Anekant Education Society's

Tuljaram Chaturchand College

of Arts, Science, Commerce, Baramati

(Autonomous)

DEPARTMENT OF CHEMISTRY

(Faculty of Science and Technology)

B.Sc. Degree Program Chemistry

S.Y.B.Sc- Chemistry

(NEP Pattern)

Choice Based Credit System Structure and Syllabus

(To be implemented from June 2024)

Anekant Education Society's
Tuljaram Chaturchand College of Arts, Commerce & Science, Baramati
Dist. Pune
(Autonomous)

Tuljaram Chaturchand College of Arts, Science & Commerce, Baramati is an autonomous & dynamic institute and has successfully implemented the National Education Policy-2020 since the academic year 2023-24. We are updating our academic policies as per local needs keeping in view the global perspectives. Accordingly, we have updated our program outcomes as per the graduate attributes defined in New Education Policy. In general, program outcomes are categorized into two categories as disciplinary & interdisciplinary outcomes and generic outcomes.

Program Outcomes for B.Sc.

1. **Comprehensive Knowledge and Understanding**: Graduates will possess a profound understanding of their field of study, including foundational theories, principles, methodologies, and key concepts, within a broader multidisciplinary context.
2. **Practical, Professional, and Procedural Knowledge**: Graduates will acquire practical skills and expertise essential for professional tasks within their field. This includes knowledge of industry standards, best practices, regulations, and ethical considerations, with the ability to apply this knowledge effectively in real-world scenarios.
3. **Entrepreneurial Mindset and Knowledge**: Graduates will cultivate an entrepreneurial mindset, identifying opportunities, fostering innovation, and understanding business principles, market dynamics, and risk management strategies.
4. **Specialized Skills and Competencies**: Graduates will demonstrate proficiency in technical skills, analytical abilities, problem-solving, effective communication, and leadership, relevant to their field of study. They will also adapt and innovate in response to changing circumstances.
5. **Capacity for Application, Problem-Solving, and Analytical Reasoning**: Graduates will possess the capacity to apply learned concepts in practical settings, solve complex problems, and analyze data effectively. This requires critical thinking, creativity, adaptability, and a readiness to learn and take calculated risks.
6. **Communication Skills and Collaboration**: Graduates will effectively communicate complex information, both orally and in writing, using appropriate media and language. They will also collaborate effectively in diverse teams, demonstrating leadership qualities and facilitating cooperative efforts toward common goals.
7. **Research-related Skills**: Graduates will demonstrate observational and inquiry skills, formulate research questions, and utilize appropriate methodologies for data collection and analysis. They will also adhere to research ethics and effectively report research findings.
8. **Learning How to Learn Skills**: Graduates will acquire new knowledge and skills through self-directed learning, adapt to changing demands, and set and achieve goals independently.
9. **Digital and Technological Skills**: Graduates will demonstrate proficiency in using ICT, accessing information sources, and analyzing data using appropriate software.
10. **Multicultural Competence, Inclusive Spirit, and Empathy**: Graduates will engage effectively in multicultural settings, respecting diverse perspectives, leading diverse teams, and demonstrating empathy and understanding of others' perspectives and emotions.
11. **Value Inculcation and Environmental Awareness**: Graduates will embrace ethical and moral values, practice responsible citizenship, recognize and address ethical issues, and take appropriate actions to promote sustainability and environmental conservation.
12. **Autonomy, Responsibility, and Accountability**: Graduates will apply knowledge and skills independently, manage projects effectively, and demonstrate responsibility and accountability in work and learning contexts.
13. **Community Engagement and Service**: Graduates will actively participate in community-engaged services and activities, promoting societal well-being.

Anekant Education Society's
Tuljaram Chaturchand College of Arts, Commerce & Science, Baramati
Dist. Pune
(Autonomous)
Course & Credit Structure for S.Y.B.Sc Chemistry
(2023 Pattern as per NEP–2020)

Sem	Course Type	Course Code	Course Title	Theory/ Practical	Credits
III	Major Mandatory	CHE-201-MJM	Physical Chemistry-I	Theory	02
	Major Mandatory	CHE -202-MJM	Inorganic Chemistry-I	Theory	02
	Major Mandatory	CHE -203-MJM	Organic Chemistry-I	Theory	02
	Major Mandatory	CHE -204-MJM	Chemistry Practical- III	Practical	02
	Minor	CHE-211-MN	Basic concepts of Chemistry-I	Theory	02
	Minor	CHE-212-MN	Basic Practicals in Chemistry–I	Practical	02
	Open Elective	CHE-216-OE	Chemistry in everyday life	Theory	02
	Vocational Skill Course (VSC)	CHE-221-VSC	Fundamental of Analytical Chemistry	Theory	02
	Ability Enhancement Course (AEC)	MAR / HIN /SAN -231-AEC	□□□□□ □□□□□□ □ □□□□ □□□□□□□ □□□□□ □□□□ □□□□ □□□□□□□□ □□□□□□ □□□□□□□□	Theory	02
	Co-curricular Course (CC)	YOG/PES/CUL /NSS/NCC -239-CC	To be Selected from the Basket	Theory	02
	Field Project (FP)	CHE-235-FP		Practical	02
	Generic IKS Course (IKS)	GEN-245-IKS		Theory	02
			Total Credits Semester-III		**24**
IV	Major Mandatory	CHE-251-MJM		Theory	02
	Major Mandatory	CHE -252-MJM		Theory	02
	Major Mandatory	CHE -253-MJM		Theory	02
	Major Mandatory	CHE -254-MJM		Practical	02
	Minor	CHE-261-MN		Theory	02
	Minor	CHE-262-MN		Practical	02
	Open Elective (OE)	CHE-266-OE		Practical	02
	Skill Enhancement Course (SEC)	CHE-221-SEC		Practical	02
	Ability Enhancement Course (AEC)	MAR / HIN/ SAN -281-AEC	□□□□ □□□□□□□□□ □ □□□□□□□ □□□□□□□ □□□□□ □□□□ : □□□□□□□□ □□□□ □□□□□ □□□□□□ □□□□□□□□	Theory	02
	Co-curricular Course (CC)	YOG/PES/CUL/NSS/ NCC-289-CC	To be Selected from the Basket	Theory	02
	Community Engagement project (CEP)	CHE-285-CEP		Practical	02

	Total Credits Semester-IV	**22**
	Cumulative Credits Semester III + Semester IV	**46**

CBCS Syllabus as per NEP 2020 for S.Y.B.Sc. (2023 Pattern)

Name of the Programme	**:** B.Sc.Chemistry
Program Code	**:** CHE
Class	**:** S.Y.B.Sc.
Semester	**:** III
Course Type	**:** Mandatory Theory
Course Name	**:** Physical Chemistry-I
Course Code	**:** CHE-201-MJM
No. of Lectures	**:** 30
No. of Credits	**:** 2credits

Course Objectives:

1. Student should able to know the principle of chemical kinetics.
2. Students should able to understand concept of reaction rate and order of reaction,
3. Students should able to calculate the activation energy of chemical reaction.
4. Students should able to understand the chemical thermodynamics and its laws.
5. Students should able to know the concept of entropy and spontaneity of a reaction.
6. Students should able to understand free energy, chemical equilibrium and response to different factors.
7. Student should able to know the concept of equilibrium constant in terms of concentration and pressure.
8. Students should able to compare the chemical reactions using Clausius- Clapeyron equation.

Course Outcomes:

After completion of this course students will be able

1. To know concept of reaction rate, order of reaction, activation energy and rate theories.
2. To understand second law of thermodynamics, entropy calculation.
3. To know concept of free energy, chemical equilibrium and response to different factors.
4. To understand the chemical thermodynamics and its laws.
5. To know the concept of entropy and spontaneity of a reaction
6. To understand free energy, chemical equilibrium and response to different factors.
7. To know the concept of equilibrium constant and its calculation in terms of concentration and pressure.
8. To compare the chemical reaction for its rate by using -Clausius- Clapeyron equation.

Topics and Learning Points

Unit 1. Chemical Kinetics (10 L)

Introduction, The concept of reaction rate. Effects of various factors like temperature, pressure, presence of catalyst on the reaction rate. Order and Molecularity of a chemical reaction. Derivation of integrated reaction rate equation for zero, first, second order (for equal initial concentrations of reactants) reactions Half-life period of reaction. General methods for determination of order of reaction. Concept of activation energy and its determination from Arrhenius equation. Numerical problems.

Unit 2. Chemical Thermodynamics (08 L)

Concept of entropy, Second Law of thermodynamics and its statements, Calculation of entropy change for reversible and irreversible processes under different conditions. Physical significances of entropy, entropy change for an ideal gas, entropy change accompanying change of phase. Numerical and problems. Third Law of Thermodynamics – statement, Concept of absolute entropy.

Unit 3. Free energy and Chemical Equilibrium (12 L)

Introduction, Helmholtz free energy, variation of Helmholtz free energy with volume and temperature, Helmholtz free energy change for chemical reaction, Gibbs free energy, variation of Gibbs free energy with pressure and temperature, Gibbs free energy change for chemical reaction, Free energy change for an ideal gas. Standard free energy change, Gibb's – Helmholtz equation, Properties and significances of Gibbs free energy change, Van't Haff reaction isotherm, thermodynamic equilibrium constant, Relation between Kp and Kc for gaseous reactions, variation in equilibrium constant with temperature, criteria for chemical equilibrium, Physical equilibrium, Clapeyron equation, Clausius- Clapeyron equation, Applications of Clausius-Clapeyron equation, numerical and problems.

References:

1. Principles of Physical Chemistry, S. H. Marron and C. F. Pruton, 6th edn.
2. Essentials of Physical Chemistry, Bahl, Tuli, Revised multicolour edn. 2009
3. Physical Chemistry, G. M. Barrow, Tata McGraw-Hill (2007)
4. University Chemistry, B. H. Mahan, 3rd edn. Narosa (1998)
5. Chemical Thermodynamics, R. P. Rastogi and R.P. Misera
6. Thermodynamics, Statistical Thermodynamics and Kinetics, Thomas Engel, Philip Reid, Pearson publication,
7. Atkin's Physical Chemistry, Peter Atkins, Julio De Paula, Oxford publication. 8th ed.
8. Elements of Physical Chemistry, Peter Atkins, Julio De Paula, Oxford publication, 5th ed.

Mapping of Program out comes with Course Outcomes

Class: B.Sc. (SEM III) **Subject**: Chemistry

Course: Physical Chemistry I **Course Code**: CHE201-MJM

Weightage: 1=weak or low relation, 2=moderate or partial relation, 3=strong or direct relation

COs	PO1	PO2	PO3	PO4	PO7	PO8	PO9	PO10	PO11	PO12	PO13
CO1	3	3	0	3	3	0	0	0	0	0	0
CO2	3	3	0	3	3	0	0	0	0	0	0
CO3	3	3	0	3	3	0	0	0	0	0	0
CO4	3	3	0	3	3	0	0	0	0	0	0
CO5	3	3	0	3	3	0	0	0	0	0	0
CO6	3	3	0	3	3	0	0	0	0	0	0
CO7	3	3	0	3	3	0	0	0	0	0	0

Comprehensive Knowledge and Understanding (PO1):

CO1. To know concept of reaction rate, order of reaction, activation energy and rate theories.
CO2. To understand second law of thermodynamics, entropy calculation.
CO3. To know concept of free energy, chemical equilibrium and response to different factors.
CO4. To understand the chemical thermodynamics and its laws.
CO5. To know the concept of entropy and spontaneity of a reaction
CO6. To understand free energy, chemical equilibrium and response to different factors.
CO7. To know the concept of equilibrium constant and its calculation in terms of concentration and pressure.

Practical, Professional, and Procedural Knowledge (PO2):

CO1. To know concept of reaction rate, order of reaction, activation energy and rate theories.
CO2. To understand second law of thermodynamics, entropy calculation.
CO3. To know concept of free energy, chemical equilibrium and response to different factors.
CO4. To understand the chemical thermodynamics and its laws.
CO5. To know the concept of entropy and spontaneity of a reaction
CO6. To understand free energy, chemical equilibrium and response to different factors.
CO7. To know the concept of equilibrium constant and its calculation in terms of concentration and pressure.

Specialized Skills, Critical Thinking, and Problem-Solving (PO4):

CO1. To know concept of reaction rate, order of reaction, activation energy and rate theories.
CO2. To understand second law of thermodynamics, entropy calculation.
CO3. To know concept of free energy, chemical equilibrium and response to different factors.
CO4. To understand the chemical thermodynamics and its laws.
CO5. To know the concept of entropy and spontaneity of a reaction
CO6. To understand free energy, chemical equilibrium and response to different factors.
CO7. To know the concept of equilibrium constant and its calculation in terms of concentration and pressure.

Research, Analytical Reasoning, and Ethical Conduct (PO7):

CO1. To know concept of reaction rate, order of reaction, activation energy and rate theories.
CO2. To understand second law of thermodynamics, entropy calculation.
CO3. To know concept of free energy, chemical equilibrium and response to different factors.
CO4. To understand the chemical thermodynamics and its laws.
CO5. To know the concept of entropy and spontaneity of a reaction
CO6. To understand free energy, chemical equilibrium and response to different factors.
CO7. To know the concept of equilibrium constant and its calculation in terms of concentration and pressure.

CBCS Syllabus as per NEP 2020 for S.Y.B.Sc. (2023 Pattern)

Name of the Programme	**:** B.Sc. Chemistry
Program Code	**:** CHE
Class	**:** S.Y.B.Sc.
Semester	**:** III
Course Type	**:** Mandatory Theory
Course Name	**:** Inorganic Chemistry-I
Course Code	**:** CHE-202-MJM
No. of Lectures	**:** 30
No. of Credits	**:** 2 credits

Course Objectives:

1. To understand basic concept of MOT
2. To introduce the LCAO principle.
3. Students should learn Homonuclear diatomic molecules, Heteronuclear diatomic molcules.
4. Students should learn properties of d block elements.
5. Students should learn about different solvent and properties .
6. Students will be able to understand the theories of acids and bases.
7. Students will be able to remember concepts of d-block elements and molecular orbital theory

Course Outcomes:

1. Students should be able to know overlapping of atomic orbital and formation of bonds.
2. Students should be able to know the configuration transition elements .
3. Students should be able to compare VBT and MOT.
4. Students should be able to know solubility of solute.
5. Students should be able to compare the theories of acids and bases.
6. Students should be able to know colors of inorganic compounds.
7. Students should be able get the knowledge of MOT and able to know the bond order in diatomic molecules.

Topics and Learning Points

Unit 1. Molecular Orbital Theory of diatomic molecules (14 L)

Limitations of Valence Bond theory(VBT), Need of Molecular orbital theory (MOT), Features of MOT, Sigma and pi bond, Molecular orbital Method, LCAO principle and method, s-s combinations of orbitals, s-p combinations of orbitals, p-p combinations of orbitals, Non-bonding combinations of orbitals, Rules for linear combination of atomic orbitals.

Examples of molecular orbital treatment for homo-nuclear diatomic molecules: (Explain each molecule with respect to MO energy level diagram, bond order and magnetic behavior) $H2^{+}$ molecule ion, H2

molecule, He_2^+ molecule ion, He_2 molecule, Li_2 molecule, Be_2 molecule, B_2 molecule, C_2 molecule, N_2 molecule, O_2 molecule, O_2^+, O_2^- and O_2^{2-} molecule ion, F_2 molecule, Ne_2 molecule.
Heteronuclear diatomic molecules: Examples of molecular orbital treatment for hetero- nuclear diatomic molecules, NO molecule, NO^+ ion ,CO molecule, HF molecule.

Unit 2. Chemistry of d-block (10 L)
Introduction, General properties of transition metals, electronic configuration, size of atoms and ions, density, melting points and boiling points, reactivity, oxidation state, catalytic properties, color and magnetic properties of complexes. Comparison of 1 st transition series with 2^{nd} & 3^{rd} transition series w.r.t.- a) electronic configuration b) reactivity c) Stability of oxidation state d) magnetic behavior and e) Stability of complexes (in brief)

Unit 3.. Acid, base and solvents (6 L)
Properties of solvents, Arrhenius theory, Lowry-Brownsted theory, Solvent system, Lux-Flood concept, Lewis concept, Hydracids and Oxyacids.

References:

1) Concise inorganic chemistry J.D.Lee 7th edition.
2) Principles of inorganic chemistry .B.K.Sharma
3) Modern Inorganic chemistry. Dr.R.D.Brown

Mapping of Program out comes with Course Outcomes

Class: B.Sc. (SEM III) Subject: Chemistry
Course: Inorganic Chemistry I Course Code: CHE202-MJM
Weightage: 1=weak or low relation, 2=moderate or partial relation, 3=strong or direct relation

COs	PO1	PO2	PO3	PO4	PO7	PO8	PO9	PO10	PO11	PO12	PO13
CO1	3	0	0	3	0	0	0	0	0	0	0
CO2	3	0	0	3	0	0	0	0	0	0	0
CO3	3	0	0	3	0	0	0	0	0	0	0
CO4	3	0	0	3	0	0	0	0	0	0	0
CO5	3	0	0	3	0	0	0	0	0	0	0
CO6	3	0	0	3	0	0	0	0	0	0	0
CO7	3	0	0	3	0	0	0	0	0	0	0

Comprehensive Knowledge and Understanding (PO1):

CO1: Students should be able to know overlapping of atomic orbital and formation of bonds.
CO2: Students should be able to know the configuration transition elements .
CO3: Students should be able to compare VBT and MOT.
CO4: Students should be able to know solubility of solute .
CO5: Students should be able to compare the theories of acids and bases.
CO6: Students should be able to know colors of inorganic compounds.
CO7: Students should be able get the knowledge of MOT and able to know the bond order in diatomic molecules.

Specialized Skills, Critical Thinking, and Problem-Solving (PO4):

CO1: Students should be able to know overlapping of atomic orbital and formation of bonds.
CO2: Students should be able to know the configuration transition elements .
CO3: Students should be able to compare VBT and MOT.
CO4: Students should be able to know solubility of solute .
CO5: Students should be able to compare the theories of acids and bases.
CO6: Students should be able to know colors of inorganic compounds.
CO7: Students should be able get the knowledge of MOT and able to know the bond order in diatomic molecules.

CBCS Syllabus as per NEP 2020 for S.Y.B.Sc (2023 Pattern)

Name of the Programme	**:** B.Sc. Chemistry
Program Code	**:** CHE
Class	**:** S.Y.B.Sc
Semester	**:** III
Course Type	**:** Mandatory Theory
Course Name	**:** Organic Chemistry-I
Course Code	**:** CHE-203-MJM
No. of Lectures	**:** 30
No. of Credits	**:** 2 credits

Course Objectives:

1. To understand basic concept of isomerism, types of isomers and their stereochemistry.
2. To introduce the Baeyer's strain theory and its applications.
3. Students should learn the optical isomerism and know about their stability, energy calculation with potential diagram and optical activity of these conformers.
4. Students should learn the types of reagents, types of organic reaction and types of rearrangement.
5. Students should learn about alcohols and phenols with their properties, preparation and reactions.
6. Student should know about carboxylic acids and amines their properties, preparation and reactions.
7. Students should learn functional groups, changes in the reactive site of organic compound.

Course Outcomes:

1. Students will be able to learn the stereochemistry of the mono-substituted cyclohexane with stability.
2. Students will be able to apply the knowledge to draw the conformations of cycloalkanes.
3. Students will be able to learn the concepts of the functional and how the changes take place in functional group.
4. Students will be able to apply the knowledge of functional group to learn about the alcohol.
5. Students will be able to apply the knowledge to study about the phenols and know about the difference between alcohols and phenols.
6. Students will be able to learn about the carboxylic acids and amines.
7. Students will be able to apply the knowledge to know meaning of functional groups and their reactions.

Topics and Learning Points

Unit-1 Stereoisomerism **(8L)**

Introduction to optical isomerism - Optical Activity, specific rotation, Enantiomerism, Diastereomerism.

Stereoisomerism (Cycloalkanes)- Baeyer's strain theory, heat of combustion, affecting the stability of conformation, Conformation of cyclohexane, Mono-substituted cyclohexane.Structures of geometrical isomers of dimethyl cyclohexane.

Unit-2: **Chemistry of Alcohols and Phenols** **(10L)**

Alcohols: Introduction, nomenclature, physical properties, general methods of preparations, chemical reactions.

Phenols: Introduction, nomenclature, physical properties, general methods of preparations, chemical reactions.

Unit-3: **Chemistry of Carboxylic Acids and Amines** **(12L)**

Carboxylic acids: Introduction, nomenclature, physical properties, general methods of preparations, chemical reactions.

Amines: Introduction, nomenclature, physical properties, general methods of preparations, chemical reactions.

References:

1. Organic Chemistry. Morrison and Boyd, 6thEd Prentice Hall, NewDelhi-2001.
2. Stereochemistry of carbon compounds, E. L. Eliel
3. Reactions, rearrangements and reagents ,S .N. Sanyal
4. Organic Chemistry- Clayden, Oxford Uni. Press.

Mapping of Program out comes with Course Outcomes

Class: B.Sc. (SEM III) Subject: Chemistry
Course: Organic Chemistry I Course Code: CHE-203-MJM
Weightage: 1=weak or low relation, 2=moderate or partial relation, 3=strong or direct relation

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13
CO1	3	0	0	3	0	0	3	0	0	0	0	0	0
CO2	3	0	0	3	0	0	3	0	0	0	0	0	0
CO3	3	0	0	3	0	0	3	0	0	0	0	0	0
CO4	3	0	0	3	0	0	3	0	0	0	0	0	0
CO5	3	0	0	3	0	0	3	0	0	0	0	0	0
CO6	3	0	0	3	0	0	3	0	0	0	0	0	0
CO7	3	0	0	3	0	0	3	0	0	0	0	0	0

Comprehensive Knowledge and Understanding (PO1):

CO1: Students will be able to learn the stereochemistry of the mono-substituted cyclohexane with stability.

CO2: Students will be able to apply the knowledge to draw the conformations of cycloalkanes.

CO3: Students will be able to learn the concepts of the functional and how the changes take place in functional group.

CO4: Students will be able to apply the knowledge of functional group to learn about the alcohol.

CO5: Students will be able to apply the knowledge to study about the phenols and know about the difference between alcohols and phenols.

CO6: Students will be able to learn about the carboxylic acids and amines.

CO7: Students will be able to apply the knowledge to know meaning of functional groups and their reactions.

Specialized Skills, Critical Thinking, and Problem-Solving (PO4):

CO1: Students will be able to learn the stereochemistry of the mono-substituted cyclohexane with stability.

CO2: Students will be able to apply the knowledge to draw the conformations of cycloalkanes.

CO3: Students will be able to learn the concepts of the functional and how the changes take place in functional group.

CO4: Students will be able to apply the knowledge of functional group to learn about the alcohol.

CO5: Students will be able to apply the knowledge to study about the phenols and know about the difference between alcohols and phenols.

CO6: Students will be able to learn about the carboxylic acids and amines.

CO7: Students will be able to apply the knowledge to know meaning of functional groups and their reactions.

CBCS Syllabus as per NEP 2020 for S.Y.B.Sc (2023Pattern)

Name of the Programme	**:** B.Sc.Chemistry
Program Code	**:** CHE
Class	**:** S.Y.B.Sc
Semester	**:** III
Course Type	**:** Major Practical
Course Name	**:** Chemistry Practical-III
Course Code	**:** CHE-204-MJM
No. of Practicals	**:** .15
No. of Credits	**:** 2 credits

Course Objectives:

1. To introduce chemical and laboratory safety.
2. To learn basic of chemistry practical from all the discipline of chemistry.
3. To determine the order and rate of the reaction to understand the chemical kinetics.
4. To determine the solubility of Benzoic acid at different temperature and learn thermodynamics.
5. To determine the type of given organic compound and characterize it by doing full analysis.
6. To learn the estimation of compounds.
7. To know the synthesis of inorganic complexes.
8. To learn the volumetric analysis

Course Outcomes (COs):

1. Student will able to understand the theoretical aspects and scientific principles of selected experiments through demonstrations which helps in developing the subject interest.
2. Student will able to develop experimental and operational skills through hands on training showcasing accident-free working, critical thinking and numerical solving ability in laboratory.
3. Student will able to prepare the standard solutions required in chemical synthesis/analysis with qualitative/ quantitative approach.
4. Student will able to perform good laboratory practices through pre-setting of experiments by utilizing their scientific temper with interdisciplinary manner.
5. Student will able to carry out the analysis of given organic compound in terms of its type, functional group, elements detection and melting points.
6. Student will able to learn the processes involved in synthesis of inorganic complexes.
7. Student will able to apply the knowledge about various chemical methods of analysis to solve various social/ scientific problems. It can be useful in the research with many interdisciplinary subjects such as microbiology, nanoscience and engineering.

Topics and Learning Points

Section I: Physical Chemistry Practical (Any five experiments)

1. Determination of rate constant of a reaction between potassium persulphate and potassium iodide for equal initial concentration of the reactants. .
2. Determination of solubility of Benzoic acid at different temperature and calculate ΔHof solution.
3. To determine the first order rate constant of acid catalyzed ester hydrolysis.
4. To determine the rate constant of base catalyzed ester hydrolysis.
5. Determination of the relative strength of HCl and H_2SO_4 by studying the kinetics of hydrolysis of ester.
6. To study the kinetics of iodination of acetone and hence determine the order of reaction.

Section II: Organic Chemistry Practical

1) Organic Qualitative Analysis (Six Single compounds).
Identification of organic compounds through –

a) Type determination b) preliminary tests c) detection of elements (Sodium fusion tests)

d) Detection of functional groups e) melting point / Boiling point

i) Acid : benzoic, salicylic, phthalic, cinnamic, oxalic, salicylic acid

ii) Phenol : α-naphthol, β-naphthol, resorcinol, o-nitrophenol, p- nitrophenol

iii) Base: Aniline, p-toludine, diphenylamine, N, N-dimethylaniline, o-nitroaniline m-nitroaniline, p-nitroaniline

iv) Neutral : Benzaldehyde, glucose, fructose, acetone, ethylmethyl ketone, acetophenone, methyl acetate, ethyl acetate, naphthalene, Anthracene, Nitrobenzene, mdinitrobenzene, Acetamide, Urea, Acetanilide, Chloroform, Carbon tetrachloride, Thiourea.

Section III: Inorganic Chemistry Practical

1. Synthesis of co ordination compounds (Four)
   a) $[Mn(acac)_3]$
   b) $K_3[Fe(OX)_3]$
   c) $[Cu(NH_3)_4]SO_4.H_2O$
   d) $[Ni(en)_3]Cl_2$
   e)) $[Co(NH3)_{5Cl}]Cl_2$
2. Determination of the % purity of NaCl volumetrically.
3. Determination the amount of Ni/Al by complexometric titration using EBT indicator.
4. Separation and identification of metal ions by paper chromatography.

References:

1. Senior Practical Physical Chemistry, Khosla, Garg & Gulati, R, Chand & Co
2. Practical Physical Chemistry, A M. Jemes, F. E. Prichard, 3rd edn, Longman.
3. Advanced Practical Physical Chemistry, J. B. Yadav, Goel Publishing house
4. Organic Qualitative Analysis – A. I. Vogel
5. Vogel's Qualitative Inorganic Analysis, Svehla G. Pearson Education, 2012
6. Vogel's Quantitative Inorganic Analysis, Mendham J.2012

Mapping of Program out comes with Course Outcomes

Class: B.Sc. (SEM III) Subject: Chemistry

Course: Chemistry Practical-III Course Code: CHE-204-MJM

Weightage: 1=weak or low relation, 2=moderate or partial relation, 3=strong or direct relation

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13
CO1	3	0	0	0	3	0	3	0	0	0	0	0	0
CO2	0	3	0	3	0	0	3	0	0	0	0	0	0
CO3	0	3	0	3	0	0	0	0	0	0	0	0	0
CO4	0	3	0	3	0	0	3	0	0	0	0	0	0
CO5	3	0	0	3	3	0	3	0	0	0	0	0	0
CO6	3	0	0	3	0	0	3	0	0	0	0	0	0
CO7	3	0	0	3	3	0	3	0	0	0	0	0	0

Comprehensive Knowledge and Understanding (PO1):

CO1: Student will able to understand the theoretical aspects and scientific principles of selected experiments through demonstrations which helps in developing the subject interest.

CO5 Student will able to carry out the analysis of given organic compound in terms of its type, functional group, elements detection and melting points.

CO6: Student will able to learn the processes involved in synthesis of inorganic complexes.

CO7: Student will able to apply the knowledge about various chemical methods of analysis to solve various social/ scientific problems. It can be useful in the research with many interdisciplinary subjects such as microbiology, nanoscience and engineering.

Practical, Professional, and Procedural Knowledge (PO2):

CO2: Student will able to develop experimental and operational skills through hands on training showcasing accident-free working, critical thinking and numerical solving ability in laboratory.

CO3: Student will able to prepare the standard solutions required in chemical synthesis/analysis with qualitative/ quantitative approach.

CO4: Student will able to perform good laboratory practices through pre-setting of experiments by utilizing their scientific temper with interdisciplinary manner.

Specialized Skills, Critical Thinking, and Problem-Solving (PO4):

CO2: Student will able to develop experimental and operational skills through hands on training showcasing accident-free working, critical thinking and numerical solving ability in laboratory.

CO3: Student will able to prepare the standard solutions required in chemical synthesis/analysis with qualitative/ quantitative approach.

CO4: Student will able to perform good laboratory practices through pre-setting of experiments by utilizing their scientific temper with interdisciplinary manner.

CO5: Student will able to carry out the analysis of given organic compound in terms of its type, functional group, elements detection and melting points.

CO6: Student will able to learn the processes involved in synthesis of inorganic complexes.

CO7: Student will able to apply the knowledge about various chemical methods of analysis to solve various social/ scientific problems. It can be useful in the research with many interdisciplinary subjects such as microbiology, Nanoscience and engineering.

Capacity for Application, Problem-Solving, and Analytical Reasoning (PO5):

CO5: Student will able to carry out the analysis of given organic compound in terms of its type, functional group, elements detection and melting points.

CO6: Student will able to learn the processes involved in synthesis of inorganic complexes.

CBCS Syllabus as per NEP 2020 for S.Y.B.Sc (2023 Pattern)

Name of the Programme	**:** B.Sc. Chemistry
Program Code	**:** CHE
Class	**:** S.Y.B.Sc
Semester	**:** III
Course Type	**:** Minor Theory
Course Name	**:** Basic concept of Chemistry-I
Course Code	**:** CHE-211-MN
No. of Lectures	**:** 30
No. of Credits	**:** 2 credits

Course Objectives:

1. To understand the states of matter and their properties.
2. To explain critical constants and their correlation with van der Waal's constants.
3. To describe properties of liquids, vapor pressure, and methods for measuring vapor pressure and viscosity.
4. To trace the development of the periodic table from Dobereiner's Triads to the Modern periodic table.
5. To classify elements into s, p, d, and f-blocks based on electronic configuration and to analyze trends in properties such as atomic and ionic size, ionization potential, electron affinity, and electronegativity.
6. To apply the functional group approach to study the structure, nomenclature, and properties of alkanes, alkenes, and alkynes.
7. To describe the preparations of alkanes, alkenes, and alkynes through various methods such as catalytic hydrogenation, Wurtz reaction, Kolbe's synthesis, and from Grignard reagent.

Course Outcomes:

After completion of this course students will be able

1. To understand the fundamental principles governing the behavior of gases and liquids.
2. To interpret critical constants and their significance in the behavior of gases.
3. To conduct experiments to measure vapor pressure and viscosity of liquids.
4. To describe the historical development of the periodic table and its impact on the understanding of chemical elements.
5. To explain the periodic trends in the properties of elements based on their positions in the periodic table and classify elements into s, p, d, and f-blocks based on their electronic configurations.
6. To apply the functional group approach to identify and classify aliphatic hydrocarbons.

7. To perform synthesis of alkanes, alkenes, and alkynes using appropriate methods as well as to understand and predict the reactivity of alkanes, alkenes, and alkynes in various reactions.

Topics and Learning Points

Unit 1: Gaseous and Liquid States (10 L)
Introduction: States of matter and their properties.
Gaseous state : Significance of ideal and kinetic gas equation (no derivation), Real gases, Compressibility factor, van der Waal's equation of state, critical constants, correlation between critical constants and van der Waal's constants.
Liquid state: Properties of liquids, vapor pressure and its measurement by isoteniscopic method, Viscosity and its measurements by Ostwald's viscometers.

Unit 2: Introduction to the periodic table (10 L)
Development of the periodic table- Dobereiner's Triads, Newland's Law of Octaves, Mendeleev's periodic table and Modern periodic table (Theories and limitations), Classification of the elements into s,p,d and f -block elements on the basis of electronic configuration, Trends in properties (atomic and ionic size, ionization potential, electron affinity, electronegativity).

Unit 3: Aliphatic Hydrocarbons (10 L)
Functional group approach for the following reactions (preparations & reactions) to be studied in context to their structure.
Alkanes (Up to 5 Carbons): Nomenclature and properties; Preparation: Catalytic hydrogenation, Wurtz reaction, Kolbe's synthesis, from Grignard reagent. Reactions: Free radical Substitution: Halogenation.

Alkenes (Up to 5 Carbons): Nomenclature and properties; Preparation: Elimination reactions: Dehydration of alkenes and dehydrohalogenation of alkyl halides (Saytzeff's rule); cis alkenes (Partial catalytic hydrogenation) and trans alkenes (Birch reduction). Reactions: cis-addition (alk. KMnO4) and trans-addition (bromine), Addition of HX (Markownikoff's and anti-Markownikoff's addition).

Alkynes (Upto 5 Carbons): Nomenclature and properties; 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. $KMnO_4$.

References:

1. Principles of Physical Chemistry, S. H. Marron and C. F. Pruton, 6th edn.
2. Essentials of Physical Chemistry, Bahl, Tuli, Revised multicolour edn. 2009
3. Physical Chemistry, G. M. Barrow, Tata McGraw-Hill (2007)
4. Concise inorganic chemistry 5th,6th 7th edition .J.D.Lee
5. Principles of inorganic chemistry .B.K.Sharma
6. Modern Inorganic chemistry .Revised edition. Dr.R.D.Brown
7. Organic Chemistry. Morrison and Boyd, 6thEd Prentice Hall, NewDelhi-2001.
8. Organic Chemistry- Clayden, Oxford Uni. Press.

Mapping of Program out comes with Course Outcomes

Class: B.Sc. (SEM III) Subject: Chemistry

Course: Basic concepts of Chemistry-I Course Code: CHE-211-MN

Weightage: 1=weak or low relation, 2=moderate or partial relation, 3=strong or direct relation

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13
CO1	3	0	0	3	3	0	3	0	0	0	0	0	0
CO2	0	3	0	3	0	0	3	0	0	0	0	0	0
CO3	0	3	0	3	0	0	3	0	0	0	0	0	0
CO4	3	0	0	3	3	0	3	0	0	0	0	0	0
CO5	3	0	0	3	3	0	3	0	0	0	0	0	0
CO6	3	0	0	3	3	0	3	0	0	0	0	0	0
CO7	3	3	0	3	3	0	3	0	0	0	0	0	0

Comprehensive Knowledge and Understanding (PO1): CO1, CO4, CO5, CO6, CO7

CO1: To understand the fundamental principles governing the behavior of gases and liquids.

CO4: To conduct experiments to measure vapor pressure and viscosity of liquids.

CO5: To describe the historical development of the periodic table and its impact on the understanding of chemical elements.

CO6: To explain the periodic trends in the properties of elements based on their positions in the periodic table and classify elements into s, p, d, and f-blocks based on their electronic configurations.

CO7: To apply the functional group approach to identify and classify aliphatic hydrocarbons.

Practical, Professional, and Procedural Knowledge (PO2): CO3, CO7

CO3: To conduct experiments to measure vapor pressure and viscosity of liquids.

CO7: To perform synthesis of alkanes, alkenes, and alkynes using appropriate methods as well as to understand and predict the reactivity of alkanes, alkenes, and alkynes in various reactions

Specialized Skills, Critical Thinking, and Problem-Solving (PO4):

CO2: To interpret critical constants and their significance in the behavior of gases.

CO3: To conduct experiments to measure vapor pressure and viscosity of liquids.

CO4: To describe the historical development of the periodic table and its impact on the understanding of chemical elements.

CO5: To explain the periodic trends in the properties of elements based on their positions in the periodic table and classify elements into s, p, d, and f-blocks based on their electronic configurations.

CO6: To apply the functional group approach to identify and classify aliphatic hydrocarbons.

CO7: To perform synthesis of alkanes, alkenes, and alkynes using appropriate methods as well as to understand and predict the reactivity of alkanes, alkenes, and alkynes in various reactions.

Capacity for Application, Problem-Solving, and Analytical Reasoning (PO5):

CO1: To understand the fundamental principles governing the behavior of gases and liquids.

CO4: To conduct experiments to measure vapor pressure and viscosity of liquids.

CO5: To describe the historical development of the periodic table and its impact on the understanding of chemical elements.

CO6: To explain the periodic trends in the properties of elements based on their positions in the periodic table and classify elements into s, p, d, and f-blocks based on their electronic configurations.

CO7: To apply the functional group approach to identify and classify aliphatic hydrocarbons

CBCS Syllabus as per NEP 2020 for S.Y.B.Sc (2023 Pattern)

Name of the Programme	**:** B.Sc. Chemistry
Program Code	**:** CHE
Class	**:** S.Y.B.Sc
Semester	**:** III
Course Type	**:** Minor Practical
Course Name	**:** Basic Practicals in Chemistry-I
Course Code	**:** CHE-212-MN
No. of Practicals	**:** 15
No .of Credits	**:** 2 credits

Course Objectives:

1. To understand and follow laboratory safety protocols.
2. To Identify and handle hazardous substances with precaution and to familiarize with Material Safety Data Sheets (MSDS) for hazardous chemicals.
3. To determine the molar gas constant R using the eudiometric method and to determine the relative viscosity of organic liquids using a viscometer.
4. To practice plotting linear functions.
5. To standardize different solutions and determine the strength of a given solution.
6. To determine the number of molecules of water of crystallization in crystalline substance and to determine the hardness of water using EDTA.
7. To purify given organic compounds using sublimation and crystallization method.
8. To determine the type of given organic compound and report its melting point.

Course Outcomes:

1. To identify and assess potential hazards associated with chemicals and equipment.
2. To calculate the molar gas constant R accurately and to determine the relative viscosity of organic liquids with precision.
3. To plot linear functions accurately and interpret the results.
4. To standardize NaOH and KMnO4 solutions accurately and to determine the strength of a given HCl solution and a KMnO4 solution in normal terms.
5. To calculate the number of molecules of water of crystallization and to determine the hardness of water using EDTA titration accurately.
6. To successfully purify organic compounds using sublimation and crystallization methods.
7. To identify the type of given organic compound and characterized by its melting point.

Topics and Learning Points

Chemical and Laboratory Safety:-

1. Introduction to laboratory (Dos and Don'ts in laboratory)
2. Precaution in handling of hazardous substance.
3. Safety symbols on label of pack of chemicals and its meaning.
4. Understanding of MSDS of few hazardous chemicals**.**

Physical Chemistry Practical:-

1. To determine the molar gas constant R by eudiometric method and to express R in different units.
2. To determine relative viscosity of given organic liquids by viscometer.
3. Plotting of linear function.
4. Determination of heat capacity of calorimeter for different volumes.

Inorganic Chemistry Practical:-

1. To standardize NaOH solution and hence find the strength of the given HCl solution.
2. To standardize given $KMnO_4$ solution and to find its strength in normal terms.
3. To determine the number of molecules of water of crystallization in crystalline magnesium sulphate by heating.
4. To determine hardness of water using EDTA

Organic Chemistry Practical:-

1. To purify the given organic compound by sublimation method.(02 compound)
   a) To report the MP of the sample before and after sublimation.
   b) To find yield of purified sample
2. To purify the given organic compound by crystallization method.(02 compound)
   a) To report the MP of the sample before and after sublimation.
   b) To find yield of purified sample
3. Determination of type of given solid organic compound and report its MP.
4. Determination of type of given liquid organic compound and report its BP.

References:

1. Senior Practical Physical Chemistry, Khosla, Garg & Gulati, R, Chand & Co
2. Practical Physical Chemistry, A M. Jemes, F. E. Prichard, 3rd edn, Longman.
3. Advanced Practical Physical Chemistry, J. B. Yadav, Goel Publishing house
4. Organic Qualitative Analysis – A. I. Vogel
5. Vogel's Qualitative Inorganic Analysis, Svehla G. Pearson Education, 2012
6. Vogel's Quantitative Inorganic Analysis, Mendham J.2012

Mapping of Program out comes with Course Outcomes

Class: B.Sc. (SEM III) Subject: Chemistry

Course: Basic Practicals in Chemistry-I Course Code: CHE-212-MN

Weightage: 1=weak or low relation, 2=moderate or partial relation, 3=strong or direct relation

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13
CO1	3	3	0	0	0	0	0	0	0	0	0	0	0
CO2	3	3	0	3	0	0	0	0	0	0	0	0	0
CO3	0	0	0	3	3	0	0	0	0	0	0	0	0
CO4	0	3	0	3	3	0	0	0	0	0	0	0	0
CO5	0	3	0	3	3	0	0	0	0	0	0	0	0
CO6	0	3	0	3	0	3	0	0	0	0	0	0	0
CO7	0	3	0	3	0	0	3	0	0	0	0	0	0

Comprehensive Knowledge and Understanding (PO1):

CO1: To identify and assess potential hazards associated with chemicals and equipment.

CO2: To calculate the molar gas constant R accurately and to determine the relative viscosity of organic liquids with precision..

Practical, Professional, and Procedural Knowledge (PO2): CO1, , CO4, CO5, CO6, CO7

CO1: To identify and assess potential hazards associated with chemicals and equipment.

CO2: To calculate the molar gas constant R accurately and to determine the relative viscosity of organic liquids with precision.

CO4: To standardize NaOH and KMnO4 solutions accurately and to determine the strength of a given HCl solution and a KMnO4 solution in normal terms.

CO5: To calculate the number of molecules of water of crystallization and to determine the hardness of water using EDTA titration accurately.

CO6: To successfully purify organic compounds using sublimation and crystallization methods.

CO7: To identify the type of given organic compound and characterized by its melting point.

Specialized Skills, Critical Thinking, and Problem-Solving (PO4):

CO2: To calculate the molar gas constant R accurately and to determine the relative viscosity of organic liquids with precision.

CO3: To plot linear functions accurately and interpret the results.

CO4: To standardize NaOH and KMnO4 solutions accurately and to determine the strength of a given HCl solution and a KMnO4 solution in normal terms.

CO5: To calculate the number of molecules of water of crystallization and to determine the hardness of water using EDTA titration accurately.

CO6: To successfully purify organic compounds using sublimation and crystallization methods.

CO7: identify the type of given organic compound and characterized by its melting point.

Capacity for Application, Problem-Solving, and Analytical Reasoning (PO5):, , ,

CO3: To plot linear functions accurately and interpret the results.

CO4: To standardize NaOH and KMnO4 solutions accurately and to determine the strength of a given HCl solution and a KMnO4 solution in normal terms.

CO5: To calculate the number of molecules of water of crystallization and to determine the hardness of water using EDTA titration accurately.

CO6: To successfully purify organic compounds using sublimation and crystallization methods.

Name of the Programme	**:** B.Sc. Chemistry
Program Code	**:** CHE
Class	**:** S.Y.B.Sc
Semester	**:** III
Course Type	**:** Open Elective
Course Name	**:** Chemistry in Everyday life
Course Code	**:** CHE-216-OE
No .of Lectures	**:** 30
No. of Credits	**:** 2 credits

Course Objectives:

1. To understand basic concept of chemicals present in breverages.
2. To learn importance and uses of food additives and flavours
3. To study properties and preparation of dyes.
4. To become skilled at about different properties of dyes.
5. To understand the composition of edible oils.
6. To know importance, uses of soaps and detergent.
7. To understand manufacturing of soaps and detergent.

Course Outcomes:

1. Students will be able to understand basic concept of chemicals present in breverages.
2. Students should find out importance and uses of food additives and flavours
3. Students should identify properties and preparation of dyes.
4. Students should discover about different properties of dyes.
5. Students will be able to recognize the composition of edible oils.
6. Students will be able understand importance, uses of soaps and detergent.
7. Students will be able comprehend manufacturing of soaps and detergent.

Topics and Learning Points

Unit 1. Chemistry of Beverages: (5 L)

Analysis of caffeine in coffee and tea, detection of chicory in coffee, chloral hydrate in toddy, estimation of methyl alcohol in alcoholic beverages.

Unit 2. Food additives, Flavors: (5 L)

Food preservatives like benzoates, propionates, sorbates, disulphites, Vanillin, alkyl esters (fruit flavors) and monosodium glutamate.

Unit 3. Dyes: (5 L)

Color and constitution (electronic concept). Classification of dyes. Methods of applying dyes to the fabrics. A general study of azo dyes, Organol brown, Congo red and methyl organe.

Unit 4. Oils and fats: **(5 L)**

Composition of edible oils, detection of purity, rancidity of fats and oil. Tests for adulterants like aregemone oil and mineral oils.

Unit 5. Soap and Detergents **(10L)**

Importance of soap, Raw Materials used in Soap Manufacture, Soaps (Continuous Process), Cleansing action of Soap and detergents, Classification of Soaps. Detergents- Introduction, Advantages and disadvantages of Detergents, Surfactants and detergent, Emulsion and Emulsifying agents, Wetting and Non-wetting agents, Hydrophobic and Hydrophilic nature, Micelles, Types of surfactants, Detergent's builders and Additives, Manufacture of detergents, Comparison between Soap Detergent.

.

References:

1. B. K. Sharma: introduction to Industiral Chemistry, Goel Publishing, Meerut (1998)
2. Medicinal Chemistry by Ashtoush Kar.
3. Drugs and Pharamaceutical Sciences Series, Marcel Dekker, Vol. II, INC, New York.
4. Analysis of Foods – H.E. Cox: 13. Chemical Analysis of Foods – H.E.Cox and pearson.
5. Foods: Facts and Principles. N. Shakuntala Many and S. Swamy, 4th ed. New Age International (1998)
6. Physical Chemistry – P l Atkins and J. de Paula – 7 th Ed. 2002, Oxford University Press.
7. Handbook on Feritilizer Technology by Swaminathan and Goswamy, 6th ed. 2001, FAI.
8. Organic Chemistry by I. L. Finar, Vol. 1 & 2.
9. Polymer Science and Technology, J. R. Fired (Prentice Hall).

Mapping of Program out comes with Course Outcomes

Class: B.Sc. (SEM III) Subject: Chemistry
Course: Chemistry in everyday life Course Code: CHE-216- OE
Weightage: 1=weak or low relation, 2=moderate or partial relation, 3=strong or direct relation

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13
CO1	3	0	0	0	0	0	0	0	0	0	0	0	0
CO2	3	0	0	0	0	0	0	0	0	0	0	0	0
CO3	3	0	0	0	0	0	0	0	0	0	0	0	0
CO4	3	0	0	0	0	0	0	0	0	0	0	0	0
CO5	3	0	0	0	0	0	0	0	0	0	0	0	0
CO6	3	0	0	0	0	0	0	0	0	0	0	0	0
CO7	3	0	0	0	0	0	0	0	0	0	0	0	0

Comprehensive Knowledge and Understanding (PO1):

CO1: Students will be able to understand basic concept of chemicals present in beverages.

CO2: Students should find out importance and uses of food additives and flavors

CO3: Students should identify properties and preparation of dyes.

CO4: Students should discover about different properties of dyes.

CO5: Students will be able to recognize the composition of edible oils.

CO6: Students will be able understand importance, uses of soaps and detergent.

CO7: Students will be able comprehend manufacturing of soaps and detergent.

Name of the Programme.	**:** B.Sc. Chemistry
Program Code	**:** CHE
Class	**:** S.Y.B.Sc
Semester	**:** III
Course Type	**:** Vocational Skill Course
Course Name	**:** Fundamentals of Analytical Chemistry
Course Code	**:** CHE-221-VSC
No. of Lectures	**:** 30
No. of Credits	**:** 2 credits

Course Objectives (COs):

1. Student should able to know the analytical chemistry as a branch of chemistry for chemical analysis.
2. Student should able to know different types of errors in quantitative analysis. To explain errors in measurements and reporting the results of quantitative analysis.
3. Student should able to know volumetric analysis. To acquire the knowledge of operation, calibration and maintenance of apparatus used in volumetric analysis.
4. To describe different volumetric analysis methods as a traditional methods for quantitative analysis.
5. To classify the basic titrations into four types of titrations as acid-base, precipitation, complexometric, and redox titrations.
6. To apply the volumetric analysis theoretical knowledge in the applications of volumetric analysis.
7. To introduce different instrumental techniques for measurements of species qualitatively as well as quantitatively.

Course Outcomes (COs):

After completion of this course students will be able

1. To understand the fundamental principles of analytical chemistry.
2. To analyze and interpret experimental data accurately.
3. To calibrate different apparatus for accurate operation of experimental procedure.
4. To conduct experiments to measure sample concentration by using volumetric analysis methods.
5. To explain the different types of volumetric titrations and able to apply it in experiments.
6. To understand the basic instruments such as pH meter and conductivity meter used in almost all chemical laboratory.
7. To perform the experiments on instruments, pH meter and conductivity meter and able to report the results precisely.

Topics and Learning Points

Unit-1: Introduction to Analytical Chemistry (04L)

Introduction, chemical analysis, applications of chemical analysis, sampling, types of analysis, common techniques, Instrumental methods of analysis, factor affecting on choice of method.

Unit-2: Errors in Quantitative analysis, (06L)

Introduction to Error, Accuracy, Precision, Methods of expressing accuracy and precision, Classifications of errors, Significant figures, Distribution of random errors, Mean and Standard deviations, Reliability of results, Numerical.

Unit-3: Volumetric Analysis (14 L)

Introduction to volumetric analysis Calibration of apparatus, Standard solutions, Equivalent weights in different type of reactions, Classification of volumetric analysis,

Neutralization titration: Acid base indicators, Ostwald's theory of indicators, neutralization curves for strong acid- strong base, weak acid- strong base, weak base- strong acid, Determination of equivalence point and calculations. Problems.

Complexometric titration: Principle, Mg- EDTA titration, metal ion indicators, choice of indicators. Applications,

Redox titration: Principle, detection of equivalence point using suitable indicators. Titration between oxalic acid and $KMnO_4$. Applications.

Precipitation titration: Principle, titration between $AgNO_3$ and halide ions by Volhard's method and Fajan's method. Detection of end point of the titration. Applications.

Iodometric titration: Principle, detection of end point, difference between iodometry and iodimetry, standardization of $Na_2S_2O_3$ solution using $K_2Cr_2O_7$ and estimation of iodine. Applications

Unit-4: Instrumental methods (06 L)

Principle, Instrumentation, working and applications of pH meter and conductivity meter, Numerical problems

References:

1. Instrumental Methods of Chemical Analysis- Chatwal and Anand
2. Basic Concept of Analytical Chemistry-2nd edition S.M. Khopkar
3. Vogel's textbook of Quantitative Inorganic Analysis-4th edition
4. Instrumental Methods of Chemical Analysis- 6th edition Willard, Merritt, Dean and Settle
5. Analytical Chemistry by Skoog
6. Introduction to Instrumental Analysis- R.D. Braun
7. Instrumental methods of Chemical Analysis-Willard, Dean & Merrit-6th Edition

Mapping of Program out comes with Course Outcomes

Class: B.Sc. (SEM III) Subject: Chemistry

Course: Fundamental of Analytical Chemistry Course Code: CHE-221- VSC

Weightage: 1=weak or low relation, 2=moderate or partial relation, 3=strong or direct relation

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	PO8	PO9	PO10	PO11	PO12	PO13
CO1	3	0	0	0	0	3	0	0	0	0	0	0	0
CO2	0	3	0	0	0	0	3	0	0	0	0	0	0
CO3	0	3	0	0	0	0	3	0	0	0	0	0	0
CO4	0	3	0	0	0	0	3	0	0	0	0	0	0
CO5	0	3	0	0	0	0	3	0	0	0	0	0	0
CO6	3	0	0	0	0	3	0	0	0	0	0	0	0
CO7	0	3	0	0	0	0	3	0	0	0	0	0	0

Comprehensive Knowledge and Understanding (PO1):,
CO1: To understand the fundamental principles of analytical chemistry.
CO6: To understand the basic instruments such as pH meter and conductivity meter used in almost all chemical laboratory.
Practical, Professional, and Procedural Knowledge (PO2):
CO2: To analyze and interpret experimental data accurately.
CO3: To calibrate different apparatus for accurate operation of experimental procedure.
CO4: To conduct experiments to measure sample concentration by using volumetric analysis methods.
CO5: To understand the basic instruments such as pH meter and conductivity meter used in almost all chemical laboratory.
CO7: To perform the experiments on instruments, pH meter and conductivity meter and able to report the results precisely