Anekant Education Society's

Tuljaram Chaturchand College,

Of Arts, Science and Commerce, Baramati

(Empowered Autonomous)

Department of Chemistry

B.Sc. Degree Program in CHEMISTRY

(Faculty of Science)

S.Y.B.Sc. (Chemistry)

Semester –IV

(NEP 1.0 Pattern)

Choice Based Credit System Structure and Syllabus

(2023 Pattern)

To be implemented from June 2024

CBCS Syllabus as per NEP 2020 (NEP 1.0) for S.Y.B.Sc Chemistry

NameoftheProgramme:	B.Sc.Chemistry
ProgrammeCode:	CHE
Class:	S.Y.B.Sc
Semester:	IV
CourseType:	MajorMandatory(Theory)
CourseCode:	CHE-251-MJM
CourseTitle:	Physical ChemistryII
No.ofCredits:	02
No.ofTeachingHours:	30

CourseObjectives:

1. Student should able to understand the thermodynamic of ideal and non-ideal solutions.
2. Students can utilize the various laws related to solution.
3. Student able to understand ionic equilibrium concept.
4. Students can learn the common ion effect, ionization of weak acid and base.
5. Students can apply the knowledge of degree of hydrolysis, solubility and solubility product in routine laboratory processes.
6. Student able to understand phase equilibrium concept.
7. Student can solve Gibbs phase rule and apply in various phase systems.

CourseOutcomes:

By the end of the course, students will be able to:

CO1: Students should able to know details of thermodynamics of ideal solution, Raoult's law, P-X and T-X diagrams.

CO2: Students are able to apply the theory of Azeotropes, partially miscible liquids& steam distillation in practical.

CO3: Students should able to learn the basics of ionic equilibrium, strong & weak electrolytes.

CO4: Students are able to understand the concepts of salt hydrolysis and utilized it in pH calculations.

CO5: Students are able to learn concept of common ion, buffer solution solubility product and their applications.

CO6: Students should able to understand Phase equilibrium, Gibbs phase rule, phase diagrams of one and two component systems.

CO7: Students should able to solve related numerical and problems.

TopicsandLearningPoints

TeachingHours

UNIT1:SOLUTIONS (10 L)

Thermodynamics of ideal solutions: Ideal solutions and Raoult's law, deviations from Raoult's law - non-ideal solutions. Vapour pressure-composition and temperature-composition curves of ideal and non-ideal solutions. Distillation of solutions, Lever rule.Azeotropes. Partial miscibility of liquids: Critical solution temperature; effect of impurity on partial miscibility of liquids. Immiscibility of liquids- Principle of steam distillation.Nernst distribution law and its applications, solvent extraction.

UNIT2:IONIC EQUILIBRIUM (10 L)

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.

UNIT3:PHASE EQUILIBRIUM AND PHASE RULE (10 L)

Phases, components and degrees of freedom of a system, criteria of phase equilibrium.Gibbs Phase Rule and its thermodynamic derivation.Polymorphism, Phase diagrams of one-component systems (water and Sulphour), Two component systems involving eutectics, congruent and incongruent melting points (Pb- Ag, Zn-Cd, $FeCl_3$-H_2O).

References:

1. PhysicalChemistry,P.W.Atkins,ELBS,5thEdition.
2. PrinciplesofPhysicalChemistry,MarronandPrutton,4thEdition.
3. PhysicalChemistry,G.M.Barrow4thEdition.
4. EssentialsofPhysical Chemistry,Bahl,Tuli, Revised multicolouredn.2009
5. UniversityChemistry,B.H. Mahan,3rdedn.Narosa (1998)
6. ChemicalThermodynamics, R.P.Rastogi and R.P. Misera

Mapping of Program Outcomes with Course Outcomes

Class: S.Y.B.Sc. Chemistry (SEM IV)

Course: Physical Chemistry- II**Course Code**: CHE-251 MJM

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

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	0	0	0	0	0	0
CO2	3	3	0	0	0	0	0
CO3	0	0	3	0	0	0	0
CO4	0	0	0	3	0	0	0
CO5	0	0	0	0	3	0	0
CO6	0	0	0	0	0	3	0
CO7	0	0	0	0	0	0	3

Program Outcome 1 (PO 1: Disciplinary Knowledge):

CO 1: Students will be able to apply the knowledge of the concept of solutions and their types, demonstrating their grasp of chemical principles and understanding of solutions.

Program Outcome 2 (PO 2: Critical Thinking and Problem Solving):

CO 2: Students will be able to learn concepts like ideal and non-ideal solutions with Raoult's law, showcasing their critical thinking skills in understanding solution behaviour.

Program Outcome 3 (PO 3: Social Competence):

CO 3: Students will be able to draw and explain P-X and T-X diagrams, contributing to social competence by addressing graphical representation and communication of solution properties.

Program Outcome 4 (PO 4: Research-Related Skills and Scientific Temper):

CO 4: Students will be able to apply the knowledge of ionic equilibrium for ionization of acids, bases, salts, and their hydrolysis, enhancing research-related skills and scientific temper in understanding chemical equilibria.

Program Outcome 5 (PO 5: Trans-Disciplinary Knowledge):

CO 5: Students will be able to understand the factors affecting the ionization of electrolytes, demonstrating trans-disciplinary knowledge by integrating principles of ionic behaviour in various solutions.

Program Outcome 6 (PO 6: Personal and Professional Competence):

CO 6: Students will be able to understand the application of Gibb's phase rule, enhancing their personal and professional competence in understanding phase equilibria.

Program Outcome 7 (PO 7: Effective Citizenship and Ethics):

CO 7: Students will be able to apply Gibb's phase rule for water and sulfur systems, contributing to effective citizenship by addressing phase equilibria and the ethical conduct of research.

CBCS Syllabus as per NEP 2020 (NEP 1.0) for S.Y.B.Sc Chemistry (2023Pattern)

NameoftheProgramme:	B.Sc.Chemistry
ProgrammeCode:	CHE
Class:	S.Y.B.Sc
Semester:	IV
CourseType:	MajorMandatory(Theory)
CourseCode:	CHE-252-MJM
CourseTitle:	Inorganic ChemistryII
No.ofCredits:	02
No.ofTeachingHours:	30

CourseObjectives:

1. Students will be understanding coordination compounds.
2. Students will be able to learn understand the tetrahedral, square planer, trigonalbipyramidal and octahedral metal complex.
3. Understand the synthesis of metal complex by using various methods.
4. Students should learn the concept of Ligands and co-ordination compounds.
5. Students should know the complexes of metals.

CourseOutcomes:

1. Student should able to understand the terms which involved in coordination chemistry.
2. Student able to understand IUPAC nomenclature of different inorganic compounds.
3. Students can learn the isomerism, types of isomerism.
4. Students can apply the knowledge of degree of hydrolysis, solubility and solubility product in routine laboratory processes.
5. Student able to understand the different types of catalytic processes.
6. Students will be understanding coordination compounds.
7. Students will be able to learn understand the tetrahedral, square planer, trigonalbipyramidal and octahedral metal complex.
8. Understand the synthesis of metal complex by using various methods.

1. Introduction to Coordination chemistry (16 L)

General account and meaning of the terms involved in coordination chemistry: Coordinate bond, central metal atom or ions, ligand, double salt, coordination compound, coordination number, charge on the complex ion, oxidation number of central metal ion, first and second coordination sphere, Ligands: Definition, Classification, Chelate and chelating agents, IUPAC nomenclature of coordination compounds, Different geometries of coordination compounds with C. N.= 2, 4 and 6 with examples of each geometry. Stability of coordination complexes, Isomerism: Polymerization isomerism, Ionization isomerism, Hydrate isomerism, Linkage isomerism, Coordination isomerism, Coordination position isomerism, Geometric isomerism or stereoisomerism, Optical isomerism, Werner Theory of coordination compounds, Sedgwick and Pauli theory and EAN rule, Problems

2. Chemistry of Carbonyls Complexes. (8 L)

Introduction, Definition, bonding in carbonyl complexes, 18 electron rule-M bonds in carbonyl complexes, geometries of coordination complexes, CO π acid Ligands. Synthesis of carbonyl complexes: direct reaction, reductive carboxylation, photolysis, thermolysis, homogeneous catalysis: hydro-formylation by Cobalt carbonyl complex, Wacker's process and Monsanto acetic acid process, Wilkinson catalyst.

3.General Principles of Metallurgy (6 L)

Introduction,Occurance of metals,Overs and Minerals, types of overs,operations involved in metallurgy-Crushing,concentration,various methods of concentration, such as hand picking, gravity separation, Magnetic separation. Froth flotation,calcinations,Roastingetc.Reduction – various methods of reduction such as –smelting,aluminothermic process and electrolytic reduction, refining of metals, various methods of refining such as-poling,liquation,electrolytic and vapour phase refining(van Arkel process)

Reference Books:

1. Concise Inorganic Chemistry, Lee, J.D. ELBS, 1991.
2. Basic Inorganic Chemistry, Cotton, F.A., Wilkinson, G. &Gaus, P.L. 3rd ed., Wiley.
3. Concepts and Models in Inorganic Chemistry, Douglas, B.E., McDaniel, D.H. & Alexander, J.J. John Wiley & Sons.
4. Inorganic Chemistry: Principles of Structure and Reactivity, Huheey, J. E., Keiter, E.A., Keiter, R.L. &Medhi, O.K. Pearson(2006)
5.Advanced Inorganic Chemistry-Satyaprakash,Tuli,Basu.
6. Text book of P.L.Soni

Mapping of Program Outcomes with Course Outcomes

Class: S.Y.B.Sc. Chemistry (SEM IV)

Course: Inorganic Chemistry- II**Course Code**: CHE-252- 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
CO1	3	1	1	2	1	1	1	1	1
CO2	3	2	1	1	1	1	1	1	1
CO3	2	2	1	1	1	1	1	1	1
CO4	2	3	1	2	1	1	1	1	1
CO5	2	2	1	2	1	1	1	1	1
CO6	3	1	1	2	1	1	1	1	1
CO7	3	2	1	2	1	1	1	1	1
CO8	2	2	1	3	1	1	1	1	1

1. **PO1 (Disciplinary Knowledge)**:
   - **CO1**: Strong relation as understanding key terms is essential for comprehensive disciplinary knowledge.
   - **CO2**: Strong relation since nomenclature is foundational in chemistry.
2. **PO2 (Critical Thinking and Problem Solving)**:
   - **CO2**: Moderate relation because applying nomenclature involves problem-solving skills.
   - **CO4**: Strong relation, as applying concepts of hydrolysis and solubility requires critical thinking.
3. **PO3 (Social Competence)**:
   - **CO2**: Weak relation since IUPAC nomenclature has minimal impact on social skills.
4. **PO4 (Research-related Skills and Scientific Temper)**:
   - **CO1**: Moderate relation as understanding terms supports practical lab applications.
   - **CO4:** Moderate relation since knowledge of solubility is crucial for laboratory work.
5. **PO5 (Trans-disciplinary Knowledge)**:
   - **CO3**: Weak relation, as isomerism primarily pertains to chemistry and has limited cross-disciplinary application.
6. **PO6 (Personal and Professional Competence)**:
   - **CO5**: Weak relation since understanding catalysis does not heavily impact personal competence.
7. **PO7 (Effective Citizenship and Ethics)**:
   - **CO6**: Weak relation as knowledge of coordination compounds is less relevant to citizenship and ethics.
8. **PO8 (Environment and Sustainability)**:
   - **CO4**: Moderate relation, as concepts of solubility relate to environmental impact.
9. **PO9 (Self-directed and Life-long Learning)**:
   - **CO8**: Weak relation as synthesis knowledge does not significantly promote lifelong learning.

CBCS Syllabus as per NEP 2020 (NEP 1.0) for S.Y.B.Sc Chemistry (2023Pattern)

NameoftheProgramme: B.Sc.Chemistry
ProgrammeCode: CHE
Class: S.Y.B.Sc
Semester: IV
CourseType: MajorMandatory(Theory)
CourseCode: CHE-253-MJM
CourseTitle: Organic ChemistryII
No.ofCredits: 02
No.ofTeachingHours: 30

CourseObjectives:

1. Student knows meaning of the aldehydes and ketones.
2. Students learn the name reactions
3. Students understand the homocyclic and heterocyclic compounds.
4. Students get the skill of the naming of the homocyclic and heterocyclic compounds.
5. Students know the functions of the biomolecules.
6. Students understand the concept of mutarotation.
7. Students draw the structures of disaccharides molecules.
8. Students learn the amino acids and protein.

CourseOutcomes:

C.O. 1: Student should be able to understand chemistry of aldehydes and ketones.
C.O. 2: Student should be able to remember the difference between the homocyclic and heterocyclic compounds.
C.O. 3: Student should be able to apply the knowledge for the naming the compounds.
C.O. 4: Student should be able to understand the reactions shown by heterocyclic compounds.
C.O. 5: Student should be able to remember the importance of biomolecules.
C.O. 6: Student should be able to analyze the sequence amino acids in protein.
C.O. 7: Student should be able to remember reactions shown by glucose.
C.O. 8: Student should be able to remember the structures of amino acids.

TopicsandLearningPoints

TeachingHours

Unit1.Chemistry of Aldehydes and Ketones [8 L]

Structure of carbonyl groups, nomenclature of aldehyde and ketones, physical properties of aldehydes and ketones, preparations of aldehydes and ketones, reaction of aldehydes and ketones, Cannizzaro reaction, Aldol condensation, Perkins reaction, analysis of aldehyde and ketones.
Ref. 1& 3.

Unit 2. Chemistry of Homocyclic and Heterocyclic compounds [8 L]

a) Homocyclic compounds: Naphthalene and Anthracene - nomenclature of derivatives, preparation and reactions

b) Heterocyclic compounds –1. Five membered: Furan, Pyrrole, Thiophene- nomenclature preparation and reactions. 2. Six membered heterocyclic compounds – Pyridine- preparation

c) Structure and synthesis of Quinoline and Isoquinoline.

Ref. 1 & 3.

Unit 3. Introduction of Bio-molecules [14 L]

a) Introduction: scope and impact of biochemistry on living system, importance of biochemistry.
Ref. 2

b) Carbohydrates : Definition, classification, reactions of carbohydrates – glucose oxidation, reduction, osazone formation, ester formation, isomerization, Killiani Fischer synthesis, Ruff degradation, configuration of D(+) Glucose, Fischer proof and mutarotation, cyclic structure of glucose-Fischer and Haworth structure of glucose. Structures of maltose, sucrose, lactose, cellobiose, polysaccharides - starch, cellobiose.
Ref. 2

c) Amino acids: α-amino acids: Fischer projection, relative configuration, classification, structure of amino acid, properties and reactions of α-amino acids.

d) Proteins: Formation of peptide linkage, laboratory synthesis of protein, structure of protein α-helical and β-plated structure, primary, secondary, tertiary and quaternary structure of proteins.

Ref.2

References:

1. Organic Chemistry – 6th Edn. Morrison and Boyd Prentice Hall (2001)
2. Outline of Biochemistry 5th Edn, E.E. Conn, P. K.Sumpf, G. Bruening and R. H.DoiWiley 1987.
3. Organic Chemistry- J. Clayden, N. Greeves and Stuart Warren, Oxford University Press 2012

Mapping of Program Outcomes with Course Outcomes

Class: S.Y.B.Sc. Chemistry (SEM IV)

Course: Organic Chemistry- II **Course Code**: CHE-253- 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
CO. 1	3	1	1	2	1	1	1	1	1
CO. 2	2	1	1	1	1	1	1	1	1
CO. 3	3	2	1	1	1	1	1	1	1
CO. 4	2	3	1	2	1	1	1	1	1
CO. 5	1	1	1	1	1	1	1	2	1
CO. 6	2	2	1	2	1	2	1	1	1
CO. 7	1	1	1	1	1	1	1	2	1
CO. 8	1	1	1	1	1	1	1	3	1

1) **PO1 (Disciplinary Knowledge)**:
   - **CO. 1:** Strong relation, as understanding aldehydes and ketones is essential to demonstrate comprehensive disciplinary knowledge.
   - **CO.3:** Strong relation because accurately naming compounds reflects a strong grasp of the discipline.
2) **PO2 (Critical Thinking and Problem Solving)**:
   - **CO. 4**: Strong relation since analyzing reactions requires critical thinking and problem-solving skills.
   - **CO. 3**: Moderate relation, as applying naming conventions involves analytical skills.
3) **PO3 (Social Competence)**:
   - **CO. 5**: Weak relation, as knowledge of biomolecules has limited direct impact on social competence.
4) **PO4 (Research-related Skills and Scientific Temper)**:
   - **CO. 1**: Moderate relation since understanding chemical concepts aids in conducting experiments.
   - **CO. 6**: Moderate relation, as analyzing amino acid sequences is critical for research.
5) **PO5 (Trans-disciplinary Knowledge)**:
   - **CO. 5**: Weak relation, as the importance of biomolecules relates less to integrating disciplines.
6) **PO6 (Personal and Professional Competence)**:
   - **CO. 6**: Moderate relation, as teamwork may be involved in analyzing protein sequences.
7) **PO7 (Effective Citizenship and Ethics)**:
   - **CO. 5**: Weak relation, as knowledge of biomolecules has minimal direct impact on ethics or citizenship.
8) **PO8 (Environment and Sustainability)**:
   - **CO. 5**: Moderate relation, as understanding biomolecules relates to sustainability issues.
   - **CO. 8**: Strong relation since understanding amino acid structures is crucial for sustainable practices in biology.

9) **PO9 (Self-directed and Life-long Learning)**:

CO. 5: Weak relation, as the focus on biomolecules does not significantly impact lifelong learning.

CBCS Syllabus as per NEP 2020 (NEP 1.0) for S.Y.B.Sc Chemistry (2023Pattern)

NameoftheProgramme:	B.Sc.Chemistry
ProgrammeCode:	CHE
Class:	S.Y.B.Sc
Semester:	IV
CourseType:	Major (Practical)
CourseCode:	CHE-254-MJM
CourseTitle:	Chemistry Practical-IV
No.ofCredits:	02
No.ofTeachingHours:	60

CourseObjectives:

1. To learn basic of chemistry practical from all the discipline of chemistry
2. To learn the estimation of compounds.
3. To know the synthesis of derivatives.
4. To learn the volumetric analysis.
5. To know the preparation of solutions

CourseOutcomes:

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 soil, water, food, pharmaceutical, chemical and industrial samples by volumetric and instrumental techniques considering social, economic and legal ethics/ accepts.

6. Student will be aware with the MSDS data of various chemicals which inform the

toxicity level. It helps in developing the safe working methods and ethical use of them.
7. Student will able to apply their experimental skill during use of sophisticated

instruments. It helps in demonstrating standard operational procedures (SOP'S) which can be useful in future research focus/approach with enrichment in personal and professional ability.
8. 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.

Section I: Analytical Chemistry Practical (Any five experiments)

1. Determination of Ca in presence of Mg using EDTA.
2. Determination of the strength of given H2O2 solution with standard 0.05 N KMnO4 solution.
3. Estimation of Nickel or Aluminum from the given salt solution by using Eriochrome Black T indicator (back titration method)
4. Determination of molecular weight of mono / dibasic acid volumetrically.
5. To perform the pH titration between weak acid and strong base and hence select the best indicator to locate the equivalence point graphically.
6. Verification of Beer's law using different concentrations of KMnO4 and determine the unknown concentration of KMnO4 by calibration curve method.
7. Identification of metal by paper chromatography in any two mixture containing two / three metal ions like- Ni, Cu, Al, Fe, Co, Mn.
8. To study formation of Fe(III)-thiocyanate complex calorimetrically and determine the effect of metal ion and ligand concentration on complex formation.
9. To determine the amount of copper from the given solution iodometrically.

Reference books:

1. Analytical Chemistry, G. D. Christian 6th edn.
2. Vogel's textbook of Quantitative chemical analysis, R. C. Denney, J. D. Barnes. M. J. K. Thomas, 6th edn.

Section II: Inorganic Chemistry Practical (Any Three Mixtures without phosphate and borate)

1. Preliminary Tests, Dry tests for Basic radical, Preparation of solution, Analysis of basic radicals into group with confirmatory tests
2. Preliminary Tests, Dry tests for Acidic radical, Preparation of solution, detection of acidic radicals and confirmatory tests

Section III:Organic Chemistry Practical

1) **OrganicPreparation**(anytwo) (Withcrystallization, M.P.andTLC)
i) Aspirinfromsalicylicacid
ii) *p*-NitroBenzoicacidfrom*p*-nitrotoluene
iii) phthalicanhydridefromphthalicacid (sublimation)
iv) Osazoneformglucose
v) QuinoneformHydroquinone
vi) Methyl orange from sulfanilic acid
vii) Para red from *p*-nitroaniline
viii) Acetanalide from aniline
ix) Benzimidazole from *o*-phenylenediamine

References:

1. *Vogel'sTextBookofPracticalInorganicChemistry*.5thEdn.,PearsonEducation,2005
2. *Practical Physical Chemistry* J. B. Yadav
3. *Vogel'sTextBookofPracticalOrganicChemistry*.5thEdn.,PearsonEducation,2005
4. *Experimental Physical Chemistry* V. D. Athawale, ParulMarul, New Age International Publishers
5. *Systematic Experiments in Chemistry* ArunSethi New Age International Publishers

Mapping of Program Outcomes with Course Outcomes

Class: S.Y.B.Sc. Chemistry (SEM IV)

Course: Chemistry Practical **Course Code**: CHE-254- 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
CO1	3	1	1	2	1	1	1	1	1
CO2	2	3	1	2	1	2	1	1	1
CO3	3	2	1	2	1	1	1	1	1
CO4	2	2	1	3	1	1	1	1	1
CO5	2	2	1	2	3	1	1	2	1
CO6	1	1	1	1	1	1	1	3	1
CO7.	3	2	1	3	1	2	1	1	1
CO8	2	3	1	2	2	1	1	1	1

Justification of Mapping

1. **PO1 (Disciplinary Knowledge)**:
   CO1: Strong relation as understanding theoretical principles is essential for comprehensive disciplinary knowledge.

CO3: Strong relation, since preparing standard solutions is a foundational skill in chemistry.

2. **PO2 (Critical Thinking and Problem Solving)**:
   - **CO2**: Strong relation, as developing operational skills requires critical thinking and problem-solving abilities.
   - **CO8**: Strong relation, as applying chemical methods to solve problems necessitates analytical skills.
3. **PO3 (Social Competence)**:
   - **CO5 (1)**: Weak relation, as the focus is primarily on technical skills rather than social skills.
4. **PO4 (Research-related Skills and Scientific Temper)**:
   - **CO4**: Strong relation, since performing good laboratory practices requires scientific inquiry and research skills.
   - **CO7**: Strong relation, as applying skills with sophisticated instruments is critical for research.
5. **PO5 (Trans-disciplinary Knowledge)**:
   - **CO5**: Strong relation, as analyzing various samples relates to interdisciplinary applications in fields like environmental science and health.
   - **CO8**: Moderate relation, as solving social problems with chemical knowledge connects to interdisciplinary approaches.
6. **PO6 (Personal and Professional Competence)**:
   - **CO2**: Moderate relation, as hands-on training promotes both personal and professional growth.
   - **CO7**: Moderate relation, since using sophisticated instruments enhances professional competence.
7. **PO7 (Effective Citizenship and Ethics)**:
   - **CO5**: Weak relation, but ethical considerations in analysis relate indirectly to citizenship.
   - **CO6**: Strong relation, as awareness of MSDS data reflects commitment to ethical practices.
8. **PO8 (Environment and Sustainability)**:
   - **CO4**: Weak relation; while laboratory practices may touch on sustainability, they are not the primary focus.
   - **CO6**: Strong relation, as understanding chemical safety has significant environmental implications.
9. **PO9 (Self-directed and Life-long Learning)**:
   - **CO7**: Weak relation, but using instruments can foster a sense of lifelong learning in directly.

CBCS Syllabus as per NEP 2020 (NEP 1.0) for S.Y.B.Sc Chemistry (2023Pattern)

NameoftheProgramme:	B.Sc.Chemistry
ProgrammeCode:	CHE
Class:	S.Y.B.Sc
Semester:	IV
CourseType:	Minor(Theory)
CourseCode:	CHE-261-MN
CourseTitle:	Basic Concepts of ChemistryII
No.ofCredits:	02
No.ofTeachingHours:	30

CourseObjectives:

1. Tointroducebasicconceptsinatomicstructure:Bohrmodel,energyleveldiagrams, hydrogenspectra, basicofquantumchemistry.
2. To identify the basics of mole concept and requirements in ChemicalStoichiometry
3. Toawarethestudentsaboutmethodsofexpressingconcentration ofsolutionandprincipleofstandardizationofsolution
4. Tolearnbasicofredoxreactions andbalancingofthembydifferent methods
5. To know the fundamental concepts which govern the structure, bonding, properties and reactivity of organic molecules.
6. To learn covalent character, hybridization, bond angles, bond energies, bond polarities and shapes of molecules.
7. Students are expected to know common and IUPAC names.

Course Outcomes:

Bytheendofthecourse,students willbeableto:

CO1. This course makes understanding of assumptions of Bohr model, atomic spectra,andrelatedmathematicalcalculations.

CO2. Student should able to understand the principles of quantum mechanicsanditsapplications.

CO3. Studentwillbeabletoanalyzefailureofclassicalmechanicsand

importanceofquantummechanics

CO4. Students should able to know concepts like mole, molecular weight,equivalentweight,GMVrelationshipandtheirapplicationsinchemistry.

CO5. Student will be understand the balancing the redox reactions by differentmethods.

CO6. This course makes understanding of structure, bonding, and reactivity of organic molecules.

CO7. Students are able to draw of organic molecules, and organic compounds.

Topics and Learning Points

Unit 1: Atomic structure (10 L)

Historical perspectives of the atomic structure; Bohr's theory, Derivation of atomic radius and energy, energy level diagram of hydrogen atom and limitations of Bohr's theory, atomic spectrum of hydrogen atom, Origin of Quantum Mechanics: Failure of Classical mechanics-black body radiation, photoelectric effect, electron diffraction, Quantization of energy, de Broglie's hypothesis, Heisenberg's uncertainty principle, Numerical

.

Unit 2: Chemical Stoichiometry and Oxidation–Reduction (10 L)

Mole Concept-Determination of molecular weight by gram molecular volume relationship, problems based on mole concept. Methods of expressing concentration-strength, normality, molarity, molality, mole fraction, % w/v, % w/w, % v/v, ppt, ppm, ppb,

Standardization of solutions, primary and secondary standard substances, preparation of standard solutions of acids and bases, problems based on acid-base titrations only

Definitions to related terms like oxidation, reduction, oxidizing agent, reducing agent, oxidation number, valency, Balancing of redox reactions using oxidation number method and ion electron method, Problems based on equivalent weight of oxidant and reductant.

Unit 3: Essentials of organic chemistry (10 L)

Organic Compounds:

Structure and reactivity of organic molecules, Structural effects- Inductive Effect, Resonance Effect, Hyper conjugation Effect, Steric Effect, Hydrogen bonding and Tautomerism. Comparative study of strength of acids and bases based on Inductive and Resonance effect. Curved arrow notation, drawing electron movements with arrows, half-headed and double-headed arrows, homolytic and heterolytic bond fission,

References:

1. PrinciplesofPhysicalChemistry,S.H.MarronandC.F.Pruton,6th edn.
2. EssentialsofPhysicalChemistry,Bahl,Tuli,Revisedmulticolouredn.2009
3. PhysicalChemistry,G.M. Barrow,TataMcGraw-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: S.Y.B.Sc. (Sem IV) **Subject:** Chemistry

Course: Basic Concepts of Chemistry II **Course Code:** CHE-261-MN

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

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	3	2	1	3	2	1	2	1	3
CO2	3	3	2	3	1	2	1	2	2
CO3	2	2	1	2	3	1	2	3	1
CO4	3	3	2	3	2	2	1	2	2
CO5	1	1	1	1	3	2	2	3	2
CO6	2	2	2	2	2	3	2	1	3
CO7	3	2	2	3	2	2	1	3	3

Justification for the mapping

PO1 (Disciplinary Knowledge):

CO1: focusing on comprehensive knowledge of physical chemistry principles.

CO3: focusing on understanding quantum principles and their application in molecular systems.

CO4: involving understanding chemical equilibrium and its interdisciplinary applications.

CO5: focusing on the principles and applications of electrochemical reactions.

CO7: involving theoretical understanding and application of statistical principles in physical chemistry.

PO2 (Critical Thinking and Problem solving):

CO2: involving problem-solving and analytical skills in physical chemistry calculations

CO6: involving analytical skills in interpreting spectroscopic results.

PO5 (Trans-disciplinary knowledge):

CO4: involving understanding chemical equilibrium and its interdisciplinary applications.

PO4 (Research-related skills and Scientific temper):

CO7: involving theoretical understanding and application of statistical principles in physical chemistry.

CBCS Syllabus as per NEP 2020 (NEP 1.0) for S.Y.B.Sc Chemistry (2023Pattern)

Name of the Programme	**:** B.Sc. Chemistry
Program Code	**:** CHE
Class	**:** S.Y.B.Sc
Semester	**:** IV
Course Type	**: Minor** Practical
Course Name	**:** Basic Practicals in Chemistry - II
Course Code	**:** CHE-262-MN
No. of Lectures	**:** 60
No. of Credits	**:** 2 credits

CourseObjectives:

1. Tointroducechemicalandlaboratorysafety.
2. Toadequatestudentswithgraphofvariousfunctions.
3. Tolearn basicofchemistrypracticalfromallthedisciplineofchemistry.
4. Tolearntheestimationofcompounds.
5. To know the synthesis of derivatives.
6. Tolearnthevolumetricanalysis.
7. Toknowthepreparationofsolutions.

CourseOutcomes:

Bytheendofthecourse,students willbeableto:

CO1. Students will get advantage while performing experiment in laboratory intermsofsafety.

CO2. Students will be able to apply mathematical knowledge in graphicalrepresentationofexperimentaldata.

CO3. Basic experiments in all discipline of chemistry gives understanding ofapplicationsoftheorywhichislearntheorycourses.

CO4. Studentsshouldabletoprepretheorganicderivatives.

CO5. Studentsshouldabletoestimatetheorganiccompoundsvolumetrically.

CO6. Developtheabilityofsolutionpreparation.

CO7.Developtheexperimentalskills.

TopicsandLearningPoints

TeachingHours=Total60

UNIT1:Physicalchemistry and Analytical Chemistry

1. Estimation of aspirin from given tablet.
2. Balancing of chemical equation using titration data between Oxalic acid and $KMnO_4$.
3. Determination of oxidation state and equivalent weight of magnesium and zinc metals by Eudiometric method..
4. Polar plots of s and p orbitals.
5. Determinationofheatcapacityofcalorimeterfordifferentvolumes.

UNIT2:Inorganicchemistry

1. Estimation of copper iodometrically from given sample solution.
2. Estimation of Calcium from calcium supplementary tablet /Milk power by complex - metric titration.
3. Estimation of water of crystallization in Mohr's salt by titrating with $KMnO_4$.
4. Determine chloride ion concentration in a given sample of water by Mohr's method.
5. Synthesis of tetramineCopper(II) Sulphate.

UNIT3:Organicchemistry

1. Organicqualitativeanalysis(Fivecompounds3S,2L)

Determination of elements, functional group and physical constant of the organic compound (acidic, basic, phenolic or neutral compound).

References:

1. J.N.GurthuandR.Kapoor,*AdvancedExperimentalChemistry(Organic)*,S.Chandand Co.,1987.
2. B.S.Furniss,A.J.Hannaford,P.W.G.SmithandA.R.Tatchell,*Vogel's TextBookofPracticalOrganicChemistry*.5thEdn.,PearsonEducation,2005.
3. PracticalPhysicalChemistry,JBYadav.
4. EssentialspracticalPhysicalChemistry,RajbojandChandhekar.
5. *Vogel'sTextBookofPracticalInorganicChemistry*.5thEdn.,PearsonEducation,2005.

Mapping of Program Out comes with Course Outcomes

Class: S.Y.B.Sc. (Sem IV) **Subject:** Chemistry

Course: Basic Practicals in Chemistry - II **Course Code:** CHE-262-MN
Weightage: 1=weak or low relation, 2=moderate or partial relation, 3=strong or direct relation

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	3	2	1	3	2	1	2	1	3
CO2	3	3	2	3	1	2	1	2	2
CO3	2	2	1	2	3	1	2	3	1
CO4	3	3	2	3	2	2	1	2	2
CO5	1	1	1	1	3	2	2	3	2
CO6	2	2	2	2	2	3	2	1	3
CO7	3	2	2	3	2	2	1	3	3

Justification for the mapping

PO1 (Disciplinary Knowledge):

CO1: focusing on comprehensive knowledge of organic chemistry principles.

CO3: involving the application of spectroscopic methods for organic compound characterization.

CO4: focusing on understanding the mechanisms and stereochemistry of organic reactions.

CO5: involving the principles and applications of aromatic compounds in organic chemistry.

PO2 (Critical Thinking and Problem solving):

CO6: involving analytical skills in predicting

PO4 (Research-related skills and Scientific temper):

CO2: emphasizing practical application and experimentation in organic synthesis techniques.

CBCS Syllabus as per NEP 2020 (NEP 1.0) for S.Y.B.Sc Chemistry (2023Pattern)

Name of the Programme : B.Sc. Chemistry
Program Code : CHE
Class : S.Y.B.Sc
Semester : IV
Course Type : Practical
Course Name : Chemistry Practical
Course Code : CHE-266-OE
No. of Lectures : 60
No. of Credits : 2 credits

Course Objectives:

1. To educate the students about chemicals present in beverages
2. To aware the students about additives/preservatives and artificial flavours/colours in food
3. To enrich the knowledge of students about different dyes and their detection methods
4. Learn to distinguish between pure and adulterated edible oil by chemical method
5. To learn idea about preparation of soap
6. To teach students about chloride content and foaming properties of different soap in different water samples
7. To help students to identify adulterated food, Beverages, edible oils

Course Outcome:

By the completion of the course, students will be able to

1. Identify different chemicals present in beverages
2. Understand different methods used to identify additives/preservatives and artificial favours/colours in food
3. Understand different methods for detection of dyes
4. Identify adulterated edible oil by chemical methods
5. Prepare their own soap by simple method
6. Understand chloride content and foaming properties of different soaps in tap water and distilled water

7. Identify and analyze pure and adulterated food, Beverages, edible oils which will help them to improve scientific thinking for better life

Experiments / Practicals

1. Qualitative analysis of sugars
   a) In Food samples
   b) In Beverages
2. Identification of colours by Thin layer chromatography
   a) In Food samples
   b) In Beverages
3. Detection of chemical preservatives acetic acid/ benzoic acid/ boric acid
   a) In Food samples
   b) In Beverages
4. Qualitative analysis of diacetyl in Beverages
5. Detection of additive/ artificial sweetener Saccharin
   a) In Food samples
   b) In Beverages
6. Detection of Urea/ Starch in given sample of milk
7. Detection of NaCl/ Nitrate in given sample of milk
8. Detection of Thiourea in Beverages
9. Analysis of moisture in given Food sample
10. Detection of Preservatives in given sample of milk
    a) Formaldehyde
    b) Boric acid
11. Detection of artificial colour Caramel in sample of foods/beverages
12. Detection of Dyes from Turmeric powder
    a) Metanil Yellow Dye
    b) Aniline Dye
13. Detection of Chlorophyll dye in given sample
14. Detection of Adulteration in the given sample of edible oil
15. Determination of acid value of the given oil.
16. Measurement of Foaming Capacity of different soaps
    a) In Tap water
    b) In Distilled water
17. Preparation of Soap
18. Determination of Chloride content in given sample of soap

References:

6. *Vogel's Text Book of Practical Inorganic Chemistry*.5thEdn.,PearsonEducation,2005

7. The Chemical Analysis of Foods and Food Products Morris B. Jacobs, Third edition

8. *Systematic Experiments in Chemistry* Arun Sethi, New Age International Publishers

Mapping of Program Outcomes with Course Outcomes

Class:S.Y.B.Sc. (Sem IV) **Subject:** Chemistry

Course: Chemistry Practical **Course Code:**CHE-266-OE

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

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	3	3	2	3	3	2	1	2	2
CO2	3	3	2	3	3	2	1	2	2
CO3	3	3	0	3	3	2	1	2	2
CO4	3	3	2	3	3	2	1	2	2
CO5	3	3	2	3	3	2	1	2	2
CO6	3	3	0	0	3	2	0	2	0
CO7	3	3	2	3	3	2	2	3	3

Justification for the mapping

PO1 (Disciplinary Knowledge):

CO1 Identify different chemicals present in beverages

CO2 Understand different methods used to identify additives/preservatives and artificial favours/colours in food

CO3 Understand different methods for detection of dyes

CO4 Identify adulterated edible oil by chemical methods

CO5 Prepare their own soap by simple method

CO6 Understand chloride content and foaming properties of different soaps in tap water and distilled water.

CO7 Identify and analyze pure and adulterated food, Beverages, edible oils which will help them to improve scientific thinking for better life

PO2 (Critical Thinking and Problem Solving):

CO1 Identify different chemicals present in beverages

CO2 Understand different methods used to identify additives/preservatives and artificial favours/colours in food

CO3 Understand different methods for detection of dyes

CO4 Identify adulterated edible oil by chemical methods

CO5 Prepare their own soap by simple method

CO6 Understand chloride content and foaming properties of different soaps in tap water and distilled water.

CO7 Identify and analyze pure and adulterated food, Beverages, edible oils which will help them to improve scientific thinking for better life

PO3 (Social Competence):

CO1 Identify different chemicals present in beverages

CO2 Understand different methods used to identify additives/preservatives and artificial favours/colours in food

CO 4 Identify adulterated edible oil by chemical methods

CO5 Prepare their own soap by simple method

CO7 Identify and analyze pure and adulterated food, Beverages, edible oils which will help them to improve scientific thinking for better life

PO4 (Research-related Skills and Scientific Temper):

CO1 Identify different chemicals present in beverages

CO2 Understand different methods used to identify additives/preservatives and artificial favours/colours in food

CO3 Understand different methods for detection of dyes

CO4 Identify adulterated edible oil by chemical methods

CO5 Prepare their own soap by simple method.

CO7 Identify and analyze pure and adulterated food, Beverages, edible oils which will help them to improve scientific thinking for better life

PO5 (Trans-disciplinary Knowledge):

CO1 Identify different chemicals present in beverages

CO2 Understand different methods used to identify additives/preservatives and artificial favours/colours in food

CO3 Understand different methods for detection of dyes

CO4 Identify adulterated edible oil by chemical methods

CO5 Prepare their own soap by simple method

CO6 Understand chloride content and foaming properties of different soaps in tap water and distilled water.

CO7 Identify and analyze pure and adulterated food, Beverages, edible oils which will help them to improve scientific thinking for better life

PO6 (Personal and Professional Competence):

CO1 Identify different chemicals present in beverages

CO2 Understand different methods used to identify additives/preservatives and artificial favours/colours in food

CO3 Understand different methods for detection of dyes

CO4 Identify adulterated edible oil by chemical methods

CO5 Prepare their own soap by simple method

CO6 Understand chloride content and foaming properties of different soaps in tap water and distilled water.

CO7 Identify and analyze pure and adulterated food, Beverages, edible oils which will help them to improve scientific thinking for better life

PO7 (Effective Citizenship and Ethics):

CO1 Identify different chemicals present in beverages

CO2 Understand different methods used to identify additives/preservatives and artificial favours/colours in food

CO3 Understand different methods for detection of dyes

CO4 Identify adulterated edible oil by chemical methods

CO5 Prepare their own soap by simple method

CO7 Identify and analyze pure and adulterated food, Beverages, edible oils which will help them to improve scientific thinking for better life

PO8 (Environment and Sustainability):

CO1 Identify different chemicals present in beverages

CO2 Understand different methods used to identify additives/preservatives and artificial favours/colours in food

CO3 Understand different methods for detection of dyes

CO4 Identify adulterated edible oil by chemical methods

CO5 Prepare their own soap by simple method.

CO6 Understand chloride content and foaming properties of different soaps in tap water and distilled water

CO7 Identify and analyze pure and adulterated food, Beverages, edible oils which will help them to improve scientific thinking for better life

PO9 (Self-directed and Life-long Learning):

CO1 Identify different chemicals present in beverages

CO2 Understand different methods used to identify additives/preservatives and artificial favours/colours in food

CO3 Understand different methods for detection of dyes

CO4 Identify adulterated edible oil by chemical methods
CO5 Prepare their own soap by simple method.
CO7 Identify and analyze pure and adulterated food, Beverages, edible oils which will help them to improve scientific thinking for better life

CBCS Syllabus as per NEP 2020 (NEP 1.0) for S.Y.B.Sc Chemistry (2023Pattern)

Name of the Programme : B.Sc. Chemistry
Program Code : CHE
Class : S.Y.B.Sc
Semester : IV
Course Type : Practical
Course Name : Chemistry Practical
Course Code : CHE-221-SEC
No. of Lectures : 60
No. of Credits : 2 credits

Course Objectives:

1. To develop skills required in physical chemistry experiments such as the appropriate handling of apparatus, instruments and chemicals.
2. To aware the preparation stock / standard solutions.
3. To provide skills needed for operation and safe conduct of experiments based on instruments
4. To develop the knowledge required for interpretation of experimental data and method to report it.
5. To familiar the students with an adequate extent of experimental techniques with hands on training using modern instrumental methods of chemical analysis.
6. To obtain the ability to interpret and communicate scientific information effectively inwritten and oral formats.
7. To understand and analyze current event and issues regarding routine laboratory practices.

Course Outcomes:

1. By the end of the course, students will be able to:
2. Understand in details about general laboratory practices in terms of safely handling of chemicals and apparatus.
3. Learn the preparation and utilization of various laboratory solutions by considering environmentally friendly behavior of chemical.
4. Know the handling of instruments and generation of experimental data.
5. Develop the experimental and operational skill with hands on training using sophisticated instruments and practicing for mathematical and graphical interpretation.
6. Apply theoretical concept learn in classroom to field work through performing practical.
7. Develop problem solving skill through experiments and reporting data in proper way. Apply theory and practical knowledge to design new experiment

1. To determine the amount of Aspirin from a given tablet. Also calculate absolute error, standard deviation and relative standard deviation with reference to the mean of analysis.

2.To determine the amount of acetic acid in commercial vinegar by titrating with approx. NaOH solution using selected best indicator.

3.To determine the cell constant of given cell using 0.1 M KCl solution and determine dissociation constsnt of given monobasic weak acid .

4.Determination of unknown concentration of $KMnO_4$ by Colorimetry.

5. Determination of unknown concentration of $CuSO_4$ by Colorimetry .

6.Determination of P^H of given acidic buffer solution by potentiometer.

7. Determination of P^H of given basic buffer solution by potentiometer.

8..Standardization of conductivity meter and to determine cell constant.

9.Determination of dissociation constant of given weak acid. Simple acid base titration by conductometry .

10. Titration between strong acid and strong base by using P^Hmetry .

11. Titration between weak acid and weak base by using P^H metry .

12. Titration between strong acid and strong base by using conductometry .

13. Titration between weak acid and weak base by using conductometry .

References:

1. *Experimental Physical Chemistry* V. D. Athawale, ParulMarul, New Age International Publishers

Mapping of Program Outcomes with Course Outcomes

Class: S.Y.B.Sc. (Sem IV) **Subject:** Chemistry

Course: Chemistry Practical **Course Code:**CHE-221-SEC

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
CO1	3	2	1	2	1	1	1	1	1
CO2	3	2	1	2	2	1	1	2	1
CO3	3	2	1	3	1	1	1	1	1
CO4	3	3	1	3	1	2	1	1	1
CO5	2	2	1	2	2	1	1	1	1
CO6	2	3	1	2	1	1	1	1	1
CO7	3	3	1	3	2	1	1	1	1

Justifications for Mapping

1. **PO1 (Disciplinary Knowledge)**:
   - **CO1**: Strong relation as understanding laboratory practices is foundational for comprehensive knowledge in chemistry.
   - **CO2**: Strong relation, as preparation and utilization of solutions are essential in the discipline.
2. **PO2 (Critical Thinking and Problem Solving)**:
   - **CO2**: Moderate relation since applying an environmentally friendly approach requires critical thinking.
   - **CO4**: Strong relation, as developing operational skills through hands-on training enhances problem-solving abilities.
3. **PO3 (Social Competence)**:
   - **CO1**: Weak relation since handling chemicals has limited impact on social skills.
4. **PO4 (Research-related Skills and Scientific Temper)**:
   - **CO3**: Strong relation, as handling instruments and generating data are critical for research.
   - **CO4**: Strong relation, as operational skills with sophisticated instruments directly relate to research capabilities.
5. **PO5 (Trans-disciplinary Knowledge)**:
   - **CO2**: Moderate relation, as environmentally friendly practices can integrate concepts from multiple disciplines.
   - **CO5**: Moderate relation, as applying theoretical concepts to fieldwork can involve interdisciplinary methods.
6. **PO6 (Personal and Professional Competence)**:
   - **CO4**: Moderate relation, as hands-on training fosters both personal and professional growth.
   - **CO6**: Weak relation, as reporting data is important but does not heavily impact personal competence.
7. **PO7 (Effective Citizenship and Ethics)**:

CO2: Weak relation, but ethical considerations in environmentally friendly practices are relevant.

CO3: Weak relation since handling instruments has minimal direct impact on citizenship and ethics.

8. **PO8 (Environment and Sustainability)**:
   CO2: Moderate relations as environmentally friendly practices are directly relevant to sustainability.
   CO5: Weak relation, as applying theory in fieldwork might touch on sustainability, but isn't the primary focus.
9. **PO9 (Self-directed and Life-long Learning)**:
   CO4: Weak relation, but using sophisticated instruments can encourage a sense of lifelong learning.