SYLLABI AND SCHEME OF EXAMINATIONS FOR

(MINOR COURSE FOR UNDER GRADUATE PROGRAMS OFFERED BY THE DEPARTMENT OF CHEMISTRY)

B.Sc. (Life Sciences/Physical Sciences Program)

(Based on Curriculum and Credit Framework for UG Programs under NEP)

WITH EFFECT FROM THE SESSION 2024-25

MAHARSHI DAYANAND UNIVERSITY ROHTAK (HARYANA)

SCHEME OF EXAMINATIONS FOR MINOR COURSE OFFERED BY THE DEPARTMENT OF CHEMISTRY

For B.Sc. (Life Sciences/Physical Sciences Program)

Minor Courses (MIC)/ Minor (Vocational) Course MIC(VOC)	TYPE OF PROGRAM			Credits Distribution			Total Credits	Workload			Total Workload	Marks				
	LIFE SCIENCES/PHYSICAL SCIENCES PROGRAM	Nomenclature	Course Code	L	T	P		L	T	P		Theory		Practical		Total Marks
	SEMESTER											Internal	External	Internal	External	
MIC1 @ 4 credits	I	Basic Concepts of Chemistry	**24CHE401MI01**	2	0	0	**04**	2	0	0	**06**	15	35	---	---	**100**
		Minor Chemistry Practical-I		0	0	2		0	0	4		---	---	15	35	
MIC2 @ 4 credits	III	Chemistry of Metals & Non-Metals, Hydrocarbons and Solutions	**25CHE403MI01**	2	0	0	**04**	2	0	0	**06**	15	35	---	---	**100**
		Minor Chemistry Practical-II		0	0	2		0	0	4		---	---	15	35	
MIC3 @ 4 credits	IV	Molecular Structure, Thermodynamics, Equilibrium & Alkyl Halides	**25CHE404MV01**	2	0	0	**04**	2	0	0	**06**	15	35	---	---	**100**
		Minor Chemistry Practical-III		0	0	2		0	0	4		---	---	15	35	

MIC4 (VOC) @ 4 credits	V	Chemistry of Pnictogens, Ionic Solids, Electrochemistry and Aryl Halides	**26CHE405MV01**	2	0	0	**04**	2	0	0	**06**	15	35	---	---	**100**
		Minor Chemistry Practical-IV		0	0	2		0	0	4		---	---	15	35	
MIC5 (VOC) @ 4 credits	VI	Transition Metals, Batteries, Alcohols & Phenols	**26CHE406MI01**	2	0	0	**04**	2	0	0	**06**	15	35	---	---	**100**
		Minor Chemistry Practical-V		0	0	2		0	0	4		---	---	15	35	
MIC6 (VOC) @ 4 credits	VI	Chemistry of Polymer, Kinetics, Carbonyl Compounds & Coordination Complexes	**26CHE406MV01**	2	0	0	**04**	2	0	0	**06**	15	35	---	---	**100**
		Minor Chemistry Practical-VI		0	0	2		0	0	4		---	---	15	35	
MIC7 (VOC) @ 4 credits	VII	Organometallics, Surface Chemistry & Carbohydrates	**27CHE407MV01**	2	0	0	**04**	2	0	0	**06**	15	35	---	---	**100**
		Minor Chemistry Practical-VII		0	0	2		0	0	4		---	---	15	35	
MIC8 (VOC) @ 4 credits	VIII (Option-I) OR VIII (Option-II)	Chemistry of Acid-Base, Dyes, Bio-inorganics, Photochemistry, and Carbohydrates	**27CHE408MV01**	2	0	0	**04**	2	0	0	**06**	15	35	---	---	**100**
		Minor Chemistry Practical-VIII		0	0	2		0	0	4		---	---	15	35	

Note:

1. The Syllabi and Scheme of Examinations (SOE) for Minor (Vocational) Courses for UG Semester-VII and Semester-VIII will be same as applicable for Vocational Course in Post Graduate semester-I and semester-II respectively.
2. Course coding of Minor courses for Single Major Programs will be applicable for Life Sciences/Physical Sciences Programs/ Life Sciences/Physical Sciences Programs after IInd semester irrespective of their offering in any semester.
3. The student who select any Minor Course (MIC) of any discipline in first semester should study the Minor courses (MIC) in the same discipline in the subsequent semesters. However, while exercising the option for choosing Minor Vocational Course MIC (VOC), the student may opt the discipline either related to the discipline of Minor Course or the discipline of Major Course or any other discipline as per his/her choice.

Syllabi for Minor Course Offered by the Department of Chemistry

for B.Sc. (Life Sciences/Physical Sciences Program)

Semester — I (Session: 2024- 25)

Name of Program	**B.Sc. (Life Sciences/Physical Sciences)**	**Program Code**	**UMLS4 or UMPS4**
Paper No.	**Paper – I**	**Nomenclature**	**Basic Concepts of Chemistry**
Name of the Course	**Minor Course**	**Course Code**	**24CHE401MI01**
Credits	**02**	**Maximum Marks**	**50**
Hours per Week	**02**	**External Marks**	**35**
Duration of Examination	**02 Hrs.**	**Internal Marks**	**15**

Course Objectives: The course reviews the structure of atom, which is a necessary pre-requisite in understanding the nature of chemical bonding in compounds. It discusses the periodicity in properties with reference to the s and p-block, which is necessary in understanding their group chemistry. The students will learn about mole concept, molar mass and molecular formula and stoichiometry principle. The course is infused with the recapitulation of fundamentals of organic chemistry. To establish the applications of these concepts, aliphatic and aromatic hydrocarbons are introduced. The constitution of the course strongly aids in the paramount learning of the concepts and their applications.

Note: Examiner will set nine questions and the candidates will be required to attempt five questions in all. Question number one will be compulsory containing seven short answer type questions covering the entire syllabus. Further, examiner will set two questions from each unit and the candidates will be required to attempt one question from each unit. All questions will carry equal marks.

Course Learning Outcomes (CLO): By the end of the course, the students will be able to:

CLO1: Understand the atomic models by various atomic theories.

CLO2: Understand the structural idea and relevance in describing shapes of s, p and d orbitals.

CLO3: Understand the periodicity in atomic and ionic radii, electronegativity, ionization energy, electron affinity of elements of the periodic table and anomalous behavior of elements.

CLO4: Recapitulate the mole concept.

CLO5: Develop skills in using the mole concept for stoichiometric calculations.

CLO6: Learn to apply stoichiometric principles to determine the quantities of reactants and products involved in chemical reactions.

CLO7: Gain knowledge about the structure and bonding in organic molecules, including the concept of hybridization, bond angles, bond polarity and resonance.

CLO8: Explore the fundamental types of organic reactions, including substitution, addition, elimination and rearrangement reactions.

Unit–I

Atomic Structure

Atomic models, Rutherford's model and its limitations, Bohr's model and its applications, dual nature of matter and light, de Broglie's relationship, Heisenberg uncertainty principle, concept of orbitals, quantum

numbers, shapes of s, p and d orbitals, rules for filling electrons in orbitals - Aufbau principle, Pauli's exclusion principle and Hund's rule, electronic configuration of atoms, stability of half-filled and completely filled orbitals.

Unit–II

Periodic Table and Atomic Properties

Brief history of the development of periodic table, modern periodic law and the present form of periodic table, periodic trends in properties of elements -atomic radii, ionic radii, inert gas radii, ionization enthalpy, electron gain enthalpy, electronegativity, valency. Nomenclature of elements with atomic number greater than 100.

Unit–III

Mole Concept

Atomic mass, mole concept and molar mass, Avogadro's number and its significance, percentage composition, empirical and molecular formula, chemical reactions, ways of expressing concentration of solutions (molarity, normality, molality, mole percentage, strength), stoichiometric calculations involving reactants and products.

Unit–IV

Fundamentals of Organic Chemistry

Electronic displacements: Inductive effect, electromeric effect, resonance, hyperconjugation. Cleavage of bonds: homolysis and heterolysis. Reaction intermediates: carbocations, carbanions, free radicals, and carbenes. Electrophiles and nucleophiles. Aromaticity: benzenoids and Huckel's rule.

Books Recommended/References:

1. NCERT Chemistry Textbook for class 11^{th} and 12^{th}.
2. Modern Inorganic Chemistry by R. D. Madan.
3. A Textbook Inorganic Chemistry by O. P. Tandon.
4. Essentials of Physical Chemistry by A. Bahl, B. S. Bahl and G. D. Tuli.
5. Principles of Physical Chemistry by B. R. Puri, L. R. Sharma and M. S. Pathania.
6. Organic Chemistry by R. T. Morrison and R. N. Boyd.
7. Organic Chemistry by I. L. Finar.
8. Basic Organic Chemistry by R. Chandra, S. Singh and A. Singh.

Name of Program	**B.Sc. (Life Sciences/Physical Sciences)**	**Program Code**	**UMLS4 or UMPS4**
Paper No.	**Paper – I**	**Nomenclature**	**Minor Chemistry Practical – I**
Name of the Course	**Minor Course**	**Course Code**	**24CHE401MI01**
Credits	**02**	**Maximum Marks**	**50**
Hours per Week	**04**	**External Marks**	**35**
Duration of Examination	**04 Hrs.**	**Internal Marks**	**15**

Course Objectives: The objective of this course is to furnish students with fundamental knowledge in volumetric titration. Students will be able to demonstrate a comprehensive understanding of surface tension including its principles, measurement techniques and practical applications in various fields. It further develops a clear understanding of the purification of organic compounds by crystallization and the criteria of purity.

***Note: Examiner will set two experiments for practical examinations*.** **(12×2) Marks**

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

CLO1: Gain a comprehensive understanding of the principles underlying titration techniques.

CLO2: Prepare and estimate various ions present in a solution of unknown concentration.

CLO3: Determine of surface tension using drop number method. **CLO4:** Develop skills in designing and performing experiments related to surface tension. **CLO5:** Do purification of organic compounds. **CLO6:** Learn about the calibration of thermometer and determination of B.P. and M.P. of organic compounds.
List of Experiments
Unit–I (Inorganic)
1. Determination of strength of oxalic acid using NaOH by volumetric titration. 2. Estimation of oxalic acid with acidified $KMnO_4$ by volumetric titration.
Unit–II (Physical)
1. Determination of strength of HCl using NaOH by volumetric titration. 2. Determination of the surface tension of a liquid by drop number method. (i) Water (ii) Alcohol
Unit–III (Organic)
1. Purification of organic compounds by crystallization using the following solvents: (i) Water (ii) Alcohol (iii) Alcohol-Water 2. Criteria of purity: Determination of M.P./B.P.
Viva-Voce **(06 Marks)**
Note Book **(05 Marks)**
Books Recommended/References:
1. A text Book of Quantitative Inorganic Analysis by A. I. Vogel. 2. Applied Analytical Chemistry by O. P. Vermani. 3. Vogel's Quantitative Chemical Analysis by J. Mendham. 4. Instrumental Methods of Analysis by B. K. Sharma. 5. Principles of Instrumental Analysis by D. A. Skoog, F. J. Holler, and S. R. Crouch. 6. Senior Practical Physical Chemistry by B. D. Khosla.

Semester — III (Session: 2025- 26)

Name of Program	**B.Sc. (Life Sciences/Physical Sciences)**	**Program Code**	**UMLS4 or UMPS4**
Paper No.	**Paper – II**	**Nomenclature**	**Chemistry of Metals & Non-Metals, Hydrocarbons and Solutions**
Name of the Course	**Minor Course**	**Course Code**	**25CHE403MI01**
Credits	**02**	**Maximum Marks**	**50**
Hours per Week	**02**	**External Marks**	**35**
Duration of Examination	**02 Hrs.**	**Internal Marks**	**15**
Course Objectives: The aim of this course is to make students learn about occurrence of elements in nature, physical and chemical aspects of metals and non-metals. The course aims to provide students with a comprehensive understanding of the properties, behavior and applications of solutions in chemistry. It aims to build the concept of chemical synthesis, properties and reactions of aliphatic and aromatic hydrocarbons.			

Note: Examiner will set nine questions and the candidates will be required to attempt five questions in all. Question number one will be compulsory containing seven short answer type questions covering the entire syllabus. Further, examiner will set two questions from each unit and the candidates will be required to attempt one question from each unit. All questions will carry equal marks.

Course Learning Outcomes (CLO): By the end of the course, the students will be able to:
CLO1: Learn about classification of elements with their properties.
CLO2: Understand the minerals and ores, metallurgical processes and refining of metals.
CLO3: Define and classify different types of solutions and various ways to express the concentration of solutions.
CLO4: Understand the concept of Raoult's law, different types of solutions and colligative properties.
CLO5: Basic chemistry of alkane, alkene and alkynes.
CLO6: Understand the structure and preparation of benzene.
CLO7: Explain the concept of aromaticity and the criteria for a molecule to be considered aromatic.
CLO8: Learn and identify the basic organic reaction mechanisms.

Unit–I

Metal and Non-Metals

Occurrence of elements in nature, physical and chemical properties of metals and non-metals, minerals and ores, metallurgical processes (benefaction, roasting, calcination and reduction of metal oxides processes), refining of metals, metallurgy of Fe, Zn, Al and Cu.

Unit–II

Solution

Types of solutions, expression of concentration of solutions of solids in liquids, solubility of gases in liquids, solid solutions, Raoult's law, colligative properties - relative lowering of vapour pressure, elevation of boiling point, depression in freezing point, osmotic pressure, determination of molecular masses using colligative properties, abnormal molecular mass, Van't Hoff factor.

Unit–III

Hydrocarbons

Alkanes: General methods of preparation and Reactions: free radical substitution.

Alkenes: General methods of preparation and Reactions: cis-addition (alk. $KMnO_4$) and trans-addition (bromine), addition of HX (Markownikoff's and anti-Markownikoff's addition), hydration, ozonolysis, oxymecuration-demercuration, hydroboration oxidation.

Alkynes: General methods of preparation and Reactions: formation of metal acetylides and acidity of alkynes, addition of bromine and alkaline $KMnO_4$, ozonolysis and oxidation with hot alk. $KMnO_4$, hydration to form carbonyl compounds.

Unit–IV

Aromatic Hydrocarbons

Structure of benzene (Kekule, hybrid and resonance), preparation of benzene. Reactions**:** electrophilic substitution reactions in benzene citing examples of nitration, halogenation, sulphonation and Friedel-Craft's alkylation and acylation with special emphasis on carbocationic rearrangement, side chain oxidation of alkyl benzene.

Books Recommended/References:

1. NCERT Chemistry Textbook for class 11^{th} and 12^{th}.
2. Modern Inorganic Chemistry by R. D. Madan.
3. A Textbook of Inorganic Chemistry by O. P. Tandon.
4. Essentials of Physical Chemistry by A. Bahl, B.S. Bahl, and G.D. Tuli.
5. Principles of Physical Chemistry by B. R. Puri, L. R. Sharma and M. S. Pathania.
6. Organic Chemistry by R. T. Morrison and R. N. Boyd.
7. Organic Chemistry by I. L. Finar.
8. Basic Organic Chemistry by R. Chandra, S. Singh and A. Singh.

Name of Program	B.Sc. (Life Sciences/Physical Sciences)	Program Code	UMLS4 or UMPS4
Paper No.	Paper – II	Nomenclature	Minor Chemistry Practical – II
Name of the Course	Minor Course	Course Code	25CHE403MI01
Credits	02	Maximum Marks	50
Hours per Week	04	External Marks	35
Duration of Examination	04 Hrs.	Internal Marks	15

Course Objectives: The course introduces the learner to various types of soap preparations, pH determination of different food items, the concept of viscosity as a measure of a fluid's resistance to flow and about their importance in various industries. This course also deals with sublimation process, preparation and purification of organic compound by crystallization and distillation methods.

***Note: Examiner will set two experiments for practical examinations*.** **(12×2) Marks**

Course Learning Outcomes (CLO): By the end of the course, the students will be able to:

CLO1: Learn preparation of soaps and detergent.
CLO2: Identify the pH of different samples of food items.
CLO3: Determine the viscosity of given solutions.
CLO4: Determine the solubility of benzoic acid at different temperatures.
CLO5: Explain preparation and purification of organic compounds.
CLO6: Have an idea of sublimation process.

List of Experiments

Unit–I (Inorganic)

1. Preparation of soaps and detergents by using vegetable oils (olive oil and coconut oil).
2. Determination of the pH of different samples of food items by pH strip method.

Unit–II (Physical)

1. Determination of viscosity of aqueous solutions of ethanol and sugar at room temperature.
2. Determination of the solubility of benzoic acid at various temperatures.

Unit–III (Organic)

1. Preparation and purification of iodoform from ethanol (or acetone) through crystallization and distillation and ascertaining purity through melting point.
2. Study the process of sublimation of camphor and phthalic acid.

Viva-Voce **(06 Marks)**

Note Book **(05 Marks)**

Books Recommended/References:

1. Soap-Making Manual-A practical handbook on the raw materials, their manipulation, analysis and control in the modern soap plant by E. G. Thomssen.
2. Vogel's Qualitative Inorganic Analysis by G. Svehla.
3. Advanced Physical Chemistry Practical by G. Raj.
4. Advanced Practical Physical Chemistry by J. B. Yadav.
5. Advanced Practical Organic Chemistry by N. K. Vishnoi.
6. Practical Organic Chemistry – A Primer by V. Peesapati.

Semester — IV (Session: 2025- 26)

Name of Program	**B.Sc. (Life Sciences/Physical Sciences)**	**Program Code**	**UMLS4 or UMPS4**
Paper No.	**Paper – III**	**Nomenclature**	**Molecular Structure, Thermodynamics, Equilibrium & Alkyl Halides**
Name of the Course	**Minor Course**	**Course Code**	**25CHE404MV01**
Credits	**02**	**Maximum Marks**	**50**
Hours per Week	**02**	**External Marks**	**35**
Duration of Examination	**02 Hrs.**	**Internal Marks**	**15**

Course Objectives: The course provides basic knowledge about ionic, covalent and metallic bonding. It discusses VSEPR theory and concept of hybridization which is necessary in understanding the structure of molecules. The course is infused with the basic understanding of the chemical energetics, laws of thermodynamics, chemical and ionic equilibrium. It acquaints the students with the methods of preparation and reactions of alkyl halides.

Note: Examiner will set nine questions and the candidates will be required to attempt five questions in all. Question number one will be compulsory containing seven short answer type questions covering the entire syllabus. Further, examiner will set two questions from each unit and the candidates will be required to attempt one question from each unit. All questions will carry equal marks.

Course Learning Outcomes (CLO): By the end of the course, the students will be able to:

CLO1: Draw the plausible structures and geometries of molecules using radius ratio Rule, VSEPR theory and MO diagrams (homo-nuclear diatomic molecules).

CLO2: Understand the structural idea and relevance in describing shapes of s, p and d orbitals.

CLO3: Understand the laws of thermodynamics, thermochemistry and equilibria.

CLO4: Explain the Hess's law of constant heat summation and its application to determine the overall enthalpy change of a reaction.

CLO5: Predict the effects of changes in concentration, temperature, and pressure on the position of equilibrium.

CLO6: Understand concept of pH and its effect on the various physical and chemical properties of the compounds.

CLO7: Understand the preparation, properties and reactions of alkyl halides.

CLO8: Design synthetic pathways for the preparation of specific compounds using alkyl halides.

Unit–I

Chemical Bonding and Molecular Structure

Valence electrons, ionic bond, covalent bond, bond parameters, Lewis' structure, polar character of covalent bond, valence bond theory and its limitations, resonance, geometry of covalent molecules, VSEPR theory, concept of hybridization, involving s, p and d orbitals and shapes of some simple molecules, molecular orbital theory of homonuclear diatomic molecules (qualitative idea only), hydrogen bond and its types with examples, Van der Waal forces.

Unit–II

Thermodynamics

Concept of system, types of system, surroundings, extensive and intensive properties, state functions and variables. Laws of thermodynamics – internal energy and enthalpy, heat capacity and specific heat, entropy, Gibbs free energy & Helmholtz function, measurement of ΔU and ΔH, Hess's law of constant heat summation, enthalpy of bond dissociation, combustion, formation, atomization, sublimation, phase transition, ionization.

Unit–III
Chemical and ionic equilibrium Dynamic nature of equilibrium, law of mass action, equilibrium constant, factors affecting equilibrium - Le Chatelier's principle & its applications, Theories of acid and base, ionization of acids and bases, strong and weak electrolytes, degree of ionization, acidic and basic strength, concept of pH, hydrolysis of salts (elementary idea), buffer solution, solubility product, common ion effect.
Unit–IV
Alkyl halides Structure of haloalkanes and their classification as 1º, 2º & 3º, general methods of preparation, chemical reactions: nucleophilic substitution reactions with mechanism and their types (SN1, SN2 and SNi, E1, E2 & E1cB), nucleophilic substitution reactions with specific examples from: hydrolysis, nitrite & nitro formation, nitrile & isonitrile formation and Williamson's ether synthesis.
Books Recommended/References:
1. NCERT Chemistry Textbook for class 11^{th} and 12^{th}. 2. Modern Inorganic Chemistry by R. D. Madan. 3. A Textbook of Inorganic Chemistry by O. P. Tandon. 4. Essentials of Physical Chemistry by A. Bahl, B. S. Bahl and G. D. Tuli. 5. Principles of Physical Chemistry by B. R. Puri, L. R. Sharma and M. S. Pathania. 6. Organic Chemistry by R. T. Morrison and R. N. Boyd. 7. Organic Chemistry by I. L. Finar. 8. Basic Organic Chemistry by R. Chandra, S. Singh and A. Singh.

Name of Program	**B.Sc. (Life Sciences/Physical Sciences)**	**Program Code**	**UMLS4 or UMPS4**
Paper No.	**Paper – III**	**Nomenclature**	**Minor Chemistry Practical – III**
Name of the Course	**Minor Course**	**Course Code**	**25CHE404MV01**
Credits	**02**	**Maximum Marks**	**50**
Hours per Week	**04**	**External Marks**	**35**
Duration of Examination	**04 Hrs.**	**Internal Marks**	**15**

Course Objectives: The objective of this course is to make students aware of the concept the water quality, purification techniques, principle of total dissolved solids (TDS) in water and critical solution temperature (CST). Students are exposed to identify the nature of reaction (exothermic or endothermic). It also provides an overview of the systematic approach to identify organic compounds based on elemental composition.

***Note: Examiner will set two experiments for practical examinations*.** **(12×2) Marks**

Course Learning Outcomes (CLO): By the end of the course, the students will be able to:
CLO1: Determine TDS of different samples of water.
CLO2: Identify the nature of reaction (Exo/Endothermic).
CLO3: Purify the given sample of water.
CLO4: Determine the CST of phenol-water system.
CLO5: Determine extra elements of the simple organic compounds.
CLO6: Understand the theoretical principles behind the detection of extra elements in organic compounds.

List of Experiments

Unit–I (Inorganic)
1. Determine the TDS of different water samples. 2. Determine nature of reaction of water with quick lime (Exo/Endothermic).

Unit–II (Physical)	
1. Purification of the different water samples by using different techniques. 2. Determine the CST of phenol-water system.	
Unit–III (Organic)	
1. Systematic detection of extra elements of the simple organic compounds.	
Viva-Voce	**(06 Marks)**
Note Book	**(05 Marks)**
Books Recommended/References:	
1. Water Treatment, How To Make Water Safe To Drink by D. Holman. 2. B.Sc. Chemistry Practical by S. Goyal. 3. Organic Chemistry by S. N. Dhawan. 4. Practical Organic Chemistry by A. K. Manna.	

Semester — V (Session: 2026- 27)

Name of Program	**B.Sc. (Life Sciences/Physical Sciences)**	**Program Code**	**UMLS4 or UMPS4**
Paper No.	**Paper – IV**	**Nomenclature**	**Chemistry of Pnictogens, Ionic Solids, Electrochemistry and Aryl Halides**
Name of the Course	**Minor Course**	**Course Code**	**26CHE405MV01**
Credits	**02**	**Maximum Marks**	**50**
Hours per Week	**02**	**External Marks**	**35**
Duration of Examination	**02 Hrs.**	**Internal Marks**	**15**

Course Objectives: The course illustrates the diversity and fascination of inorganic chemistry through the study of properties and utilities of p-block elements and their compounds. The students will learn about the properties of solids with details about crystal structure. It reviews the terms redox reactions, oxidation number, balancing redox reactions, dry cell – electrolytic cells and galvanic cells, EMF of a cell, standard electrode potential and Nernst equation. The students will also learn about the general methods of preparation, chemical reaction of aryl halides.

Note: Examiner will set nine questions and the candidates will be required to attempt five questions in all. Question number one will be compulsory containing seven short answer type questions covering the entire syllabus. Further, examiner will set two questions from each unit and the candidates will be required to attempt one question from each unit. All questions will carry equal marks.

Course Learning Outcomes (CLO): By the end of the course, the students will be able to:

CLO1: Learn about the structure of p-block elements, their properties and discuss their use in daily life as well as industrial applications.

CLO2: Understand anomalous behavior of nitrogen, phosphorus, oxygen and sulphur.

CLO3: Explain the crystal structure and calculate related properties of cubic systems.

CLO4: Understand the principles of semiconductor devices and their role in electronic circuits.

CLO5: Explain the concept of oxidation and reduction, redox reactions, oxidation number, balancing redox reactions.

CLO6: Understand different types of galvanic cells and their Nernst equations.

CLO7: Understand the preparation, properties and reactions of aryl halides.

CLO8: Compare and contrast the relative reactivity and bond strength of C-X bonds in alkyl, allyl, benzyl, vinyl and aryl halides.

Unit–I

p - Block Elements

General electronic configuration of p-block elements, inert pair effect, atomic and ionic radii, oxidation states, ionization energy, electron gain enthalpy, electronegativity, color and their oxidizing power, allotropy and catenation. Diagonal relationship and anomalous behavior of first member of each group, compounds of p-block elements. Reactivity towards hydrogen, oxygen, halogen and metals. Anomalous behavior of nitrogen, phosphorus, oxygen and sulphur. Interhalogen compounds, compounds of Xe with F and O.

Unit–II

Ionic Solids

Forms of solids, symmetry elements, unit cells, crystal systems, Bravais lattice types and identification of lattice planes. Voids, packing in solids, packing efficiency in crystalline solids, radius ratio rule, expanded structure of ionic solids, structures of NaCl, KCl and CsCl, CaF_2 and Na_2O (qualitative treatment only), defects in crystals. Brief introduction to metallic bond, band theory of metallic bond. Semiconductors-Introduction, types and applications.

Unit–III

Electrochemistry

Concept of oxidation and reduction, redox reactions, oxidation number, balancing redox reactions, dry cell – electrolytic cells and galvanic cells, EMF of a cell, standard electrode potential, Nernst equation and its application to chemical cells. Definition of corrosion, mechanism of corrosion, classification of corrosion.

Unit–IV

Aryl Halides

Structure and resonance, general methods of preparation, chemical reaction: nucleophilic aromatic substitution ArSN1, ArSN2, (bimolecular displacement mechanism), effect of substituent on reactivity of haloarenes, reaction with strong bases $NaNH_2/NH_3$ (elimination addition mechanism involving benzyne intermediate), relative reactivity and strength of C-X bond in alkyl, allyl, benzyl, vinyl and aryl halides.

Books Recommended/References:

1. NCERT Chemistry Textbook for class 11^{th} and 12^{th}.
2. Modern Inorganic Chemistry by R. D. Madan.
3. A Textbook of Inorganic Chemistry by O. P. Tandon.
4. Essentials of Physical Chemistry by A. Bahl, B. S. Bahl and G. D. Tuli.
5. Principles of Physical Chemistry by B. R. Puri, L. R. Sharma and M. S. Pathania.
6. Organic Chemistry by R. T. Morrison and R. N. Boyd.
7. Organic Chemistry by I. L. Finar.
8. Basic Organic Chemistry by R. Chandra, S. Singh and A. Singh.

Name of Program	**B.Sc. (Life Sciences/Physical Sciences)**	**Program Code**	**UMLS4 or UMPS4**
Paper No.	**Paper – IV**	**Nomenclature**	**Minor Chemistry Practical–IV**
Name of the Course	**Minor Course**	**Course Code**	**26CHE405MV01**
Credits	**02**	**Maximum Marks**	**50**
Hours per Week	**04**	**External Marks**	**35**
Duration of Examination	**04 Hrs.**	**Internal Marks**	**15**

Course Objectives: Objective of this course is to make students learn the volumetric titration, principles of refractometry and preparation of buffer solutions. The course exposes students to learn the techniques for measuring

refractive indices and pH of solutions by using refractometer and pH meter respectively. It acquaints the students with systematic approach to identify organic compounds based on functional groups.

***Note: Examiner will set two experiments for practical examinations*.** **(12×2) Marks**

Course Learning Outcomes (CLO): By the end of the course, the students will be able to:

CLO1: Determine the strength of HCl and CH_3COOH using NaOH volumetrically.

CLO2: Estimate sodium carbonate solution and water of crystallization by using standardized HCl volumetrically.

CLO3: Determine the refractive index of a pure liquid.

CLO4: Prepare some buffer solutions.

CLO5: Identify organic compounds based on functional groups.

CLO6: Understand the principles behind various qualitative tests that are performed to confirm the presence of functional groups in organic compounds.

List of Experiments

Unit–I (Inorganic)

1. Determination of strength of HCl using NaOH by volumetric titration.
2. Determination of strength of CH_3COOH using NaOH by volumetric titration.
3. Estimation of sodium carbonate solution using standardized HCl by volumetric.
4. Estimation of water of crystallization in washing soda by volumetric titration with HCl.

Unit–II (Physical)

1. Determine the refractive index of a given liquid.
2. Preparation of buffer solutions:
   (i) Sodium acetate-acetic acid.
   (ii) Ammonium chloride-ammonium acetate.
   (iii) Carbonate-bicarbonate buffer.
3. Measurement of pH of buffer solutions and comparison of the values with theoretical values.

Unit–III (Organic)

1. Systematic identification of functional groups in the given organic compounds:
   Benzaldehyde, vanillin, oxalic acid, succinic acid, benzoic acid, salicylic acid, aspirin, phthalic acid, cinnamic acid, benzamide, urea, acetanilide, benzanilide.

Viva-Voce **(06 Marks)**

Note Book **(05 Marks)**

Books Recommended/References:

1. B.Sc. Chemistry Practical by S. Goyal.
2. Advanced Physical Chemistry Practical by G. Raj.
3. Advanced Practical Physical Chemistry by J. B. Yadav.
4. Advanced Practical Organic Chemistry by N K Vishnoi.
5. Practical Organic Chemistry – A Primer by V. Peesapati.

Semester — VI (Session: 2026- 27)

Name of Program	**B.Sc. (Life Sciences/Physical Sciences)**	**Program Code**	**UMLS4 or UMPS4**
Paper No.	**Paper – V**	**Nomenclature**	**Transition Metals, Batteries, Alcohols & Phenols**
Name of the Course	**Minor Course**	**Course Code**	**26CHE406MI01**

Credits	**02**	**Maximum Marks**	**50**
Hours per Week	**02**	**External Marks**	**35**
Duration of Examination	**02 Hrs.**	**Internal Marks**	**15**

Course Objectives: The aim of this course is to make students understand properties of the transition metals, principle, working and applications of the battery. It acquaints the students with the functional group approach to study organic chemistry and establish applications of this concept structure, methods of preparation and reactions for alcohols and phenols.

Note: Examiner will set nine questions and the candidates will be required to attempt five questions in all. Question number one will be compulsory containing seven short answer type questions covering the entire syllabus. Further, examiner will set two questions from each unit and the candidates will be required to attempt one question from each unit. All questions will carry equal marks.

Course Learning Outcomes (CLO): By the end of the course, the students will be able to:

CLO1: Understand the characteristics of transition metals, interstitial compounds and alloy formation.

CLO2: Understand the preparation and properties of $K_2Cr_2O_7$ and $KMnO_4$.

CLO3: Understand the different types of battery.

CLO4: Explore the principles, working mechanism and various applications of batteries.

CLO5: Understand the structure and classification of alcohols as primary (1°), secondary (2°), and tertiary (3°).

CLO6: Understand the preparation and reactions of alcohols and phenols.

CLO7: Explain the industrial and pharmaceutical applications of alcohols and phenols.

CLO8: Differentiate between the structures and properties of alcohols and phenols, including their reactivity and acidity.

Unit–I

d-Block Elements

General introduction, electronic configuration, occurrence and characteristics of transition metals, general trends in properties of the transition metals – metallic character, ionization enthalpy, oxidation states, ionic radii, color, catalytic property, magnetic properties, interstitial compounds, alloy formation, preparation and chemical properties of $K_2Cr_2O_7$ and $KMnO_4$.

Unit–II

Primary and Secondary Batteries

Characteristics of an ideal battery, principle, working, applications and comparison of the following batteries: Pb- acid battery, Li-metal batteries, Li-ion batteries, Li-polymer batteries, solid state electrolyte batteries, fuel cells.

Unit–III

Alcohols

Structure and classification of alcohols as 1º, 2º & 3º, methods of preparation of 1º, 2º & 3º by using Grignard reagent, ester hydrolysis and reduction of aldehydes, ketones, carboxylic acids and esters. Chemical Reactions: Acidic character of alcohols and reaction with sodium, with HX (Lucas Test), esterification, oxidation (with PCC, alkaline $KMnO_4$, acidic $K_2Cr_2O_7$ and conc. HNO_3), Oppeneauer oxidation.

Unit–IV

Phenols

Acidity of phenols and factors affecting their acidity, methods of preparation from cumene, diazonium salts and benzene sulphonic acid. Chemical Reactions: Directive influence of OH group and electrophilic substitution reactions, viz. nitration, halogenation, sulphonation, Reimer-Tiemann reaction, Gattermann–Koch reaction, Houben-Hoesch condensation, Schotten-Baumann reaction.

Books Recommended/References:
1. NCERT Chemistry Textbook for class 11^{th} and 12^{th}. 2. Modern Inorganic Chemistry by R. D. Madan. 3. A Textbook of Inorganic Chemistry by O. P. Tandon. 4. Essentials of Physical Chemistry by A. Bahl, B. S. Bahl and G. D. Tuli. 5. Principles of Physical Chemistry by B. R. Puri, L. R. Sharma and M. S. Pathania. 6. Organic Chemistry by R. T. Morrison and R. N. Boyd. 7. Organic Chemistry by I. L. Finar. 8. Basic Organic Chemistry by R. Chandra, S. Singh and A. Singh.

Name of Program	**B.Sc. (Life Sciences/Physical Sciences)**	**Program Code**	**UMLS4 or UMPS4**
Paper No.	**Paper – V**	**Nomenclature**	**Minor Chemistry Practical – V**
Name of the Course	**Minor Course**	**Course Code**	**26CHE406MI01**
Credits	**02**	**Maximum Marks**	**50**
Hours per Week	**04**	**External Marks**	**35**
Duration of Examination	**04 Hrs.**	**Internal Marks**	**15**

Course Objectives: The objective of this course is to make students aware of the preparation of potash alum and effect of acid on baking and washing soda. It gives an insight into principle of conductometric titrations and its industrial applications. This course also deals with the principle of paper chromatography as a separation technique and some rapid test for carbohydrates analysis.

***Note: Examiner will set two experiments for practical examinations*.** **(12×2) Marks**

Course Learning Outcomes (CLO): By the end of the course, the students will be able to:
CLO1: Prepare potash alum and mohr's salt.
CLO2: Explain effect of acid on baking and washing soda.
CLO3: Determine the cell constant of conductivity cell.
CLO4: Determine the strength of unknown acid solution using conductometric titrations.
CLO5: Explain qualitative analysis of green leaf pigments using paper chromatography.
CLO6: Understand qualitative analysis of carbohydrates.

List of Experiments

Unit–I (Inorganic)

1. Preparation of potash alum.
2. Preparation of mohr's salt.
3. Determination of strength of HCl acid by baking and washing soda using anyone method.

Unit–II (Physical)

1. Conductometry:
   (i) Determination of cell constant.
   (ii) Perform the following conductometric titrations:
   a) Strong acid vs strong base.
   b) Weak acid vs strong base.

Unit–III (Organic)

1. Separation of amino acids by paper chromatography (Tryptophan & Threonine).
2. Qualitative tests for carbohydrates- Molisch test, Barfoed's reagent test, rapid furfural test, Tollen's test and Fehling solution test.

Viva-Voce	**(06 Marks)**
Note Book	**(05 Marks)**

Books Recommended/References:

1. Laboratory Manual Chemistry of NCERT for class 11^{th} and 12^{th}.
2. Basic Concepts: Physical Chemistry Experiments by N. Seedher.
3. Senior Practical Physical Chemistry by B. D. Khosla.
4. Practical Chemistry by O. P. Pandey, D. N. Bajpai and S. Giri.
5. Practical Organic Chemistry – A Primer by V. Peesapati.
6. Practical Organic Chemistry by A. K. Manna.

Name of Program	**B.Sc. (Life Sciences/Physical Sciences)**	**Program Code**	**UMLS4 or UMPS4**
Paper No.	**Paper – VI**	**Nomenclature**	**Chemistry of Polymer, Kinetics, Carbonyl Compounds & Coordination Complexes**
Name of the Course	**Minor Course**	**Course Code**	**26CHE406MV01**
Credits	**02**	**Maximum Marks**	**50**
Hours per Week	**02**	**External Marks**	**35**
Duration of Examination	**02 Hrs.**	**Internal Marks**	**15**

Course Objectives: The course introduces the students to coordination compounds which find manifold applications in diverse areas like qualitative and quantitative analysis, metallurgy, as catalysts in industrial processes as medicines, paints and pigments as well as in life. The student is also familiarized with kinetics of chemical reaction and gets an idea about order and molecularity, temperature dependence and catalysis of the reactions. This course also deals with basic understanding of polymeric materials and preparation, physical properties and reactions of carbonyls.

Note: Examiner will set nine questions and the candidates will be required to attempt five questions in all. Question number one will be compulsory containing seven short answer type questions covering the entire syllabus. Further, examiner will set two questions from each unit and the candidates will be required to attempt one question from each unit. All questions will carry equal marks.

Course Learning Outcomes (CLO): By the end of the course, the students will be able to:

CLO1: Understand types of coordination complexes.
CLO2: Understand the theories for bonding in coordination compounds.
CLO3: Explore the rate of chemical reactions and the factors affecting rate of reaction.
CLO4: Derive rate laws, rate constants, orders and concentrations of reactants or products as a function of time.
CLO5: Know the basics of polymers, their classification and uses.
CLO6: Have a detail idea about some specific polymers like polythene, nylon polyesters, bakelite and rubber.
CLO7: Have the understanding of preparation, physical properties and reactions of carbonyls.
CLO8: Learn the important name reactions.

Unit–I

Coordination Chemistry

Coordination entity, ligands and their types, coordination number, coordination sphere, coordination polyhedron, homoleptic and heteroleptic complex, types of coordination complexes, IUPAC nomenclature of coordination compounds, recapitulation of Werner's coordination theory, VBT for complexes, CFST for octahedral and tetrahedral complexes, success of CFST, spectrochemical series and calculation of CFSE for low spin and high spin complexes of 3d -series elements.

Unit–II
Chemical Kinetics Rate of a reaction (Average and instantaneous), rate of appearance and disappearance, factors affecting rate of reaction: concentration, temperature, catalyst; order and molecularity of a reaction, rate law and specific rate constant, integrated rate equations of zero & 1^{st} order, half-life of reactions. Temperature dependence on reaction rates, catalysts and catalysis & its types.
Unit–III
Polymer Introduction and history of polymeric materials, different schemes of classification of polymers, methods of polymerization (addition and condensation polymerisation), copolymerization and some important polymers: natural and synthetic like polythene, nylon polyesters, bakelite and rubber. Biodegradable and non-biodegradable polymers, conducting polymers with examples.
Unit–IV
Aldehydes and Ketones (Aliphatic and Aromatic) General methods of preparation, reactions: nucleophilic addition, nucleophilic addition-elimination reaction including reaction with HCN, ROH, $NaHSO_3$, ammonia and its derivatives. Iodoform test, Aldol & cross Aldol condensation, Cannizzaro's and cross Cannizzaro's reaction with mechanisms, Wittig reaction, Benzoin condensation. Clemmensen reduction, Wolff Kishner reduction, Meerwein Ponndorf Verley reduction.
Books Recommended/References:
1. NCERT Chemistry Textbook for class 11^{th} and 12^{th}. 2. Modern Inorganic Chemistry by R. D. Madan. 3. A Textbook of Inorganic Chemistry by O. P. Tandon. 4. Essentials of Physical Chemistry by A. Bahl, B. S. Bahl and G. D. Tuli. 5. Principles of Physical Chemistry by B. R. Puri, L. R. Sharma and M. S. Pathania. 6. Organic Chemistry by R. T. Morrison and R. N. Boyd. 7. Organic Chemistry by I. L. Finar. 8. Basic Organic Chemistry by R. Chandra, S. Singh and A. Singh.

Name of Program	**B.Sc. (Life Sciences/Physical Sciences)**	**Program Code**	**UMLS4 or UMPS4**
Paper No.	**Paper – VI**	**Nomenclature**	**Minor Chemistry Practical – VI**
Name of the Course	**Minor Course**	**Course Code**	**26CHE406MV01**
Credits	**02**	**Maximum Marks**	**50**
Hours per Week	**04**	**External Marks**	**35**
Duration of Examination	**04 Hrs.**	**Internal Marks**	**15**

Course Objectives: This course aims to make the students understand iodometric titration and pH metry. Students will gain a comprehensive understanding of the pesticide market, including the selection, usage, and implications of potent pesticides in agricultural and public health contexts.

***Note: Examiner will set two experiments for practical examinations*.** **(12×2) Marks**

Course Learning Outcomes (CLO): By the end of the course, the students will be able to:
CLO1: Estimate Fe (II) ions by using internal indicator.
CLO2: Explore iodometric titration.
CLO3: Determine the strength of given acid solution by using pH meter.
CLO4: Evaluate the benefits and risks associated with pesticide use.

CLO5: Explore alternative pest control methods that minimize the use of chemical pesticides.
CLO6: Understand preparation of neem based botanical pesticides.

List of Experiments

Unit–I (Inorganic)

1. Estimation of Fe (II) ions by titrating it with $K_2Cr_2O_7$ using internal indicator.
2. Estimation of Cu (II) ions iodometrically using $Na_2S_2O_3$.

Unit–II (Physical)

1. pH- metry: Perform following pH- metric titrations:
   (i) Strong acid vs strong base.
   (ii) Weak acid vs strong base.

Unit–III (Organic)

1. Carryout market survey of potent pesticides with details as follows: a) Name of pesticide b) Chemical name, class and structure of pesticide c) Type of formulation available and Manufacturer's name d) Useful information on label of packaging regarding: Toxicity, LD50 ("Lethal Dose, 50%"), Side effects and Antidotes.
2. Preparation of neem based botanical pesticides.

Viva-Voce **(06 Marks)**

Note Book **(05 Marks)**

Books Recommended/References:

1. B.Sc. Chemistry Practical by S. Goyal.
2. Advanced Physical Chemistry, Practical Handbook by G. Raj.
3. Basic Concepts: Physical Chemistry Experiments by N. Seedher.
4. Advanced Practical Organic Chemistry by N. K. Vishnoi.

Semester — VII (Session: 2027- 28)

Name of Program	**B.Sc. (Life Sciences/Physical Sciences)**	**Program Code**	**UMLS4 or UMPS4**
Paper No.	**Paper – VII**	**Nomenclature**	**Organometallics, Surface Chemistry & Carbohydrates**
Name of the Course	**Minor Course**	**Course Code**	**27CHE407MV01**
Credits	**02**	**Maximum Marks**	**50**
Hours per Week	**02**	**External Marks**	**35**
Duration of Examination	**02 Hrs.**	**Internal Marks**	**15**

Course Objectives: The course introduces the students to organometallic compounds, the concept of hapticity and the 18-electron rule governing the stability of a wide variety of organometallic species. The students will learn about surface phenomenon, adsorption isotherms and colloidal systems including their interactions, dynamics and methods of characterization to appreciate their significance in industrial, environmental and biological contexts. Students will delve into carbohydrate structures, preparation and their properties.

Note: Examiner will set nine questions and the candidates will be required to attempt five questions in all. Question number one will be compulsory containing seven short answer type questions covering the entire syllabus. Further, examiner will set two questions from each unit and the candidates will be required to attempt one question from each unit. All questions will carry equal marks.

Course Learning Outcomes (CLO): By the end of the course, the students will be able to:

CLO1: Have a detail idea about the basics of organometallic compounds.
CLO2: Apply 18-electron rule to rationalize the stability of metal carbonyls and related species.
CLO3: Understand the fundamental principles of adsorption and desorption.
CLO4: Distinguish between physical and chemical adsorption processes.
CLO5: Understand the principles of colloidal science, including colloidal stability, aggregation, and surface chemistry.
CLO6: Explore the applications of colloidal systems in various fields, such as pharmaceuticals, food science and nanotechnology.
CLO7: Have the understanding of structure, preparation and properties of carbohydrates.
CLO8: Explore the use of carbohydrates in medical applications.

Unit–I

Organometallic Compounds

Definition, nature of metal carbon bond, classification of organometallic compounds by bond types viz. i) covalent ii) ionic iii) electron deficient iv) cluster compounds v) π bond compounds including sandwich derivatives. Structure and bonding in, metal- ethylenic, metal carbonyls and cyclopentadienyl derivative. Properties and bonding of alkyls of Li, Al, Hg and Sn, concept of hapticity of organic ligand, Zeise salt and ferrocene. EAN rule as applied to carbonyls.

Unit–II

Adsorption

Physical and chemical adsorption, difference between physisorption and chemisorption, Freundlich adsorption isotherm (derivation excluded), Langmuir adsorption isotherm, applications of adsorption. Concept of desorption.

Unit – III

Colloidal states

Introduction, types of colloidal systems, classification of colloids, true solutions, colloidal solutions and suspensions. General properties of colloidal systems, properties of hydrophobic colloidal systems.
(a) electrical properties: charge on colloidal particles, coagulation of colloidal sols: Hardy and Schulze rule, Gold number
(b) electrokinetic properties: electrophoresis and electro-osmosis. Surfactants, types of emulsions, emulsifiers, gels, preparation of gels, importance and applications of colloids.

Unit–IV

Carbohydrates

Classification and nomenclature. Monosaccharides, mechanism of osazone formation, interconversion of glucose and fructose, chain lengthening and chain shortening of aldoses. Conversion of glucose into mannose. Determination of ring size of glucose and fructose. Open chain and cyclic structure of D (+)-glucose & D (-) fructose.

Books Recommended/References:

1. Modern Inorganic Chemistry by R. D. Madan.
2. A Textbook of Inorganic Chemistry by O. P. Tandon.
3. Organometallic and Bioinorganic Chemistry by A. Kumar.
4. Principles of Physical Chemistry by B. R. Puri, L. R. Sharma and M. S. Pathania.
5. Organic Chemistry by R. T. Morrison and R. N. Boyd.
6. Basic Organic Chemistry by R. Chandra, S. Singh and A. Singh.

Name of Program	**B.Sc. (Life Sciences/Physical Sciences)**	**Program Code**	**UMLS4 or UMPS4**
Paper No.	**Paper – VII**	**Nomenclature**	**Minor Chemistry**

			Practical – VII
Name of the Course	**Minor Course**	**Course Code**	**27CHE407MV01**
Credits	**02**	**Maximum Marks**	**50**
Hours per Week	**04**	**External Marks**	**35**
Duration of Examination	**04 Hrs.**	**Internal Marks**	**15**

Course Objectives: This course aims to make the students understand the principle of redox and potentiometric titration. Students will gain a comprehensive understanding of reaction mechanism behind the preparation of some simple organic compounds.

***Note: Examiner will set two experiments for practical examinations*.** **(12×2) Marks**

Course Learning Outcomes (CLO): By the end of the course, the students will be able to:

CLO1: Explore redox titration with $KMnO_4$ and determine the water of crystallization in mohr's salt and oxalic acid.

CLO2: Prepare the salt bridge by using KCl and agar-agar.

CLO3: Set the galvanic cell and can determine its cell voltage.

CLO4: Determine the strength of given acid by potentiometric titration.

CLO5: Explore the adsorption phenomena.

CLO6: Understand the reaction of some simple organic compounds.

List of Experiments

Unit–I (Inorganic)

1. Determination of water of crystallization in mohr's salt by redox titration with $KMnO_4$.
2. Determination of water of crystallization in oxalic acid by redox titration with $KMnO_4$.
3. Determine strength of given $KMnO_4$ solution using mohr's salt.
4. Determine strength of $KMnO_4$ solution using oxalic acid solution.

Unit–II (Physical)

1. Potentiometry

(i) Study the preparation of salt bridge using KCl and agar-agar.

(ii) Setting of a galvanic cell and determination of cell voltage.

(iii) Potentiometric titration of strong acid against strong base.

(iv) Potentiometric titration of weak acid against strong base.

2. Study adsorption of acetic acid on the surface of activated charcoal.

Unit–III (Organic)

1. Simple organic preparations and checking the purity of samples prepared:

(i) Chalcone from benzaldehyde and acetophenone.

(ii) Pheny-azo-β-naphthol dye from aniline.

(iii) Adipic acid from cyclohexene.

(iv) 2-Butoxynaphthalene from 2-naphthol and 1-iodobutane.

(v) 3,4-Dihydropyrimidin-2(1H)-ones from aldehyde, β-ketoester and urea (Biginelli reaction).

(vi) Benzilic acid from benzil.

Viva-Voce **(06 Marks)**

Note Book **(05 Marks)**

Books Recommended/References:

1. B.Sc. Chemistry Practical by S. Goyal.
2. Advanced Physical Chemistry, Practical Handbook by G. Raj.
3. Basic Concepts: Physical Chemistry Experiments by N. Seedher.
4. Advanced Practical Organic Chemistry by N. K. Vishnoi.
5. Comprehensive Practical Organic Chemistry: Qualitative Analysis by V. K. Ahluwalia and S. Dhingra.

Semester — VIII (Session: 2027- 28)

OPTION- I &II

Name of Program	**B.Sc. (Life Sciences/Physical Sciences)**	**Program Code**	**UMLS4 or UMPS4**
Paper No.	**Paper – VIII**	**Nomenclature**	**Chemistry of Acid-Base, Dyes, Bio-inorganics, Photochemistry, and Carbohydrates**
Name of the Course	**Minor Course**	**Course Code**	**27CHE408MV01**
Credits	**02**	**Maximum Marks**	**50**
Hours per Week	**02**	**External Marks**	**35**
Duration of Examination	**02 Hrs.**	**Internal Marks**	**15**

Course Objectives: The objective of this course is to deliver information about bioinorganic and acid-base chemistry. The student learns the importance of inorganic chemical species, specially metals in biological systems through discussions on metal-containing enzymes such as the sodium-potassium pump. This course also aims to provide students with a comprehensive understanding of the principles and applications of photochemistry. Students will gain a comprehensive understanding of the chemistry and applications of disaccharides, polysaccharides and dyes.

Note: Examiner will set nine questions and the candidates will be required to attempt five questions in all. Question number one will be compulsory containing seven short answer type questions covering the entire syllabus. Further, examiner will set two questions from each unit and the candidates will be required to attempt one question from each unit. All questions will carry equal marks.

Course Learning Outcomes (CLO): By the end of the course, the students will be able to:

CLO1: Understand the concept of acid-base reactions in aqueous solvents.
CLO2: Explain acid-base theories, their practical applications and significance in chemical reactivity and molecular interactions.
CLO3: Describe the importance of metals in biological processes.
CLO4: Understand the concept of metal excess, deficiency, toxicity and their adverse effects on biological systems.
CLO5: Define and explain terms such as absorption, fluorescence, phosphorescence and intersystem crossing.
CLO6: Describe the Jablonski diagram and its significance in photochemistry.
CLO7: Identify common disaccharides and polysaccharides.
CLO8: Classify dyes based on their chemical structure and applications.

Unit–I

Acids and Bases

Brönsted–Lowry concept, conjugate acids and bases, relative strengths of acids and bases, effects of substituent and solvent, differentiating and levelling solvents. Lewis acid-base concept, classification of Lewis acids and bases, Lux-Flood concept and solvent system concept. Hard and soft acids and bases (HSAB concept), applications of HSAB process.

Unit–II

Bioinorganic Chemistry

Metal ions present in biological system, classification based on action (essential, non-essential, trace, toxic), Na/K-pump, carbonic anhydrase and carboxypeptidase. Excess and deficiency of some trace metals. Toxicity of metal ions (Hg, Pb, Cd and As), reasons for toxicity. Metalloporphyrins with special reference to hemoglobin and myoglobin. Biological role of Na^{+}, K^{+}, Ca^{+2}, Mg^{+2}, Fe^{+2} ions.

Unit–III
Photochemistry Interaction of radiation with matter, difference between thermal and photochemical processes. Laws of photochemistry: Grothus - Drapper law, Stark-Einstein law (law of photochemical equivalence) Jablonski diagram depicting various processes occurring in the excited state, qualitative description of fluorescence, phosphorescence, non-radiative processes (internal conversion, intersystem crossing), quantum yield, photosensitized reactions-energy transfer processes (simple examples).
Unit–IV
Disaccharides and polysaccharides An introduction to disaccharides (maltose, sucrose and lactose) and polysaccharides (starch and cellulose) without involving structure determination. **Synthetic Dyes** Colour and constitution (electronic concept). Classification of dyes. Chemistry and synthesis of Methyl orange, Congo red, Malachite green, Crystal violet, Phenolphthalein, Fluorescein, Alizarin and Indigo.
Books Recommended/References:
1. Modern Inorganic Chemistry by R. D. Madan. 2. Organometallic and Bioinorganic Chemistry by A. Kumar. 3. Fundamental of Photochemistry by K. K. Rohtagi and Mukherjee. 4. Principles of Physical Chemistry by B. R. Puri, L. R. Sharma and M. S. Pathania. 5. Organic Chemistry by R. T. Morrison and R. N. Boyd. 6. Basic Organic Chemistry by R. Chandra, S. Singh and A. Singh.

Name of Program	**B.Sc. (Life Sciences/Physical Sciences)**	**Program Code**	**UMLS4 or UMPS4**
Paper No.	**Paper – VIII**	**Nomenclature**	**Minor Chemistry Practical – VIII**
Name of the Course	**Minor Course**	**Course Code**	**27CHE408MV01**
Credits	**02**	**Maximum Marks**	**50**
Hours per Week	**04**	**External Marks**	**35**
Duration of Examination	**04 Hrs.**	**Internal Marks**	**15**

Course Objectives: The objective of this course is to furnish students with fundamental knowledge in preparation of some inorganic compounds. Students will be able to demonstrate a comprehensive understanding of colligative properties and Rast method for determining molecular weight and kinetics of acid hydrolysis of ester. It further develops a clear understanding of the synthesis and purification of organic compounds.

***Note: Examiner will set two experiments for practical examinations*.** **(12×2) Marks**

Course Learning Outcomes (CLO): By the end of the course, the students will be able to:

CLO1: Learn preparation of some inorganic compounds.

CLO2: Understand the concept of the ring test:

CLO3: Explore the concept of colligative properties and their role in determining the boiling point elevation of solutions.

CLO4: Understand the principles and procedures of the Rast method for determining molecular weight.

CLO5: Understand the hydrolysis of esters, particularly the acid-catalyzed mechanism and the role of catalysts in chemical reactions.

CLO6: Learn and employ synthesis and purification of some organic compounds.

List of Experiments

Unit–I (Inorganic)

1. Preparation of cuprous chloride.
2. Preparation of prussian blue from iron fillings.
3. Preparation of Potassium tri (oxalato) ferrate (III).
4. Preparation of $Ni(dmg)_2$.
5. Perform ring test for NO_3^- ion.

Unit–II (Physical)

1. Study the elevation in boiling point on adding some concentrations of electrolyte and non-electrolyte to a specific volume of water.
2. Determine the molecular weight of a non-volatile solute by Rast method.
3. Determine the solubility of benzoic acid at various temperatures and determine ΔH of the dissolution process.
4. Prepare the arsenious sulphide sol and compare the precipitating power of mono-, bi- and tri-valent anions.
5. Study kinetics of hydrolysis of ester in the presence of acid.

Unit–III (Organic)

1. Two-step organic synthesis and checking purity of samples prepared:

(i) Acetanilide from acetophenone *via* acetophenone oxime.

(ii) *p*-Nitroaniline from acetanilide *via p*-nitroacetanilide.

(iii) Methyl orange from sulphanilic acid *via* diazotized sulphanilic acid.

(iv) 2,4-Dinitrophenylhydrazine from chlorobenzene *via* 1-chloro-2,4-dinitrobenzene.

(v) Anthranilic acid from phthalic anhydride *via* phthalimide.

(vi) *m*-Nitroaniline from nitrobenzene *via m*-dinitrobenzene

Viva-Voce **(06 Marks)**

Note Book **(05 Marks)**

Books Recommended/References:

1. B.Sc. Chemistry Practical by S. Goyal.
2. Advanced Physical Chemistry, Practical Handbook by G. Raj.
3. Basic Concepts: Physical Chemistry Experiments by N. Seedher.
4. Advanced Practical Organic Chemistry by N. K. Vishnoi.
5. Comprehensive Practical Organic Chemistry: Qualitative Analysis by V. K. Ahluwalia and S. Dhingra.