Ahmednagar Jilha Maratha Vidya Prasarak Samaj's

New Arts, Commerce and Science College,Ahmednagar

(Autonomous)

(Affiliated to Savitribai Phule Pune University, Pune)

Choice Based Credit System (CBCS)

Bachelor of Science (B. Sc.)

Syllabus of

F. Y. B. Sc. Chemistry

Implemented from

Academic year 2021 -22

Ahmednagar Jilha Maratha Vidya Prasarak Samaj's

New Arts, Commerce and Science College, Ahmednagar

(Autonomous)

Board of Studies in Chemistry

Sr. No.	Name	Designation	Representative
1	Dr. A. E. Athare	Chairman	HOD
2	Asso. Prof. P. S. Mutkule	Member	Faculty
3	Asso. Prof. S. B. Dare	Member	Faculty
4	Dr. S. J. Takate	Member	Faculty
5	Asst. Prof. P. B. Gaikwad	Member	Faculty
6	Asst. Prof. A. V. Karande	Member	Faculty
7	Dr. N. R. Dhatrak(SPPU)	Member	VC Nominee
8	Dr. B. B. Shingate (BAMU, Aurangabad)	Member	Other University
9	Dr. S. S. Kolekar (Shivaji University,Kolhapur)	Member	Other University
10	Dr. P. C. Mhaske (S. P. College ,Pune)	Member	Alumni
11	Dr. D. N. Sawant (NCL, Pune)	Member	Industry/Placement

1. Prologue/ Introduction of the programme:

Academics and research in India is a priority which depends upon the quality of education. Quality higher education include innovations that can be useful for efficient governance of higher education institutions, systems and society at large. Fundamental approach to learning outcome-based curriculum emphasizes upon demonstration of understanding, knowledge, skills, attitudes and values in particular programme of study. This approach is intended to follow flexibility and innovation in design of the programme, its assessment and expect graduate attributes demonstrating the level of learning outcome. It is expected to provide effective teaching – learning strategies including periodic review of the programme and its academic standard. The learning outcome-based curriculum for B.Sc. degree in Chemistry is designed to address the needs of the students with chemistry as the core subject of study. The curriculum is expected to assist in the maintenance of the standard of chemistry degrees/programmes and periodic programme review within a broad framework of agreed/expected graduate attributes qualification descriptors, programme learning outcomes and course-level learning outcomes. The framework is intended to allow flexibility and innovation in programme design, syllabi development, teaching-learning process and quality assessment of students learning levels.

This curriculum for the bachelor-level program in Chemistry is developed keeping in view of the student centric learning pedagogy, which is entirely outcome-oriented and curiosity-driven. To avoid rote-learning approach and foster imagination, the curriculum is more leaned towards self-discovery of concepts. The curriculum focuses on pragmatist approach whereby practical application of theoretical concepts is taught with substantial coverage of practical and field works. The platform aims at equipping the graduates with necessary skills for Chemistry-related careers, careers with general graduate-level aptitude and for higher education in Chemistry and allied subjects. Augmented in this curriculum are graduate attributes including critical thinking, scientific reasoning, moral ethical reasoning, qualification descriptors that are specific outcomes pertinent to the discipline of chemistry, learning outcomes for individual courses, pedagogical methods and assessment methods. While designing syllabus, emphasis is given on the objectively measurable teaching-learning outcomes to ensure employability of the graduates. In line with recent trends in education section, this syllabus foster implementation of modern pedagogical tools and concepts such as flip-class, hybrid learning, MOOCs and other e-learning platforms. The framework is designed such a way to enable the learners implementing the concepts to address the real world problems. The curriculum focuses on issues pertinent to India and also of the west; for example, green chemistry and biomaterials etc. Curriculum are holistic and aim to mould responsible Indian citizen to have reflective thinking, scientific temper, and digital literacy in order to acquire requisite skill to be self employed entrepreneurial.

2. Programme outcomes for B.Sc. Chemistry

Students enrolled in the program complete a curriculum that exposes and trains students in a full range of essential skills and abilities. They will have the opportunity to master the following objectives.

Programme Outcomes

- To understand the basic facts and concepts in Chemistry
- To understand the importance of Chemistry in daily life.
- To develop a better understanding and reasoning of facts.
- Gain the knowledge of Chemistry through theory and practicals.
- To skill-up for basic analytical tools.
- To skill-up for various laboratory techniques used in pharmaceutical laboratories and chemical industries.
- To make efficient for various spectrometric analyses
- Demonstrate, solve and an understanding of major concepts in all disciplines of chemistry.
- Solve the problem and also think methodically, independently and draw a logical conclusion.
- Employ critical thinking and the scientific knowledge to design, carry out, record and analyse the results of chemical reactions.
- Create an awareness of the impact of chemistry on the environment, society, and development outside the scientific community.
- Find out the green route for chemical reaction for sustainable development.
- To inculcate the scientific temperament in the students and outside the scientific community.
- Use modern techniques, decent equipment's and Chemistry software's
- Use modern chemical tools, Models, Chem-draw, Charts and Equipment's.
- To explain nomenclature, stereochemistry, structures, reactivity, and mechanism of the chemical reactions.
- Identify chemical formulae and solve numerical problems.
- Know structure-activity relationship.
- Understand good laboratory practices and safety.
- Develop research-oriented skills.
- Make aware and handle the sophisticated instruments/equipment's

I. Programme Structure and Course Titles

Sr. No.	Class	Semester	Course Code	Course Title	Credits
1.	F.Y. B.Sc.	I	**BSC-CH 101 T**	**Physical Chemistry**	**02**
2.	F.Y. B.Sc.	I	**BSC-CH 102 T**	**Organic Chemistry**	**02**
3.	F.Y. B.Sc.	I	**BSC-CH 103 P**	**Practical Course I**	**1.5**
4.	F.Y. B.Sc.	II	**BSC-CH 201 T**	**Inorganic Chemistry**	**02**
5.	F.Y. B.Sc.	II	**BSC-CH 202 T**	**Analytical Chemistry**	**02**
6.	F.Y. B.Sc.	II	**BSC-CH 203 P**	**Practical Course II**	**1.5**
7.	S.Y. B.Sc.	III	**BSC-CH 301 T**	**Physical and analytical Chemistry**	**02**
8.	S.Y. B.Sc.	III	**BSC-CH 302 T**	**Organic and Inorganic Chemistry**	**02**
9.	S.Y. B.Sc.	III	**BSC-CH 303 P**	**Practical Course III**	**02**
10.	S.Y. B.Sc.	IV	**BSC-CH 401 T**	**Physical and analytical Chemistry**	**02**
11.	S.Y. B.Sc.	IV	**BSC-CH 402 T**	**Organic and Inorganic Chemistry**	**02**
12.	S.Y. B.Sc.	IV	**BSC-CH 403 P**	**Practical Course IV**	**02**
13.	T.Y. B.Sc.	V	**BSC-CH 501 T**	**Physical Chemistry - I**	02
14.	T.Y. B.Sc.	V	**BSC-CH 502 T**	**Inorganic Chemistry-I**	02
15.	T.Y. B.Sc.	V	**BSC-CH 503 T**	**Organic Chemistry - I**	02
16.	T.Y. B.Sc.	V	**BSC-CH 504 T**	**Analytical Chemistry -I**	02
17.	T.Y. B.Sc.	V	**BSC-CH 505 T**	**Industrial Chemistry**	02
18.	T.Y. B.Sc.	V	**BSC-CH 506 T**	**Chemistry of Biomolecules**	02
19.	T.Y. B.Sc.	V	**BSC-CH 507 P**	**Physical Practical -I**	02
20.	T.Y. B.Sc.	V	**BSC-CH 508 P**	**Inorganic Chemistry Practical -I**	02
21.	T.Y. B.Sc.	V	**BSC-CH 509 P**	**Organic Chemistry Practical - I**	02
22.	T.Y. B.Sc.	V	**BSC-CH 510 T**	**Medicinal Chemistry**	02

				OR **Polymer Chemistry**	
23.	T.Y. B.Sc.	V	**BSC-CH 511 T**	**Environmental Chemistry** **OR** **Chemo Informatics**	02
24.	T.Y. B.Sc.	VI	**BSC-CH 601 T**	**Physical Chemistry - II**	02
25.	T.Y. B.Sc.	VI	**BSC-CH 602 T**	**Physical Chemistry - III**	02
26.	T.Y. B.Sc.	VI	**BSC-CH 603 T**	**Inorganic Chemistry -II**	02
27.	T.Y. B.Sc.	VI	**BSC-CH 604 T**	**Inorganic Chemistry -III**	02
28.	T.Y. B.Sc.	VI	**BSC-CH 605 T**	**Organic Chemistry - II**	02
29.	T.Y. B.Sc.	VI	**BSC-CH 606 T**	**Organic Chemistry - III**	02
30.	T.Y. B.Sc.	VI	**BSC-CH 607 P**	**Physical Chemistry Practical - II**	02
31.	T.Y. B.Sc.	VI	**BSC-CH 608 P**	**Inorganic Chemistry Practical - II**	02
32.	T.Y. B.Sc.	VI	**BSC-CH 609 P**	**Organic Chemistry Practical - II**	02
33.	T.Y. B.Sc.	VI	**BSC-CH 610 T**	**Analytical Chemistry - II** **OR** **Chemistry of Soil and Agrochemicals** **OR** **Forensic Chemistry**	02
34.	T.Y. B.Sc.	VI	**BSC-CH 611 T/P**	**Project** **OR** **Cosmetics and Perfumes** **OR** **Dairy Chemistry**	02

Semester -I	Paper -I
Course Code: BSC-CH 101 T	Title of the Course: Physical Chemistry
Credits: 02	Total Lectures: 30Hrs

Course Outcomes:

- Students will be able to apply thermodynamic principles to physical and chemical process.
- Calculations of enthalpy, Bond energy, Bond dissociation energy, resonance energy.
- Variation of enthalpy with temperature –Kirchhoff's equation.
- Chemical equilibrium will make students to understand relation between Free energy and equilibrium, factors affecting on equilibrium constant. Gas equilibrium, equilibrium constant and molecular interpretation of equilibrium constant, Van't Haff equation and its applications
- Ionic equilibria chapter will lead students to understand concept to ionization process occurred in acids, bases and pH, Common ion effect, hydrolysis constant, ionic product, solubility product, Degree of hydrolysis and pH for different salts, buffer solutions.

Detailed Syllabus:

Unit 1: Chemical Energetics [10L]

Review of thermodynamics, Laws of Thermodynamics. Principles and definitions of thermo chemistry. 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 thermo chemical data. Variation of enthalpy of a reaction with temperature

Kirchhoff's equation. Statement of Third Law of thermodynamics and calculation of Absolute entropies of substances, problems

Unit 2: Chemical Equilibrium **[10L]**

Introduction: Free Energy and equilibrium - Concept, Definition and significance

Reaction Gibbs Energy, Exergonic and endergonic reaction. Perfect gas equilibrium, general case of equilibrium, relation between equilibrium constants, Molecular interpretation of equilibrium constant. Response of equilibria to conditions- response to pressure, response to temperature, Van't Haff equation, Value of K at different temperature, Problems

Unit 3: Ionic Equilibria **[10L]**

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.

Suggested Readings:

1. Glasstone Samuel, *Thermodynamics for Chemists*, Affiliated East West Private Limited.
2. Bahl Arun, Bahl B S, Tuli G D *Essentials of Physical Chemistry*, S. Chand ,2016
3. Atkins Peter. W., Paula Julio.de, Keeler J., *Atkin's Physical Chemistry*, 11th Edition, Oxford University Press, 2018.
4. Ball D. W. *Physical Chemistry*, Thomson Press, Cenagage Learning,2011
5. Castellan G.W. *Physical Chemistry* ,4th Edition, Narosa ,2008
6. Maron Samuel H. and. Prutton Carl F, *Principles of Physical Chemistry*, 4thEdition, Collier Macmillan Ltd.

Semester -I	Paper -II
Course Code: BSC-CH 102 T	**Title of the Course: Organic Chemistry**
Credits: 02	**Total Lectures: 30Hrs**

Course Outcomes:

- The students are expected to understand the fundamentals, principles, and recent developments in the subject area.
- It is expected to inspire and boost interest of the students towards chemistry as the main subject.
- To familiarize with current and recent developments in Chemistry.
- To create foundation for research and development in Chemistry.

Detailed Syllabus

Unit 1: Fundamentals of Organic Chemistry [10L]

Physical Effects, Electronic Displacements: Inductive Effect, Resonance and Hyperconjugation. Cleavage of Bonds: Homolysis and Heterolysis. Structure, shape and reactivity of organic molecules: Nucleophiles and electrophiles. Reactive Intermediates: Carbocations, Carbanions and free radicals. Strength of organic acids and bases, Aromaticity: Benzenoids and Hückel's rule.

Unit 2: Stereochemistry [10L]

Introduction, classification, Interconversions of Wedge Formula, Newman, Sawhorse and Fischer representations. Conformations with respect to ethane, butane and cyclohexane. Configuration: Geometrical – *cis/ trans,* and E / Z Nomenclature (for upto two C=C systems). Optical isomerism, Enantiomerism, Diastereomerism and Meso compounds. Concept of chirality (upto two carbon atoms). Threo and Erytrho; D and L nomenclature; Cahn Ingold Prelog Rules: R/ S nomenclature

Unit 3: Aliphatic Hydrocarbons: [10L]

Preparations & reactions to be studied in context to their structure.

Alkanes: *Preparation:* Catalytic hydrogenation, Wurtz reaction, Kolbe's synthesis, from Grignard reagent. *Reactions:* Free radical Substitution: Halogenation.

Alkenes: *Preparation:* Elimination reactions: Dehydration of alcohol and Dehydrohalogenation of alkyl halides (Saytzeff rule); cis alkenes (Partial catalytic hydrogenation) and trans alkenes (Birch reduction).

Reactions: cis addition (alkaline $KMnO_4$) and trans addition (bromine), Addition of HX (Markownikoff's and anti-Markownikoff's addition), Hydration, Ozonolysis, Oxymecuration- demercuration, Hydroboration-oxidation.

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.

Suggested Readings:

1. McMurry J.E. *Fundamentals of Organic Chemistry*, 9 th edition, Cengage Learning UK , 2016.
2. Eliel E.L. *Stereochemistry of Carbon Compounds*, Tata McGraw Hill Education, 2000.
3. Bruice Paula, *Organic Chemistry*, 8 th Edition, Pearson Education, USA, 2016.
4. Vollhardt P. , Schore N., *Organic Chemistry*, Macmillan Learning ,New York , 8 th Edition, 2018.
5. Solomon T.W.G., Fryhle Craig B, *Organic Chemistry*, Wiley, USA ,12 th Edition ,2016.
6. Loudon Marc, Parise Jim, *Organic Chemistry*, Macmillan Learning ,New York , 8 th edition,2016.

Semester -I	**Paper -III**
Course Code: BSC-CH 103 P	**Title of the Course: Practical Course I**
Credits: 1.5	**Total Lectures: 45Hrs**

Course Outcome:

- Importance of chemical safety and Lab safety while performing experiments in laboratory
- Determination of thermo chemical parameters and related concepts
- Techniques of pH measurements
- Preparation of buffer solutions
- Elemental analysis of organic compounds
- Chromatographic Techniques for separation of constituents of mixtures

Detailed Syllabus

Section A: Chemical and Lab Safety

1. Toxicity of compounds used in chemistry laboratory.
2. Safety symbol on labels of pack of chemicals and its meaning
3. What are MSDS sheets? Find out MSDS sheets of at least 3 hazardous chemicals ($K_2Cr_2O_7$, Benzene, cadmium nitrate, sodium metal, etc.)
4. Precautions in handling of hazardous substances in laboratory (like Conc. acids, ammonia, organic solvents etc.)

Section B: Physical Chemistry

a. Thermo Chemistry (Any three)

1. Determination of heat capacity of calorimeter for different volumes.
2. Determination of enthalpy of neutralization of hydrochloric acid with sodium hydroxide.
3. Determination of enthalpy of ionization of acetic acid.
4. Determination of integral enthalpy of solution of KNO_3/ or NH_4Cl.
5. Determination of enthalpy of hydration of copper sulphate.

b. Ionic Equilibria (Two experiments)

1. 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.
2. Measurement of the pH of buffer solutions: Preparation of Sodium acetate-acetic acid buffer solutions and determine its buffer capacity

Section C: Organic Chemistry (Five experiments)

1. To determine type and detection of extra elements (N, S, Cl, Br, I) in organic compounds **(Three)**

2. Separation of constituents of mixtures by Chromatography: Measure the Rf value in each case **(Two)**

(a) 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

(b) Identify and separate the sugars present in the given mixture by paper chromatography.

Suggested Reading:

1. Mendham, J. *Vogel's Quantitative Chemical Analysis*, Pearson, 2009.
2. Vogel, A.I., Tatchell, A.R., Furnis, B.S., Hannaford, A.J. & Smith, P.W.G., *Text book of Practical Organic Chemistry*, Prentice-Hall, 5th edition, 1996.
3. Mann, F.G. & Saunders, B.C. *Practical Organic Chemistry*, Orient-Longman, 1960.
4. Khosla, B. D.; Garg, V. C. & Gulati, A. *Senior Practical Physical Chemistry*, R.Chand &Company, New Delhi ,2011.
5. Hill Robert H. Jr., Finster David C. *Laboratory Safety for Chemistry Students*, 2nd Edition ,Wiley , 2016
6. Prudent Practices in the Laboratory: Handling and Management of Chemical Hazards, ISBN 978-0-309-13864-2, DOI 10.17226/12654,National Academies Press Washington.
7. Garcia J. I., Dobado J. A., *Experimental Organic Chemistry Laboratory Manua*l, Academic Press, UK, 2016.

Semester -II	Paper -I
Course Code: BSC-CH 201 T	Title of the Course: Inorganic Chemistry
Credits: 02	Total Lectures: 30Hrs

Course Outcome:

1. Periodicity of Elements

- To understand rules for filling electrons in various orbitals, stability of half-filled and completely filled orbitals, concept of exchange energy and relative energies of atomic orbitals.
- To understand periodicity in properties of element.
- To explain ionic bond, types of ions, energy consideration in ionic bonding, lattice and solvation energy, Born-Lande equation and Born-Haber cycle, valance bond theory and VSEPR theory.
- Various theories and principles applied to revel atomic structure, Schrodinger equation for hydrogen atom, Significance of quantum numbers, Shapes of orbitals.

Detailed Syllabus

Unit1: Periodic table and Periodicity of Elements [10L]

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
e) Ionization energies
f) Electronegativity, Pauling's Electronegativity scale
g) Oxidation states of elements

Unit 2: Chemical Bonding [10L]

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-Lande equation for calculation of lattice energy.

Born-Haber cycle and its applications, polarizing power and 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_3 ii) Cl_2O iii) BrF_5 iv) XeO_3 v) $XeOF_4$

Unit 3: Atomic Structure **[10L]**

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) atomic spectra, Bohr's theory and its limitations, Heisenberg Uncertainty principle.

Quantum mechanics: Time independent Schrodinger equation and meaning of various terms in it, Significance of ψ and $\psi 2$, Schrödinger equation for hydrogen atom. Radial and angular parts of the hydogenic wave functions (atomic orbitals) and their variations for 1s, 2s, 2p, 3s, 3p and 3d orbitals (Only graphical representation). Radial and angular nodes and their significance. Radial distribution functions and the concept of the most probable distance with special reference to 1s and 2s atomic orbitals. Significance of quantum numbers, orbital angular momentum and quantum numbers. Shapes of s, p and d atomic orbitals, nodal planes. Discovery of spin, spin quantum number and magnetic spin quantum number.

Suggested Reading:

1. Lee, J.D. *Concise Inorganic Chemistry,* ELBS, 1991.
2. Cotton, F.A., Wilkinson, G. & Gaus, P.L. *Basic Inorganic Chemistry,* 3rd edition, 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.

Semester -II	Paper -II
Course Code: BSC-CH 202 T	Title of the Course: Analytical Chemistry
Credits: 02	Total Lectures: 30Hrs

Course Outcomes:

- Students will be acquainted with fundamentals of analytical chemistry.
- Students will learn and master principles of Qualitative Analysis of Organic Compounds.
- Students will learn and master principles of Chromatographic Techniques.
- Students will learn and master principles of principles of pH-metry.

Detailed Syllabus:

Unit1: Introduction to Analytical Chemistry [02L]

What is analytical Chemistry, the analytical perspectives, Common analytical problems.

Unit2: Qualitative Analysis of Organic Compounds [06L]

Types of organic compounds, characteristic tests and classifications, reactions of different functional groups, analysis of binary mixtures.

Analysis: Detection of nitrogen, sulfur, halogen and phosphorous by Lassigne's test.

Purification of organic compounds: Introduction, recrystallization, distillation, sublimation

Unit 3: Calculations used in Analytical Chemistry [08L]

Some important 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, partper thousand, Solution –dilatants volume ration, functions , density and specific gravity of solutions,problems Chemical Stoichiometry, Empirical and Molecular Formulas, Stoichiometric Calculations, Problems.

Unit 4: Chromatographic Techniques Paper and Thin Layer Chromatography [10L]

Introduction- Introduction to chromatography, IUPAC definition of chromatography.

History of Chromatography- paper chromatography, Thin Layer Chromatography, Ion exchange Chromatography, Gas permeation Chromatography, affinity chromatography, Gas chromatography, Supercritical fluid chromatography, High Performance Liquid Chromatography, Capillary electrophoresis, Classification of chromatographic methods – according to separation methods, according to development procedures.

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.

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.

Unit 5: Introduction to pHmetry **[04L]**

Introduction, pH meter, Glass pH electrode, combination of pH electrode- Complete Cell, Standard Buffer, Accuracy of pH measurement, Working of pH meter, Applications of pH meter.

Suggested Reading:

1. A Braithwaite and F. J. Smith, *Chromatographic methods*, 5th edition, Kluwer Academic Publishers, 1996.
2. Christian G.D., Dasgupta P.K., Schug K.A., Analytical Chemistry, 7th edition, Wiley ,2016.
3. Vogel A.I. , Qualitative Organic Analysis, 4th edition (ELBS)
4. Skoog D. A, West D. M, Holler F J., *Fundamentals of Analytical Chemistry*, 9th edition,2009.
5. Chatwal G. R, Anand S. K, *Instrumental Methods of Chemical Analysis*, Himalaya Publishing House.
6. Fifield F.W., Kealey D., *Principles and Practice of Analytical Chemistry*, Fifth Edition, Blackwell Science, 2000.

Semester -II	**Paper -III**
Course Code: BSC-CH 203 P	**Practical Course II**
Credits: 1.5	**Total Lectures: 45Hrs**

Course Outcome:

- The practical course is in relevance to the theory courses to improve the understanding of the concepts.
- It would help in development of practical skills of the students.
- Use of microscale techniques is encouraged.

Detailed Syllabus:

Section A: Inorganic Chemistry

Synthesis of commercially important inorganic compounds (Any Two)

1. Synthesis of potash alum from scrap Aluminum metal
2. Synthesis of Mohr's Salt [$(FeSO_4)$ $(NH_4)_2SO_4$]•$6H_2O$
3. Preparation of Dark red inorganic pigment: Cu_2O

Note:

i. In synthesized compound student must confirm the particular cation and anion by performing qualitative tests.

ii. 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.

iii. Synthesized compounds should be collected from 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 $FeSO_4$ should be used in inorganic qualitative analysis experiments or for estimations.

II] Volumetric Analysis (Any Two)

1. Estimation of sodium carbonate and sodium hydrogen carbonate present in a mixture.
2. Determination of basicity of oxalic acid hence determination equivalent weight.
3. Estimation of water of crystallization in Mohr's salt by titrating with $KMnO_4$.

III] Analysis of commercial products containing inorganic substances (Any Two)

1. Estimation of Ca from calcium supplementary tablet by Complexometric titration.
2. Estimation of acid neutralizing capacity of antacids like Gelusil tablet/ syrup
3. Estimation of selectively Cu (II) from brass alloy by iodometrically (Use KIO_3 as primary standardfor standardization of $Na_2S_2O_3$).

Section B: Organic Chemistry

A) Organic Purification Techniques

Purification of organic compounds by

1. Crystallization (from water and alcohol)
2. Distillation (Two Compounds)
3. Sublimation (micro technique)

B) Organic preparations (Any Three)

Mechanism of various reactions involved to be discussed. Recrystallization, determination of melting point and calculation of quantitative yields to be done.

1. Bromination of acetanilide using KBr and Ceric ammonium nitrate in aqueousmedium.(Green Chemistry Approach)
2. Semicarbazone derivatives of aldehyde /ketone
3. Oxime derivative of aldehyde/ketone
4. 2,4-dinitrophenylhydrazone derivative of aldehyde/ketone

N. B.:

1. Use molar concentrations for volumetric estimations/synthesis experiments.
2. Use optimum concentrations and volumes
3. Double burette method should be used for volumetric analysis
4. Use of microscale technique is recommended

Suggested Reading:

1. Svehla, G. *Vogel's Qualitative Inorganic Analysis*, Pearson Education, 2012.
2. Mendham, J. *Vogel's Quantitative Chemical Analysis*, Pearson, 2009.
3. Brian S. Furniss, Antony J. Hannaford, Peter W. G. Smith, Austin R. Tatchell., *Vogel's Textbook of Practical Organic Chemistry,* John Wiley and Sons, New York, 5th edition, 2005.
4. Mann, F.G. & Saunders, B.C. *Practical Organic Chemistry* Orient-Longman, 1960.
5. Khosla, B. D.; Garg V. C. & Gulati A., *Senior Practical Physical Chemistry*, R. Chand & Company, New Delhi, 2011.

Additional Credits for All UG programmes

Sr. No.	Title	Credits	Remark
1.	Physical Education (F.Y. B. A/ B. Com/ B.Sc.)	01	Compulsory
2.	Constitution of India (F.Y. B. A/ B. Com/ B.Sc.)	01	Compulsory
3.	Completion of Skillbased Certificate programme organized by any department of the college	02	Compulsory
4.	SWAYAM certificate programme	02	Optional
5.	Participation in NSS Winter Camp	02	Optional
6.	C Certificate in NCC	02	Optional
7.	Selection and participation in RDC parade at New Delhi	04	Optional
8.	Completion of Project under BDT Star College Scheme	02	Optional
9.	Representation at State/ National level Cocurricular Activities	02	Optional
10.	Representation at State/ National level Extracurricular Activities	02	Optional
11.	Winning Medal/ Prize at National level cocurricular/ Extracurricular activities	04	Optional
12.	Prize in curricular/ extracurricular/ cultural activities at college level	01	Optional
13.	Active participation in excursion tours/ study tour and experiential learning activities	01	Optional
14.	Book Review on book suggested by academic Council	02	Optional