M. C. E. Society's
Abeda Inamdar Senior College
Of Arts, Science and Commerce, Camp, Pune-411001
(Autonomous) Affiliated to Savitribai Phule Pune University
NAAC accredited 'A' Grade

B. Sc. Programme Objectives and Outcomes

Programme Objectives:

1. To develop conscience towards social responsibility, human values and sustainable development through curriculum delivery and extra-curricular activities
2. To develop scientific temperament with strong fundamental knowledge of the subject
3. To develop analytical thinking and problem-solving skills needed for various entrance and competitive examinations and Post Graduate Studies
4. To train students in laboratory skills and handling equipment along with soft skills needed for placement

Programme Outcomes:

1) The students will graduate with holistic development.
2) The students will be qualified to continue higher studies in their subject.
3) The students will be eligible to appear for various competitive examinations and pursue higher education.
4) The students will be able to apply for the jobs with a minimum requirement of B. Sc. Programme**.**

Programme Specific Objectives and Outcomes

Programme Specific Objectives:

The B.Sc. Chemistry Programme will enable the students;

PSOB-1. To develop fundamental understanding of Principles of Chemistry as a discipline.

PSOB-2. To understand various laws, concepts, formulae and develop problem solving skills in Chemistry.

PSOB-3. To familiarize with advance level Chemistry and applications required for higher studies.

PSOB-4. To get hands on training on various instruments and develop skills needed in Chemistry lab.

Programme Specific Outcomes:

After successful completion of B.Sc. Chemistry Course student will have:

PSOC-1. Fundamental knowledge of theory and practical courses in Chemistry.

PSOC-2. Understanding of structures, reactivity, mechanism and problem-solving skills.

PSOC-3. Knowledge and confidence to pursue higher studies in Chemistry.

PSOC-4. Skills in laboratory techniques and experience in instrument handling.

Structure of F. Y. B. Sc. Chemistry [CBCS]

Semester	Course code	Title of course	No. of Credits
I	21SBCH111	Fundamentals of Physical Chemistry	2
I	21SBCH112	Fundamentals of Organic Chemistry	2
I	21SBCH113	Chemistry Practical-I	1.5
II	21SBCH121	Fundamentals of Inorganic Chemistry	2
II	21SBCH122	Fundamentals of Analytical Chemistry	2
II	21SBCH123	Chemistry Practical-IB	1.5

*N.B.:

1. Each lecture (L) will be of 50 minutes.
2. Each practical of 3h 15 min and 12 practical per semester
3. 12 weeks for teaching 03 weeks for continuous assessments
4. For details refer UGC rules and regulations (CBCS for Science Program under Science & Technology).

Choice Based Credit System [CBCS]
From Academic Year 2021-22

Syllabus for
First Year Bachelor of Science (F.Y. B. Sc.)
Chemistry

Board of Studies (Chemistry)
Post Graduate Department of Chemistry and Research Center
Abeda Inamdar Senior College of Arts, Science and Commerce, Pune-411001

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Course/ Paper Title	**Fundamentals of Physical Chemistry**
Course Code	**21SBCH111**
Semester	**I**
No. of Credits	**2 (36 Lectures of 50 Minutes)**

Aims & Objectives of the Course: The student should learn:

Sr. No.	Objectives
1.	Fundamental principles of mathematics used in Chemistry for problem solving and calculations.
2.	Laws and Concepts of Chemical Energetics and Thermodynamics.
3.	Laws and Concepts of Chemical Equilibrium
4.	Laws and Concepts of Ionic Equilibria

Expected Course Specific Learning Outcomes

Sr. No.	Learning Outcome
1.	**Unit I: Chemical Mathematics** 1. The student understands the graphical representation and processing. 2. Students understands and uses the rules and differentiation and integration in chemical derivations
2.	**Unit II: Chemical Energetics** 1. Students will be able to apply thermodynamic principles to physical and chemical process 2. Calculations of enthalpy, Bond energy, Bond dissociation energy, resonance

	energy 3. Variation of enthalpy with temperature –Kirchoff's equation
3.	**Unit III: Chemical Equilibrium** Knowledge of Chemical equilibrium will make students to understand 1. Relation between Free energy and equilibrium and factors affecting on equilibrium constant. 2. Exergonic and endergonic reaction 3. Gas equilibrium, equilibrium constant and molecular interpretation of equilibrium constant 4. Van't Haff equation and its application
4.	**Unit IV: Ionic Equilibria** Ionic equilibria chapter will lead students to understand 1. Concept to ionization process occurred in acids, bases and pH scale 2. Related concepts such as common ion effect, hydrolysis constant, ionic product, solubility product 3. Degree of hydrolysis and pH for different salts, buffer solutions.

Syllabus

Unit No.	Title with Contents	No. of Lectures
I	**Chemical Mathematics:** Graph: Cartesian co-ordinates, plotting of graph from experimental data, equation of straight line, slope, Intercept & its characteristics. Derivative: Definition, Simple rules of differentiation partial differentiation, examples related to chemistry. Integration: Definition, Simple rules of Integration, Integration between limits, examples related to chemistry. **Ref. No. 1: Pages 1-10** **Ref. No. 2: Pages 3-27**	**8**
II	**Chemical Energetics:** Review of thermodynamics and the Laws of Thermodynamics. Important principles and definitions	**8**

	of thermochemistry. Concept of standard state and standard enthalpies of formations, integral and differential enthalpies of solution and dilution. Calculation of bond energy, bond dissociation energy and resonance energy from thermochemical data. Variation of enthalpy of a reaction with temperature-Kirchhoff's equation. Numerical Problems **Ref. No. 1: Pages 525-570** **Ref. No. 3: Pages 1-50**	
III	**Chemical Equilibrium:** Introduction: Free Energy and equilibrium - Concept, Definition and significance, the reaction Gibbs Energy, Exergonic and endergonic reaction. The perfect gas equilibrium, the general case of equilibrium, the relation between equilibrium constants, Molecular interpretation of equilibrium constant. The response of equilibria to conditions-response to pressure, response to temperature, Van't Hoff equation, Value of K at different temperature, Problems. **Ref. No. 1: Pages 620-645** **Ref. No. 3: Pages 236-261**	**8**
IV	**Ionic Equilibria:** Strong, moderate and weak electrolytes, degree of ionization, factors affecting degree of ionization, ionization constant and ionic product of water. Ionization of weak acids and bases, pH scale, common ion effect. Salt hydrolysis-calculation of hydrolysis constant, degree of hydrolysis and pH for different salts, Buffer solutions. Solubility and solubility product of sparingly soluble salts– applications of solubility product principle. Numerical Problems. **Ref. No. 1: Pages 706-742**	**12**

References:

1. Puri, Sharma, Pathania, Principles of Physical Chemistry (47th Edition), Vishal Publishing Co.
2. R. L. Madan, Chemistry for Degree Students, as per UGC model Curriculum, S. Chand (2010)
3. N. B. Singh, S. S. Das, A.K. Singh, Physical Chemistry Volume-II, New Age International Publishers (2009)

4. Peter Atkins and Julio de Paula, Elements of Physical Chemistry, Sixth edition (2013), Oxford press
5. Ball D. W., Physical Chemistry, Thomson Press, India (2007)
6. Thomas Engel, Philip Reid; Physical Chemistry, Pearson Education (2006)
7. J. N. Gurtu, A. Gurtu; Advanced Physical Chemistry, Pragati Edition
8. Samuel H. Maron and Carl F. Prutton, Principal of physical Chemistry, 4th Edition, Collier Macmillan Ltd.
9. Undergraduate Physical Chemistry, UGC curriculum Vol. I – Guria-Gurtu Pragati Prakashan
10. Textbook of Physical Chemistry – P. L. Soni, O. P. Dharmatma, U. N. Dash Sultan Chand and Sons
11. University General Chemistry -An introduction to Chemical Science-C. N. R. Rao Macmillan.

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Syllabus for F.Y.B.Sc. Chemistry

2021-22 (CBCS – Autonomy 21 Pattern)

Board of Studies (Chemistry)
Post Graduate Department of Chemistry and Research Center
Abeda Inamdar Senior College of Arts, Science and Commerce, Pune-411001

Course/ Paper Title	**Fundamentals of Organic Chemistry**
Course Code	**21SBCH112**
Semester	**I**
No. of Credits	**2 (36 Lectures of 50 Minutes)**

Aims & Objectives of the Course: The student should learn:

Sr. No.	Objectives
1.	Chemistry of Aliphatic and Aromatic Hydrocarbons
2.	Concepts in Stereochemistry

Expected Course Specific Learning Outcomes

Sr. No.	Learning Outcome
1.	**Unit I: Aliphatic and Aromatic Hydrocarbons** Mechanistic understanding of nature and reactivity of hydrocarbons. Application of various reactions to carry out interconversion between hydrocarbons.
2.	**Unit II: Stereochemistry** Conceptual understanding of Isomerism, Classification, Optical Activity, Stereochemistry of Cyclic Compounds, Problems based on Assignment of R/S and E/Z

Syllabus

Unit No.	Title with Contents	No. of Lectures
I	Functional group approach for the following reactions (preparations & reactions with mechanism) to be studied in context to their structure. **1. Alkanes:** *Preparation:* Catalytic hydrogenation, Wurtz reaction, Kolbe's synthesis, from Grignard reagent. *Reactions:* Free radical Substitution: Halogenation. **2. Alkenes:** *Preparation:* Elimination reactions: Dehydration of alkenes and dehydrohalogenation of alkyl halides (Saytzeff's Rule); cis alkenes (Partial Catalytic Hydrogenation) and trans alkenes (Birch reduction), Wittig Reagent. *Reactions:* Cis-addition (alk. $KMnO_4$) and trans-addition (bromine), Addition of HX (Markownikoff's and anti-Markownikoff's addition), Hydration, Ozonolysis, Oxymecuration-Demercuration, Hydroboration-Oxidation. **3. Alkynes**: *Preparation:* Acetylene from $CaC_2$and conversion into higher alkynes; by dehalogenation of tetra halides and dehydrohalogenation of vicinal-dihalide *Reactions:* formation of metal acetylides, addition of bromine and alkaline $KMnO_4$, Ozonolysis and oxidation with hot alk. $KMnO_4$. Problems based on interconversions of hydrocarbons (2 and more than 2 Step Reactions) **4. Benzene and Alkyl Benzenes:** Introduction and IUPAC nomenclature, preparation (Case benzene): from phenol, by decarboxylation, from acetylene, from benzene sulphonic acid. Reactions (Case benzene and Alkyl Benzenes): Electrophilic substitution: nitration, halogenation and sulphonation. Friedel-Craft's reaction (alkylation and acylation) (up to 4 carbons chain on benzene). Side chain oxidation of alkyl benzenes (up to 4 carbons on benzene).	**20**

	Ref. No. 1: Pages 73-114, 143-176, 177-221, 250-262, 310-328, 337-341 **Ref. No. 2: Pages 131-173** **Ref. No. 3: Pages 201-297, 677-684**	
II	**Stereochemistry:** Introduction, classification, Interconversion of Wedge Formula, Newmann, Sawhorse and Fischer representations. Conformations with respect to ethane, butane and cyclohexane. Configuration: Geometrical cis/trans and E/Z Nomenclature (for up to two C=C systems). Optical isomers, Enantiomers, Diastereomers and Meso compounds). Concept of chirality (upto two carbon atoms). Threo and Erythro; D and L nomenclature; CIP Rules: R/S (up to 2 chiral carbon atoms). Stereochemistry of Cyclic Compounds, Baeyer's Angle Strain Theory, Conformational isomers of cyclohexane and their energy. Isomerism in dimethyl cyclohexane. Examples of chiral drugs and significance of stereo chemically pure drugs. **Ref. No. 1: Pages 115-141, 289-301** **Ref. No. 4: Pages 3-11, 124-127, 204-207**	**16**

References:

1. Organic Chemistry by Morrison & Boyd, 6th Edn.
2. A Guidebook to Mechanism in Organic Chemistry, by Peter Sykes, 6thEdn.
3. Bahl, A. & Bahl, B.S. *Advanced Organic Chemistry,* S. Chand, 2010.
4. Eliel, E. L. Stereochemistry of Carbon Compounds, Tata McGraw Hill Education, 2000.

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2021-22 (CBCS – Autonomy 21 Pattern)

Board of Studies (Chemistry)
Post Graduate Department of Chemistry and Research Center
Abeda Inamdar Senior College of Arts, Science and Commerce, Pune-411001

Course/ Paper Title	**Practical Course in Chemistry-I**
Course Code	**21SBCH113**
Semester	**I**
No. of Credits	**1.5 (46.8 Lectures of 50 Minutes)**

Aims & Objectives of the Course: The student should learn:

Sr. No.	Objectives
1.	Laboratory Safety and MSDS
2.	Practical application of Thermodynamic and Ionic Equilibrium
3.	Organic Purification and Organic Synthesis
4.	Tests for Food Adulteration

Expected Course Specific Learning Outcomes

Sr. No.	Learning Outcome
1.	Understanding of importance of safety measures and precautions in laboratory.
2.	Conceptual understanding of thermochemical parameters and related concepts.
3.	Preparation of buffer solutions and significance.
4.	Understanding of Purity of Chemicals and parameters to ascertain purity.
5.	Elemental analysis of organic compounds (non-instrumental)
6.	Awareness of Food Adulteration and Methods of Detection

Syllabus

Sr. No.	Title with Contents	Practical Sessions
	Section A: Chemical and Lab Safety (Any Two)	
1.	Toxicity of the compounds used in chemistry laboratory.	**1**
2.	Safety symbol on labels of pack of chemicals and its meaning	**1**
3.	What are MSDS sheets? Find out MSDS sheets of at least 2 hazardous chemicals ($K_2Cr_2O_7$, Benzene, cadmium nitrate and sodium metal)	**1**
4.	Precautions in handling of hazardous substances like concentrated acids, ammonia and organic solvents.	**1**
	Section B: Thermochemistry (Any Four)	
5.	Determination of heat capacity of calorimeter for different volumes.	**1**
6.	Determination of enthalpy of neutralization of hydrochloric acid with sodium hydroxide.	**1**
7.	Determination of enthalpy of ionization of acetic acid.	**1**
8.	Determination of integral enthalpy of solution of salts (KNO_3, NH_4Cl).	**1**
9.	Determination of enthalpy of hydration of copper sulphate.	**1**
10.	Study of the solubility of benzoic acid in water and determination of ΔH.	**1**
	Section C: Organic Chemistry	**1**
11.	**Purification of Organic Compounds (Two Techniques)** Crystallization (From Water and Alcohol)	**1**
12.	Distillation (One Component Volatile)	**1**
13.	Sublimation (Microscale Technique)	**1**
14.	**Organic Qualitative Analysis (Two Compounds)** To determine type and detection of extra elements (N, S, Cl, Br, I) in Organic Compounds and Determine Functional Groups (containing up to two extra elements)	**1**
	Section D: Analytical Chemistry	
15.	**Tests for Food Adulteration (Any One) (As per DART defined by FSSAI)** Tests for Milk and Milk Products, Oils and Fats and Honey	**1**
16.	Tests for Salt, Spices & Condiments	**1**
17.	**Analysis of Commercial products containing Inorganic substances (Any One)** Estimation of Ca from calcium supplementary tablet by complexometric titration.	**1**

18.	Estimation of acid neutralizing capacity of antacids like Gelusil tablet/ Gelusil syrup	**1**
19.	Estimation of selectively Cu(II) from brass alloy by iodometrically (Use KIO_3as primary standard for standardization of $Na_2S_2O_3$and not$K_2Cr_2O_7$).	**1**

References:

1. Systematic Experimental Physical Chemistry, S.W. Rajbhoj and T.K. Chondekar, Anjali Publication (2013).
2. Advanced Experimental Chemistry volume - I, J.N. Gurtu R. Kapoor, S. Chand and Co. New Delhi.
3. Experimental Physical Chemistry, V. D. Athawale, P. Mathur, New Age International Publishers.
4. Experimental Physical Chemistry, R. C. Das, B. Behara, Tata McGraw Hill Publishing Co. Ltd.
5. A Senior Practical Physical Chemistry, Khosla, B. D.; Garg, V. C. & Gulati, R. Chand & Co.: New Delhi (2011).
6. Mendham, J. Vogel's Quantitative Chemical Analysis, Pearson,2009.
7. 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.
8. Mann, F.G. & Saunders, B.C. *Practical Organic Chemistry* Orient-Longman,1960.
9. Prof. Robert H. Hill Jr., David C. Finster Laboratory Safety for Chemistry Students, 2nd Edition Wiley ISBN: 978-1-119-02766-9 May2016
10. Prudent Practices in the Laboratory: Handling and Management of Chemical Hazards, Updated Version, ISBN 978-0-309-13864-2 | DOI 10.17226/12654, the National Academies Press Washington, D.C.

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Syllabus for F.Y.B.Sc. Chemistry

2021-22 (CBCS – Autonomy 21 Pattern)

Board of Studies (Chemistry)
Post Graduate Department of Chemistry and Research Center
Abeda Inamdar Senior College of Arts, Science and Commerce, Pune-411001

Course/ Paper Title	**Fundamentals of Inorganic Chemistry**
Course Code	**21SBCH121**
Semester	**II**
No. of Credits	**2 (36 Lectures of 50 Minutes)**

Aims & Objectives of the Course: The student should learn:

Sr. No.	Objectives
1.	Theories of Atomic Structure
2.	Periodic changes and relations in properties of elements
3.	Theories of Chemical Bonding and Shapes of Molecules

Expected Course Specific Learning Outcomes

Sr. No.	Learning Outcome
1.	**Unit I: Atomic Structure** a) Various theories and principles explaining atomic structure. b) Origin of quantum mechanics and its need to understand structure of hydrogen atom. c) Significance of quantum numbers d) Shapes of orbitals
2.	**Unit II: Periodicity of Elements** a) Explain rules for filling electrons in various orbitals- Aufbau's principle, Pauli exclusion principle, Hund's rule of maximum multiplicity b) Discuss electronic configuration of an atom and anomalous electronic configurations.

	c) Describe stability of half-filled and completely filled orbitals d) Discuss concept of exchange energy and relative energies of atomic orbitals e) Design Skeleton of long form of periodic table f) Describe Block, group, modern periodic law and periodicity. g) Classification of elements as main group, transition and inner transition elements. h) Write name, symbol, electronic configuration, trends and properties. i) Explain periodicity in the following properties in details: i. Effective nuclear charge, shielding or screening effect; some numerical problems. ii. Atomic and ionic size. iii. Crystal and covalent radii. iv. Ionization energies. v. Electronegativity- definition, trend, Pauling electronegativity scale. vi. Oxidation state of elements.
3.	**Unit III: Chemical Bonding** a) Attainment of stable electronic configurations. b) Define various types of chemical bonds- Ionic, covalent, coordinate and metallic bond. c) Explain characteristics of ionic bond, types of ions, energy consideration in ionic bonding, lattice and solvation energy and their importance in the context of stability and solubility of ionic compounds. d) Summarize Born-Lande equation and Born-Haber cycle, e) Define Fajan's rule, bond moment, dipole moment and percent ionic character. f) Describe VB approach, Hybridization with example of linear, trigonal, square planer, tetrahedral, TBP, and octahedral. g) Discuss assumption and need of VSEPR theory. h) Interpret concept of different types of valence shell electron pairs and their contribution in bonding. i) Application of non-bonded lone pairs in shape of molecule j) Basic understanding of geometry and effect of lone pairs with examples such as ClF_3, Cl_2O, BrF_5, XeO_3 and $XeOF_4$.

Syllabus

Unit No.	Title with Contents	No. of Lectures
I	**Atomic Structure:** Origin of Quantum Mechanics: Why study quantum mechanics? Quantum mechanics arose out of interplay of experiments and Theory Energy quantization- i) Black body radiation ii) The photoelectric effect iii) Wave particle duality- a) The particle character of electromagnetic radiation b) the wave character of particle, iv) diffraction by double slit v)	**10**

	atomic spectra, Review of Bohr's theory and its limitations, Heisenberg Uncertainty principle. Significance of quantum numbers, orbital angular momentum and quantum numbers ml and ms. Shapes of s, p and d atomic orbitals, nodal planes. Discovery of spin, spin quantum number (s) and magnetic spin quantum number (ms). **Ref. No.1: Pages 1-38, 141-154**	
II	**Periodic Table and Periodicity of Elements:** Periodic table: periodic table after 150 years, review on the eve of international year of periodic table [IYPT]. Periodicity of elements: Rules for filling electrons in various orbitals, electronic configurations of the atoms. Stability of half-filled and completely-filled orbitals, concept of exchange energy. Relative energies of atomic orbitals, Anomalous electronic configurations Long form of periodic table-s, p, d and f block elements, Detailed discussion of following properties of elements with reference to s and p block a) Effective nuclear charge, shielding or screening effect b) Atomic and ionic radii c) Crystal radii d) Covalent radii) Ionization energies e) Electronegativity, Pauling's / electronegativity scale f) Oxidation states of elements **Ref. No. 2: Pages 8-33**	**12**
III	**Chemical Bonding:** Attainment of stable electronic configurations, Types of Chemical bonds: Ionic, covalent, coordinate and metallic bonds Ionic Bond: General characteristics of ionic bonding, Types of ions, Energy considerations in ionic bonding, lattice energy and solvation energy and their importance in the context of stability and solubility of ionic compounds. Statement of Born-Landé equation for calculation of lattice energy, Born-Haber cycle and its applications, polarizing power and	**14**

	polarizability. Fajan's rules, ionic character in covalent compounds, bond moment, dipole moment and percentage ionic character. Covalent bond: Valence Bond Approach, Hybridization with suitable examples of linear, trigonal planar, square planar, tetrahedral, trigonal bipyramidal and octahedral arrangements. VSEPR theory, Assumptions, need of theory, application of theory to explain geometries of molecules such as i) ClF_3ii) Cl_2O iii) BrF_5 iv) XeO_3 v) $XeOF_4$ vi) XeF_6 vii) XeO_2F_2 **Ref. No. 2: Pages 35-51**	

References:

1. Lee, J. D. Concise Inorganic Chemistry ELBS, 1991.
2. Cotton, F. A., Wilkinson, G. & Gaus, P.L. Basic Inorganic Chemistry, 3rd ed., Wiley.
3. Douglas, B. E., McDaniel, D.H. & Alexander, J. J. Concepts and Models in Inorganic Chemistry, John Wiley & Sons.
4. Huheey, J. E., Keiter, E.A., Keiter, R.L. & Medhi, O.K. Inorganic Chemistry: Principles of Structure and Reactivity, Pearson Education India, 2006.

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2021-22 (CBCS – Autonomy 21 Pattern)

Board of Studies (Chemistry)
Post Graduate Department of Chemistry and Research Center
Abeda Inamdar Senior College of Arts, Science and Commerce, Pune-411001

Course/ Paper Title	**Fundamentals of Analytical Chemistry**
Course Code	**21SBCH122**
Semester	**II**
No. of Credits	**2 (36 Lectures of 50 Minutes)**

Aims & Objectives of the Course: The student should learn:

Sr. No.	Objectives
1.	Primary Introduction of Analytical Chemistry as a branch of Chemistry
2.	Principles of Stoichiometry and Problem Solving
3.	Principles of Organic Qualitive Analysis

Expected Course Specific Learning Outcomes

Sr. No.	Learning Outcome
1.	**Unit I. Introduction to Analytical Chemistry** i. Analytical Chemistry-Branch of chemistry ii. Perspectives of Analytical Chemistry iii. Analytical problems
2.	**Unit II. Stoichiometry:** i. Calculations of mole, molar concentrations and various units of concentrations which will be helpful for preparation of solution, calculations, expression and calculation of different concentration terms. ii. SI units, distinction between mass and weight vi. Units such as parts per

	million, parts per billion, parts per thousand, solution-dilatant volume ratio, function density and specific gravity of solutions. iii. Calculation of Oxidation number
3.	**Unit III. Qualitative Analysis of Organic Compounds** i. Basics of type determination, characteristic tests and reactions of different functional groups. ii. Separation of binary mixtures and analysis iii. Elemental analysis -Detection of nitrogen, sulfur, halogen and phosphorous by Lassiagne test. iv. Purification techniques for organic compounds.
4.	**Unit IV. Chromatographic Techniques-Paper and Thin layer Chromatography** i. Basics of chromatography and types of chromatography ii. Theoretical background for Paper and Thin Layer Chromatography
5.	**Unit V. pH Metry** i. pH meter and electrodes for pH measurement ii. Measurement of pH iii. Working of pH meter iv. Applications of pH meter

Syllabus

Unit No.	Title with Contents	No. of Lectures
I	**Introduction to Analytical Chemistry:** Meaning and analytical prospective, scope and function: Analytical problems and their solutions, trends in analytical methods and procedures **Ref. No. 1: Pages 7-9**	**03**
II	**Stoichiometry:** Units of measurements, SI units, distinction between mass and weight, mole, millimole and calculations, significant figures Solution and their concentrations: Molar concentrations, Molar analytical Concentrations, Molar equilibrium concentration, percent, concentration, part per million, part per billion, part per thousand, solution-dilatant volume ratio, functions, density and specific gravity of solutions, problem solving. Chemical Stoichiometry: Empirical and Molecular Formulas, Stoichiometric Calculations, Problem solving.	**10**

	Ref. No.1: Pages. 65-103 **Ref. No.2: Pg. No. 259-260** **Ref. No. 3: Pg. No. 62-78**	
III	**Qualitative Analysis of Organic Compounds:** Types of organic compounds, characteristic tests and classifications, Tests for functional groups, analysis of binary mixtures, analysis and detection of nitrogen, sulfur, halogen and phosphorous by Lassiagen's test. Purification of Organic compounds: Introduction, recrystallization, distillation, sublimation. **Ref. No.4: Pages.16-46** **Ref. No.5: Pages. 135-138, 153-155, 169-171, 173-180**	**07**
IV	**Chromatographic Techniques:** Introduction- Introduction to chromatography, IUPAC definition of chromatography. History of Chromatography- paper chromatography, Thin Layer Chromatography, Ion exchange Chromatography, Gel permeation Chromatography, column chromatography, Gas chromatography, Supercritical fluid chromatography, High Performance Liquid Chromatography, Classification of chromatographic methods – according to separation methods and development procedures. **a. Thin Layer Chromatography**: Theory and principles, outline of the method, surface adsorption and spot shape, Comparison of TLC with other forms of chromatography, adsorbents, preparation of plates, application of samples, development. **b. Paper Chromatography**- Origin, overview of technique, sample preparation, types of paper, solvents, equilibrium, development, sample application and detection, Identification, Quantitative methods, applications of paper chromatography **Ref. No. 1: Pages 506-511, 517-525** **Ref. No. 2: Pages 186-204, 216-244**	**10**

V	**pH Meter**: Introduction, pH meter, Glass pH electrode, combination of pH electrode-Complete Cell, Standard Buffer – reference for pH measurement, Accuracy of pH measurement using pH meter, Analytical Applications of pH meter. **Ref.No.1: Pages 316-325** **Ref.No.2: Pages 555-558, 565-570**	**06**

References:

1. G D Christian -Analytical Chemistry 5th Edn.
2. Qualitative Organic Analysis, 4th Edn. by A. I. Vogel (ELBS)
3. Vogel's Quantitative Analysis, 5th Edn.
4. Douglas A. Skoog, Donald M West, F. James Holler, Stainly R. Crounch, Fundamentals of Analytical Chemistry, 9th Edn.
5. David Harvey, Modern Analytical Chemistry, McGraw Hill Higher education
6. Gurudeep R. Chatwal, Sham K. Anand, Instrumental Methods of Chemical Analysis, Himalaya Publishing House.
7. Comprehensive Practical organic chemistry Qualitative Analysis by V. K. Ahluwalia, Sunita Dingra, Pg. 1-46
8. Vogel's textbook of Practical Organic chemistry, 5th Edn.
9. A Braithwait and F. J. Smith, Chromatographic method, 5th edition, Kluwer Academic Publishers

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2021-22 (CBCS – Autonomy 21 Pattern)

Board of Studies (Chemistry)
Post Graduate Department of Chemistry and Research Center
Abeda Inamdar Senior College of Arts, Science and Commerce, Pune-411001

Course/ Paper Title	**Practical Course in Chemistry-II**
Course Code	**21SBCH123**
Semester	**II**
No. of Credits	**1.5 (46.8 Lectures of 50 Minutes)**

Aims & Objectives of the Course: The student should learn:

Sr. No.	Objectives
1.	Principles of pH Metry and Application
2.	Inorganic Synthesis and Volumetric Analysis
3.	Application of Green Chemistry in Organic Synthesis
4.	Application of Paper Chromatography

Expected Course Specific Learning Outcomes

Sr. No.	Learning Outcome
1.	Understanding of importance of safety measures and precautions in laboratory.
2.	Conceptual understanding of thermochemical parameters and related concepts.
3.	Preparation of buffer solutions and significance.
4.	Understanding of Purity of Chemicals and parameters to ascertain purity.
5.	Elemental analysis of organic compounds (non-instrumental)
6.	Awareness of Food Adulteration and Methods of Detection

Syllabus

Sr. No.	Title with Contents	Practical Sessions
	Section A: Physical Chemistry	
1.	**Ionic Equilibria (Any Three)** Measurement of pH of different solutions like aerated drinks, fruit juices, shampoos and soaps (use dilute solutions of soaps and shampoos to prevent damage to the glass electrode) using pH-meter.	**1**
2.	MeasurementofthepHofbuffersolutionsandcomparisonoftheva lueswiththeoreticalvalues.	**1**
3.	Preparation of buffer solutions Sodium acetate-acetic acid and determine its buffer capacity	**1**
4.	Ammonium chloride-ammonium hydroxide and determine its buffer capacity	**1**
	Section B: Inorganic Chemistry	
5.	**Synthesis of commercially important inorganic compounds (Any Two)** Synthesis of potash alum from aluminum metal (scrap Aluminum metal)	**1**
6.	Synthesis of Mohr's Salt $[(FeSO_4)(NH_4)_2SO_4].6H_2O$	**1**
7.	Preparation of Dark red inorganic pigment: Cu_2O	**1**
8.	Synthesis of $FeSO_4.7H_2O$	**1**
9.	**Volumetric Analysis (Any Two)** Estimation of sodium carbonate and sodium hydrogen carbonate present in a mixture.	**1**
10.	Determination of basicity of boric acid or oxalic acid or citric acid hence determination of their equivalent weight.	**1**
11.	Estimation of water of crystallization in Mohr's salt by titrating with $KMnO_4$.	**1**
12.	**To draw polar plots of s and p orbitals.**	**1**
	Section C: Organic Chemistry	
13.	**Green Organic Preparations (AnyTwo)** Bromination of Cinnamic acid using sodium bromide and Sodium bromate	**1**
14.	Bromination of acetanilide using KBr and Cerric Ammonium Nitrate in aqueous medium	
15.	Preparation of dibenzylidene acetone with LiOH.	
	Section D: Analytical Chemistry	
16.	**Paper Chromatography (Any Two)** Separation of constituents of mixtures by Chromatography:	**1**

	Measure the Rf value in each case. Identify and separate the components of a given mixture of 2 amino acids (glycine, aspartic acid, glutamic acid, tyrosine or any other amino acids) / pigments from plant extract / 2 organic compounds by paper chromatography.	
17.	Identify and separate the sugars present in the given mixture by paper Chromatography. [Combination of two compounds/plant extract to be given]	

N. B.:

1. Use molar concentrations for volumetric /estimations/synthesis experiments.
2. Use optimum concentrations and volumes.
3. Two burette method should be used for volumetric analysis (Homogeneous Mixtures)
4. Use of microscale technique is recommended wherever possible.

Note:

1. In synthesized compound student must confirm the particular cation and anion by performing qualitative tests.
2. Costing of product for 100 g pack can be calculated on the basis of cost of raw materials used and percent yield of the product.
3. Synthesized compounds should be collected from all students and stored properly. They should be used in other experiments such as Mohr's salt for determination of water of crystallization. Potash alum and $FeSO_4$ can be given in IQA experiments or for estimations at S.Y. and T.Y. level.

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5. Khosla, B. D.; Garg, V. C. & Gulati, A. Senior Practical Physical Chemistry, R. Chand & Co.: New Delhi (2011).

Dr. Khursheed Ahmed
BoS Chairman and Head
Department of Chemistry