The Kelkar Education Trust's
Vinayak Ganesh Vaze College of Arts, Science & Commerce

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Mithagar Road, Mulund East, Mumbai-400081, India

College with Potential for Excellence

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Syllabus for S.Y. B. Sc. Programme

Chemistry

Syllabus as per Choice Based Credit System

(June 2020 Onwards)

Submitted by

Department of Chemistry
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(AUTONOMOUS)

❖ Syllabus as per Choice Based Credit System

1. Name of the Programme	**S. Y. B. Sc.Chemistry : CBCS**	
The Chemistry course in S. Y. B. Sc is a one Year Full Time Course consisting of two semesters, to be known as Semester III and Semester IV. Each semester consists of THREE core courses and practicals.		
2. Course Code	SCH301	SCH401
	SCH302	SCH402
	SCH303	SCH403
3. Course Title	General Chemistry : Paper - I	
	General Chemistry: Paper - II	
	Basics of Analytical Chemistry:Paper - III	
4. Semester wise Course Contents	Copy of the detailed syllabus enclosed	
5. References and additional references	Enclosed in the Syllabus	
6. No. of Credits per Semester	09	
7. No. of lectures per Unit	15	
8. No. of lectures per week	03	
9. No. of Tutorial per week	--	
10. Scheme of Examination	Semester End Exam:**60 marks** (4 Questions of 15 marks each)	
	Internal Assessment :**40 marks**	
	Class Test :15 marks	
	Project/ Assignment :15 marks	
	Class Participation:10 marks	
11. Special notes, if any	No	
12. Eligibility, if any	As laid down in the College Admission brochure / website	
13. Fee Structure	As per College Fee Structure specifications	
14. Special Ordinances / Resolutions, if any	No	

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Programme Structure and Course Credit Scheme :

Programme :S. Y. B. Sc.	**Semester: III**	**Credits**	**Semester: IV**	**Credits**
Course1 :General Chemistry	**Course Code** SCH301	2.0	**Course Code** SCH401	2.0
Course2 :General Chemistry	**Course Code** SCH302	2.0	**Course Code** SCH402	2.0
Course3 :Basics of Analytical Chemistry	**Course Code** SCH303	2.0	**Course Code** SCH403	2.0
Course4 : ChemistryPractical Paper I	**Course Code** SCHP1	1.0	**Course Code** SCHP4	1.0
Course 5: ChemistryPractical Paper II	**Course Code** SCHP2	1.0	**Course Code** SCHP5	1.0
Course 6: ChemistryPractical Paper III	**Course Code** SCHP3	1.0	**Course Code** SCHP6	1.0

❖ **Semester-wise Details of Chemistry Course**

Semester - III

Teaching Scheme (Hrs/Week)				**Continuous Internal Assessment (CIA) 40 marks**			**End Semester Examination Marks**		**Total**
Course	**L**	**P**	**C**	**CIA-1**	**CIA-2**	**CIA-3**	**Theory**	**Practical**	
Course 1	03	03	2.0	15	15	10	60	--	100
Course 2	03	03	2.0	15	15	10	60	--	100
Course 3	03	03	2.0	15	15	10	60	--	100
Course 4, Pracs.	--	--	1.0	--	--	--	--	50	50
Course 5, Pracs.	--	--	1.0	--	--	--	--	50	50
Course 6, Pracs.	--	--	1.0	--	--	--	--	50	50
Total credits of the course = 06 + 03 **= 09**									
Max. Time, End Semester Exam (Theory) : 2 .00 Hrs.									

Semester - IV

Teaching Scheme (Hrs/Week)				Continuous Internal Assessment (CIA) 40 marks			End Semester Examination Marks		Total
Course	**L**	**P**	**C**	**CIA-1**	**CIA-2**	**CIA-3**	**Theory**	**Practical**	
Course 1	03	03	2.0	15	15	10	60	--	100
Course 2	03	03	2.0	15	15	10	60	--	100
Course 3	03	03	2.0	15	15	10	60	--	100
Course 4, Pracs.	--	--	1.0	--	--	--	--	50	50
Course 5, Pracs.	--	--	1.0	--	--	--	--	50	50
Course 6, Pracs.	--	--	1.0	--	--	--	--	50	50
Total credits of the course = 06 + 03 **= 09**									
Max. Time, End Semester Exam (Theory) : 2 .00 Hrs.									

- L - Lectures
- T - Tutorials
- P - Practical
- C - Credits

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Course Objectives

1 To infuse in the learner a spirit of inquiry into the fundamental aspects of the various core areas of Chemistry.
2 To make the learner capable of analysing and interpreting results of the experiments he conducts or performs.
3 To make the learner capable of solving problems in the various units of this course.
4 To give the learner an opportunity to get hands on experience of the various concepts and processes in the various branches of chemistry.
5 To impart various skills of handling chemicals, reagents, apparatus, instruments and the care and safety aspects involved in such handling.
6 To make the learner capable of acquiring or pursuing a source of livelihood like jobs in chemical industry
7 To arouse the interest to pursue higher levels of learning in chemistry.

Course Content - Semester III

Course Code	Unit	Topics	Credits	L/Week
SCH301	I	Chemical Thermodynamics-II, Electrochemistry	02	01
	II	Chemical Bonding		01
	III	Reactions and reactivity in alkyl and aryl halides, alcohols and phenols		01
SCH302	I	Chemical Kinetics-II, Solutions	02	01
	II	Selected topics on p block elements		01
	III	Carbonyl Compounds; Epoxides		01
SCH303	I	Introduction to Analytical Chemistry and Statistical, Treatment of analytical data-I	02	01
	II	Classical Methods of Analysis		01
	III	Instrumental Methods-I		01
SCHP1		Chemistry Practical I	01	03
SCHP2		Chemistry Practical II	01	03
SCHP3		Chemistry Practical III	01	03

S. Y. B. Sc. CHEMISTRY :Choice Based Credit System			
Semester III			
PAPER : I			
Course Name: General Chemistry(45lectures)		**Course Code SCH301**	
Periods per week (1 period 50 minutes)		**03**	
Credits		**02**	
Evaluation System		**Hours**	**Marks**
	Theory Examination	2.0	60
	Theory Internal		40

		No. of lectures
Unit I	**1.1 Chemical Thermodynamics-II** **1.1.1** Free Energy Functions: Helmholtz Free Energy, Gibb's Free Energy**,** Variation of Gibb's free energy with Pressure and Temperature. **1.1.2** Gibbs-Helmholtz equation, van't Hoff reaction isotherm and van't Hoff reaction, isochore. (Numericals expected). **1.1.3** Thermodynamics of Open System: Partial Molal Properties, Ch**emical** Potential and its variation with Pressure and Temperature, Gibb's Duhem equation. **1.1.4** Concept of Fugacity and Activity. Variation of fugacity with temperature and pressure. **1.2 Electrochemistry** **1.2.1** Conductivity, equivalent and molar conductivity and their variation with dilution for weak and strong electrolytes. **1.2.2** Kohlrausch law of independent migration ofions. **1.2.3** Applications of conductance measurements: Determination of degree of ionization and ionization constant of weak electrolyte, solubility and solubility product of sparingly soluble salts, ionic product of water. (Numericals expected). **1.2.4** Transference number and its experimental determination using Moving boundary method (Numerical expected).factors affecting transport number	**08** **07**
Unit II	**Chemical Bonding** **2.1** Non-directional bonding **2.1.1** Ionic Bond, Conditions for the Formation of Ionic bond **2.1.2** Types of Ionic Crystals **2.1.3** Radius Ratio Rules **2.1.4** Lattice Energy, Borne-Lande Equation and Kapustinski Equation **2.1.5** Born-Haber Cycle and its Application	**05**

	2.2 Directional Bonding- Orbital Approach **2.2.1.** Covalent Bonding : Valence Bond Theory- Introduction and basic tenets **2.2.2.** Interaction between two hydrogen atoms and Potential energy diagram of the resultant system **2.2.3**. Corrections applied to the system of formation of Hydrogen molecule **2.2.4**. Resonance and concept of Formal charge, Rules forwriting resonance structures **2.2.5.** Bonding in polyatomic species, need for hybridization andtypes of hybrid orbitals- sp, sp_2, sp_3, sp^2d, sp^3d, sp^2d^2, sp^3d^3, energetics of hybridisation. **2.3 Molecular Orbital Theory** **2.3.1.** Comparing atomic orbitals and Molecular orbitals **2.3.2**. Linear combination of atomic orbitals to give molecular orbitals LCAO-MO approach **2.3.3.** Molecular orbital diagram H_2, He_2 , diatomic molecules of second period elements and their ions, heteronucleardiatomic molecules CO, NO, HCl. Calculate bond order and predict magnetic property. (Problems and Numericals expected wherever possible)	**05** **05**
Unit III	**Organic Chemistry** **3.1 Reactions and reactivity in alkyl and aryl halides** **3.1.1** Alkyl halides: Nucleophilic substitution reactions: SN^1, SN^2, Neighbouring Group participation (NGP), SNi and SNi' mechanisms with stereochemical aspects and factors affecting nucleophilic substitution reactions-nature of substrate, solvent, nucleophilic reagent and leaving group. **3.1.2 Aryl halides** Reactivity of aryl halides towards nucleophilic substitution reactions. Nucleophilic aromatic substitution (SNAr) addition-elimination mechanism and benzyne mechanism. **3.2 Alcohols and Phenols** **3.2.1 Alcohols:** Nomenclature, Preparation: Hydration of alkenes, Oxymercuration-demercuration reaction ; hydrolysis of alkyl halides, reduction of aldehydes and ketones, using Grignard reagent. Properties: Hydrogen bonding, types and effect of hydrogen bonding on different properties. Acidity of alcohols, Reactions of alcohols. **3.2.2 Phenols:** Preparation, physical properties and acidic character., factors affecting acidity of phenols . Reactions of phenols.	**09** **06**

Learning Outcomes:

On studying the syllabi the learner will be able to

- Recognize the importance of certain thermodynamic functions like Gibbs free energy, partial molal properties, fugacity, activity and will be able to apply these concepts to various physicochemical processes.
- Predict the behaviour of the electrolytes by conductance phenomenon and to apply
- Kohlrausch law for determination of solubility product of salt and ionic product of water.
- Realise the importance of transport number of an ion by solving the problems associated with it and will also gain the knowledge of the methods of determination of transport number.
- Discuss the energetics of ionic and covalent bond formation.
- Predict the coordination number of ion in crystal
- Discuss the trends in lattice energy of ionic compounds
- Explain bonding and shape of polyatomic species based on Valence Bond Theory
- Apply Molecular orbital theory to homo and hetero diatomic molecules, predict their magnetic properties, correlate bond energy and bond length with bond order
- Identify a given nucleophilic substitution reaction mechanism as SN^1, SN^2(with or without NGP) SNi or SNi$'$.
- Explain the effect of the nature of substrate, solvent, reagent and leaving group on the reaction pathway and the stereochemical outcome of the reaction.
- Write the mechanism for a SNAr reaction.
- Predict the products of a SNAr .Write the mechanism of a given nucleophilic substitution reaction mechanism and label the major and minor products**.**
- Identify the different methods for the synthesis of alcohols and phenols
- Predict the product of organic reactions involving alcohols and phenols as substrates.
- Design the synthesis of simple alcohols and phenol
- Predict acidity of substituted phenols based on substituents

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Reference Books :

1. Barrow, G.M. Physical Chemistry Tata McGraw-Hill (2007).
2. Castellan, G.W. Physical Chemistry 4th Ed. Narosa (2004).
3. J.D.Lee , Concise Inorganic Chemistry, 4^{th} edition ,ELBS
4. D. F. Shriver and P. W. Atkins, Inorganic chemistry, 3rd edition, Oxford University Press (1999) page
5. James E. Huheey, Inorganic Chemistry: Principles of Structure and Reactivity
6. Clayden, J.; Greeves, N.; Warren, S.; Wothers, P.; Organic Chemistry, Oxford University Press
7. Mc Murry, J.E. Fundamentals of Organic Chemistry, 7th Ed. Cengage Learning India Edition, 2013.

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S. Y. B. Sc. CHEMISTRY : Choice Based Credit System				
Semester III				
PAPER : II				
Course Name: General Chemistry(45 lectures)			**Course Code SCH302**	
Periods per week (1 period 50 minutes)			**03**	
Credits			**02**	
Evaluation System			**Hours**	**Marks**
		Theory Examination	2.0	60
		Theory Internal		40

		No. of lectures
Unit I	**1.1 Chemical Kinetics - II**	**07**
	1.1.1. Types of Complex Chemical reactions: Reversible or opposing, consecutive parallel reactions (No derivations, only examples expected), Thermal chain reactions: H. and Br. Reaction (only steps involved, no kinetic expression expected).	
	1.1.2. Effect of temperature on the rate of reaction, Arrhenius equation, Concept of energy of activation (Ea). (Numericals expected).	
	1.1.3. Theories of reaction rates: Collision theory and activated complex theory of bimolecular reactions. Comparisonbetween the two theories. (Qualitative treatment only)	
	1.2 Solutions	**08**
	1.2.1 Thermodynamics of ideal solutions: Ideal solutions and Raoult's law**,** deviations from Raoult's law–non-ideal solutions. Vapour pressure-composition and temperature composition curves of ideal and non-ideal solutions. Distillation of solutions. Leverrule. Azeotropes.	
	1.2.2 Partial miscibility of liquids: Critical solution temperature; effect of impurity on partial miscibility of liquids with respect to Phenol-Water, Triethanolamine – Water and Nicotine – Water systems	
	1.2.3 Immiscibility of liquids- Principle of Steamdistillation.Nernst distribution law and its applications, solvent extraction. (Numericals extraction. (Numericals expected)	
Unit II	**2.1 Chemistry of Boron**	**15**
	2.1.1. Electron deficient compounds- BH_3, BF_3,BCl_3 with respect to Lewis acidity and applications.	
	2.1.2. Preparation of simple boranes like diborane and tetraborane**.**	
	2.1.3. Structure and bonding in diborane and tetraborane (2e-3c bonds).	
	2.1.4. Synthesis of Borax	
	2.2 Chemistry of Silicon and Germanium	
	2.2.1 Silicon compounds: Occurrence, Structure and inertness of SiO_2	

	2.2.2. Preparation and structure of $SiCl_4$ **2.2.3.** Occurrence and extraction of Germanium **2.2.4** Preparation of extra pure Silicon and Germanium **2.3 Chemistry of Nitrogen Family** **2.3.1**. Trends in chemical reactivity- Formation ofhydrides, halides, oxides with special reference tooxides of nitrogen. **2.3.2. Oxides of nitrogen with respect to preparation and structure of NO, NO_2,** N_2O and N_2O_4. **2.3.3**. Synthesis of ammonia by Bosch- Haber process . .	
Unit III	**3.1 <u>Carbonyl Compounds</u>** **3.1.1**. Nomenclature of aliphatic, alicyclic and aromatic carbonyl compounds. Structure, general methods of preparation; Oxidation of primary and secondary alcohols using PCC, hydration of alkynes, action of Grignard reagent on esters, Rosenmund reduction, Gattermann – Koch formylation and Friedel Craft acylation ofarenes **3.1.2.** General mechanism of nucleophilic addition, andacid catalyzed nucleophilic addition reactions. **3.1.3**. Reactions of aldehydes and ketones with $NaHSO_3$, HCN, RMgX, alcohol, amine, phenyl hydrazine, 2,4-Dinitrophenyl hydrazine, $LiAlH_4$ and $NaBH_4$. **3.1.4.** Keto-enol tautomerism: Mechanism of acid and Base catalysed enolization **3.1.5.** Active methylene compounds: ethyl acetoacetate and diethyl malonate and their applications inorganic synthesis. **3.1.6.** Synthesis of enamines; alkylation and acylation of enamines . **3.2 <u>Epoxides:</u>** **3.2.1**. Nomenclature and methods of preparation. **3.2.2**. Reactions of epoxides: reactivity, ring openingreactionsby nucleophiles (a) In acidic conditions: hydrolysis, reaction with halogenhalide, alcohol, hydrogen cyanide. (b) In neutral or basic conditions: ammonia, amines,Grignard reagents, alkoxides.	**12** **03**

Learning Outcomes:

On studying the syllabi the learner will be able to

- Classify the type of complex reactions
- Interpret the effect of temperature on the rate of the reaction through Arrhenius equation,
- Compare the collision theory with the activated complex theory and to justify the concepts through problem solving.
- Classify the solution into ideal and non-ideal and correlate the ideality of the solution with Raoult's law,
- Interpret the vapour pressure-composition and vapour pressure-temperature curves for ideal and non-ideal solutions,
- Predict the effect of impurity on partially miscible liquid with respect to phenol-water, Triethanol-water and nicotine water system,
- Apply the Nernst distribution law to solvent extraction techniques and to describe the principle of steam distillation.
- Define electron deficient compounds, Write the electronic configuration of group 13 elements and apply lewis acid and base concept to group 13 elements.
- Write the preparation of boranes, diboranes and pentaboranes, Draw the structure and bonding in diboranes and tetraboranes.
- Write the electronic configuration of of group 14 elements.
- Establish inertness of SiO_2, describe preparation of $SiCl_4$ and draw the structure of $SiCl_4$.
- Describe the extraction of Germanium.
- Write the electronic configuration of group 15 elements; identify different trends in chemical reactivity, understand the method of preparation of oxides of nitrogen.
- Draw the structure of oxides of nitrogen, Describe synthesis of ammonia by Haber's process.
- Identify the different methods for the synthesis of aldehydes and ketones
- Write the general mechanism of nucleophilic addition reaction
- Predict the product of organic reactions involving aldehydes and ketones assubstrates
- Write the mechanism for keto enol tautomerism under acidic and basic conditions
- Plan synthesis of simple compounds using diethyl malonate and ethyl acetoacetate
- Synthesize simple compounds using alkylation and acylation of enamines
- List the different methods for the synthesis of epoxides
- Write the products and mechanism for ring opening of epoxides under acidic and basic conditions.

Reference Books :

1. Kotz, J.C., Treichel, P.M. & Townsend, J.R. General Chemistry Cengage Learning India Pvt.Ltd., New Delhi (2009).

2. B. S. Bahl and G. D. Tuli 'Essentials of Physical Chemistry,' S.Chand and Company(Pvt) Ltd, New Delhi

3. J.D.Lee , Concise Inorganic Chemistry, 4th edition ,ELBS

4. R Gopalan , Universities Press India Pvt.Ltd. Inorganic Chemistry for Undergraduate**s**

5. Kalsi, P. S. Textbook of Organic Chemistry 1st Ed., New Age International (P) Ltd.

6. Pub.Graham Solomons, T.W. Organic Chemistry, John Wiley &Sons, Inc.

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S. Y. B. Sc. CHEMISTRY : Choice Based Credit System			
Semester III			
PAPER : III			
Course Name: Basics of Analytical Chemistry (45 lectures)		**Course Code SCH303**	
Periods per week (1 period 50 minutes)		**03**	
Credits		**02**	
Evaluation System		**Hours**	**Marks**
	Theory Examination	2.0	60
	Theory Internal		40

		No. of lectures
Unit I	**Introduction to Analytical Chemistry and Statistical Treatment of Analytical data - I** **1.1.3** Classical and Non-Classical Methods of Analysis; their types and importance **1.1 Role of Analytical Chemistry** **1.1.1** Language of analytical chemistry: important terms and their significance in Analytical Chemistry. **1.1.2 Purpose of Chemical Analysis; Analysis Based** (i) On the nature of information required: (Proximate, Partial, Trace, Complete Analysis) and (ii) On the size of the sample used (Macro, semi-micro and microanalysis) **1.2 Significance of Sampling in Analytical Chemistry** **1.2.1** Terms involved in Sampling **1.2.2** Types of Sampling **1.2.3** Sampling techniques **1.3** Results of Analysis **1.3.1** Errors in Analysis and their types **1.3.2** Precision and Accuracy in Analysis **1.3.3** Corrections for Determinate Errors (Problems including Numericals expected wherever required.	**09** **06**
Unit II	**2.1 Classical Methods of Analysis** **2.1.1** Titrimetric Methods: Terms involved in Titrimetric methods of analysis**.** Comparing Volumetry and Titrimetry **2.1.2** The Conditions suitable for titrimetry **2.1.3** Types of titrimetry – Neutralisation (Acidimetry, alkalimetry),Redox, (Iodometry, Iodimetry) Precipitation and Complexometric titrations and indicators used in these titrations. **2.1.4** Tools of Titrimetry: Graduated glasswares and Callibration Standard solutions (Primary and Secondary standards in Titrimetry) and Calculations in Titrimetry	**05**

	2.2 <u>NeutralisationTitrations</u> **2.3.1** Concept of pH and its importance in Neutralisation Titrations **2.3.2** End point and Equivalence point of Neutralisation titrations Determination of End point byusing- **2.3.3** Indicators causing color change, Change in potential,(by potentiometry**)** Change in conductance (by conductometry) **2.3.4** Construction of titration curve (on the basis of change in pH) of a Titration of 1. Strong acid-weak base 2. Strong base-weak acid 3. Gravimetric analysis	**04**
	2.4 <u>General Introduction to Gravimetry</u> **2.4.1 Types of Gravimetric Methods :** **2.4.2 Precipitation Gravimetry**: i) Steps involved in precipitation gravimetryanalysis, ii) Conditions for precipitation iii) Completion of precipitation, iv) Role of Digestion, Filtration, Washing, Drying Ignition ofprecipitate. v) Applications of Gravimetric Analysis: Determination of sulfur in organic compounds; Estimation of Nickel in Cu-Ni alloy using dimethyl glyoxime; Determination of Aluminum by converting it to itsoxide.	**06**
Unit III	**Instrumental Methods-I** **3.1** Basic Concepts in Instrumental method Relation between the Analyte, Stimulus and measurement of change in the observable property. **3.2** Block Diagram of an Analytical instrument. **3.3 Types of Analytical Instrumental methods based on** 1.Optical interactions (eg.Spectrometry :uv-visible, Polarimetry) 2. Electrochemical interactions (eg. Potentiometry,Conductometry,) 3. Thermal interactions (eg. Thermogravimetry) **3.4 Spectrometry** **3.4.1** Interaction of electromagnetic radiation with matter: Absorption and Emission spectroscopy. **3.4.2** Basic Terms: Radiant Power, Absorbance,Transmittance, monochromatic light, Polychromatic light, Wavelength of maximum absorbance, Absorptivity and Molar Absorbtivity **3.4.3** Statement of Beer's Law and Lambert's Law, Combined Mathematical Expression of Beer -Lambert's Law, Validity of Beer-Lambert's Law, ,	**03** **07**

	Deviations from Beer-Lambert's Law ((Real deviations, Instrumental deviations and Chemical deviations)(Numerical problems based on Beer-Lambert's Law) **3.4.4** Instrumentation for absorption spectroscopy: Colorimeters and Spectrophotometers **3.4.5** Block Diagrams for Single beam and Colorimeter, and spectrophotometer (Principles, Construction and working-Details of Components expected i.e , source ,Sample holder , Filters/Monochromators, Detectors such as Photomultiplier tube) **3.4.6** Applications of UV-Visible Spectrophotometry a) Qualitative analysis such as Identification of functional groups in Organic compounds , Chromophores and Auxochrome, c*is* and *trans* isomers. b) Quantitative analysis by Calibration curve method **3.4.7** Photometric Titrations: Principle, Instrumentation, Types of Photometric titration Curves with examples	**02** **03**

Learning Outcomes:

On studying the syllabi the learner will be able to

- Outline the various instrumental methods ofanalysis
- Identify the advantages of using instruments to make measurements
- Discover the various observable properties of a given analyte and the stimulus best suited for its analysis.
- Illustrate about a generalized diagram of an analytical instrument
- Choose a suitable instrumental method for analysis and learn the basic terms in spectrometry
- Compare the relationship between absorbance (and its variations) and concentration of the analyte.

Reference Books :

1. Instrumental Analysis by Douglas A. Skoog, F. James Holler, Stanley R.Crouch
2. Skoog et al. "Fundamentals of Analytical chemistry" Cengage Learning, Eight Edition, chapter 13, 14 and 15
3. Instrumental Methods of Chemical Analysis by Gurdeep R. Chatwal ,Sham K.Anand pp2.107-2.148
4. Gary D. Christan," Analytical Chemistry", VIth Edition, Wiley StudentsEdition, Chapter No8,9,10
5. Modern Analytical Chemistry , David Harvey (page numbers 232-265)
6. Fundamental of Analytical Chemistry by Douglas A. Skoog, West, F. James Holler, S. R. Crouch

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PRACTICALS

SEMESTER - III

COURSE CODE: SCHP1 **Paper- I** **CREDITS: 01**

RECAPITULATION: Laboratory Safety Practices

I) Conductometry

a) To verify Ostwald's dilution law for weak acid conductometrically.

b) To determine solubility of sparingly soluble salts (any two) conductometrically.

II) pH Metry

To determine amount of strong acid by pH measurements

III) Phase equilibria

Phase equilibria : To determine the critical solution temperature (CST) of phenol – water system.

IV) Chemical kinetics

a) Determination of energy of activation of acid catalyzed hydrolysis of methylacetate.

b) To investigate the reaction between $K_2S_2O_8$ and KI with equal initial concentrations of the reactants

V) Identification of cations and anions with complexities

Identification of cations in a given mixture and Analytically separating them

[From a mixture containing not more than two of the following: Pb(II), Ba(II), Ca(II), Sr (II), Cu(II), Cd(II), Mg(II), Zn(II), Fe(II), Fe(III), Ni(II), Co(II) Al(III), Cr(III)]

Purity of substance :

Crystallisation of potassium iodate and to estimate its purity before and after the separation

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Reference Books :

1. Khosla B.D., Garg V.C. and Gulati A., Senior Practical Physical Chemistry, R. Chand and Co., New Delhi (2011).
2. Garland C. W., Nibler J.W. and Shoemaker D.P., Experiments in Physical Chemistry, 8th Ed., McGraw-Hill, New York (2003).
3. Halpern A.M. and McBane G.C., Experimental Physical Chemistry, 3rd Ed., W.H. Freeman and Co., New York (2003).
4. Athawale V.D. and Mathur P., Experimental Physical Chemistry, New Age International, New Delhi (2001)

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PRACTICALS

SEMESTER - III

COURSE CODE: SCHP2 **Paper- II** **CREDITS: 01**

RECAPITULATION: Laboratory Safety Practices

Water Analysis

a) To Estimate total hardness of water
b) To determine chemical oxygen demand of water sample
c) To determine Acidity and alkalinity of water sample

Organic Preparations (Any seven)

Short organic preparation and their purification

Use 0.5-1.0g of the organic compound. Purify the product by recrystallization.
Report theoretical yield, percentage yield and melting point of the purified product.

Organic preparation

1. Cyclohexanone oxime from cyclohexanone.
2. Glucosazone from dextrose or fructose
3. Tribromoanilinefromaniline.
4. m-Dinitrobenzene from nitrobenzene
5. Phthalic anhydride from phthalic acid by sublimation
6. Acetanilide from aniline
7. p-Bromoacetanilide from acetanilide
8. Iodoform from acetone

Reference Books :

1. Practical Inorganic Chemistry by G. Marr and B. W. Rockett van Nostrand Reinhold Company (1972)
2. Mann, F.G. & Saunders, B.C. Practical Organic Chemistry, Pearson Education (2009)
3. Ahluwalia, V.K. & Aggarwal, R. Comprehensive Practical Organic Chemistry: Preparation and Quantitative Analysis, University Press (2000). Mann, F.G. & Saunders, B.C. Practical Organic Chemistry, Pearson Education (2009)
4. Furniss, B.S.; Hannaford, A.J.; Smith, P.W.G.; Tatchell, A.R. Practical Organic Chemistry, 5th Ed., Pearson (2012)
5. Vogel, A.I., Tatchell, A.R., Furnis, B.S., Hannaford, A.J. & Smith, P.W.G., Textbook of Practical Organic Chemistry, Prentice-Hall, 5th edition, 1996.

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PRACTICALS

SEMESTER - III

COURSE CODE: SCHP3 **Paper- III** **CREDITS: 01**

RECAPITULATION: Laboratory Safety Practices

I. Tools of Analytical chemistry

II. Gravimetric Estimations

1. Nickel as nickel-dmg
2. Barium as Barium sulphate

III. Colorimetry

To verify Beer-Lambert's Law

IV. pH metry

Determination of buffer capacity of acid buffer and basic buffer

V. Estimation of drugs

Estimation of aspirin

Reference Books :

1. D. A. Skoog, D. M. West, F. J. Holler, and S. R. Crouch, Analytical Chemistry: An Introduction, 7th ed., Chapter 15, pp.345-381.
2. A.I. Vogel. "Textbook of Quantitative Inorganic Analysis," Longman,London (I961).
3. R.V. Dilts. "Analytical Chemistry. Methods of Separation," van Nostrand,N.Y. (1974).
4. Some Experiments for B. Tech in Chemistry & Chemical Technology compiled by Prof. J.B.BARUAH, Mrs. Abhilasha Mohan Baruah and Mr. ParikshitGogoi.

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S. Y. B. Sc. CHEMISTRY : Choice Based Credit System (CBCS)

SEMESTER : IV

Course Content - Semester IV

Course Code	Unit	Topics	Credits	L/Week
SCH401	I	Electrochemistry-II, Phase Equilibria	02	01
	II	Comparative Chemistry of the transition metals &Coordination Chemistry		01
	III	Carboxylic acids and their derivatives, Sulphonic acids		01
SCH402	I	Solid state, Catalysis	02	01
	II	Ions in aqueous medium & Uses and Environmental Chemistry of volatile Oxides and oxo-acids		01
	III	Nitrogen containing compounds; stereochemistry II		01
SCH403	I	Separation Techniques in Analytical Chemistry	02	01
	II	Instrumental Methods-II		01
	III	Statistical Treatment of analytical data --II		01
SCHP4		Chemistry Practical I	01	03
SCHP5		Chemistry Practical II	01	03
SCHP6		Chemistry Practical III	01	03

S. Y. B. Sc. CHEMISTRY :Choice Based Credit System			
Semester IV			
PAPER : I			
Course Name: General Chemistry(45 lectures)		**Course Code SCH401**	
Periods per week (1 period 50 minutes)		**03**	
Credits		**02**	
Evaluation System		**Hours**	**Marks**
	Theory Examination	2.0	60
	Theory Internal		40

		No. of lectures
Unit I	**1.1 Electrochemistry II** **1.1.1** Electrochemical conventions, Reversible and Irreversible cells**.** **1.1.2** Nernst equation and its importance, Types of electrodes, Standard electrode potential, Electrochemical series(Numericals expected). **1.1.3** Thermodynamics of a reversible cell, calculation of thermodynamic properties: ΔG, ΔH and ΔS from EMF data. (Numerical sexpected) **1.1.4** Calculation of equilibrium constant from EMF data. (Numericals expected) **1.1.5** Concentration cells with transference and without transference. Liquid junction potential and saltbridge. **1.1.6** pH determination using hydrogen electrode and quinhydrone electrode (Numericals expected) **1.2 Phase Equilibria** **1.2.1** Phases, components and degrees of freedom of a system,criteria of phase equilibrium. Gibbs Phase Rule and its thermodynamic derivation. **1.2.2** Derivation of Clausius – Clapeyron equation and its importancein phase equilibria.(numerical expected) **1.2.3** Phase diagrams of one-component systems (water andsulphur). **1.2.4** Two component systems involving eutectics, congruent and incongruent melting points (lead-silver system)	**08** **07**
Unit II	**Comparative Chemistry of Transition Metals** **2.1.1** Definition, general characteristics of Transition elements **2.1.2** Chemistry of 3d transition elements with reference to: Variable oxidation states, colour, magnetic property ability to form complexes, colour, magnetic property , ability to form complexes , catalytic property **2.1.3** Qualitative tests for transition metal ions (with reference to Chromium**,** Manganese, iron, Cobalt, Nickel and Copper)	**06**

	Coordination Chemistry **2.2.1** Historical perspectives, Molecular compound – double salt, complex salt **2.2.2** Werner's theory of Coordination compounds **2.2.3** Basic terms complex ion, charge on the complex, ligand and their types Coordination number and Nomenclature **2.24** Effective atomic number Rule, Eighteen electron rule **2.2.5** Isomerism (structural, stereo, optical) of coordination compounds (CN = 4, 6) **2.2.6** Evidences for formation of coordination compounds **2.2.7** Applications of coordination compounds **2.2.8** Nature of the Metal-Ligand Bond i) Valence Bond Theory: Hybridisation of the central metal orbitals sp_3, dsp^2 /sp^2d, sp^3d, sp^2d^2,sp^3d^3 ii) Inner and Outer orbital complexes (suitable examples) iii) Eletroneutrality principle and backbonding iv) Limitations of Valence Bond Theory	**09**
Unit III	**3.1 <u>Carboxylic Acids and their Derivatives</u>** **3.1.1** Nomenclature, structure and physical properties, acidity of carboxylic acids, effects of substituents on acid strength of aliphatic and aromatic carboxylic acids**.** **3.1.2** General methods of preparation of carboxylic acids: oxidation of alcohols and alkyl benzene, carbonation of Grignard and hydrolysis ofnitriles. **3.1.3** Reactions:Acidity, salt formation, decarboxylation, Reduction of Carboxylic acids with $LiAlH_4$, diborane, Hell-Volhard-Zelinsky reaction, Conversion of carboxylic acid to acid chlorides, esters, amides and acid anhydrides and their relative reactivity. **3.1.4** Acid derivatives : Mechanism of nucleophilic acylsubstitution and acid- catalysed nucleophilic acylsubstitution. Interconversion of acid derivatives by nucleophilic acylsubstitution. **3.2 <u>Sulphonic acids</u>** **3.2.1** Nomenclature, preparation of aromatic sulphonic acids by sulphonation of benzene (with mechanism), toluene and naphthalene. **3.2.2** Reactions: Acidity of arene sulfonic acid, Comparative acidity of carboxylic acid and sulfonic acids. Salt formation, sulphonation. Reaction with alcohol, Phosphorous pentachloride, IPSO substitution.	**11** **04**

Learning Outcomes:

On studying the syllabi the learner will be able to

- Identify a chemical cell from a concentration cell and correlate thermodynamic concepts with electrochemistry
- Develop Nernst equation for emf of the cell and electrode potential and make use of it to determination the equilibrium constant of a cell
- Outline the importance of liquid junction potential.
- Discuss the importance of pH of a solution and its determination by electrochemical cells.
- Define and explain the concept of phase, components and degree of freedom.
- Explain the importance of phase rule and its application to one component system and two component system
- Predict various properties of transition elements on the basis of their electronic configuration
- List the structures of possible isomers of a given complex.
- Discuss the stability of complex based on EAN rule and 18 electron rule.
- Outline the structure of complex and interpret the nature of metal-ligand bond based on Valence Bond Theory.
- Discuss the different methods for the synthesis of carboxylic acids.
- Predict the product of organic reactions involving carboxylic acids as substrates
- Write the mechanism of nucleophilic acyl substitution reactions
- Design synthesis of simple carboxylic acids and their derivatives by interconversion.

Reference Books :

1. Kotz, J.C., Treichel, P.M. & Townsend, J.R. General Chemistry CengageLearning India Pvt.Ltd., New Delhi (2009).
2. Mahan, B.H. University Chemistry 3rd Ed. Narosa (1998).
3. Petrucci, R.H. General Chemistry 5th Ed. Macmillan Publishing Co., NewYork (1985). 6. K.L.Kapoor A textbook of Physical chemistry.
4. J.D.Lee , Concise Inorganic Chemistry, 4th edition ,ELBS
5. Inorganic Chemistry – Gary Wulfsberg, Viva Book, First Indian Edition 2002
6. F.A Cotton and G.Wilkinson ‘Basic Inorganic chemistry’John Wiley & Sons
7. Finar, I. L. Organic Chemistry (Volume 2: Stereochemistry and the Chemistry of Natural Products), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education
8. Eliel, E. L. and Wilen, S. H. Stereochemistry of Organic Compounds, Wiley: London, 1994

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S. Y. B. Sc. CHEMISTRY :Choice Based Credit System				
Semester IV				
PAPER : II				
Course Name: General Chemistry(45 lectures)			**Course Code SCH402**	
Periods per week (1 period 50 minutes)			**03**	
Credits			**02**	
Evaluation System			**Hours**	**Marks**
		Theory Examination	2.0	60
		Theory Internal		40

		No. of lectures
Unit I	**1.1 Solid State** **1.1.1** Recapitulation of laws of crystallography and types of crystals **1.1.2** Characteristics of simple cubic, face centered cubic and body centered cubic systems, interplanar distance in cubic lattice (onlyexpression for ratio of interplanar distances are expected) **1.1.3** Use of X-rays in the study of crystal structure, Bragg's equation (derivation expected), X-rays diffraction method of studying crystal lattice structure, structure of NaCl and KCl. Determination of Avogadro's number (Numericals expected) **1.2 Catalysis** **1.2.1** Types of catalysis, catalytic activity, specificity and selectivity, inhibitors, Catalyst poisoning and deactivation. **1.2.2** Mechanisms and kinetics of acid-base catalyzed reactions, effect of pH. **1.2.3** Effect of particle size and efficiency of nanoparticles as catalyst . **1.3 Molecular Spectroscopy** **1.3.1** Rotational Spectrum: Introduction to dipole moment, polarization of a bond, bond moment,molecularstructure,.Rotational spectrum of a diatomic molecule, rigid rotor, moment of inertia, energy levels, conditions for obtaining pure rotational spectrum, selection rule, nature of spectrum, determination of internuclear distance and isotopic shift.	**07** **04** **04**
Unit II	**2.1 Ions in aqueous medium** Acidity of Cations and Basicity of Anions 2.1.1 Hydration of cations; Hydrolysis of Cations predicting degree of hydrolysis of Cations- effect of charge and radius. 2.1.2 Latimer Equation. Relationship between pka, acidity and z^2/r ratio of metal ions graphical presentations. **2.1.3** Classification of cations on the basis of acidity. Category-Non acidic,	**07**

	Moderately acidic, Strongly acidic, Very strongly acidic, with pka values range and with examples. **2.1.4** Hydration of Anions; Effect of charge and radius; Hydration of anion concept, diagram classification on the basis of basicity. **2.2 Metallurgy** **2.2.1** Types of metallurgies. **2.2.2** General steps of metallurgy ; Concentration of ore, calcinations, roasting**,** reduction and refining. **2.2.3** Metallurgy of copper: Occurance, physicochemicalprinciples**,** Extraction of copper from pyrites and refiningby electrolysis. Extraction of titanium and vanadium. **2.2.4** Environmental chemistry of volatile oxides of nitrogen and Sulphur**.** **2.2.5** Uses of acids of nitrogen and Sulphur	**08**
Unit III	**Nitrogen containing compounds and heterocyclic compounds** **3.1.1 Amines: Nomenclature, basicity ,factors affecting basicity of aliphatic** and aromatic amines; **3.1.2** Preparation: Reduction of aromatic nitro compounds using catalytic hydrogenation, chemical reduction using Fe-HCI, Sn-HCl, Zn-acetic acid, reduction of nitriles, ammonolysis of halides, reductive amination Hofmann bromamide reaction ((no mechanism) **3.1.3** Reactions- Salt Formation, N-acylation, N-alkylation, Hofmann's exhaustive methylation (HEM),Hofmann- elimination reaction, reaction with nitrous acid, carbylamine reaction, Electrophilic substitution in aromatic amines: bromination, nitration and sulphonation. **3.1.4 Diazonium Salts:** Preparation and their reactions/synthetic application- Sandmeyer Reaction - Gattermann reaction, Gombergreaction, Replacement of diazo group by -H,-OH. Azo coupling with phenols, naphthols and aromatic amines, reduction ofdiazonium salt to aryl hydrazine and hydroazobenzene . **3.1.5 Five membered Heterocyclic compounds** Nomenclature , structure and aromaticity in five membered heterocyclic compound containing one heteroatom; Paal Knorr synthesis for furan, thiophene and pyrrole; reactivity of pyrrole, furan and thiophene towards electrophilic aromatic substitution reactions ; General mechanism of Electrophilic aromatic substitution ; Diels Alder reaction of furan ; Basicity and acidity of pyrrole. **3.2 Stereochemistry - II** **3.2.1** Elements of symmetry: Mirror Plane symmetry (inversion centre), rotation-reflection (alternating) axis **3.2.2** Chirality of compounds without stereogenic centre: allenes spirans and biphenyls	**10** **05**

	3.2.3 Stability of cycloalkanes: Strains in cycloalkanes- angle, eclipsing, Trans annular (3 to 8 membered). **3.2.4** Conformations of cyclohexane, chair , boat and twist boat forms , relative stability with energy **3.2.5** Stereochemistry of mono and di- alkyl cyclohexanes and their relative Stabilities.	

Learning Outcomes:

On studying the syllabi the learner will be able to

- Recall the laws of crystallography and the types of crystal
- Deduce Bragg's equation,
- Interpret the crystal structure by X ray diffraction method and
- Determine the value of Avogadro number, Identify the type of catalysis
- Explain the role of inhibitors in catalysis and catalytic activity
- Evaluate the mechanism of acid-base catalysed reactions
- Understand the hydrolysis of cations and anions, Classify the non aqueous solvents.
- Identify acidic and basic nature of salts in aqueous medium.
- Explain predominance diagram, Define metallurgy.
- Discuss various methods used in the reduction of ores.
- Describe extraction of titanium and vanadium.
- Explain impact of volatile oxides of nitrogen and sulphur on environment.
- Describe the uses of nitric acid, Describe the uses of sulphuric acid.
- Identify the different methods for the synthesis of amines
- Predict the basicity of amines based on structure.
- Outline the product of organic reactions involving amines as substrates
- Synthesise diazonium salts and apply them to designing synthesis of substituted aromatic compounds
- Define the different symmetry elements in a molecule and Identify the symmetry elements.
- Discuss the strain involved in cyclic compounds
- Draw the different conformations of cyclohexane and compare their energies
- Predict the stereochemistry of mono and di substituted cyclohexane derivatives

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Reference Books :

1. Solid state chemistry and its Applications by A.R.West , Wiley publications, Second edition 2015/16
2. Solid state Chemistry-An Introduction' by L.Smart and E.Moore,CRC Press Taylor and Francis group, 3rd Edition 2005.
3. "Chemical Kinetics and Catalysis" by Masel R I January 1 2015
4. Emeleus and Anderson, Modern Aspects of Inorganic Chemistry, page no. 435-463.
5. Ramesh Kapoor and R.S. Chopra, Inorganic Chemistry, R. Chand publishers, New Delhi
6. Comprehensive Organic Chemistry- The synthesis and reactions of Organic Compounds, Derek barton ,W. David Ollis.
7. Mc Murry, J.E. Fundamentals of Organic Chemistry, 7th Ed. Cengage Learning India Edition, 2013

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S. Y. B. Sc. CHEMISTRY :Choice Based Credit System				
Semester IV				
PAPER : III				
Course Name: Basics of Analytical Chemistry (45 lectures)			**Course Code SCH403**	
Periods per week (1 period 50 minutes)			**03**	
Credits			**02**	
Evaluation System			**Hours**	**Marks**
		Theory Examination	2.0	60
		Theory Internal		40

		No. of lectures
Unit I	**Methods of separation**	
	1 <u>Separation Techniques in Analytical Chemistry</u>	**04**
	1.1 An Introduction to Analytical Separations and its importance in analysis. **1.2** Estimation of an analyte without effecting separation. **1.3 Types of separation methods** **1.3.1** Based on Solubilities (Precipitation,iltrationCrystallisation) **1.3.2** Based on Electrical effects-Electrophoresis **1.3.3** Based on retention capacity of a Stationary Phase-Chromatography; **1.3.4** Based on distribution in two immiscible phases- **1.3.5** Based on capacity to exchange with a resin-IonExchange; **1.3.6** Based on Gravity-Centrifugation **1.3.7** Based on volatility-Distillation	
	1.4 <u>Solvent extraction</u>	**06**
	1.4.1 Introduction, Nernst distribution Law, Distribution Ratio, Partition Coefficient. **1.4.2** Conditions of extraction: Equilibration time, Solvent volumes, temperature, pH. **1.4.3** Single step and multi step extraction ,percentage extraction for single step and multistep extraction. Separation factor. **1.4.4** Batch and continuous extraction	
	1.5 <u>Chromatography</u>	**05**
	1.5.1 Introduction to Chromatography **1.5.2** Classification of chromatographic methods based on stationary and Mobile phase. **1.5.3** Paper Chromatography: Principle, techniques and applications of Paper Chromatography in separation of cations. **1.5.4** Thin layer Chromatography Principle, technique and Applications in determining the purity of a given solute; Following progress of a given reaction.	

Un it II	**Instrumental Methods - II** **Instruments based on the electrochemical properties of the analytes.** **Potentiometry** 2.1 Instruments based on the electrochemical properties of the analytes. Potentiometry **2.1.1** Principle **2.1.2** Role of Reference and indicator electrodes **2.1.3** Applications in Neutralisation reactions with reference to the titration of a Strong acid against a Strong Base (using quinhydroneelectrode) Graphical methods for detection of endpoints **2.2 pHmetry** **2.2.1** Principle **2.2.2** Types of pH meters **2.2.3** Principle, Construction Working and Care of CombinedGlass electrode **2.2.4** Applications in titrimetry (Strong acid-Strong Base) biological and environmental analysis. . **2.3 Conductometry** **2.3.1** Principle **2.3.2** Conductivity cell its construction and care **2.3.3** Applications in NeutralisationTitrimetry with respect to i) Strong Acid-StrongBase ii) Strong Acid-WeakBase iii) Strong Base-weakAcid iv. Weak Acid- WeakBase. **2.3.4** Advantages& limitations of conductometric titrations**.** **2.4 Radioanalytical Methods** **2.4.1** Introduction to Radio analytical techniques **2.4.2** Introduction, Classification of analytical techniques **2.4.3** Principle and theory of Neutron activation analysi**s,** **2.4.4** Advantages of neutron activation analysis **2.4.5** Application of neutron activation analysis	**04** **03** **05** **03**
Unit III	**Statistical Treatment of analytical data-II** **3.1 Nature of Indeterminate Errors** **3.1.1** The true and acceptable value of a result of analysis **3.1.2** Measures of central tendency: mean, median. mode,average **3.1.3** Measures of dispersion: Absolute deviation, relativedeviation, relative average deviation, standard deviation, (s, sigma) variance, coefficient of variation. **3.2 Distribution of random errors** **3.2.1** Gaussian distribution curve. **3.2.2** Equation and salient features of Gaussian distribution curve. **3.2.3** Concept of Confidence limits and confidence interval and its computation using Population standard deviation, Student's test, Range **3.2.4** Criteria for rejection of doubtful result 2.5 d rule, 4.0 d rule, Q test	**03** **02** **03** **02**

	3.5 Test of Significance Null hypothesis, F-test (variance ratio test)	**02**
	3.6 Graphical representation of data and obtaining best fitting straight line a) For line passing through origin b)For line not passing through origin [Numerical problems wherever possible, expected]	**03**

Learning Outcomes:

On studying the syllabi the learner will be able to

- Discover the importance of separation in sample treatment
- Compare various methods of separations
- Choose a method of separation of an analyte from the matrix
- Illustrate how a solute gets distributed between two immiscible phases
- Discuss the principle of solvent extraction and various terms involved therein
- Interpret the effects of various parameters on solvent extraction of a solute
- Assess the classification of Chromatographic methods
- Interpret the principles of Paper and thin layer chromatography and make use of it in practice.
- Elaborate the nature of interaction between applied electrical potential and the concentration of the analyte.
- Inspect the nature of chemical reactions that influence potential of a given cell.
- Compare with the various types of electrodes or half cells.
- Examine the nature, need and importance of pH
- Categorize the applications of the various instrumental methods dealt with
    - The use of statistical methods in chemical analysis.
    - The nature of indeterminate errors
    - The randomness of such errors and its distribution around a correct or acceptable result
    - Computation of Confidence limits and confidence interval
    - Test for rejection of doubtful result
    - Method to draw best fitting straight line

Reference Books :

1. D.A. Skoog, D.M. West, F.J. Holler and CX.R. Crouch – Fundamentals of Analytical chemistry, 8th edition
2. G.H. Morrison and H. Freiser , Solvent extraction in analytical chemistry
3. P. G. Swell and B. Clarke, Chromatographic separations , Analytical chemistry by open Learning , John Wiley and sons, 1987
4. Modern Analytical Chemistry , David Harvey (page numbers 596 -606)
5. Principles of Instrumental analysis, D. A. Skoog, 3rd edition, Saunders college publishing. Chapters: 20, 23 Page nos: 600 - 605, 631, 704 - 711.
6. Vogel's Text book of quantitative inorganic analysis, 4th edition, ELBS/ Longman. Chapters: XIV, XV Page nos: 566 - 601, 615 – 625.
7. Instrumental methods of analysis, B. K. Sharma, Goel publishing house. Miscellaneous methods: Chapters: 1, 3, 4 Page nos: 1 - 14, 21 - 57.
8. Modern Analytical Chemistry , David Harvey (page numbers 53 -84)
9. Fundamentals of analytical chemistry – Skoog and West

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PRACTICALS

SEMESTER IV

COURSE CODE: SCHP4 **Paper - I** **CREDITS: 01**

I) Potentiometry

1. To determine standard EMF and the standard free energy change of Danielcell potentiometrically .
2. To determine the amount of HCl in the given samplepotentiometrically.

II) Chemical Kinetics

To compare the strengths of HCl and H_2SO_4 by studying kinetics of acid hydrolysis of methylacetate.

III) Inorganic Preparations

1. Sodium Hexanitrocobaltate (III)
2. Calcium or magnesium oxalate using PFHS technique
3. Bis ethylenediaminecopper(II) sulphate.
4. Potassium diaqua bis(oxalato) cuprate(II)

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Reference Books :

1. Khosla B.D., Garg V.C. and Gulati A., Senior Practical Physical Chemistry, R. Chand and Co., New Delhi (2011).
2. Garland C. W., Nibler J.W. and Shoemaker D.P., Experiments in Physical Chemistry, 8th Ed., McGraw-Hill, New York (2003).
3. Halpern A.M. and McBane G.C., Experimental Physical Chemistry, 3rd Ed., W.H. Freeman and Co., New York (2003).
4. Athawale V.D. and Mathur P., Experimental Physical Chemistry, New Age International, New Delhi (2001)

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PRACTICALS

SEMESTER - IV

COURSE CODE: SCHP5 **Paper- II** **CREDITS: 01**

Qualitative Analysis of organic compounds including bi-functional groups on the basis of

1. Preliminary examination
2. Solubilityprofile
3. Detection of elements C, H, (O), N, S, X.
4. Detection of functionalgroups
5. Determination of physical constants(M.P/B.P)

Solid or liquid Compounds containing not more than two functional groups from among the following classes may be given for analysisto be given:

Carboxylic acids, phenol, carbohydrates, aldehydes, ketones, ester, amides, nitro, anilides, amines, alkyl and aryl halide.

Students are expected to write balanced chemical reactions wherever necessary.

(Minimum 6 compounds to be analyzed)

Reference Books :

1. Practical Inorganic Chemistry by G. Marr and B. W. Rockett van Nostrand Reinhold Company (1972)
2. Mann, F.G. & Saunders, B.C. Practical Organic Chemistry, Pearson Education (2009)
3. Ahluwalia, V.K. & Aggarwal, R. Comprehensive Practical Organic Chemistry: Preparation and Quantitative Analysis, University Press (2000). Mann, F.G. & Saunders, B.C. Practical Organic Chemistry, Pearson Education (2009)
4. Furniss, B.S.; Hannaford, A.J.; Smith, P.W.G.; Tatchell, A.R. Practical Organic Chemistry, 5th Ed., Pearson (2012)
5. Vogel, A.I., Tatchell, A.R., Furnis, B.S., Hannaford, A.J. & Smith, P.W.G., Textbook of Practical Organic Chemistry, Prentice-Hall, 5th edition, 1996.

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PRACTICALS

SEMESTER - IV

COURSE CODE: SCHP6 **Paper- III** **CREDITS: 01**

I. Tools of Analytical Chemistry – II

II. Paper Chromatography

Separation of cations like Fe(III), Ni(II) and Cu(II) in a sample

III. Solvent Extraction

Separation of a solute

III. Conductometry

Estimation of given acid by conductometric titration with strong base

IV. Potentiometry

Estimation of Fe(II) in the given solution by titrating against $K_2Cr_2O_7$ potentiometrically

V. Gravimetric Estimations

Estimation of sulphate as $BaSO_4$

VI. Organic Estimation

Estimation of Acetamide by hydrolysis

Reference Books :

1. D. A. Skoog, D. M. West, F. J. Holler, and S. R. Crouch, Analytical Chemistry: An Introduction, 7th ed., Chapter 15, pp.345-381.
2. A.I. Vogel. "Textbook of Quantitative Inorganic Analysis," Longman,London (I961).
3. R.V. Dilts. "Analytical Chemistry. Methods of Separation," van Nostrand,N.Y. (1974).
4. Some Experiments for B. Tech in Chemistry & Chemical Technology compiled by Prof. J.B.BARUAH, Mrs. Abhilasha Mohan Baruah and Mr. ParikshitGogoi.