



**Maharashtra Education Society
Abasaheb Garware College, Pune
(Autonomous)**

National Education Policy

(Affiliated to Savitribai Phule Pune University)

**Three Years Degree Program in
Chemistry
(Faculty of Science and Technology)**

Syllabi under Autonomy and National Education Policy

F.Y. B. Sc. (Chemistry)

Choice Based Credit System [CBCS] Syllabus for National Education Policy

To be implemented from Academic Year 2024-2025

Title of the subject: F.Y.B.Sc. (Chemistry)

Preamble:

The syllabus of Chemistry for First year has been redesigned for National Education policy under Autonomous Choice based Credit System (CBCS) to be implemented from 2024-2025.

In CBCS pattern semester system has been adopted for FY, SY and TY which includes Discipline Specific Core Course (DSCC) at F Y level, Ability Enhancement Compulsory Course (AECC), Discipline Specific Elective Course (DSEC) and open elective course (OE), Skill Enhancement Course (SEC), Indian Knowledge Science (IKS), Vocational Skill course (VSC) etc. Syllabus for Compulsory Courses of Chemistry i.e major subject of chemistry (1 Theory and 1 Practical in each semester) subject for F. Y. B. Sc. is to be implemented from the year 2024-25 along with two other subject of science and one arts as well as SEC,VEC courses. Syllabus for S. Y. and T. Y. B. Sc. will be implemented from the year 2024-25 and 2025-26 respectively as per structure approved.

Course Outcome:

Major Subjects:

Chemistry is often referred to as the central science because it joins together physics and mathematics, biology and medicine, and the earth and environmental sciences. Knowledge of the nature of chemicals and chemical processes therefore provides insights into a variety of physical and biological phenomena. Through the core curriculum, students will gain a foundation of knowledge of human cultures and the physical and natural world; develop principles of personal and social responsibility for living in a diverse world; and advance intellectual and practical skills that are essential for all learning. Students will learn quantum mechanical approach to atomic structure, Periodicity of elements, various theories for chemical bonding. Students will know about basics of analytical chemistry, some techniques of analysis and able to do calculations essential for analysis. 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 micro scale techniques wherever required. After completing the course work learner will be acquired with knowledge of chemical energetics, Chemical equilibrium and ionic equilibria. Students will learn Fundamentals of organic chemistry, stereochemistry (Conformations, Configurations and nomenclatures) and functional group approach for aliphatic hydrocarbons. 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 micro scale techniques wherever required.

OE: Open Elective Courses

Electives give students freedom of choice. In the elective courses enable students to take classes outside their prescribed plan of course work. To understand how electives may impact your study plan, it's important to know the differences between core subjects and elective subjects.

IKS: Indian Knowledge System

The goal of the IKS centres is to act as a catalyst for initiating research, education, and outreach activities in various parts. IKS is a collective range of Indian Knowledge that has exhibited in systematised ways of knowing. Starting from the oldest compositions of knowledge i. e, the Vedic literature to the country's native and tribal folklore, the Indian Knowledge is spread as a spectrum.

SEC: Skill enhancement Course

Skill Enhancement Course means a course designed to provide value-based or skill-based knowledge and should contain both theory and lab/hands-on/training/fieldwork. The main purpose of these courses is to provide students with life-skills in the hands-on mode to increase their employability. An increase in innovation and creativity for new products and services. Skills development and training undeniably encourages a more creative and innovative workforce. New ideas are often born as a result of skills development and training and this means more business and increased profits.

Eligibility: Students should be passed 12th science

Structure of the course F. Y. B. Sc. Chemistry-According to NEP-2024

Year	Sem	Course Number	Course Code	Vertical	Total Credits	Course Title	Theory Credit	Practical Credit	Credit for the Course
First Year	1	111	CHE-111-TH		2	Physical and Inorganic Chemistry	2	0	2
		112	CHE-112-PR		2	Chemistry Practical-I	0	2	2
		111	OE-111-CHE	GE/OE	2	Introduction to Nanoscience (परिचय अतिसुक्ष्म शास्त्राचा)	2	0	2
		101	SEC-101-CHE	SEC	2	Basic Laboratory techniques in chemistry-I	0	2	2
		161	CHE-161-TH		2	Organic and Analytical Chemistry	2	0	2
	162	CHE-162-PR	2		Chemistry Practical-II	0	2	2	
	2	161	OE-161-CHE	GE/OE	2	Basic Chemistry Practical-I	0	2	2
		151	SEC-151-CHE	SEC	2	Water testing and Analysis	0	2	2

CHE-Chemistry, , OE-Optional Elective, , SEC-Skill enhancement Course ,

SEMESTER - I

1. Course code and Title: CHE-111-TH: Physical and Inorganic Chemistry-I (2 Credits, 30 L)

A] Physical Chemistry:

1. Chemical Energetics (08 L)

Review of thermodynamics, Heat, work, internal energy, enthalpy and first law of thermodynamics, Importance of state functions: internal energy and enthalpy, Entropy and second law of thermodynamics. Concept of standard state and standard enthalpies of formations, integral and differential enthalpies of solution and dilution. 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

2. Ionic Equilibria (07L)

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.

B) Inorganic Chemistry:

1. Periodicity of Elements (08L)

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

Oxidation states of elements

2. Chemical Bonding (08)

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 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.

Learning Outcome

1. Chemical energetics: Students will be able to apply thermodynamic principles to physical and chemical process in

1. Calculations of enthalpies
2. Variation of enthalpy with temperature –Kirchhoff's equation
3. Third law of thermodynamic and its applications

2. Ionic Equilibria: Ionic equilibria chapter will lead students to understand Concept to ionization process occurred in acids, bases and pH scale.

4. Related concepts such as Common ion effect hydrolysis constant, ionic product, solubility product.
5. Degree of hydrolysis and pH for different salts, buffer solutions

3. Periodicity of Elements

1. Explain rules for filling electrons in various orbitals- Aufbau's principle, Pauli exclusion principle, Hund's rule of maximum multiplicity
2. Discuss electronic configuration of an atom and anomalous electronic configurations.
3. Describe stability of half-filled and completely filled orbitals.
4. Discuss concept of exchange energy and relative energies of atomic orbitals
5. Design Skeleton of long form of periodic table.
6. Describe Block, group, modern periodic law and periodicity.
7. Classification of elements as main group, transition and inner transition elements
8. Write name, symbol, electronic configuration, trends and properties.
9. Explain periodicity in the following properties in details:
 - a. Effective nuclear charge, shielding or screening effect; some numerical problems.
 - b. Atomic and ionic size.
 - c. Crystal and covalent radii
 - d. Ionization energies
 - e. Electronegativity- definition, trend, Pauling electronegativity scale.
 - f. Oxidation state of elements

4. Chemical Bonding

10. Attainment of stable electronic configurations.
11. Define various types of chemical bonds- Ionic, covalent, coordinate and metallic bond
12. 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
13. Summarize Born-Landé equation and Born-Haber cycle,
14. Define Fajan's rule, bond moment, and dipole moment and percent ionic character.
15. Describe VB approach, Hybridization with example of linear, trigonal, square planar, tetrahedral, TBP, and octahedral.

Physical chemistry Reference Books:

1. Samuel Glasstone, *Thermodynamics for Chemists*, Affiliated East West Private Limited.
2. B. S. Bahl, G. D. Tuli, Arun Bahl, *Essentials of Physical Chemistry*
3. Peter Atkins and Julio de Paula, *Elements of Physical Chemistry*, Sixth edition (2013), Oxford press
4. Ball D. W., *Physical Chemistry*, Thomson Press, India (2007)
5. Castellan, G.W. *Physical Chemistry*, 4th Ed. Narosa (2004).
6. *Atkins' Physical Chemistry – Thermodynamics and Kinetics*, 11th Edition, Oxford Press
7. Thomas Engel, Philip Reid; *Physical Chemistry*, Pearson Education (2006)
8. J. N. Gurtu, A. Gurtu; *Advanced Physical Chemistry*, Pragati Edition
9. Mortimer R. G., *Physical Chemistry*, 3rd Edition, Elsevier, Noida (UP)
10. Samuel H. Maron and Carl F. Prutton, *Principals of physical Chemistry*, 4th Edition, Collier Macmillan Ltd.

Inorganic chemistry Reference Books:

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.
5. Graham Solomon, T.W., Fryhle, C.B. & Snyder, S.A. *Organic Chemistry*, John Wiley & Sons (2014).
6. Mc Murry, J.E. *Fundamentals of Organic Chemistry*, 7th Ed. Cengage Learning India Edition,

2. Course code and Title: CHE-112-PR: Chemistry Practical -I (2 Credits, 15P)

A) Chemical and Laboratory Safety (Compulsory)

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

B) Physical Chemistry Practical**a. Thermochemistry (Any Four)**

5. Determination of integral enthalpy of solution of salts (KNO_3 , NH_4Cl).
6. Determination of enthalpy of hydration of copper sulphate.
7. Study of the solubility of benzoic acid in water and determination of ΔH .
8. Determination of heat capacity of calorimeter for different volumes.
9. Determination of enthalpy of neutralization of hydrochloric acid with sodium hydroxide.
10. Determination of enthalpy of ionization of acetic acid.

b. Ionic equilibrium (Any Two)

11. Preparation of Sodium acetate-acetic acid buffer solutions and measurement of the pH of buffer solutions and determine its buffer capacity. (compare of observed values with theoretical values).
 1. Preparation of Ammonium chloride-ammonium hydroxide buffer solutions and measurement of the pH of buffer solutions and its buffer capacity. (compare of observed values with theoretical values).
 2. 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

B) Inorganic Chemistry practical's: (6 Practical)**a) Synthesis of commercially important inorganic compounds (Any three)**

14. Synthesis of potash alum from aluminium metal (scrap Aluminium metal)
15. Synthesis of Mohr's Salt [$(FeSO_4)(NH_4)_2SO_4 \cdot 6H_2O$]
16. Preparation of Dark red inorganic pigment: Cu_2O
17. Synthesis of $FeSO_4 \cdot 7H_2O$

b) Polar Plot of S and P-orbital**b) Inorganic Qualitative Analysis (Any Three)**

18. Inorganic Qualitative Analysis (Mixture –I)
19. Inorganic Qualitative Analysis (Mixture –II)
20. Inorganic Qualitative Analysis (Mixture –III)
- 21.. Inorganic Qualitative Analysis (Mixture –IV)

Learning Outcome:

1. Student understand the chemical and lab safety when working in the chemical laboratory.
2. Determination of thermochemical parameters and related concepts
3. Techniques of pH measurements
4. Preparation of buffer solutions
5. Inorganic Estimations using volumetric analysis
6. Synthesis of Inorganic compounds
7. Analysis of commercial products
8. Purification of organic compounds
9. Preparations and mechanism of reactions involved

3. Course code and Title: OE-111-CHE: Introduction to Nanoscience
(परिचय अतिसुक्ष्मशास्त्राचा) (2 Credit, 30L)

Chapter I: History and Introduction to Nanoscience and Nanotechnology (09L)

Background, Definitions, Relationship and Differences, Nano and Nature: Nanoscopic colors (Butterfly Wings), Bioluminescence (Fireflies), Introduction to hydrophilic and hydrophobic materials, the historical development of nanomaterial organization of matter- atoms, molecules, clusters and supramolecular. Structure and Bonding: Chemical bonds (types and strength), Intermolecular forces, Molecular and crystalline structures- Bulk to surface transition and calculations, the density of states, band gap.

Chapter II: Nanoscale Science (08L)

Interconversion of units, Introduction to the surface area to volume ratio and aspect ratio, Difference between the surface area to volume ratio of bulk materials and nanomaterials (sphere, hollow sphere, rods, hollow rods, cubes, and hollow cubes), and related numerical problems, Difference in an aspect ratio of bulk wire and nanowire and related numerical problems, Nanomaterials and wavelength of light

Chapter III: Classification of Nanomaterial (08L)

Introduction to dimensional growth process, Classification of nanomaterials into 0D, 1D, 2D and 3D, Relationship between dimension and shape of nanomaterials(Quantum dots, Quantum wires,

Carbon nanotubes, Buckyballs, Fullerenes), Introduction to size effect on electronic and optical properties(Quantum confinement)

Chapter IV Properties and Applications of Nanomaterials

(05L)

Optical, Mechanical, magnetic, electrical properties, Nano-electronics(metal/organic nano electronics), Nano-optics, Nanomagnetic-, chemical- and bio-sensing, energy applications, textiles, cosmetics, biotechnology, medical, construction, Nanoscience in plant protection and agriculture, drug carrier and drug delivery and other contemporary applications.

References:

1. Introduction to Nanoscience and nanotechnology, CRC Press,Tylor and Francis group, Boca Raton, G.L.Hornyak, H.F. Tibbals, J. Dutta and J.J. Moore.
2. Introductory Nanoscience: Physical and Chemical Concept, CRC Press,Tylor and Francis Group, Boca Raton, M. Kuno.
3. Nanotechnology: A gentle introduction to next big idea, Mark Ratner and Daniel Ratner, Low price edition, Third Impression, Pearson Education.
4. Nanotechnology by Dr. Shulbha Kulkarni
5. The Chemistry of Nanomaterials: Synthesis, Properties and Applications,2 volume set, C.N.R.Rao (Editor), Archim Muller(Editor), Anthony K. Cheetham (Editor) 2004, Wiley Publisher. *

Learning Outcome:

1. Students known the Basic of nanoscience.
2. Students can understand difference between nanomaterials and bulk materials etc.
3. Students can understand how the types of nanomaterials etc.
4. Students known properties of nanomaterials.
5. Students can know the applications of nanomaterials

4. Course code and Title: SEC-101-CHE -: Basic Laboratory technique in Chemistry-I Practical [(2 Credits, 15P)]

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1. Calibration of volumetric and graduated glassware equipment
 2. Understanding the proper handling and operation of Analytical balances: Mass and Weight, Dual-Pan Balance and Electronic Balance. ii. Performing the calibration of weighing balances and ensuring precision in measurements.
 3. Experimental determination of melting point and boiling point of chemical compounds [02 each]

- Purification of organic solvents using distillation and refluxing [Theory and demonstration]
- Purification of given organic compounds by crystallization method.
- Precipitation, washing and drying of the precipitates
- Preparation of standard solutions [molar and normal]
- Preparation of standard reagents [ppm and ppb]
- Use of a scientific calculator to perform various operations required in calculations
- Plotting a linear graph using given data [slope and intercept calculation]
- Basic and advanced features of Microsoft Excel Calculations related to equations that are used in major subjects
- Creation of Graph related to Chemistry using Microsoft Excel.
- Basic and advanced features of Microsoft Power Point. Preparation of 10-15 slides on topic related to chemistry. Documents should contain tables, figures, equations, symbols, images, videos, links and e-resources etc.
- Introduction to Chemistry software. Draw a chemical structure, reaction scheme, reaction mechanism etc using ChemSketch / Chemdraw or any other software.
- Field trip [Report writing]

References:

- A of Practical Vogel of Organic chemistry**
- Practical chemistry for Collegesbooks.google.co.in > books
E. J. Wood • 2012**

SEMESTER- II

Sem	Course Number	Course Code	Total Credits	Course Title	Theory Credit	Practical Credit	Credit for the Course
2	161	CHE-161-TH	2	Organic and Analytical Chemistry	2	0	2
	162	CHE-162-PR	2	Chemistry Practical-II	0	2	2
	161	OE-161-CHE	2	Basic Chemistry	0	2	2

				Practicals-I			
	151	SEC-151-CHE	2	Water testing and Analysis	0	2	2

**5. Course code and Title: CHE-161-TH: Organic and Analytical Chemistry
(2 Credits, 30 L)**

A) Organic chemistry :

1. Fundamentals of Organic Chemistry (08L)

Electronic Displacements: Inductive Effect, Electrometric Effect, Resonance and Hyper conjugation. 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 Comparative study with emphasis on factors affecting pK values, Types of organic reactions (addition, elimination, substitution, rearrangement with one example).

Self- Learning: Importance of arrows in organic reactions.

2. Stereochemistry (07L)

Introduction, classification, Interconversion of Wedge Formula, Newmann, Sawhorse and Fischer representations. Conformations with respect to 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 erythro; D and L; nomenclature; CIP Rules: R/ S (for upto 2 chiral carbon atoms) Stereochemistry of Glucose

Self- Learning: Conformations of ethane and propane

B) Analytical Chemistry :

3. Introduction to Analytical Chemistry: (03L)

What is analytical Chemistry? Chemical Analysis, Qualitative and Quantitative analysis, Applications of Chemical Analysis, Stages in a chemical Analysis, Sampling and Physical state of sample, Gross sample and Grab sample.

4. Calculations in Analytical Chemistry: (06 L)

Stoichiometry- mole concept, Avogadro's number, Solution- solute solvent, types of solution, Methods of expressing concentrations, strength, Normality, Molarity & Molality, ppm, % solution, weight by volume solution, volume by volume solution & density. Standard Solution Primary and Secondary standard. Standardization of secondary standards.

5. 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, sulphur, halogen and phosphorous by Lassaigne's test. Purification of organic compounds- Introduction, recrystallization, distillation, sublimation.

Reference Books:

1. Sykes, P. *A Guidebook to Mechanism in Organic Chemistry*, Orient Longman, New Delhi (1988).
2. Finar, I.L. *Organic Chemistry (Vol. I & II)*, E.L.B.S.
3. Morrison, R.T. & Boyd, R.N. *Organic Chemistry*, Pearson, 2010.
4. Bahl, A. & Bahl, B.S. *Advanced Organic Chemistry*, S. Chand, 2010.
5. A Braithwait and F. J. Smith, *Chromatographic method*, 5th edition, Kluwer Academic publishers
6. G D Christian -*Analytical Chemistry*
7. *Qualitative Organic Analysis 4th Edn* by A I Vogel (ELBS)
8. *Vogel's Quantitative Analysis*
9. Douglas A Skoog, Donald M West, F James Holler ,Stainly R Crouch , *Fundamentals of Analytical Chemistry*, 9th edition

Learning Outcomes

The students are expected to understand the fundamentals, principles, and recent developments in the subject area.

2. It is expected to inspire and boost interest of the students towards chemistry as the main subject.
3. To familiarize the applications of Chemistry in day to day life.
4. To create foundation for research and development in Chemistry.

Reference Books

1. Graham Solomon, T.W., Fryhle, C.B. & Snyder, S.A. *Organic Chemistry*, John Wiley & Sons (2014).
2. McMurry, J.E. *Fundamentals of Organic Chemistry*, 7th Ed. Cengage Learning India Edition, 2013.
3. Sykes, P. *A Guidebook to Mechanism in Organic Chemistry*, Orient Longman, New Delhi (1988).
4. Eliel, E. L. *Stereochemistry of Carbon Compounds*, Tata McGraw Hill education, 2000.
5. Finar, I. L. *Organic Chemistry (Vol. I & II)*, E.L.B.S.
6. Morrison, R.T. & Boyd, R.N. *Organic Chemistry*, Pearson, 2010.
7. Bahl, A. & Bahl, B.S. *Advanced Organic Chemistry*, S. Chand, 2010.

6. Course code and Title: **CHE-162-PR: Chemistry Practical-II**
(2 Credits, Any 15P)

Learning Outcome:

1. Importance of chemical safety and Lab safety while performing experiments in laboratory
2. Determination of thermochemical parameters and related concepts
3. Techniques of pH measurements
4. Preparation of buffer solutions
5. Elemental analysis of organic compounds (non instrumental)
6. Chromatographic Techniques for separation of constituents of mixtures

Section A: Organic Chemistry (Any Six)

- 1.) Principle of Green Chemistry
- 2.) **Application of Green chemistry in organic synthesis (Any One)**
 - a] Bromination of Cinnamic acid using sodium bromide and Sodium bromate. (Green Chemistry Approach)
OR
 - b] Bromination of acetanilide using KBr and Ceric ammonium nitrate in aqueous medium. (Green Chemistry Approach)
- 3.) **Organic Qualitative Analysis (3 solid, 2 liquid) –**
Type, detection of elements (N, S, Cl, Br, I), Saturation/Unsaturation, Physical constant, Functional group test in organic compounds
- 4.) **Organic Preparation (any One)**
 - a) Nitration of acetanilide, Recrystallization of product, Physical constant before and after recrystallization.
 - b.) Preparation of derivative -2, 4 DNP of aldehyde/ketone. b) Analysis by TLC

B) Analytical chemistry Practical :

Section B: Analytical Chemistry (06 Practical's)

- a) **Solution Preparations and determination of their Concentration (Compulsory Practical)**

1. Preparation of Molar and Normal solutions of different concentrations –

a) Oxalic acid (0.01N & 0.01M) b) KMnO_4 (0.01N & 0.01M) d (c) $\text{ZnSO}_4 \cdot 7\text{H}_2\text{O}$ d) $\text{K}_2\text{Cr}_2\text{O}_7$ and e) Potassium hydrogen phthalate

2. To find the concentration of KMnO_4 by titrating it against Oxalic acid.

b] Volumetric Analysis (Any Two)

3. Estimation of sodium carbonate and sodium hydrogen carbonate present in a mixture.

4. Determination of basicity of boric acid or oxalic acid or citric acid hence determination of their equivalent weight.

5. Estimation of water of crystallization in Mohr's salt by titrating with KMnO_4 .

6. Estimation of selectively Cu (II) from given solution by iodometrically.

c] Analysis of Commercial products (any Two)

7. Estimation of Aspirin and Error determination

8. Estimation of acid-neutralizing capacity of antacids like Gelusil tablet/ Gelusil Syrup.)

9. Estimation Of Calcium from commercially Available Milk powder .

10. Determination of pH of the commercially available Shampoo, Soap, Cold drinks, and Juices.

Reference Books:

1. Svehla, G. Vogel's Qualitative Organic Analysis, Pearson Education, 2012.

2. Mendham, J. Vogel's Quantitative Chemical Analysis, Pearson, 2009.

3. 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.

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 & Co.: New Delhi (2011).

6. Prof. Robert H. Hill Jr., David C. Finster Laboratory Safety for Chemistry Students, 2nd Edition

Wiley ISBN: 978-1-119-02766-9 May 2016

7. 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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7. Course code and Title : OE-161-CHE: **Basic chemistry Practical's –I (2 Credits Practical, 15P)**

Experiments

1. Introduction of Apparatus used in chemistry Laboratory.
2. Safety symbol on labels of pack of chemicals and its meaning
3. Precautions in handling of hazardous substances like Conc. acids, ammonia, organic solvents, etc.
4. Toxicity of the compounds used in chemistry laboratory and classification of toxicity.
5. MSDS sheets, points in MSDS Find out MSDS sheets of at least hazardous chemicals ($K_2Cr_2O_7$, Benzene, cadmium nitrate, sodium metal, etc.)
6. To determine the pH of the given acids solutions.
7. To determine the pH of the given bases solution samples.
8. To determine the pH of the given water samples.
9. To determine the pH of the given soil samples.
10. To determine the pH of the given milks samples.
11. To determine the pH of the given cold drinks.
12. To determine the pH of the given fruit juices samples.
13. To determine the pH of the given shampoo samples.
14. To determine the pH of the given soap samples.
15. To determine the pH of the given fertilizers samples.

8. Course code and Title: SEC 151- CHE-: Water testing and analysis: Theory & Practical [02Credit, (15P)]

List of Experiments

1. Preparation of Molar and Normal Solutions of Chemical reagents
2. Preparation of ppm and ppb solutions of Chemical reagents
3. Preparation of a primary standard solution and standardization of a secondary standard solution using a primary standard solution
4. Performing a neutralization titration [Strong acid Vs Strong base]
5. Performing a redox titration [KMnO₄ Vs Oxalic acid]
6. Performing a complexometric titration [EDTA Vs ZnSO₄]
7. To determine the pH of the given sample solutions
8. To determine the conductivity of the given sample solutions
9. To determine Total Dissolved solids of the given sample solutions
10. To determine the alkalinity of the given sample solution
11. To determine total hardness of the given sample solutions
12. Sampling of water samples for analysis [Theoretical]
13. To determine Copper/Chromium/ Iron in the given sample by colorimetry
14. Field Visit 1 [Report Writing]
15. Field Visit 2 [Report Writing]

Important Notice:

1. Each lecture (L) will be of 60 minutes.
2. Each Practical of 4 hours and 15 practical sessions per semester.

****Examination Scheme: *******

Practical Examination Scheme:

1. The external practical and theory examination will be conducted at the end of each semester.
2. The examination structure will be given before the commencement of examination.
3. Internal practical pattern for 25 Marks will be split in to (10 Practical +5 Marks Assignment +5 Oral +5 Journal)
4. External Practical will be for 25 marks (20 Marks Practical +5 Marks Oral)

Theory Paper Examination Scheme:

Theory examination pattern for each semester for **Major, Minor, OE, subject** will be of **50 marks** [**External examination 25 marks + 25 marks Internal Examination = Total 50 marks**. For theory courses, end semester question papers will be set by the College and centralized assessment for theory papers done as per the rules laid down by the College.

For the VSC, SEC and IKS subjects the examination for (If 1 credit for theory and 1 credit for practical will be separate each with 25 marks i.e. Theory 25 marks and practical 25 marks, or 2 credit Theory or 2 Credit for Practical(Internal 25 marks + External 25 Marks) the external practical examination will be conducted at the end of each semester.

Questions will be designed to test the conceptual knowledge and understanding of the basic and advanced concepts of the subject. In question paper setting weightage for each chapter will be proportional to number of theory lectures assigned to that chapter.

Internal examination for Major, Minor, OE, subject will be of 25 marks. It may include home assignments/ google forms/ short answer questions / open book test. A student must accomplished any three of said examination laid by the college or subject teacher before external examination.

For Theory (25 Marks) Papers pattern will be

- | | | |
|---|-------------|---------------------------------------|
| Q.1: Answer the following | [5] | [Compulsory] |
| Q.2. Answer any four of the following | [8] | (Give total no.question is 6) |
| Q.3. Answer any three of the following | [12] | (Give Total no. question is 5) |
