

Syllabus for B. Sc. II (Chemistry)**Introduced from June, 2019**

1. TITLE : B.Sc. Chemistry
2. YEAR OF IMPLEMENTATION : 2019-2020
3. DURATION : one year
4. PATTERN : Semester
5. MEDIUM OF INSTRUCTION: English
6. STRUCTURE OF COURSE:
 - 1] THIRD SEMESTER (NO. OF PAPERS 2)
Paper V : Organic Chemistry (BCT 301)
Paper VI : Analytical and Industrial Chemistry (BCT 302)
Practical I : (BCP 303) (Practical examination is semester wise)
 - 2] FOURTH SEMESTER (NO. OF PAPERS 2)
Paper VII : Physical Chemistry (BCT 401)
Paper VIII : Inorganic Chemistry (BCT 402)
Practical II : (BCP 403) (Practical examination is semester wise)
 - 3] OTHER FEATURES:
 - A) LIBRARY : Reference and Textbooks, Journals and Periodicals, Reference 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, equipments and chemicals required.

**B.Sc. II Semester III
Paper V Organic Chemistry (BCT 301)**

Marks: 40

Subject	Unit No.	Title	Periods	Credits
Organic Chemistry	I	A) Amines and Diazonium Salts B) Heterocyclic Compounds	11	2
	II	Carbohydrates	10	
	III	Amino acid, protein and Nucleic Acid	10	
	IV	Organic Name Reactions and Reagents	09	
	V	Stereochemistry	05	
Grand total			45	

**Paper VI: Analytical and Industrial
Chemistry (BCT 302)**

Marks: 40

Subject	Unit No.	Title	Periods	Credits
Analytical Chemistry	I	Optical methods of analysis	08	2
	II	Electro analytical methods	15	
	III	Qualitative Analysis	08	
	IV	Gravimetric analysis	05	
	V	Basic concept in industrial Chemistry Soap and detergent	09	
Grand Total			45	

Semester IV
Paper VII- Physical chemistry (BCT 401)

Marks: 40

Subject	Unit No.	Title	Periods	Credits
Physical Chemistry	I	Electrochemistry part I : Electrolytic Conductance and Transference	12	2
	II	Electrochemistry part II : Electromotive Force	12	
	III	Phase Equilibrium	08	
	IV	Solutions	07	
	V	Physical properties of liquids	06	
Grand Total			45	

Paper VIII- Inorganic chemistry (BCT 402)

Marks: 40

Subject	Unit No.	Title	Periods	Credits
Inorganic Chemistry	I	Chemistry of elements of first transition series.	06	2
	II	Study of f - block elements	10	
	III	Co-ordination chemistry	14	
	IV	Bio Inorganic Chemistry	06	
	V	A] Chelation B] Corrosion and passivity and its applications	09	
Grand Total			45	

B.Sc. Part - II : Chemistry Semester - III
Theory : Paper - V : Organic Chemistry
Paper Code : BCT 301

Marks : 40

(Credits : 2)

Course Objectives : Student should

1. Learn the preparation and reactions of amines and diazonium salt
2. Familiar about reaction mechanism, heterocyclic chemistry
3. Study the classification, structures and reactions of carbohydrates.
4. Study of preparations and reactions of amino acids and proteins
5. Understand basic concepts of nucleic acids.
6. Study of mechanism of various name reactions.
7. Learn conformation and conformational isomers of molecules

Unit - I : A) Amine and Diazonium Salt [06L]

Amines (Aliphatic and Aromatic): (Upto 5 carbons) Preparation: from alkyl halides, Gabriel's Phthalimide synthesis, Hofmann Bromamide reaction. Reactions : Hofmann vs. Saytzeff elimination, Carbylamine test, Hinsberg test, Reaction with HNO_2 , Schotten – Baumann Reaction. Electrophilic substitution (case aniline) : nitration, bromination, sulphonation. Diazonium salts: Preparation: from aromatic amines. Reaction : conversion to benzene, phenol, dyes.

B) Heterocyclic Compound [05L]

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 - 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, Muta rotation, reaction of glucose and fructose, acetylation, osazone, methylation, reduction and oxidation , chain lengthening and shortening reaction.

Unit - III : Amino acid, Protein and Nucleic acid [10L]

General structure of α - amino acid, isoelectric point, synthesis of an amino acid ammination of haloacid, azalactone, Curtius method, Gabriel method. Synthesis of polypeptide - Bergmann method, Fischer method, solid phase synthesis, structure of protein, Nucleic acid – classification, structure of nucleosides & nucleotides.

Unit - IV : Organic Name Reactions and Synthetic Reagents [09L]

Perkin reaction, Reformatsky Reaction, Knoevenagel Condensation, Claisen condensation, Mannich Reaction, Pinacol – Pinacolone Reaction, Clemmensen Reduction, Reimer – Tiemann reaction. Synthetic Reagent- Aceto Acetic ester (Ethyl acetoacetate) and Grignard Reagent

Unit - V : Stereochemistry [05L]

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,
- 7] Stereochemistry - D. Nasipuri, Unit - V.
- 8] Stereochemistry of organic compounds – Elile. Unit - V.

Course Outcomes :**After completion of the units students will be able to:**

1. Recapitulate the knowledge about amine, diazonium salts.
2. Understand preparation and reactions of heterocyclic compound.
3. Understand structure of carbohydrates., mutarotaion.
4. Understand structure and reactions of glucose and fructose.
5. Understand synthesis of amino acid and protein.
6. Understand preparation of nucleic acid.
7. Understand synthesis with mechanism of various name reactions.
8. Understand preparations and applications of synthetic reagents
9. Studies nomenclature of conformational isomers.
10. Understand conformational analysis of ethane and butane.

Paper VI: Analytical and Industrial Chemistry**Paper Code: BCT 302****Marks : 40****(Credits : 2)****Course Objectives : Students Should**

1. Understand optical methods of analysis.
2. Learn classification and basic principle of electroanalytical methods.
3. Study principle, classifications and applications of qualitative analysis.
4. Understand different types and steps involved in gravimetric analysis.
5. Study basic concepts of industrial chemistry.

Unit - I : Optical methods of analysis**[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, Infrared Spectrometry : Basic principles of instrumentation (choice of source, monochromator & detector) for single and double beam instrument; sampling techniques.

Unit - II : Electro analytical methods**[15L]**

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. Potentiometric titrations Introduction, Instrumentation, Types of potentiometric Titrations, Advantages of Potentiometric Titrations, 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]**

Principle 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 (Fluoride, borate, oxalate & phosphate),

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

- i] Definition & types of gravimetric analysis

- i] 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 [05 L]

Unit operation - Filtration, centrifugation, floatation, Evaporation, crystallisation, Adsorption,
Unit processes - Reduction, sulphonation, halogenations, nitration, polymerisation

B) Soap and detergents [04 L]

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

Reference Books :

1. Christian, G.D; Analytical Chemistry, 6th Ed. John Wiley & Sons, New York, 2004. Unit - I
2. Skoog, D. A. Holler F. J. & Nieman, T. A. Principles of Instrumental Analysis, Cengage Learning India Ed. Unit - I
3. Khopkar, S. M. Basic Concepts of Analytical Chemistry. New Age, International Publisher, 2009. Additional Reading. Unit -V, IV
4. Shreves chemical processes industries. Unit -V
5. Industrial chemistry by B. K. Sharma. Unit -V
6. J. Mendham, Vogels A Text books of Quantitative Chemical Analysis. Unit - V
7. Walter.E.Haris, An Introduction to Chemical Analysis. Unit - V
8. Douglas A. Skoog, Fundamentals of Analytical Chemistry. Unit - V, V(A)
9. G. Svehla, Vogels Qualitative Inorganic Analysis, Pearson. Unit - IV
10. R. M. Verma, Analytical Chemistry Theory & Practice. Unit - IV
11. W. Bernagrd King, Experiments in General Chemistry. Unit - IV

Course Outcomes :**After completion of the units students will be able to :**

1. Understand basic terms and instrumentation related to UV spectrophotometer.
2. Illustrate the IR spectrometry by schematic diagram.

3. Understand basic principle of pH metric and potentiometric titrations.
4. Understand basic principle of conductometric titrations.
5. Understand the basic terms use in qualitative and quantitative analysis.
6. Identify compounds by qualitative analysis.
7. Understand different types of gravimetric analysis.
8. Understand different steps of gravimetric analysis.
9. Understand about importance of common ion effect, diverse ion effect, pH.
10. Study the manufacture of soap.
11. Understand unit operation and unit process used in industries.

Practical Course : BCP : 303

Course Objectives : Students should

1. Study the analytical technique for structure determination of organic compound.
2. Find the amount of different compound quantitatively.
3. Prepare of various organic compounds by known reactions.
4. Study chromatographic techniques for separation and purification of compound.
5. Analyze 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 : α - naphthol, p - Nitrophenol, p - Nitrophenol.

Base : p nitro aniline, o Nitro aniline, m Nitro aniline, diphenyl amine.

Neutrals : Acetanilide, 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
- 11] Estimation of ester
- 12] Determination COD in water samples
- 13] Any other suitable experiments as per requirement.

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.)

Course Outcomes :**After completion of the experiments students will be able to:**

1. Learn qualitative analysis of organic compounds.
2. Learn to standardise and to estimate quantity of acetone, glycine etc.
3. Determines normality by titrations of strong acid Vs strong base.
4. Develop preparative skills in organic preparations.
5. Develop analytical skills in organic qualitative analysis .
6. Plan experimental projects and execute them.

Semester –IV
Paper VII: Physical Chemistry
Paper Code : BCT 401

Marks : 40**(Credits : 2)****Course Objectives : Student should**

1. Study the Electrolytic Conductance and Transference.
2. Learn the electromotive force
3. Understand the inter conversion of chemical and electrical energy and to link thermodynamics with electrochemistry.
4. Study thermodynamics of ideal solution, non ideal solution and miscibility of liquid.
5. Study the physical properties of liquid.

Unit - I : Electrochemistry part I : Electrolytic Conductance and Transference [12L]

Electrolysis and Faraday's laws of Electrolysis, Conduction of electricity, Types of conductors- Electronic and Electrolytic. Explanation of the terms: Specific, equivalent and molar conductance, relation between specific and equivalent conductance, variation of conductance with dilution, equivalent conductance at infinite dilution. Migration of ions, Hittorf's rule, Transport number, Determination of transport number by moving boundary method, Factors influencing transport number : Nature of electrolyte, Concentration, Temperature, Complex formation, Abnormal transport number, Degree of hydration, Kohlrausch law and application of conductance measurement, Numerical problems.

- i] Relationship between ionic conductance, ionic mobility and transport number.
- ii] Determination of equivalent / molar conductance at infinite dilution for weak electrolytes.
- iii] Determination of degree of dissociation.
- iv] Determination of ionic product of water.
- v] Determination of solubility and solubility product of sparingly soluble salts.
- vi] Determination of hydrolysis constant of salt.

Unit - II: Electrochemistry part - II : Electromotive Force [12L]

Galvanic cells. Concept of EMF of a cell. Measurement of EMF of a cell. Standard electrode potential, Nernst equation and its importance. Types of electrodes: Metal-Metal ion electrode, Amalgam electrode, Gas electrode, Metal insoluble salt electrode, Oxidation- reduction electrode, Thermodynamics of a reversible cell, calculation of thermodynamic

properties : ΔG , ΔH and ΔS from EMF data. Calculation of equilibrium constant from

EMF data. pH determination using hydrogen electrode and quinhydrone electrode. Numerical problems.

Unit - III : Phase Equilibrium**[08L]**

Phases, components and degrees of freedom of a system, criteria of phase equilibrium. Gibbs Phase Rule and its thermodynamic derivation. Phase diagrams of one-component systems (water and sulphur). Two component systems involving eutectics, congruent and incongruent melting points (lead - silver, FeCl_3 - H_2O). Derivation of Clapeyron and Clausius – Clapeyron equation and its importance in phase equilibria.

Unit - IV : Solutions**[7L]**

Thermodynamics of ideal solutions : Ideal solutions, Non - ideal solutions Raoult's law, deviations from Raoult's law. Vapour pressure - composition and temperature composition curves of ideal and non - ideal solutions. Distillation of solutions. Lever rule, Azeotropes. Partial miscibility of liquids : Critical solution temperature; effect of impurity on partial miscibility of liquids. Immiscibility of liquids - Principle of steam distillation. Nernst distribution law and its applications, solvent extraction (Derivation).

Unit -V : Physical properties of liquid**[6L]**

Classification of physical properties. Viscosity, coefficient of viscosity, determination of viscosity by Ostwald's Viscometer. Refractive index, measurement of refractive index by Abbe's refractometer, specific and molecular refraction, molecular refractivity. Numerical problems.

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

- Age International publication, 2nd Ed.
13. Advanced Physical Chemistry By Gurdeep Raj.
 14. Text Book of Physical Chemistry by K.L. Kapoor.

Course Outcomes:**After completion of the units students will be able to:**

1. Recapitulate the knowledge about Electrochemistry and conductance measurement.
2. Understand Kohlrausch law and solve numerical.
3. Explain derivation of relation between various types of conductance, ionic mobility.
4. Understand the concept about galvanic cells, construct and derives equation for emf of Cells.
5. Understand basic terms related to Phase rule and solutions and derivation of Equations.
6. Understand phase diagram of one and two component system.
7. Explain ideal and non ideal solution.
8. Understand Nernst distribution Law and its application.
9. Learns the physical properties of liquids and structure elucidation
10. Solve numerical problem based on viscosity.

Paper - VIII : Inorganic Chemistry
Paper Code : BCT 402**Marks : 40****(Credits : 2)****Course Objectives : Student should**

1. Develop the knowledge about Periodic Table.
2. Learn properties of d - block elements.
3. Learn properties of f - block elements in the period table.
4. Learn basic concepts in coordination chemistry.
5. Study bio inorganic chemistry and biological role of earth metals.
6. Understand chelation, corrosion and passivity.
7. Makes familiar with importance of elements in biological process.

Unit - I : Chemistry of elements of first transition series. [06 L]

Position of elements in periodic table, characteristics of d-block elements with special reference to i] Electronic structure.

- ii] Oxidation states, stability of oxidation states of Fe with respect to Latimer diagram.
- iii] Magnetic character

iv] Colored ions v] Complex formation.

Unit - II : Study of f- block elements.**[10 L]****a] Lanthanides.**

Introduction of f-block elements, Positions of Lanthanides in the Periodic Table, Electronic Configuration, Lanthanide contraction, Oxidation states, Magnetic properties, Occurrence, Separation of lanthanides by Ion exchange method.

b] Actinides.

Position in periodic table, Electronic configuration, Oxidation States. General methods of preparation of Transuranic elements.

- i] Neutron capture – followed by β decay.
- ii] Accelerated projectile bombardment.
- iii] Heavy ion bombardment.

Unit - III : Co - ordination Chemistry**[14 L]**

Introduction - Definition and formation of co-ordinate covalent bond in $\text{BF}_3 - \text{NH}_3[\text{NH}_4]^+$ and H_2O . Distinguish between double salt and complex salt, Werner's theory-Postulates. The theory as applied to cobalt amines viz. $\text{CoCl}_3 \cdot 6\text{NH}_3$, $\text{CoCl}_3 \cdot 5\text{NH}_3$, $\text{CoCl}_3 \cdot 4\text{NH}_3$, $\text{CoCl}_3 \cdot 3\text{NH}_3$. Description of the terms - ligand, co - ordination number, co-ordination sphere, Effective atomic number, IUPAC nomenclature of coordination compounds. Isomerism in complexes with C.N. 4 and 6, Geometrical Isomerism, Optical Isomerism, Structural Isomerism - Ionisation Isomerism, Hydrate Isomerism, Coordination Isomerism, Linkage Isomerism and Co-ordination position Isomerism Valence bond theory of transition metal complex with respect to, C.N. 4, complexes of Cu and Ni, C.N. 6 complexes of Fe and Co, Crystal field splitting of 'd' orbital in octahedral, tetrahedral & square planar complexes. Factors affecting to the Crystal field parameters, High spin & low spin octahedral complexes of Co (II), Crystal field stabilization energy (CFSE), Limitations of CFT.

Unit - IV : Bio Inorganic Chemistry**[06 L]**

Introduction, Essential and trace elements in biological process, Metalloporphyrins with special reference to heamoglobin and myoglobin. Biological role of alkali and alkaline earth metal ions with special reference to Na^+ & K^+ .

Unit - V : A) Chelation**[05 L]**

A brief introduction with respect to ligands, chelating agent, chelation and metal chelates. Structural requirements of chelate formation, Difference between metal chelate and metal complex, Classification of chelating agents (with specific illustration of

bidentate chelating agents) Application of chelation with respect to chelating agents - EDTA and DMG.

B] Corrosion, Passivity and its application**[04 L]**

Introduction of corrosion, Electrochemical theory of Corrosion, Factors affecting on corrosion, Methods of protection of metals from corrosion, Passivity: Definition, types of passivity, oxide film theory and evidences, application of passivity.

Reference Books :

1. Cotton, F.A. & Wilkinson, G. Basic Inorganic Chemistry, Wiley. Unit-I, II, III, IV
2. Puri, Sharma, Kalia. Inorganic Chemistry. Unit - I, II, III, IV, V
3. Concise inorganic chemistry J. D. Lee. Unit - III, IV, V
4. Instrumental methods of chemical analysis H. Kaur. Unit - V
5. Chemistry for engineers by S. K. Jain, R. S. Thakure. Unit - V
6. 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. Shriver, D.F. & Atkins, P.W. Inorganic Chemistry, Oxford University Press.
3. Wulfsberg, G. Inorganic Chemistry, Viva Books Pvt. Ltd.
4. Rodgers, G.E. Inorganic & Solid State Chemistry Cengage Learning India Ltd 2008.
5. Puri & Sharma. Principles of Physical chemistry.

Course Outcomes:**After completion of the units students will be able to :**

1. Learns about periodic table thoroughly and understands the meaning of transition.
2. Understand the various properties of d- block elements.
3. Understands the characteristics properties of lanthanide series.
4. Understands the characteristics properties of actinides series.
5. Understands what co - ordinate bond, double salts and complex salt is.
6. Understand various theory – postulates of coordination chemistry.
7. Understand about the Metallo porphyrins with special reference to hemoglobin and myoglobin.
8. Understand biological role of alkali and alkaline earth metals.
9. Understand the process of Corrosion, Passivity and its application.
10. Understand chelation and it's properties.

Practical Course
Course Code : BCP- 403

Course Objectives : Students should

1. Study different instrumental operating skill.
2. Study the rate of reaction by chemical kinetics.
3. Study the gravimetric analysis technique.
4. Find the purity of different inorganic samples.
5. Study Semi - Micro Qualitative Analysis.
6. Acquire the quantitative skills in volumetric 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 $-\text{CH}_2-$ 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 at various dilutions and to verify Ostwald's dilution law conductometrically.
- 3] To determine the normality of the given strong acid by titrating it against strong alkali conductometrically.
- 4] To determine the normality of the given weak acid by titrating it against strong alkali conductometrically.

Part [B] : Non - Instrumental**4. Chemical Kinetics**

- 1] To study the hydrolysis of methyl acetate in presence of HCl and H_2SO_4 and to determine 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 $K_2S_2O_8$ and KI in solution with unequal initial concentration of the reactants
- 4) To study the reaction between potassium bromate and potassium iodide ($KBrO_3$ and 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^{2+} , Fe^{2+} , Al^{3+} , Cr^{3+} , Zn^{2+} , Mn^{2+} , Co^{2+} , Mg^{2+} , K^+ , NH_4^+ , Ba^{2+} , Cu^{2+}

9. Any other suitable experiments as per requirement.

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. Practical Inorganic chemistry by Pass G.

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

Course Outcomes:**After completion of the experiments, students will be able to:**

1. Understand Gravimetric analysis.
2. Learn to standardize and to titrimetric estimations.
3. Understand inorganic semi- micro qualitative analysis.
4. Operate viscometer and measures time of flow for liquids.
5. Operate conductometer instrument and find out normality, equivalence point of reaction.
6. Measure the refractive index and calculation of specific and molar refractivities.
7. Plan experimental projects and execute them.
8. Acquire the quantitative skills in gravimetric analysis .
9. Acquire preparative skills in inorganic preparations.
