

Rayat Shikshan Sanstha's

**YASHAVANTRAO CHAVAN INSTITUTE OF
SCIENCE, SATARA**

(AN AUTONOMOUS COLLEGE)

Reaccredited by NAAC with 'A+' Grade

Bachelor of Science

Part - II

Chemistry

Syllabus

to be implemented w.e. f. June, 2022

Structure of the Course:

Semester III

Sr. No.	Subject Title	Theory					Practical	
		Course No. and Course code	Title of Course	No. of lectures per week	Credits		No. of lectures per week	Credits
1.	Chemistry	Course V BCT 301	Organic Chemistry	6	4	Practical III BCP: 303	8	4
		Course VI BCT 302	Analytical and Industrial Chemistry	6	4			

Semester IV

Sr. No	Subject Title	Theory					Practical	
		Course No. and Course Code	Title of Course	No. of lectures per week	Credits		No. of lectures per week	Credits
1.	Chemistry	Course VII BCT 401	Physical Chemistry	6	4	Practical IV BCP 403	8	4
		Course VIII BCT 402	Inorganic Chemistry	6	4			

B. Sc. II: Evaluation Structure

Semester III

	ESE	Internal Exam			Total	Practical III (BCP 303)			Submission	Total
		ISE-I	ISE-II	Home assignment			Exam	Journal	Seminar and Student Performance	
Course V	30	5	5	10	50	Practical III (A)	15	5	5	25
Course VI	30	5	5	10	50	Practical III (B)	15	5	5	25
	60	10	10	20	100		30	10	10	50
Grand Total =150										

Semester IV

	ESE	Internal Exam			Total	Practical IV (BCP 403)			Submission	Total
		ISE-I	ISE-II	Home assignment			Exam	Journal	Industrial Tour/ Educational Tour Student Performance	
Course VII	30	5	5	10	50	Practical IV (A)	15	5	5	25
Course VIII	30	5	5	10	50	Practical IV (B)	15	5	5	25
	60	10	10	20	100		30	10	10	50
Grand Total =150										

Structure and Titles of the B. Sc. II Course

Semester III		
Code	Name of Course	Units
BCT 301	Organic Chemistry (CREDITS:02; TOTAL HOURS: 45)	Unit I: Amines and Diazonium Salt Unit II: Chemistry of Biomolecules a) Carbohydrates b) Amino acid, Protein and Nucleic Acid Unit III: Organic Name Reactions and Reagents Unit IV: Stereochemistry
BCT 302	Analytical and Industrial Chemistry (CREDITS:02; TOTAL HOURS : 45)	Unit I: Optical Methods of Analysis Unit II: Electroanalytical Methods of Analysis Unit III: Fundamentals of Analysis a) Qualitative Analysis b) Quantitative Analysis Unit IV: a) Basic concept in Industrial Chemistry b) Industrial gases

Semester IV		
Code	Name of Course	Units
BCT 401	Physical Chemistry (CREDITS:02; TOTAL HOURS: 45)	Unit I: Electrochemistry Part I: Electrolytic Conductance and Transference Unit II: Electrochemistry Part II: Electromotive Force Unit III: Phase Equilibrium Unit IV: Physical Properties of liquids
BCT 402	Inorganic Chemistry (CREDITS:02; TOTAL HOURS: 45)	Unit I: Study of Periodic properties of Elements a) P- Block elements b) Elements of first transition series Unit II: Co-ordination chemistry Unit III: Bio Inorganic Chemistry Unit IV: Applied Inorganic Chemistry a) Chelation b) Corrosion, Passivity and its application

Semester – III

Course – V BCT 301: Organic Chemistry

Course Objectives: Student will be able to...

1. Learn the preparation and reactions of amines and diazonium salt
2. Understand the classification, structures and reactions of carbohydrates, amino acids and proteins and basic concepts of nucleic acids.
3. Know the mechanism of various name reactions.
4. Learn conformation and conformational isomers of molecules

Credits (Total Credits 2)	SEMESTER-III BCT 301	No. of hours per unit/credits
UNIT - I	Amine and Diazonium Salt	(09)
	A) Amines (Aliphatic and Aromatic): (Upto 5 carbons) Preparation: from alkyl halides, Gabriel's Phthalimide synthesis, and Hofmann Bromamide reaction. B) Reactions: Hofmann vs. Saytzeff elimination, Carbylamines test, Hinsberg test, Reaction with HNO ₂ , Schotten – Baumann Reaction. Electrophilic substitution (case aniline): nitration, bromination, sulphonation. C) Diazonium salts: Preparation: from aromatic amines. Reaction: conversion to benzene, phenol, dyes.	
UNIT - II	Chemistry of Biomolecules	(20)
	a) Carbohydrates Classification based on chemical constitution with suitable example- Sources – open chain and ring structure of carbohydrate containing five and six carbon atom, interconversion of glucose and fructose determination of configuration of glucose, Muta-rotation, reaction of glucose, acetylation, Ozonolysis, methylation, reduction and oxidation, chain lengthening and shortening reaction. b) Amino acid, protein and Nucleic Acid General structure of amino acid, isoelectric point, synthesis of an amino acid amination of halo acid, aza-lactone, Curtius method, Gabriel method. Synthesis of polypeptide Solid phase synthesis, structure of protein, Nucleic acid – classification, structure of nucleosides & nucleotides	
UNIT - III	Organic Name Reactions and Synthetic Reagents	(10)
	Perkin reaction, Reformatsky Reaction, Knoevenagel Condensation, Claisen condensation, Mannich Reaction, Pinnacol – Pinacolone Reaction, Clemmenson Reduction, Reimer – Tiemann reaction. Synthetic Reagent- Aceto Acetic ester (Ethyl acetoacetate) and Grignard Reagent	

UNIT - IV	Stereochemistry	(06)
	Nomenclature of Conformational isomers, Conformational analysis of Ethane and Butane, threo and erythro isomerism, Stereoselective and Stereospecific reactions.	

Course Outcomes: Students should be able to...

1. Recollect the concepts of amine, diazonium salts.
2. Present structure of carbohydrates and structure and reactions of glucose and fructose.
3. Demonstrate synthesis with mechanism of various name reactions and preparations and applications of synthetic reagents.
4. Recognise the conformational isomers and conformational analysis of ethane and butane.

References:

1. R. L. Madan (2016) Chemistry for Degree student, S. Chand (Unit I and Unit II)
2. Morrison & Boyd, (2002) Organic Chemistry, Pearson Education, Prentice Hall of India, 6th Edition. (Unit III)
3. V. K. Ahluwalia, R. K. Parashar, (2010) Organic reaction mechanism Narosa Publishing House, 4th Edition. (Unit III)
4. P. S. Kalsi, (2015) Stereochemistry, New Age International, 8th edition, (Unit IV)
5. D. Nasipuri., (2011) Stereochemistry of Organic Compounds, New Age International, 4th edition, (Unit IV)

Course – VI BCT 302 Analytical and Industrial Chemistry

Course Objectives: Student will be able to...

1. Understand optical methods of analysis.
2. Learn classification and basic principles of electroanalytical methods.
3. Study principle, classifications and applications of qualitative and Quantitative analysis and steps involved in gravimetric analysis
4. Understand unit operations industrial chemistry and learn industrial gases fermentation with respect to fermentor design , fermentation media

Credits (Total Credits 2)	SEMESTER-III BCT 302	No. of hours per unit/credits
UNIT - I	Optical Methods of Analysis	(08)
	A) Origin of spectra, interaction of radiation with matter, B) Fundamental laws of spectroscopy and selection rules, validity of Beer – Lambert’s law. C) UV – Visible Spectrometry: Basic principles, instrumentation (choice of source, monochromator and detector) for single and double beam instrument, D) Infrared Spectrometry: Basic principles of instrumentation (choice of source, monochromator & detector) for single and double beam instrument; sampling techniques	

UNIT - II	Electro Analytical Methods	(08)
	A) Classification of electro analytical methods, Basic principle of i] pH meter ii] Potentiometer and iii] Conductometer. B) Conductance measurement- Direct reading conductivity bridge, conductivity cell and cell constant C) Conductometric Titrations: Introduction, Instrumentation D) Types of conductometric Titrations, Advantages and disadvantages of conductometric Titrations.	
UNIT - III	Fundamentals of Analysis:	(13)
	Part A: Qualitative Analysis A) Principle of qualitative and quantitative analysis, Classification of organic and inorganic qualitative analysis B) Identification of compounds, the functional group analysis, C) 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 D) Choice of groups reagents & group analysis. Interfering anions (Flurate, borate, oxalate & phosphate), Part B: Quantitative analysis A) Definition & types of gravimetric analysis B) Precipitation technique with respect to theory, Solubility consideration; common ion effect; diverse Ion effect; pH C) Temperature and nature of solubility, Digestion, Nucleation, co & post precipitation, Filtration & washing, Drying & Ignition.	
UNIT - IV	Basic concepts in Industrial Chemistry	(16)
	a) Unit operation –Centrifugation, flotation, Evaporation, Adsorption Unit process-Reduction, sulphonation, halogenations, nitration, polymerisation b) Industrial Gases: Introduction, Manufacture and applications of 1) Carbon dioxide 2) Hydrogen 3) Sulfur dioxide	

Course Outcomes: Student should be able to...

1. Illustrate fundamentals of spectroscopy and remembers laws of spectroscopy
2. Compute and explains types of conductance, degree of dissociation,
3. Analyse organic compounds and inorganic mixtures qualitatively and quantitatively
4. Design the pathways of unit processes.

References-

1. Dr. G. R. Chatwal and Sham Anand, Instrumental Methods of Chemical Analysis, Himalaya Publishing House, (2011) Unit I and Unit II
2. G. Svehla , B. Sivasankar, Vogel’s text book of Qualitative Inorganic Analysis, Pearson Education India, (2012) Unit III
3. J. Mendham, B. Sivasankar Vogel’s text book of Quantitative Chemical Analysis, Pearson Education India, (2009) Unit III
4. S. M. Khopkar, Basic concepts in Analytical chemistry, New Age International Ltd, (2017) Unit I
5. B. K. Sharma, Industrial Chemistry, (2000) Goel publishing House, Meerut

6. G. T. Austin, Shreve's Chemical Process Industries, 5th Edition (2017), MacGraw Hill (Unit IV: page no.101 to 115,127-128)

BCP 303 Chemistry Practical III (Lab III)

Course Objectives: Students will be able to ...

1. Learn analytical technique for structure determination of organic compound.
2. Find the amount of different compound quantitatively and by using different instrumental methods.
3. Prepare of various organic compounds by known reactions.
4. Understand chromatographic techniques for separation and purification of compound.

Credits (Total Credit 04)	SEMESTER-III BCP 303 Chemistry Practical III	No. of hours per unit/credits (08)
Section I	Organic Chemistry	
1.	Organic qualitative analysis: (Minimum 8 compounds)	
	Acids: Salicylic acid, phthalic acid, aspirin, cinnamic acid, Succinic acid, Oxalic acid, Phenol: α - naphthol, resorcinol, p-nitro phenol, 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 Estimations	
	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 Di-hydropyrimidone e] Preparation of Dibenzalacetone (Green synthesis)	
Section II	Analytical and Industrial Chemistry	
4.	Chromatography: Demonstration of Thin layer chromatography. Separation, identification and determination of Rf values	
5.	Colorimetry: Determination of unknown concentration of potassium permanganate solution	

6.	pH Metry: 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	

Course Outcomes: Students will be able to...

1. Identify organic compounds using qualitative analysis technique.
2. Standardise and estimate quantity of acetone, glycine etc.
3. Develop preparative skills in organic preparations.
4. Develop analytical skills in organic qualitative analysis.

Practical Reference:

1. G. Svehla, B. Sivasankar, (2012) Vogel's text book of Qualitative Inorganic Analysis, Pearson Education India,
2. S. M. Khopkar, (2017) Basic concepts in Analytical chemistry, New Age International Ltd.
3. J. N. Gurtu & R. Kapoor., Advanced experimental Physical Chemistry Vol. I. (6th Edition, 2010) S. Chand & Co
4. S. W. Rajbhoj, Chondhekar., Systematic Experimental Physical Chemistry, (2000) Anjali Publ.
5. H. N. Patel, S. R. Jakali, H. P. Subhedar, Miss. S.P. Turakhia., College Practical Chemistry, (2022) Himalaya Publishing House, Mumbai

SEMESTER- IV

Course VII: BCT 401: Physical Chemistry

Course Objectives: Student will be able to...

1. Understand the basic concepts of Electrochemistry.
2. Improve the problem solving skills and make them familiar with simple calculations in chemistry.
3. Learn phase diagrams of one and two component system
4. Recognize physical properties of liquids

Credits (Total Credits 2)	SEMESTER-IV BCT 401 Physical Chemistry	No. of hours per unit/credits
UNIT - I	Electrochemistry Part I: Electrolytic Conductance and Transference	(14)
	A) Electrolysis and Faraday's laws of Electrolysis, Conduction of electricity, and 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. B) 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 C) Kohlrausch law and application of conductance measurement: (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 D) Numerical problems	
UNIT - II	Electrochemistry Part II: Electromotive Force	(12)
	A) Galvanic cells. Concept of EMF of a cell. Measurement of EMF of a cell. Standard electrode potential, B) Nernst equation and its importance. C) Types of electrodes: Metal/Metal ion electrode, Amalgam electrode, Gas electrode, Metal insoluble salt electrode, Oxidation-reduction electrode D) 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.	

	E) Numerical problems.	
UNIT - III	Phase Equilibrium	(10)
	<p>A) Phases, components and degrees of freedom of a system, criteria of phase equilibrium. Gibbs Phase Rule and its thermodynamic derivation.</p> <p>B) Phase diagrams of one component systems (water and sulphur)</p> <p>C) Two component systems involving eutectic point (lead silver, KI-Water, FeCl₃-water).</p> <p>D) Derivation of Clapeyron and Clausius – Clapeyron equation and its importance in phase equilibria,</p> <p>E) Numerical based on Clapeyron and Clausius equation</p>	
UNIT - IV	Physical Properties of Liquids	(09)
	<p>A) Classification of physical properties. Viscosity, coefficient of viscosity, determination of viscosity by Ostwald's Viscometer.</p> <p>B) Refractive index, measurement of refractive index by Abbe's refractometer, specific and molecular refraction, molecular refractivity.</p> <p>C) Surface Tension: Surface tension and its determination using Stalagmometer and differential capillary rise method</p> <p>D) Numerical problems.</p>	

Course Outcomes: Students should be able to...

1. Recite the knowledge about Electrochemistry and conductance measurement. Derive relation between various types of conductance, ionic mobility and understands Kohlrausch law and solve numerical.
2. Revise of the concept about galvanic cells, construct and derives equation for emf of Cells.
3. Compute basic terms related to Phase rule and solutions and derivation of equations.
4. Interpret molecular structure of liquids using physical properties.

References:

1. B. R. Puri, L. R. Sharma, M. S. Pathania, Principles of Physical Chemistry, Vishal Publishing Company, (2013) 4th edition (Unit I, Unit III)
2. B. S. Bahl and G. D. Tuli., (2010) Essentials of Physical Chemistry, S. Chand.(Unit I Unit IV)
3. U. N. Dash, U. N. Darmarha, P. L. Soni, (2016) Text Book of Physical Chemistry, S. Chand & Sons (Unit II)
4. P. W. Atkins , Julio de Paula, (2012) Elements of Physical Chemistry, Oxford University Press, (2012)
5. S. K. Dogra, D. Dogra, Physical Chemistry through problems, Wiley Eastern Ltd. (1984) (Unit I, II, III, IV)
6. A. S. Negi and S.C. Anand, A Text Book of Physical Chemistry, New Age International publ, (2nd Ed. 2007) (Unit III)

Course – VIII BCT 402 Inorganic Chemistry

Course Objectives: Student will be able to...

1. Learn about periodic table thoroughly and understands the meaning of transition. Understands the characteristics properties w.r.t. electronic configuration, lanthanide contraction, oxidation state.
2. Understand the concept of co-ordinate bond and difference between double salt and complex salt
3. Know the structure of Metallo-porphyrins with special reference to haemoglobin and myoglobin.
4. Understand the process of Corrosion, Passivity and its application

Credits (Total Credits 2)	SEMESTER-IV BCT 402 Inorganic Chemistry	No. of hours per unit/credits
UNIT - I	Study of Periodic Properties of Elements	(16)
	<p>a) P- Block Elements Position of elements in periodic table, Characteristics of p-block elements with special reference to electronic configuration and Periodic Properties, Compounds of p block elements. Anomalous behaviour.</p> <p>b) Elements of First Transition Series. Position of elements in periodic table, Characteristics of d-block elements with special reference to i) Electronic structure ii) Oxidation states iii) Magnetic character iv) Coloured ions v) Complex formation.</p>	
UNIT - II	Co-ordination Chemistry	(14)
	<p>A) Introduction-Definition and formation of co-ordinate covalent bond in $\text{BF}_3 \cdot \text{NH}_3$, $[\text{NH}_4]^+$ and H_2O. Distinction between double salt and complex salt</p> <p>B) Werner's theory-Postulates. The theory as applied to cobalt amines viz. $\text{CoCl}_3 \cdot 6\text{NH}_3$, $\text{CoCl}_3 \cdot 5\text{NH}_3$, $\text{CoCl}_3 \cdot 4\text{NH}_3$, $\text{CoCl}_3 \cdot 3\text{NH}_3$.</p> <p>C) Description of the terms- ligand, co-ordination number, co-ordination sphere, Effective atomic number IUPAC nomenclature of coordination compounds</p> <p>D) Introduction to Isomerism in complexes</p> <p>E) 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</p>	

	F) 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 - III	Bio Inorganic Chemistry	(06)
	Introduction, Essential and trace elements in biological process, Metallo-porphyrins with special reference to haemoglobin and myoglobin. Biological role of alkali and alkaline earth metal ions with special reference to Na ⁺ & K ⁺ .	
UNIT - IV	Applied Inorganic Chemistry	(09)
	<p>a) Chelation</p> <p>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</p> <p>b) Corrosion, Passivity and its application</p> <p>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.</p>	

Course Outcomes: Student should be able to...

1. Recall the position of elements in periodic table and write their properties. Summarise the characteristics properties w.r.to electronic configuration, lanthanide contraction, oxidation state.
2. Explain co-ordinate bond, double salts and complex salt on the basis of co-ordination.
3. Discuss the metallo-porphyrins with special reference to haemoglobin and myoglobin.
4. Evaluate co-ordination chemistry with reference to chelation . Elaborate application of corrosion

References

1. J. D. Lee (2008) Concise Inorganic Chemistry, Oxford University Press. (Unit I)
2. R. Gopalan, V Ramalingam, Concise Co-ordination Chemistry, Vikas Publishing House Pvt Ltd (Unit II, Unit IV)
3. B. R. Puri, L R Sharma, K C Kalia (2020) Principles of Inorganic Chemistry, Vishal Publishing Company.(Unit III)
4. H. Kaur, (2016) Instrumental methods of chemical analysis, Pragati Prakashan Meerut, (Unit IV)

BCP- 403 Chemistry Practicals –IV (Lab IV)

Course Objectives: Student will be able to...

1. Learn instrument handling skills and related calculations
2. Study the reaction rate and other parameters (plotting of graph)
3. Understand quantitative analysis techniques such as Gravimetry and Volumetry.
4. Acquire the qualitative analysis techniques including organic and inorganic semi-micro analysis.

Note:

1. Use of Electronic / Analytical Balance is allowed.
2. Use of scientific calculator is allowed.

Credits (Total Credit 04)	SEMESTER-IV BCP- 403 Chemistry Practicals –IV	No. of hours per unit/credits (08)
	Section I : Physical Chemistry	
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 -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 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	
4	Chemical Kinetics:	
	1) To study the hydrolysis of methyl acetate in presence of HCl and H ₂ SO 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 ₂ S ₂ O 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.	
	Section II: Inorganic Chemistry	
5.	Gravimetric Analysis:	

	<ol style="list-style-type: none"> 1. Gravimetric estimation of iron as ferric oxide from the given solution of ferrous ammonium sulphate and free sulphuric acid 2. Gravimetric estimation of barium as barium sulphate from the given solution containing barium chloride and free hydrochloric acid 	
6.	Inorganic Preparations:	
	<ol style="list-style-type: none"> 1. Preparation of ferrous ammonium sulphate (Mohr's salt) 2. Preparation of tetrammonium copper (II) sulphate 3. Preparation of chloro pent ammine cobalt (III) chloride 	
7.	Titrimetric Estimations:	
	<ol style="list-style-type: none"> 1. Determination of percentage purity of given sample of soda ash 2. Determination of total hardness of water using 0.01M EDTA solution 3. Determination on Percentage purity of tetramine copper (II) sulphate 	
8.	Inorganic Semi-micro Qualitative Analysis:	
	<p>Analysis of Inorganic binary mixtures of :</p> <p>Anions: Cl^-, Br^-, NO_3^-, NO_2^-, SO_4^{--}, CO_3^{--}</p> <p>Cations: Cd^{++}, Fe^{++}, Al^{+++}, Cr^{+++}, Zn^{++}, Mn^{++}, Co^{++}, Mg^{++}, K^+, NH_4^+, Ba^{++}, Cu^{++}</p>	

Course Outcomes: Students should be able to...

1. Identify unknown samples/compounds using qualitative and quantitative analysis techniques.
2. Recall theoretical concepts and interpret experimental results using conductometer.
3. Calculate rate constant of the reaction.
4. Synthesize/ Prepare Organic derives and Inorganic complexes determine purity of samples.

Practical References:

1. D.V. Jahagirdar Experiments in chemistry- (2014) Himalaya publishing house.
2. Vogel's text book of Qualitative Chemical Analysis (1989), Longman ELBS Edition.
3. A. I. Vogel, A Text Book of Quantitative Inorganic Analysis Including Elementary Instrumental Analysis) (1961) (3rd Ed., ELBS).
4. B. P. Levitt, Findlay's Experimental Physical Chemistry, Longman (1954).
5. J. N. Gurtu & R. Kapoor., Advanced experimental Chemistry Vol. I. Physical, S. Chand & Co. (6th Edition, 2010)
6. S. W. Rajbhoj, Chondhekar, Systematic Experimental Physical Chemistry (2000) Anjali Publ
7. B. D. Khosala & V. C. Garg., Practical Physical Chemistry, S. Chand & Sons. (2018).
8. H. N. Patel, S. R. Jakali, H. P. Subhedar, Miss. S.P. Turakhia. College Practical Chemistry, (Himalaya Publishing House, Mumbai) (2022).
9. B. Viswanathan and P. S. Raghvan, Practical Physical Chemistry, Viva Books (2012).