College Practical Chemistry by H. N. Patel, S. R. Jakali, H. P. Subhedar, Miss. S.P. Turakhia.
(*Himalaya Publishing House, Mumbai.*)
16. Practical Physical Chemistry ,B .Vishwanathan and P.S.Raghvan

*** Note: Practical Examination will be conducted at the end of Academic Year.**
