Punyashlok Ahilyadevi Holkar Solapur University, Solapur

Name of the Faculty: Science &Technology

NEP 2020

Syllabus: Chemistry

Name of the Course: B.Sc. II (Sem. III & IV)

(Syllabus to be implemented from June 2025)

Punyashlok Ahilyadevi Holkar Solapur University, Solapur
Faculty of Science & Technology
NEP 2020 Compliant Curriculum
BSc (Chemistry)
Program Preamble

The Bachelor of Science (BSc) in Chemistry is a comprehensive and dynamic program designed to provide students with a deep understanding of the fundamental principles of Chemistry, along with the practical skills required to apply this knowledge in various scientific and technological contexts. Aligned with the vision of the National Education Policy (NEP) 2020, the program offers a flexible, multidisciplinary, and learner-centric curriculum that encourages critical thinking, innovation, and holistic development. The BSc Chemistry program spans four years, with each year offering a progressively advanced curriculum designed to build a strong foundation in Chemistry while allowing for specialization and interdisciplinary learning. The curriculum is structured around several key components:

1. **Major Courses:** These core courses form the backbone of the program, providing in-depth knowledge and understanding of essential Chemistry concepts, theories, and methodologies. Students will engage with topics ranging from Chemical Kinetics, Gaseous State, VBT, MOT, Thermodynamics, Name reactions, Coordination Chemistry, Photochemistry, Nuclear Chemistry etc. ensuring a robust and comprehensive education in the discipline.
2. **Minor Courses:** Students have the opportunity to choose minor courses from related or distinct disciplines, promoting an interdisciplinary approach to learning. This flexibility allows students to complement their Chemistry education with insights from fields such as mathematics, Physics or microbiology, zoology, Botany, Geology for enhancing their versatility and broadening their career prospects.
3. **Open Electives/General Electives:** The program encourages intellectual exploration beyond the core discipline by offering a wide range of elective courses. These electives enable students to pursue their interests in diverse subjects, fostering creativity, critical thinking, and a well-rounded educational experience.
4. **Vocational and Skill Enhancement Courses:** Practical skills and technical proficiency are integral to the program, with vocational and skill enhancement courses providing hands-on experience in areas such as Water and soil analysis, Fertilizer and food analysis. These courses are designed to prepare students for immediate employment and equip them with the tools necessary for career advancement in various scientific and technological fields.
5. **Ability Enhancement Courses (AEC), Indian Knowledge System (IKS), and Value Education Courses (VEC):** In alignment with NEP 2020, the program integrates courses that emphasize the Indian Knowledge System, ethical values, and life skills. These courses foster a deep appreciation for India's rich cultural heritage, while also developing essential communication and ethical decision-making skills that are vital for personal and professional growth.
6. **Field Projects/Internships/Apprenticeships/Community Engagement Projects/On-Job Training:** To bridge the gap between theoretical knowledge and real-world applications, the program includes opportunities for field projects, internships, apprenticeships, and community engagement. These experiences provide students with practical insights, problem-solving abilities, and exposure to professional environments, enhancing their readiness for careers in Chemistry and related fields.
7. **Research Methodology and Research Projects:** Research is a critical component of the BSc Chemistry program, with students acquiring skills in research methodology, data collection, analysis, and scientific inquiry. By engaging in independent research projects, students are encouraged to develop innovative solutions to complex scientific problems, preparing them for advanced studies and research-oriented careers.

Multiple Entry and Multiple Exit Options

In accordance with the NEP 2020, the BSc Chemistry program incorporates a Multiple Entry and Multiple Exit framework, offering students the flexibility to enter or exit the program at various stages. This approach ensures that students can tailor their educational journey according to their personal and professional goals, with options to earn certificates, diplomas, or degrees based on the duration of study completed.

- **Year 1:**
  Upon completion of the first year, students may exit with a **Certificate in Chemistry**.
- **Year 2:**
  After two years, students may choose to exit with a **Diploma in Chemistry**.
- **Year 3:**
  Completion of the third year qualifies students for a **BSc Degree in Chemistry**.
- **Year 4:**
  The fourth year offers an advanced curriculum with a focus on research, allowing students to graduate with an **Honors Degree in Chemistry**.

Eligibility for B.Sc. II Chemistry: The candidate passing the B.Sc. Part I course OR having ATKT or Repeater student will be eligible to take admission

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NAAC Accredited-2022
'B++' Grade (CGPA-2.96)

Punyashlok Ahilyadevi Holkar Solapur University, Solapur
Faculty of Science & Technology
NEP 2020 Compliant Curriculum
BSc (Chemistry)
Program Outcomes (PO)

Students graduating from the Bachelor of Science in Chemistry program will be able to:

Major Courses:
- **PO1**: Demonstrate in-depth knowledge and understanding of core concepts, theories, and methodologies in the chosen major discipline.
- **PO2**: Apply disciplinary knowledge to solve complex problems, analyze data, and make informed decisions in professional and research contexts.

Minor Courses:
- **PO3**: Acquire complementary knowledge and skills from a related or distinct discipline, enhancing interdisciplinary understanding and versatility.

Open Electives/General Electives:
- **PO4**: Explore diverse subjects beyond the core discipline, fostering a broad-based education and cultivating critical thinking and creativity.

Vocational and Skill Enhancement Courses:
- **PO5**: Gain hands-on experience and technical proficiency in specific vocational areas, preparing for immediate career opportunities.

Ability Enhancement Courses (AEC), Indian Knowledge System (IKS), and Value Education Courses (VEC):

- **PO6**: Understand and appreciate the rich heritage of the Indian Knowledge System, integrating traditional wisdom with modern education.
- **PO7**: Develop ability enhancement skills like communication and life skills along with ethical values, social responsibility, and a strong sense of citizenship, contributing positively to society.

Field Projects/Internship/Apprenticeship/Community Engagement Projects/ On Job Training/ Internship/Apprenticeship:

- **PO8**: Apply theoretical knowledge to real-world situations through field projects, internships, community engagement and On job Training for gaining practical experience and problem-solving skills.

Research Methodology and Research Project:

- **PO9**: Acquire research skills, including data collection, analysis, and interpretation, fostering a scientific approach to problem-solving to develop independent research projects handling capabilities.

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Faculty of Science & Technology

NEP 2020 Compliant Curriculum

BSc (Chemistry)

Program Specific Outcomes (PSOs)

Students graduating from BSc(Chemistry)will able to :

PSO1. Understand basic principles of Organic, Physical, Inorganic and Analytical Chemistry.

PSO2. Identify and estimate the components of organic and inorganic chemicals and determine the physical properties of compounds.

PSO3. Synthesize specified chemicals, characterize them, and interpret spectral data to elucidate the structure of the synthesized chemical compound.

PSO4. Solve problems in thermodynamics, electrochemistry, analytical chemistry, spectroscopy, and photochemistry etc.

Punyashlok Ahilyadevi Holkar Solapur University, Solapur

Faculty of Science and Technology

Three Majors in First Year structure as per NEP-2020 Approved in For AC Meeting on 18/04/2024

4- Year Multidisciplinary UG Program with DSC as a Major (4 -Year Bachelor of Science (Honors)/(Honors with Research)

Level/ Difficulty	Sem.	Faculty			Generic/ Open Elective GE/ OE	Vocational and Skill Enhancement Courses (SEC/VSC)	Ability Enhancement Course (AEC), IKS, VEC	Field Project/ RP/CC/Internship/Apprenticeship/ Community Engagement & Services	Credits	Cumulative Credits
		Major		Minor						
		DSC	DSE							
4.5 100-200	I	DSC1-1 (2+2)#	--		GE1/ OE1(2)	SEC1 (2)	L1-1(2) IKS (2) VEC1(2) (Indian Constitution And Democracy)	--	22	**44 UG Certificate (44)**
		DSC2-1 (2+2)#	--							
		DSC3-1 (2+2)#	--							
	II	DSC1-2 (2+2)#	--		GE2/ OE2(2)	SEC 2 (2)	L1-2(2) VEC2(2) (Environmental Studies)	CC1 (2)	22	
		DSC2-2 (2+2)#	--							
		DSC3-2 (2+2)#	--							
Exit option: Award of UG Certificate in Major with 44 credits and an additional 4 credits core NSQF course/ Internship OR Continue with Major and Minor										
5.0/200	III	DSC1-3 (2+1)	---	DSC2-3 (2+1)	GE3 / OE3(2)	VSC1 (2) (DSC1) VSC2(2) (DSC2)	L2-1 (2)	CC2 (2)	22	**44 UG Diploma (88)**
		DSC1-4 (2+1)	---	DSC-2-4 (2+1)						
	IV	DSC1-5 (2+1)	---	DSC2-5 (2+1)	GE4/ OE4 (2)	VSC3 (2) (DSC1) VSC4(2) (DSC2)	L2 -2(2)	FP1/CEP1(2)	22	
		DSC1-6 (2+1)	--	DSC2-6 (2+1)						
Exit option: Award of UG Diploma in Major with 88 credits and an additional 4 credits core NSQF course/ Internship OR Continue with Major										
5.5/300	V	DSC1-7 (3+2)	DSE1-1 (2+1) or DSE1-2 (2+1)	----	----	VSC3 (2) (Hands on Training related to DSE)	IKS 2 (2) (related to major subject)	--	22	**44 UG degree (132)**
		DSC1-8 (3+2)								
		DSC1-9 (3+2)								
	VI	DSC1-10 (3+2)	DSE1-3 (2+1) or DSE1-4 (2+1)	----	---	VSC4 (2) (Hands on Training related to DSE)		FP2/CEP2/OJT1 (2)	22	
		DSC1-11 (3+2)								
		DSC1-12 (3+2)								
	Total Credits 3 Yrs	**66-8#**	**6**	**12 +8#** 20	**08**	**16**	**16**	**08**	**132**	
Exit option: Award of UG degree in Major with 132 Credits OR Continue with Major										
6.0/400	VII	DSC1-13 (4+2)	DSE1-5 (4+2)	Research Methodology (4)	------	----	----	---	22	**44 UG Honours Degree in Main faculty (176)**
		DSC1-14 (4+2)								
	VIII	DSC1-15 (4+2)	DSE1-6 (4+2)		----	-----	----	OJT/In-house Project/ Internship/ Apprenticeship (4)	22	
		DSC1-16 (4+2)								
	Total 4 Yrs	**90-8#**	**18**	**16+8#**	**08**	**16**	**16**	**12**	**176**	
Award of Bachelor of Science Honors., (B.Sc. Honors.) degree with Major and Minor (176 credits)										

		OR								
6.0/400	VII	DSC1-13 (4) DSC1-14 (4)	DSE1-5 (4)	Research Methodology (4)	------	----	----	Research Project (6)	22	**44 UG Honours with research Degree in Main faculty (176)**
	VIII	DSC1-15 (4+2) DSC1-16 (4+2)	DSE1-6 (4)		----	-----	----	Research Project (6)	22	
	Total 4 Yrs	**86-8#**	**14**	**16+8#**	**08**	**16**	**16**	**20**	**176**	

#Out of the three major courses in the first year, one major (comprising 4 credits for the 1st semester and 4 credits for the 2nd semester) will transition into a minor starting from the second year. Consequently, 8 credits will be reallocated from the major course credit count and added to the minor credit count, thereby meeting the requisite credit criteria for the minor as stipulated in the guidelines.

Structure as per NEP-2020

B. Sc. II (Chemistry)

Level	Sem	Major		Minor		VSC/ SEC	OE/GE	AEC	CC	Total Credits	Cumulative Credits
		T	P	T	P						
5.0	III	2	1	2	1	OE-1 /GE-1 (2)	VSC1 (2) (DSC1) VSC2 (2) (DSC2)	L2- 1 (2)	CC2-2	22	44
		2	1	2	1						
	IV	2	1	2	1	OE-2 /GE-2 (2)	VSC 3 (DSC1) VSC4 (DSC2)	L2-2 (2)	FP1/ CEP1	22	
		2	1	2	1						

S.No.	Course Type with course code	Paper Title	Credit
1.	Major DSC1-3	Chemistry-III (Organic Chemistry)	2
2.	Practical based on DSC1-3	Practical Lab – III	1
3.	Major DSC1-4	Chemistry IV (Inorganic Chemistry)	2
4.	Practical based onDSC1-4P	Practical Lab – IV	1
5	Minor DSC2-3	General Chemistry-I (General Physical Chemistry)	2
6.	Practical based onDSC2-3	General Chemistry Practical Lab – I	1
7	Minor DSC2-4	General Chemistry-II (General Analytical Chemistry)	2
8	Practical based onDSC2-4P	General Chemistry Practical Lab – II	1
9	GE-3/OE-3	Chemistry for Competitive Examination-I	2
10	VSC1	VSC based on DSC major	2
11	VSC2	VSC based on DSC minor	2
12	AEC I **L2-1**		2
13	CC2 (2)	CC2	2
		Total	**22**
14	Major DSC1 -5	Chemistry-V (Physical Chemistry)	2
15	Practical based onDSC1 -5P	Practical Lab - V	1
16	Major DSC1-6	Chemistry –VI (Analytical and Industrial Inorganic Chemistry)	2
17	Practical based on DSC1-6P	Practical Lab – VI	1
18	Minor DSC2-5	General Chemistry-III (General Organic Chemistry)	2
19	Practical based onDSC2-5P	General Chemistry Practical Lab – III	1
20	Minor DSC2-6	General Chemistry-IV (General Inorganic Chemistry)	2
21	Minor DSC2-6P	General Chemistry Practical Lab – IV	1
22	GE-4/ OE-4	Chemistry for Competitive Examination-II	2
23	VSC3	VSC based on DSC major	2
24	VSC4	VSC based on DSC minor	2
25	AEC II		2
26	FP1/CEP1	FP1/CEP1	2
		Total	**22**
		Grand Total	**44**

Abbreviations:

OE: Generic/ Open Electives
VSEC: Vocational Skill and Skill Enhancement Courses
SEC: Skill Enhancement Courses
AEC: Ability Enhancement Courses
FP: Field projects
CC: Co-curricular Courses
RP: Research Project
IKS: Indian Knowledge System

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***Teaching Scheme** **Lectures:02 Hours/week, 02 Credits**	***Examination Scheme** **UA:30 Marks** **CA: 20 Marks**

Course Preamble: This course is designed as a major. This course consists of two chapters. First unit includes introduction, principle, and applications of UV spectroscopy and stereochemistry covers geometrical as well as conformational isomerism. Second unit comprises nomenclature, structure and reactivity, and chemical reactions of Aldehydes, ketones and carboxylic acids. This course will help students to understand the basics concepts of organic chemistry.

	Course Objectives:
●	To learn about the basic concepts of UV spectroscopy, with its role in structure identification
●	Students should be able to understand the geometrical isomerism in oxime and confirmational isomerism
●	To learn R & S as well as E & Z nomenclature system
●	To study aldehyde and ketone including important name reactions of carbonyl compounds
●	To learn different carboxylic acids like monocarboxylic acid, hydroxy acid, unsaturated acid and dicarboxylic acid including their methods of preparation, chemical reactions.
	Course Outcomes: After completion of the course students will be able to
CO1:	Understand concept of UV-visible spectroscopy
CO2:	Learn about the possible electronic transitions

CO3:	Learn about instrumentation and calculations of λ_{max}
CO4:	Recognize the geometrical isomers of ketoxime and aldoxime
CO5:	Detect R & S configuration
CO6:	Understand various name reactions associated to aldehyde and ketone
CO7:	Learn about various carboxylic acid in detail
Unit I:	
1	**A. Spectroscopic Methods: Ultra-Violet (UV) absorption (08)**
1.1	Introduction to Spectroscopy, Beer – Lambert law (mathematical derivation not expected), Types of electronic transitions
1.2	Terms used in UV spectroscopy: Chromophore, Auxochrome, Bathochromic Hypsochromic, Hypochromic and Hyperchromic shifts
1.3	Effect of conjugation on position of UV and visible bands.
1.4	Calculation of max by Woodward-Fieser rules for conjugated dienes and enones.
1.5	Applications of UV spectroscopy – Determination of structure and stereochemistry (cis and trans)
1.6	Spectral problems based on UV. (Spectroscopic charts will not be supplied)
2	**B. Stereochemistry (07)**
2.1	**Geometrical isomerism:** Introduction, Geometrical isomerism in aldoximes and ketoximes, configuration of ketoximes-
2.2	Beckmann transformation (Mechanism & Proof are not expected) configuration of aldoximes.
2.3	**Conformational Isomerism:** Introduction, conformation of ethane and n-butane and their representation by using Saw-Horse, Fischer (Dotted Wedge line) and Newmann's projection formulae.
2.4	Conformational analysis of ethane and n-butane with the help of energy profile diagrams.
2.5	Nomenclature – D & L, R & S, E & Z systems
Unit II:	
3	**A. Aldehydes and Ketones (07)**
3.1	Introduction, Nomenclature, structure and reactivity of the carbonyl group Mechanism of nucleophilic additions to carbonyl group.
3.2	Study of following reactions with mechanism and applications 1) Aldol condensation (base catalyzed),
3.3	2) Perkin Reaction
3.4	3) Cannizzaro's Reaction
3.5	4) Knoevenagel Reaction
3.6	5) Benzoin Condensation
3.7	6) Grignard Reaction
4	**B. Carboxylic acids (08)**
4.1	**Monocarboxylic acids:** Introduction. Methods of formation of Halo acids, di- and trichloroacetic acid by HVZ reaction, substitution reactions of monochloroacetic acid by nucleophiles -CN, -OH, -I, and $-NH_2$.
4.2	**Hydroxy acids:** A) Malic acid and B) Citric acid, Methods of formation of malic acid from maleic acid and from α-bromo succinic acid. Reactions of malic acid – action of heat, oxidation reaction and reaction with HI, uses of malic acid. Methods of formation of citric acid from glycerol. Reactions of citric acid: Acetylation with acetic anhydride reduction by HI, Action of heat at 422^0K. Uses of citric acid.

4.3	**Unsaturated acids:** Methods of formation A) Acrylic acid from acrolein and by dehydration of β-hydroxy propionic acid. Reactions of acrylic acid – Addition of H_2O, reduction by Na / C_2H_5OH. Uses of acrylic acid. Methods of formation B) Cinnamic acid from benzaldehyde using diethyl malonate and by using acetic anhydride and sodium acetate. Reactions of cinnamic acid – bromination, oxidation. Uses of cinnamic acid.
4.4	**Dicarboxylic acids:** Succinic and phthalic acids. Methods of formation of succinic acid from ethylene bromide, maleic acid. Reactions of succinic acid – action of heat, action of $NaHCO_3$, C_2H_5OH in presence of acid. Uses of succinic acid. Methods of formation of phthalic acid from o-xylene and naphthalene Reactions of phthalic acid – action of heat, reaction with soda lime, NH_3. Uses of phthalic acid.
	Reference Books:
1	Organic Chemistry. Volume 1 – The fundamental principles by I.L. Finar.
2	Organic Chemistry. Volume 2 – Stereochemistry and the chemistry of natural. Products by I.L. Finar, Low-priced Edn. ELBS – Longman
3	Advanced Organic Chemistry by, B.S. Bahl, Arun Bahl. S.Chand & Company, Ltd.
4	Organic Chemistry by Morrison – Boyd.
5	Spectroscopic methods in Organic Chemistry by Williams and Fleming. Mc
6	Stereochemistry of Organic Compounds by E.L. Eliel. Orient Longman.
7	Stereochemistry of Organic Compounds by P.S. Kalsi. New Age International Ltd.
8	A Guide Book to Mechanism in Organic Chemistry by Peter Sykes.
9	Advanced Organic Chemistry, structure, reactions and mechanism by Jerry March. Mc Graw Hill Kogakusha, Ltd.
10	Spectroscopy of Organic Compounds by P.S. Kalsi.
11	Absorption spectroscopy of Organic molecules by V.M. Parikh.
12	College Organic Chemistry Part I & II by G.R. Chatwal.
13	Stereochemistry by Nasi Puri.
14	Organic synthesis by Smith.

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***Teaching Scheme** **Practical:02Hours/week, 01Credit**	***Examination Scheme** **UA: 15 Marks** **CA: 10 Marks**

Course Preamble: Chemistry practical is one of the core courses in the Chemistry curriculum. This course provides an in-depth understanding of the qualitative analysis. By applying theoretical knowledge for hands on practicals will help students to develop practical skills in analyzing and optimizing the organic chemistry concepts.

	Course Objectives:
●	To develop practical skills in basic and conceptual Organic Chemistry.
●	To gain practical knowledge by applying the experimental methods to correlate with the theory.
●	Determine the functional groups of molecules by qualitative analysis.
●	Study the volumetric estimation of compound quantitatively
●	Gain the knowledge of preparation of derivatives of organic compounds.
	Course Outcomes: After completion of the course students will be able to
	On successful completion of this practical course student will be able to:
●	Understand practical skills.
●	Correlate theoretical concepts with experiments.
●	Identify organic compounds using qualitative analysis.
●	Quantify the organic compounds using volumetric estimation.
●	Prepare the organic compounds quantitatively
	List of Experiments
Sr. No.	**A) Organic Qualitative Analysis: (Any four compounds)**
	Identification of at least **four organic compounds** with reactions including two from acids, two from phenols, one from bases and one from neutrals. **Acids:** phthalic acid, salicylic acid, Succinic acid **Phenols:** α – naphthol, p-nitrophenol, o-nitrophenol

	Bases: m-nitroanilines, N, N-dimethylaniline **Neutral:** Urea, carbon tetrachloride, ethyl methyl ketone. **Note:** A systematic study of an organic compound involves the following operations which should be taught in details with reactions in the determination of elements and functional group. 1) Preliminary tests and physical examination 2) Determination of type 3) Determination of physical constant 4) Detection of elements 5) Determination of functional group 6) A search into the literature 7) Special test if any 8) Summary 9) Result.
	Reference Books:
1	Practical Organic Chemistry by A.I. Vogel.
2	Hand book of Organic qualitative analysis by H.T. Clarke.
3	A laboratory Hand Book of Organic qualitative analysis and separation by V.S. Kulkarni. Dastane Ramchandra & Co.
4	Practical Organic Chemistry by F.G. Mann and B.C. Saunders. Low – priced Text Book. ELBS. Longman.
5	Experiments in General Chemistry by C.N.R. Rao. Affiliated East-West Press Pvt. Ltd. Delhi.
6	Advanced Practical Organic Chemistry by N.K. Vishnoi. Vikas Publishing House Private Limited.
7	Comprehensive Practical Organic Chemistry Qualitative Analysis by V.K. Ahluwalia, Sunita Dhingra. University Press. Distributor-Orient Longman Ltd.
8	Practical Chemistry – Physical – Inorganic – Organic and Viva – voce by Balwant Rai Satija. Allied Publishers Private Limited.
9	Experimental organic chemistry by J. R. Norris, published by Sarup and sons, Delhi
10	Advanced practical chemistry by J. Singh, L. D. S. Yadav, R. K. P. Singh, I. R. Siddiqui et.al, Pragati Prakashan.

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***Teaching Scheme** **Lectures:02 Hours/week, 02 Credits**	***Examination Scheme** **UA:30 Marks** **CA: 20 Marks**

Course Preamble: This major course consists of two units. Unit-I has one chapter named as coordination chemistry. Unit-II has two chapters namely chelation and study of d-block elements. These chapters mainly focus on the various aspects of coordination chemistry and physicochemical properties of d-block elements.

	Course Objectives:
•	To take review of the Co-ordination Chemistry, Chelation and study of d-block elements.
•	To provide basic knowledge about the co-ordination Chemistry, Chelation and study of d-block elements.
•	To discusses the periodicity in properties with reference to the d block.
•	To get an idea about horizontal similarity in a period in addition to vertical similarity in a group.
	Course Outcomes: After completion of the course students will be able to
CO1:	Understand definition and formation of co-ordinate covalent bond.
CO2:	Understand the IUPAC nomenclature of co-ordination compounds
CO3:	Understand the important properties valence bond theory of transition metal complexes.
CO4:	Understand the terms, ligand, denticity of ligands, chelate, coordination number and use standard rules to name coordination compounds.
CO5:	Understand chelate classification and its structure and applications
CO6:	Understand Position of d-block elements in periodic table, and Comparison of 1st transition series with 2nd & 3rd transition series
Unit 1:	
1.	**Co-ordination Chemistry** **(15)**
1.1	Definition and formation of co-ordinate covalent bond in BF_3: NH_3 and in $[NH_4]$.
1.2	Distinction between double salt and complex salt,
1.3	Werner's theory : A. Postulates of theory

	B. Applications of theory: Theory applied to cobalt amine viz; a] $CoCl_3.6NH_3$ b] $CoCl_3.5NH_3$, c] $CoCl_3.4NH_3$, d] $CoCl_3.3NH_3$ C. Limitations
1.4	Description of terms –a] ligand, b]co-ordination number, c] co-ordination sphere, d]effective atomic number, e] Geometrical isomerism and optical isomerism in co-ordination compounds for CN = 4 and CN = 6.
1.5	IUPAC nomenclature of co-ordination compounds,
1.6	Valence bond theory of transition metal complexes. A .Introduction B. Postulates of VBT/ basic concepts of VBT C. Role of transition metal in the formation of complex D. Stepwise process of formation of complex : Salient features E. Applications : High spin and low spin complexes w.r.t. CN = 4 and CN = 6. F. Limitations of Valence bond theory.
Unit II:	
2.	**Chelation (05)**
2.1	A brief introduction w.r.t. ligand, chelating agent, chelation and metal chelate.
2.2	Structural requirements of chelate formation.
2.3	Difference between metal chelate and metal complex.
2.4	Classification of chelating agents (with specific illustrations of bidentate chelating agent).
2.5.	Applications of chelation w.r.t. chelating agents: EDTA and DMG.
3.	**Study of d-block elements (10)**
3.1	Introduction,
3.2	Position of d-block elements in periodic table,
3.3	Names & electronic configuration of $1^{st,}$ 2^{nd}& 3^{rd} three transition series.
3.4	General Characteristics of 3 d-block elements w.r.t. – a) oxidation state b) colour c) Magnetic behavior (spin only formula) d) catalytic properties and e) tendency to form complexes.
3.5	Comparison of 1st transition series with 2nd& 3rd transition series w.r.t. – a) electronic configuration b) reactivity c) stability of oxidation state d) magnetic behavior and e) stability of complexes (Brief account only)

	Reference Books
1.	Concise Inorganic Chemistry by J.D. Lee ELBS 4th & 5th Edn.
2.	Basic Inorganic Chemistry by F.A. Cotton, G.Wilkinson and P.L. Gaus Wiley.
3.	Concepts and Models of Inorganic Chemistry by B. Douglas. D.Mc. Daniel and J. Alexander, John Wiley.
4.	Advanced Inorganic Chemistry by Satyaprakash, Tuli, Basu (S. Chand and Co.)
5.	Inorganic Chemistry by Puri and Sharma (S. Chand & Co.)
6.	Inorganic Chemistry by Agrawal.
7.	Inorganic Chemistry by D.E. Shriver, P.W. Atkins and C.H. Longford, Oxford.
8.	Selected topics in Inorganic Chemistry : Madan, Malik Tuli, S. Chand & Company.
9.	Vogel's Text Book of Quantitative Inorganic Analysis–Bassett, Denny, Jeffery Mendham.

पुण्यश्लोक अहिल्यादेवी होळकर सोलापूर विद्यापीठ ॥ विद्यया संपन्नता ॥ NAAC Accredited-2022 'B++' Grade (CGPA-2.96)	**Punyashlok Ahilyadevi Holkar Solapur University, Solapur** **Second Year BSc (Chemistry) Semester-III** **Vertical : DSC 1-4P** **Course Code:** **Course Name: Chemistry-Practical Lab-IV (Inorganic Chemistry)**
***Teaching Scheme** **Lectures:02 Hours/week, 01Credit**	***Examination Scheme** **UA: 15 Marks** **CA: 10 Marks**

Course Preamble: Inorganic Chemistry practical is one of the core courses in the Chemistry program. This course offers a comprehensive understanding of the practical concepts in Inorganic chemistry. Theoretical aspects and practical's correlation that will be beneficial to grow practical skills.

	Course Objectives:
•	To acquire the practical skills
•	To Review the gravimetric analysis
•	To get knowledge about steps in gravimetric analysis
•	To acquire the process involved in gravimetric analysis
	Course Outcomes: After completion of the course students will be able to
CO1:	Understand the practical skills of preparations.
CO2:	Know methods and various combination of chemicals.
CO3:	Understand the different properties of precipitation.
CO4:	Understand various steps involved in gravimetric analysis.
CO5:	Understand precipitation process in gravimetric analysis.
	Gravimetry (Any three)
1.	Gravimetric estimation of Fe as Fe_2O_3 from a solution containing ferrous ammonium sulphate and free sulphuric acid.
2.	Gravimetric estimation of Ba as $BaSO_4$ from a solution containing barium chloride and free hydrochloric acid.
3.	Gravimetric estimation of Ca as CaO from the given solution containing calcium carbonate and hydrochloric acid.
4.	Gravimetric estimation of zinc as zinc pyrophosphate from the given solution

	containing zinc sulphate, and free sulphuric acid.
5.	Gravimetric estimation of manganese as manganese ammonium phosphate from the given solution containing manganese sulphate and free sulphuric acid.
	[For the gravimetric experiments, stock solution should be given in the range of 10 to 15 cm^3 and asked to dilute to 100 cm^3 (or the stock solution should be given in the range of 20 to 30 cm^3 and asked to dilute to 250 cm^3). Use 50 cm^3 of this diluted solution for estimation.]
	Reference Books
1.	Inorganic Preparations – Alexander King George Allen & Unwind Ltd.
2.	Quantitative Inorganic Chemistry – A.I. Vogel.
3.	Practical Chemistry – Physical – Inorganic – Organic and Vice-voce by Balwant Rai Satija. Allied Publishers Pvt. Ltd.
4.	Basic Concepts in Analytical Chemistry – S.M. Khopkar.
5.	Vogel's Text Book of Quantitative Inorganic Analysis – Bassett, Denny, Jeffery Mendham.

पुण्यश्लोक अहिल्यादेवी होळकर सोलापूर विद्यापीठ ॥ विद्यया संपन्नता ॥ NAAC Accredited-2022 'B++' Grade (CGPA-2.96)	**Punyashlok Ahilyadevi Holkar Solapur University, Solapur** **Second Year BSc (Chemistry) Semester-III** **Vertical : DSC 2-3** **Course Code:** **Course Name: General Chemistry-I** **(General Physical Chemistry)**
***Teaching Scheme** **Lectures:02 Hours/week, 02 Credits**	***Examination Scheme** **UA:30 Marks** **CA: 20 Marks**

Course Preamble: This course is designed as a minor. This course consists of four chapters. They are basic mathematics required for chemistry, distribution law, thermodynamics and Ionic equilibria. This course will help students to understand the basics concepts of physical chemistry.

	Course Objectives:
•	To acquaint with the basic mathematics required to understand the concepts in physical chemistry
•	To know the fundamental concepts in thermodynamics

•	To study the concept of ionization in aqueous solution,
•	To study pH, buffers and various applications of it
	Course Outcomes: After completion of the course students will be able to
CO1:	To know about the graph plotting
CO2:	To estimate the slope and intercept
CO3:	To understand Carnot cycle
CO4:	To understand Nernst distribution law
CO5:	To derive the expression for distribution law
CO6:	To explain the concept of ionization of electrolytes with emphasis on weak acid and base and hydrolysis of salt.
Unit I:	**15L**
1	**Mathematical concepts** **(09)**
1.1	Graphical representation: Graph paper, co-ordinates of a point, equation of straight line and intercept, plotting of graph based on experimental data.
1.2	Derivative: Rules of differentiation (without proof) pertaining to algebraic and exponential functions. Examples related to chemistry.
1.3	Integration: Types of integration, Rules of Integration (without proof) pertaining to algebraic and exponential functions. Examples related to chemistry
1.4	Numerical Problems not expected
2	**Thermodynamics** **(06)**
2.1	Spontaneous and non spontaneous processes, Second law of thermodynamics and it's statements.
2.2	Carnot's Theorem (Heat engine),Carnot cycle and its efficiency.
2.3	Numerical Problems
Unit II	**15L**
3	**Distribution Law** **(08)**
3.1	Introduction
3.2	Nernst distribution law, its limitations and modification with respect to association and dissociation of solute in one of the solvents
3.3	Applications of distribution law in i. Process of extraction (derivation expect) ii. Determination of solubility iii. Distribution indicators iv. Determination of molecular weight
3.4	Numerical problems expected

4	**Ionic equilibria (07)**
4.1	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; dissociation constants of mono and diprotic acids.
4.2	Salt hydrolysis-calculation of hydrolysis constant, degree of hydrolysis and pH for different salts.
4.3	Buffer solutions; derivation of Henderson equation and its applications.
4.4	Solubility and solubility product of sparingly soluble salts
	Reference Books
1	Experimental Physical Chemistry by A. Findlay Longman.
2	Advanced Experimental Chemistry Vol. I Physical by J.N. Gurtu and R. Kapoor S. Chand & Co.
3	Experiments in Physical Chemistry by R.C. Das & B. Behra. Tata McGraw Hill.
4	Experiments in Physical Chemistry by J.C. Ghosh, Bharati Bhavan.
5	Practical book of Physical Chemistry – by Nadkarni Kothari Lawande. Bombay Popular Prakashan.
6	Experiments in Chemistry by D.V. Jahagirdar.

पुण्यश्लोक अहिल्यादेवी होळकर सोलापूर विद्यापीठ
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Punyashlok Ahilyadevi Holkar Solapur University, Solapur

Second Year BSc(Chemistry) Semester-III

Vertical : DSC 2-3P

Course Code:

Course Name: General Chemistry-I Practical-I (General Physical Chemistry)

*Teaching Scheme	*Examination Scheme
Lectures:02 Hours/week, 01 Credits	**UA:15 Marks** **CA: 10 Marks**

Course Preamble: A general Physical Chemistry practical is a laboratory course offered to the students. This course includes general physical chemistry practicals. These practicals will enhance the practical skills of the students.

	Course Objectives:
•	To enhance practical skills of the students
•	To understand the basic concepts of physical chemistry

•	To know about the plotting of graph based on the data
	Course Outcomes: After completion of the course students will be able to
CO1:	To plot the graphs on the basis of data provided
CO2:	To determine the slopes and intercepts from the graph
CO3:	To understand the concept of buffers
CO4:	To understand the concept of buffer mechanism
CO5:	To know about the pH
	General physical chemistry practicals
1	To Plot of a graph from the given experimental data and to determine the slope and Intercept of the graph (at least 2 experiments)
2	To study the effect of addition of HCl/NaOH on pH to the solutions of acetic acid and sodium acetate and their mixtures.
3	To prepare buffer solutions (at least 5) of different pH values of Sodium acetate-acetic acid buffer and to determine the pKa of acetic acid
4	To preparation of buffer solutions (at least 5) of different pH values of Ammonium chloride-ammonium hydroxide buffer and to determine the pK_b of the weak ammonium hydroxide
	Reference Books
1	Experimental Physical Chemistry by A. Findlay Longman.
2	Advanced Experimental Chemistry Vol. I Physical by J.N. Gurtu and R. Kapoor S. Chand & Co.
3	Experiments in Physical Chemistry by R.C. Das & B. Behra. Tata McGraw Hill.
4	Experiments in Physical Chemistry by J.C. Ghosh, Bharati Bhavan.
5	Practical book of Physical Chemistry – by Nadkarni Kothari Lawande. Bombay Popular Prakashan.
6	Experiments in Chemistry by D.V. Jahagirdar.

पुण्यश्लोक अहिल्यादेवी होळकर सोलापूर विद्यापीठ ।। विद्यया संपन्नता ।। NAAC Accredited-2022 'B++' Grade (CGPA-2.96)	**Punyashlok Ahilyadevi Holkar Solapur University, Solapur** **Second Year B.Sc. (Chemistry) Semester-III** **Vertical : DSC 2-4** **Course Code:** **Course Name: General Chemistry-II (General Analytical Chemistry)**
***Teaching Scheme** **Lectures:02 Hours/week, 02 Credits**	***Examination Scheme** **UA: 30 Marks** **CA: 20 Marks**

Course Preamble: General analytical Chemistry is a minor course provided to the students. This course includes the chapters like fundamental analytical chemistry, Physical properties of liquids, chromatography, metallurgy and analysis of food products. This course will help students to enhance the analytical skills.

	Course Objectives:
•	To enhance analytical skills
•	To know basic principles of titrimetric analysis
•	To know about the chromatography
•	To understand the metallurgy
	Course Outcomes: After completion of the course students will be able to
CO1:	Prepare the solutions in different units
CO2:	Understand the fundamental physical properties
CO3:	Know the general principle of Chromatography
CO4:	Understand the basics of metallurgy and metallurgical processes
CO5:	Know nutritional values of food
CO6:	Identify the different adulterations in the food
Unit I:	
1	**Fundamentals of Analytical Chemistry** **05**
1.1	Basic principle of titrimetric analysis and classification
1.2	Concept of primary and secondary standard, Preparation and dilution of reagents/solutions
1.3	Normality, Molarity, molality and Mole fraction, weight fraction, % composition by weight and by volume. Use of $N_1V_1 = N_2V_2$ formula

1.4	Preparation of ppm level solutions from source materials (salts), conversion factors, density and specific gravity of solutions
1.5	Problems are expected.
2	**Physical Properties of Liquids** **05**
2.1	Introduction
2.2	Parachor: Macleod equation and its modification by Sugden, Applications of parachor in the determination of molecular structures of benzene and -NO_2 group
2.3	Dipole moment, polar and non-polar molecules, electrical polarizations of molecules, use of dipole moment in the study of molecular structures
3.	**Chromatography** **05**
3.1	Introduction and General principle of Chromatography
3.2	Classification of Chromatography based on nature of stationary and mobile phase.
3.3	Paper Chromatography: Principle, Experimental procedure and applications
Unit II	
4	**Metallurgy** **10**
4.1	Introduction, Definitions: Metallurgy, Mineral, Ore, Gangue, Flux, and Slag.
4.2	Occurrence of metals: Types of ores
4.3	Steps involved in metallurgical processes:
	A. Concentration of ores- I. Physical methods: a) Gravity separation method, b) Magnetic separation method, c) Froth flotation process. II. Chemical Methods: a) Calcination b) Roasting B. Reduction-i) Chemical methods of reduction ii)Electrolytic reduction of Aluminium C. Refining: i) Methods of Refining ii) Electrolytic refining of copper
5	**Analysis of food products** **05**
5.1	Nutritional values of foods, idea about food processing and food preservation and adulteration
5.2	Identification of adulteration in some common food items like milk, coffee powder, chilli powder, turmeric powder, coriander powder, pulses.
	Reference Books
1	Industrial Chemistry by B.K.Sharma.
2	InorganicChemistrybyD.E.Shriver,P.W.AtkinsandC.H.Longford,Oxford
3	Svehla, G. Vogel's Qualitative Inorganic Analysis, Pearson Education, 2012.
4	Mendham, J. Vogel's Quantitative Chemical Analysis, Pearson, 2009.

5	Industrial Chemistry - R. K. Das, Asia Publishing, Mumbai.
6	Sharma, B.K. & Gaur, H. Industrial Chemistry, Goel Publishing House, Meerut (1996).
7	Environmental pollution analysis - S.M. Khopkar
8	Environmental Chemistry - A.K. De
9	Day, R. A. & Underwood, A. L. Quantitative Analysis, Prentice Hall of India
10	Dean, J. A. Analytical Chemistry Notebook, McGraw Hill.
11	G D Christian -Analytical Chemistry
12	Vogel's Quantitative Analysis

	Punyashlok Ahilyadevi Holkar Solapur University, Solapur **Second Year BSc(Chemistry) Semester-III** **Vertical :DSC 2-4P** **Course Code:** **Course Name: General Chemistry-II Practical Lab-II (General Analytical Chemistry)**
***Teaching Scheme** **Lectures:02 Hours/week, 01 Credits**	***Examination Scheme** **UA: 15 Marks** **CA: 10 Marks**

Course Preamble: This is minor course designed for the students to improve the analytical practical skills. It also provides opportunity to the students for laboratory work to inculcate the experiential learning.

	Course Objectives:
●	To develop practical skills in basic and conceptual Organic Chemistry.
●	To gain practical knowledge by applying the experimental methods to correlate with the theory.
●	To Gain the knowledge of preparation of derivatives of organic compounds.
●	To explore separation process of metal form the alloy.
	Course Outcomes: After completion of the course students will be able to
CO1:	Understand practical skills.

CO2:	Correlate theoretical concepts with experiments.
CO3:	Prepare the organic compounds quantitatively
CO4:	Understand the type of reaction involved in the preparation.
CO5:	Acquire skills in determination of viscosity of the given liquids
CO6:	Acquire skills in determination of refractive indices of the given liquids
	Organic Chemistry
	Preparations of derivatives of organic compounds (Any Three) i) Nitration of aromatic nitro hydrocarbon ii) Oximes of aldehydes & ketones iii) Picrate Aromatic hydrocarbon iv) Oxalate of amide v) Nitrate of amide
	Inorganic Chemistry
	Semi-micro Qualitative Analysis : (Any Three)
	Cations : Co^{++}, Al^{+++}, Fe^{+++}, Mn^{++}
	Anions : Cl^- , Br^-, I^-, SO_4^{2-}, NO_3^-, CO_3^{2-}
	Physical Chemistry(Any Three)
1	**Viscosity** : To determine the percentage composition of a given liquid mixture by viscosity method. (Density data be given)
2	**Refractometry:** To determine the specific and molar refractions of given liquid (benzene, toluene and xylene) by Abbe's refractometer
3	**Refractometry:** To determine the refractive of series of solutions of salt and determine the concentration of salt in a given solution
4	**Surface Tension:** To determine the surface tension of methyl acetate, ethyl acetate, n-hexane and chloroform and hence to calculate atomic parachors of C, H, Cl.
	Reference Books
1.	Advanced Inorganic Analysis by Agrawal and Keemti Lal Pragati Prakashan
2.	Practical Inorganic Chemistry by Shikha Gulati, JL Sharma, Shagun Manocha CBS Publishers and Distributors Pvt Ltd
3.	Practical Inorganic Chemistry by Samir Kumar Maji, Books & Allied (P) Ltd.
4.	Practical Organic Chemistry by A.I. Vogel.
5.	Hand book of Organic qualitative analysis by H.T. Clarke.
6.	A laboratory Hand Book of Organic qualitative analysis and separation by V.S. Kulkarni. Dastane Ramchandra & Co.
7.	Experiments in General Chemistry by C.N.R. Rao. Affiliated East-West Press Pvt. Ltd. Delhi.

8.	Experimental Physical Chemistry by Rajbhoj and Chondhekar, Anjali Pub.
9.	Advanced Experimental Chemistry Vol. I Physical by J.N. Gurtu and R. Kapoor S. Chand & Co.
10.	Experiments in Physical Chemistry by R.C. Das & B. Behra. Tata McGraw Hill.

	Punyashlok Ahilyadevi Holkar Solapur University, Solapur **Second Year BSc(Chemistry) Semester-III** **Vertical : GE/OE 3** **Course Code:** **Course Name: Chemistry-GE/OE-3 (Chemistry for Competitive Examination-I)**
***Teaching Scheme** **Lectures:02 Hours/week, 02 Credits**	***Examination Scheme** **UA:30 Marks** **CA: 20 Marks**

Course Preamble: Chemistry-GE/OE-3 is one of the courses in the Chemistry curriculum. This course provides basic knowledge of chemistry required for competitive examination. This course consists of four chapters which covers the topics like Structure of atom, Concept of matter and chemical classification of matter, Chemical bonding and Carbon Compounds.

	Course Objectives:
●	To know basic structure of atom
●	To understand various atomic models
●	To know about quantum numbers
●	To understand the chemical bonding
	Course Outcomes: After completion of this course, the students are able to
CO1:	Understand the atomic models
CO2:	Know different quantum numbers
CO3:	Understand types of chemical bonding
CO4:	Understand the IUPAC nomenclature
CO5:	Understand the chemical reactions of carbon compounds
Unit I	
1	**Structure of atom: 8L**
1.1	Introduction, Dalton's atomic model, Thomson's atomic model, Rutherford nuclear model of atom, Bohr's stable orbit atomic model
1.2	Structure of atom: Proton, neutron and electron, Distribution of electron
1.3	Electronic configuration of element: Valency, Aufbau principle and Pauli's

	exclusion principle.
1.4	Atomic number, Atomic mass, Isotopes, Isobar, Isotone
1.5	Quantum numbers.
2	**Concept of matter and chemical classification of matter: 7L**
2.1	Introduction, State of matter, Characteristics of solid, liquid and gas, Critical temperature, pressure and volume, Change of state of matter,
2.2	Chemical classification of matter: Element, Compound, Mixture, Types of element, compound and mixture.
2.3	Types of solution, Concentration of Solution: Percentage by weight, Percentage by volume Mole fraction, ppm, Molarity, Normality and Molality.
Unit II	
3	**Chemical bonding: 7L**
3.1	Introduction, Valency, Octet Rule,
3.2	Types of bonding: Ionic bond and Covalent bond,
3.3	Types of covalent bond: sigma and pi bond, Polarity of covalent bond, Dipole moment,
3.4	Co-ordinate bond, Metallic bond, van der Waals force, Hydrogen bond
4	**Carbon Compounds: 8L**
4.1	Carbon, Allotropes of carbon, non-crystalline/amorphous forms of carbon, Carbon monoxide and carbon dioxide,
4.2	Hydrocarbons: basic organic compounds, Methane
4.3	Bonds in carbon compound, Catenation, Isomerism, Classification of hydrocarbon
4.4	Functional groups in carbon compounds, IUPC nomenclature
4.5	Chemical reactions of carbon compounds.
	Reference Books:
1	General Chemistry- C. N. R. Rao
2	Organic Chemistry - Pine
3	Essentials of Physical Chemistry- Puri, Sharma and Pathania
4	Inorganic Chemistry- Puri, Sharma and Pathania
5	Essentials of Physical Chemistry- Bahl and Tuli
6	Advanced Physical Chemistry- Gurudeep Raj
7	General Science- Bhaske, Bhaske Publication
8	Science- All in One- Dr. Monali Salunkhe, Deepstambh Prakashan

	Punyashlok Ahilyadevi Holkar Solapur University, Solapur **Second Year BSc (Chemistry) Semester-III** **Vertical : VSC 1P** **Course Code:** **Course Name: Chemistry-Practical based on Major (Organic+Inorganic Chemistry)**
***Teaching Scheme** **Lectures:04 Hours/week, 02 Credits**	***Examination Scheme** **UA:30 Marks** **CA: 20 Marks**

Course Preamble: Organic and Inorganic Chemistry practicals is one of the core courses in the Chemistry program. This course offers a comprehensive understanding of the practical concepts in Organic and Inorganic chemistry. The students will get hands-on training on preparation of organic and inorganic compounds.

	Course Objectives:
●	To develop practical skills in basic and conceptual Organic Chemistry.
●	To gain practical knowledge by applying the experimental methods to correlate with the theory.
●	To prepare Inorganic complex compounds
●	To prepare and identify inorganic compounds practical yields
	Course Outcomes: After completion of the course students will be able to
CO1:	Understand practical skills.
CO2:	Correlate theoretical concepts with experiments.
CO3:	Prepare the organic compounds quantitatively
CO4:	Prepare inorganic complex compounds
CO5:	Determine practical percentage yield.
	Organic Chemistry
	Organic Quantitative Analysis: Organic Preparations (Any Four) 1. Preparation of phthalimide from phthalic anhydride. 2. Preparation of p-bromo acetanilide from acetanilide. 3. Preparation of m-dinitrobenzene from nitrobenzene using $NaNO_2$ and conc. H_2SO_4. 4. Preparation of acetanilide from aniline using acetic acid and anhydrous zinc chloride.

	5. Preparation of p-nitro ethyl benzoate from p-nitrobenzoic acid
	Inorganic Chemistry
	INORGNAIC PREPARATION (Any three)
1.	Preparation of Nickel ammonium sulphate
2.	Preparation of tetramminecopper(II) sulphate
3.	Preparation of chloropentamminecobalt(III) chloride
4.	Preparation of hexamminenickel (II) chloride
5	Preparation of ammonium ferric sulphate
	Reference Books
1	Practical Organic Chemistry by A.I. Vogel.
2	Hand book of Organic qualitative analysis by H.T. Clarke.
3	A laboratory Hand Book of Organic qualitative analysis and separation by V.S. Kulkarni. Dastane Ramchandra & Co.
4	Practical Organic Chemistry by F.G. Mann and B.C. Saunders. Low – priced Text Book. ELBS. Longman.
5	Experiments in General Chemistry by C.N.R. Rao. Affiliated East-West Press Pvt. Ltd. Delhi.
6	Inorganic Preparations – Alexander King George Allen & Unwind Ltd.
7	Quantitative Inorganic Chemistry – A.I. Vogel.
8	Practical Chemistry – Physical – Inorganic – Organic and Vice-voce by Balwant Rai Satija. Allied Publishers Pvt. Ltd.
9	Basic Concepts in Analytical Chemistry – S.M. Khopkar.
10	Vogel's Text Book of Quantitative Inorganic Analysis – Bassett, Denny, Jeffery Mendham.

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***Teaching Scheme** **Lectures:02 Hours/week, 02 Credits**	***Examination Scheme** **UA: 30 Marks** **CA: 20 Marks**

Course Preamble: This is minor course designed for the students to improve the analytical practical skills. It also provides opportunity to the students for laboratory work to inculcate the experiential learning.

	Course Objectives:
●	To develop practical skills in basic and conceptual Organic Chemistry.
●	To gain practical knowledge by applying the experimental methods to correlate with the theory.
●	To Study the volumetric estimation of compound quantitatively
●	To explore separation process of metal form the alloy.
	Course Outcomes: After completion of the course students will be able to
CO1:	Understand practical skills.
CO2:	Correlate theoretical concepts with experiments.
CO3:	Quantify the organic compounds using volumetric estimation.
CO4:	Understand the metal analysis protocol from the alloy.
CO5:	Determine the rate of chemical reactions
	Physical Chemistry
1.	**Chemical Kinetics (Any Three)** 1. To study the hydrolysis of methyl acetate in presence of HCl and H_2SO_4 and to determine the relative stength of acids. 2. To study the effect of acid strength (0.5M and 0.25M HCl) on hydrolysis of an ester. 3. To study the reaction between $K_2S_2O_8$ and KI (unequal concentration) 4. To study the reaction between $KBrO_3$ and KI (equal concentrations)
	Inorganic Chemistry (Any Three)
1.	To estimate the amount of copper from the brass metal alloy volumetrically.

2.	To estimate the amount of tin from solder alloy gravimetrically.
3.	To estimate the amount of lead from type metal alloy gravimetrically
4.	To estimate the amount of nickel from cupronickel alloy colorimetrically
	Organic Chemistry
	Organic Quantitative Analysis: Estimations (Any Three) 1. Estimation of ester 2. Estimation of acetone 3. Estimation of ibuprofen from ibuprofen tablet 4. Estimation of nitro group from m-nitroaniline
	Analytical Physical Chemistry (Any three) **1. Conductometry** : To determine degree of dissociation and dissociation constant of acetic acid at various dilutions and to verify Ostwald's dilution law conductometrically. **2. Conductometry**: To determine the equivalent conductance at infinite dilution of strong electrolyte at five different dilutions conductometrically. (e.g. any one from KCl, NaCl, KNO_3 and HCl) and verify Onsager equation. **3. Conductometry**: To determine the normality of the given strong acid by titrating it against strong alkali conductometrically. **4. Polarimetry** : To determine the specific rotation and find unknown concentration of sugar solution.
	Reference Books
1.	Advanced Inorganic Analysis by Agrawal and Keemti Lal Pragati Prakashan
2.	Practical Inorganic Chemistry by Shikha Gulati, JL Sharma, Shagun Manocha CBS Publishers and Distributors Pvt Ltd
3.	Practical Inorganic Chemistry by Samir Kumar Maji, Books & Allied (P) Ltd.
4.	A laboratory Hand Book of Organic qualitative analysis and separation by V.S. Kulkarni. Dastane Ramchandra & Co.
5.	Practical Organic Chemistry by F.G. Mann and B.C. Saunders. Low – priced Text Book. ELBS. Longman.
6.	Experiments in General Chemistry by C.N.R. Rao. Affiliated East-West Press Pvt. Ltd. Delhi.
7.	Advanced Practical Organic Chemistry by N.K. Vishnoi. Vikas Publishing House Private Limited.
8.	Comprehensive Practical Organic Chemistry Qualitative Analysis by V.K. Ahluwalia, Sunita Dhingra. University Press. Distributor-Orient Longman Ltd.
9.	Advanced Experimental Chemistry Vol. I Physical by J.N. Gurtu and R. Kapoor S. Chand & Co.
10.	Experiments in Physical Chemistry by R.C. Das & B. Behra. Tata McGraw Hill.

	Punyashlok Ahilyadevi Holkar Solapur University, Solapur **Second Year BSc (Chemistry) Semester-III** **Vertical : AEC** **Course Code: ENG-101** **Course Name: English for Communication-Paper-I**
***Teaching Scheme** **Lectures:02 Hours/week, 02 Credits**	***Examination Scheme** **UA:30 Marks** **CA: 20 Marks**

	Punyashlok Ahilyadevi Holkar Solapur University, Solapur **Second Year BSc (Chemistry) Semester-III** **Vertical : CC2** **Course Code:** **Course Name:**
***Teaching Scheme** **Lectures:02 Hours/week, 02 Credits**	***Examination Scheme** **UA:30 Marks** **CA: 20 Marks**

Semester IV

	Punyashlok Ahilyadevi Holkar Solapur University, Solapur **Second Year BSc (Chemistry) Semester-IV** **Vertical : DSC 1-5** **Course Code:** **Course Name: Chemistry-V (Physical Chemistry)**
***Teaching Scheme** **Lectures:02 Hours/week, 02 Credits**	***Examination Scheme** **UA:30 Marks** **CA: 20 Marks**

Course Preamble: Physical Chemistry is one of the major courses in the Chemistry curriculum. This course helps in understanding the fundamental principles of physical chemistry, including Electrochemistry, thermodynamics, and the solid state chemistry. This course also helps do develop problem solving skills among the students.

	Course Objectives:
•	To understand the basic key concepts in physical chemistry
•	To Understand the terminology of Electrochemistry
•	To know the basics of solid state chemistry
•	To solve the numerical problems based on Electrochemistry and solid state.
	Course Outcomes: After completion of the course students will be able to
CO1:	To know basic of electrochemistry
CO2:	To understand the concepts like transport number, degree of hydration etc
CO3:	To explain the second law of thermodynamics and its applications
CO4:	To know about the different crystal structures and crystallographic laws.
CO5:	To solve the mathematical problems based on solid state and thermodynamics
CO6:	Understand the laws of thermodynamics and their applications to physical systems.
Unit 1:	**Electrochemistry:** **15 L**
1.1	Introduction, conduction of electricity, Types of conductors: electronic and electrolytic.
1.2	Explanation of terms : Conductance, Specific resistance, specific conductance, Equivalent conductance, Molecular conductance.
1.3	Variation of specific and equivalent conductance with concentration, Equivalent conductance at infinite dilution. (Mention Onsager equation, $\lambda_v = \lambda_\infty - b\sqrt{c}$ from graph)
1.4	Migration of ions, Hittorf's rule, Transport number, Determination of transport number by moving boundary method, factors influencing transport number:

	Nature of electrolyte, concentration, temperature, complex formation and Degree of hydration.
1.5	Kohlrausch law, Applications of Kohlrausch law : i. Determination of relationship between ionic conductance, ionic mobility and transport number. ii. Determination of equivalent conductance at infinite dilution of weak electrolytes. iii. Determination of degree of dissociation of weak electrolyte. iv. Determination of ionic product of water. v. Determination of solubility of sparingly soluble salts.
1.6	Numerical problems.
Unit II	**15L**
2	**Thermodynamics** **8 L**
2.1	Introduction, concept of entropy, Entropy as a state function: Definition, mathematical expression, unit, physical significance of entropy
2.2	Entropy changes for reversible and irreversible processes in isolated systems
2.3	Entropy changes for an ideal gas as a function of V and T and as a function of P and T
2.4	Entropy change in mixing of gases
2.5	Entropy change in physical transformations : i. Fusion of a solid. ii. Vaporization of a liquid. iii. Transition from one crystalline form to another
2.6	Third law of thermodynamics, Absolute entropy and Evaluation of absolute entropy, use of absolute entropies: Determination of entropy changes in chemical reactions
2.7	Numerical problems.
3.	**The Solid State** **7 L**
3.1	Introduction, space lattice, lattice sites, lattice planes, Unit Cell
3.2	Laws of crystallography : i. Law of constancy of interfacial angles. ii. Law of rational indices iii. Law of crystal symmetry
3.3	Weiss indices and Miller indices.
3.4	Cubic lattice and types of cubic lattice, planes or faces of a simple cubic system, spacing's of lattice planes.
3.5.	Diffraction of X-rays, Derivation of Bragg's equation.
3.6.	Determination of crystal structure of NaCl and KCl on the basis of Bragg's equation.
3.7.	Numerical problems.
	Reference Books
1	Elements of Physical Chemistry : S. Glasstone and D. Lewis (D.VanNostrand Co.

	Inc)
2	Physical Chemistry : W.J. Moore (Orient Longman)
3	Principles of Physical Chemistry :Maron&Prutton (Oxford IVthEdn.)
4	Chemistry Principle & Applications : P.W. Atkins, M.J. Clugsto, M.J. Fiazer, R.A.Y. Jone (Longman)
5	Physical Chemistry : G.M. Barrow (Tata Mc-Graw Hill)
6	Essentials of Physical Chemistry : B.S. Bahl& G.D. Tuli (S. Chand)
7	Physical Chemistry: Daniels – Alberty.
8	Principles of Physical Chemistry : Puri – Sharma (S. Nagin)
9	Basic Chemical Thermodynamics: V.V. Rao.
10	Physical Chemistry Through problems : Dogra and Dogra (Wiley Eastern Ltd.,)
11	Physical Chemistry: S. Glasstone.
12	Elements of Physical Chemistry – P. Atkins & J. Paula (Oxford IVthEdn.)
13	Principles of Physical Chemistry : B. R. Puri, L. R. Sharma and M. S. Pathania
14	Introduction to Electrochemistry : S. Glasstone

	Punyashlok Ahilyadevi Holkar Solapur University, Solapur **Second Year BSc(Chemistry) Semester-IV** **Vertical : DSC 1-5 P** **Course Code:** **Course Name: Chemistry Practical Lab-V (Physical Chemistry)**
***Teaching Scheme** **Lectures:02 Hours/week, 01 Credits**	***Examination Scheme** **UA:15 Marks** **CA: 10 Marks**

Course Preamble: This is a practical course designed for the students. This course deals with the practicals based on different physical properties of liquids like refractivity, viscosity and conductivity. This course will help students to understand these properties and provide skills in their determinations. This basic practical course develops laboratory skills in physical chemistry, including experimentation, data analysis, and interpretation.

	Course Objectives:
•	To Study physical properties of liquid like viscosity, Refractive index and conductance etc.
•	To Understand the reaction rate equation and reaction rate constant, as well as the relationship between chemical reaction rates and reactant concentrations
	Course Outcomes: After completion of the course students will be able to
CO1:	To find viscosity, Refractive index and conductance etc. of given liquid samples
CO2:	To recall the various physical properties of liquids
CO3:	To know about principles and working of refractometer and conductometer.
CO4:	To know about principles and working of polarimeter.
CO5:	To determine the optical activity of a given solution.
	Physical Chemistry Practicals (Any four)
1	**Refractometry:** To determine the specific and molar refractions of benzene, toluene and xylene by Abbe's refractometer and hence determine the refraction of $–CH_2$ group. (Densities should be determined by the students.)
2	**Conductometry** : To determine degree of dissociation and dissociation constant of acetic acid at various dilutions and to verify Ostwald's dilution law conductometrically.
3	**Conductometry**: To determine the equivalent conductance at infinite dilution of strong electrolyte at five different dilutions conductometrically. (e.g. any one from KCl, NaCl, KNO_3 and HCl) and verify Onsager equation.
4	**Conductometry**: To determine the normality of the given strong acid by titrating it against strong alkali conductometrically.

5	**Viscosity** : To determine the percentage composition of a given liquid mixture by viscosity method. (Density data be given)
6	**Polarimetry** : To determine the specific rotation and find unknown concentration of sugar solution.
	Reference Books
1	Experimental Physical Chemistry by A. Findlay Longman.
2	Advanced Experimental Chemistry Vol. I Physical by J.N. Gurtu and R. Kapoor S. Chand & Co.
3	Experiments in Physical Chemistry by R.C. Das & B. Behra. Tata McGraw Hill.
4	Experiments in Physical Chemistry by J.C. Ghosh, Bharati Bhavan.
5	Practical book of Physical Chemistry – by Nadkarni Kothari Lawande. Bombay Popular Prakashan.
6	Experiments in Chemistry by D.V. Jahagirdar.

पुण्यश्लोक अहिल्यादेवी होळकर सोलापूर विद्यापीठ ।। विद्यया संपन्नता ।। NAAC Accredited-2022 'B++' Grade (CGPA-2.96)	**Punyashlok Ahilyadevi Holkar Solapur University, Solapur** **Second Year BSc(Chemistry) Semester-IV** **Vertical :DSC 1-6** **Course Code:** **Course Name: Chemistry –VI (Analytical and Industrial Inorganic Chemistry)**
***Teaching Scheme** **Lectures:02 Hours/week, 02 Credits**	***Examination Scheme** **UA:30 Marks** **CA: 20 Marks**

Course Preamble: This course is designed for knowledge of Analytical and Industrial Inorganic Chemistry. It covers the major theoretical aspects related to inorganic laboratory work and industrial processes.

	Course Objectives:
•	To get knowledge of Volumetric Analysis.
•	To understand the Gravimetric Analysis.
•	To acquire information about industrial heavy chemicals.

●	To get information to process involved in the steel alloy.
	Course Outcomes: After completion of the course students will be able to
CO1:	Acquire knowledge about gravimetric analysis
CO2:	Acquire knowledge about volumetric analysis
CO3:	Understand role of theory involved in the laboratory work
CO4:	Understand the steps involved in the industrial heavy chemicals
CO5:	Understand the process involved in steel alloy.
UNIT-I	**15L**
A	**Volumetric Analysis** **(07)**
1.	Introduction, Definitions:- Titrant; Titrand, standard solution; Titration Indicator; Equivalence point; Endpoint. Primary standard, Secondary standard. Strength of solution, volumetric analysis & their types.
2.	Acid Base Titration i) Theory of Acid-Base indicator : A) Colour change Interval B) Theories-Ostwald's theory & Quinoid theory
	ii) Neutralization curve and choice of indicator for following titrations : A) Strong acid and Strong Base B) Strong Acid and Weak Base C) Weak Acid and Strong Base
3.	Complexometric titration: A) General account, B) Types of EDTA Titrations C) Metallochromic Indicator w.r.t. Eriochrome Black-T
B	**Gravimetric analysis** **(08)**
1.	Introduction, Definitions: - Gravimetric analysis, Saturation, Super-saturation, Sol, Gel, Coagulation or Flocculation, Coagulation or Flocculation value, Peptization, Precipitation, Precipitate, Precipitant, Solubility, Aging or digestion, Ignition,
2.	General steps involved in gravimetry
3.	Precipitation – A) Physical nature of Precipitate: Gelatinous, Curdy and Crystalline. B) Conditions of Precipitation
4.	Process of precipitation – A) Nucleation B) Crystal growth C) Digestion
5.	Co-precipitation and Post precipitation and difference.
6.	Role of Organic precipitants in gravimetric analysis
7.	Study of organic precipitants viz. A) DMG, B) Aluminon, C) 8-Hydroxy quinoline.
8.	Advantages and disadvantages of organic precipitants.

UNIT-II		15L
A	**Industrial heavy Chemicals**	**(08)**
1.	Introduction	
2.	Physicochemical Principles & manufacture of following heavy chemicals: i) Ammonia by Haber process ii) Sulphuric acid by contact process	
B	**Steel and its alloys**	**(07)**
1.	Introduction and Definition	
2.	Types of Steel	
3.	Manufacture of Steel: a) Bessemer process b) L. D. process	
4.	Heat treatment on Steel (annealing, hardning, case hardening, tempering normalizing)	
	Reference Books	
1.	Inorganic Preparations – Alexander King George Allen & Unwind Ltd.	
2.	Quantitative Inorganic Chemistry – A.I. Vogel.	
3.	Practical Chemistry – Physical – Inorganic – Organic and Vice-voce by Balwant Rai Satija. Allied Publishers Pvt. Ltd.	
4.	Basic Concepts in Analytical Chemistry – S.M. Khopkar.	
5.	Vogel's Text Book of Quantitative Inorganic Analysis – Bassett, Denny, Jeffery Mendham.	

पुण्यश्लोक अहिल्यादेवी होळकर सोलापूर विद्यापीठ
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Punyashlok Ahilyadevi Holkar Solapur University, Solapur

Second Year BSc(Chemistry) Semester-IV

Vertical :DSC 1-6P

Course Code:

Course Name: Chemistry Practical Lab–VI (Analytical and Industrial Inorganic Chemistry)

*Teaching Scheme	*Examination Scheme
Lectures:02 Hours/week, 01 Credits	**UA: 15 Marks** **CA: 10 Marks**

Course Preamble: This is major course designed for the students to develop the practical skills. It also provides prospect to the students for laboratory work to train the investigational learning.

	Course Objectives:
•	To acquire the basic skills titrimetric analysis
•	To analyze the given fertilizers
•	To analyze the commercial sample
•	To determine the elements or compound present in the commercial samples.
	Course Outcomes: After completion of the course students will be able to
CO1:	To prepare the standard solutions
CO2:	To do the analysis of given fertilizer samples.
CO3:	To understand the method used to determine amount from the commercial samples.
CO4:	To comprehend the sample preparation for titrimetric analysis.
	Volumetric Analysis (Any four)
1.	Analysis of commercial vinegar – To determine the percentage of acetic acid is a given commercial sample of vinegar.
2.	To prepare standard solution of calcium chloride from calcium carbonate and determine the total hardness of given water sample.
3.	Determination of Chemical Oxygen Demand of the given sample of industrial effluent by dichromate method.
4.	Fertilizer analysis : To determine the percentage of nitrogen present in a given sample of nitrogenous fertilizer.
5.	Quality control – To determine percentage purity of soda ash in the given sample.
	Reference Books
1	Inorganic Preparations – Alexander King George Allen & Unwind Ltd.
2	Quantitative Inorganic Chemistry – A.I. Vogel.
3 4	Practical Chemistry – Physical – Inorganic – Organic and Vice-voce by Balwant Rai Satija. Allied Publishers Pvt. Ltd.
5	Basic Concepts in Analytical Chemistry – S.M. Khopkar.
6	Vogel's Text Book of Quantitative Inorganic Analysis – Bassett, Denny, Jeffery Mendham.

पुण्यश्लोक अहिल्यादेवी होळकर सोलापूर विद्यापीठ ।। विद्यया संपन्नता ।। NAAC Accredited-2022 'B++' Grade (CGPA-2.96)	**Punyashlok Ahilyadevi Holkar Solapur University, Solapur** **Second Year B.Sc. (Chemistry) Semester-IV** **Vertical : DSC 2-5** **Course Code:** **Course Name: General Chemistry III (General Organic Chemistry)**
***Teaching Scheme** **Lectures:02 Hours/week, 02 Credits**	***Examination Scheme** **UA: 30 Marks** **CA: 20 Marks**

Course Preamble: This course is designed as a minor. This course consists of two chapters. First unit includes basic concepts of alkanes, alkenes and alkynes. Second unit includes aromaticity, alcohols and phenols. This course will help students to understand the basics concepts of organic chemistry.

	Course Objectives:
•	To study saturated, unsaturated and alicyclic hydrocarbons.
•	To study the concept of aromaticity, its applications and reactions.
•	To study the reactions involved in saturated, unsaturated and alicyclic hydrocarbons
•	To study different types of alcohols and phenols.
	Course Outcomes: After completion of the course students will be able to
CO1:	Distinguish between saturated, unsaturated, alicyclic, aromatic and heterocyclic compounds.
CO2:	To comment on aromaticity of any organic compound and its stability.
CO3:	Distinguish between dihydric and trihydric alcohols.
CO4:	Understand the idea of monohydric, dihydric and trihydric phenols.
Unit 1:	**(15)**
1.	**Alkanes and Cycloalkanes:** **(7)**
1.1	Alkanes: Introduction and methods of formation of alkanes with respect to Wurtz reaction, Kolbe reaction, Corey- House reaction and decarboxylation reaction.
1.2	Mechanism of free radical halogenation of alkanes.
1.3	Cycloalkanes: Nomenclature, Methods of formation: a) Internal Wurtz reaction b) Distillation of calcium or barium salt of dicarboxylic acid

1.4	1.4 Chemical properties of cyclopropane a) Free radical substitution of chlorine in presence of light. b) Action of HBr and conc. H_2SO_4 c) Catalytic reduction by H_2/Ni
2	**Alkenes, Dienes and Alkynes** **(08)**
2.1	Nomenclature of alkenes
2.2	Methods of formation of alkenes with mechanism a) By dehydration of lower alcohols. b) By dehydrohalogenation of lower alkyl halides
2.3	Chemical reactions of alkenes: Hydrogenation, Electrophilic and free radical additions, Hydroboration, Oxidation, Epoxidation, Ozonolysis, Hydration, Hydroxylation, Oxidation with $KMnO_4$, Polymerization of alkenes: ethylene and propylene
2.4	Nomenclature of dienes
2.5.	Classification of dienes: Isolated, Conjugated and Cumulated dienes
2.6	Butadiene: Methods of formation, polymerization, 1:2 and 1:4 additions and Diels-Alder reaction
2.7	Alkynes: Nomenclature, Acidity of alkynes
2.8	Electrophilic and Nucleophilic addition reactions, Hydroboration, Oxidation
Unit-II	**(15)**
3	**Aromaticity and Benzene** **(07)**
3.1	Aromatic, non-aromatic, antiaromatic and pseudo aromatic compounds
3.2	Kekule's structure of benzene
3.3	Resonance structures of benzene
3.4	Molecular orbital picture of benzene
3.5	Representation of benzene ring
3.6	Modern theory of aromaticity. Fundamental Concepts: Delocalisation of electrons, coplanarity and Huckel's $(4n+2)\ \pi$ rule. Applications of Huckel's rule to naphthalene, pyrrole and pyridine
3.7	Mechanism of electrophilic aromatic substitution in benzene w.r.t. nitration, sulphonation, halogenations and Friedel-Craft's reaction: alkylation and acylation
4	**Alcohols and Phenols** **(08)**
4.1	**A) Alcohols:** i. Dihydric alcohols : Nomenclature, Methods of formation of ethylene glycol from ethylene, ethylene dibromide and ethylene oxide, physical properties & chemical reactions of ethylene glycol – acidic nature, reaction with hydrogen halide, oxidation – lead acetate, HIO_4 and nitric acid, Uses of ethylene glycol.

	Pinacol formation, Pinacol-Pinacolone rearrangement and its mechanism ii. Trihydric alcohols: Nomenclature, Methods of formation of glycerol – from fats and oils physical properties. Chemical reactions of glycerol – reaction with electropositive metals, reaction with hydrogen halide HCl and HI Reaction with conc. nitric acid in presence of conc. sulphuric acid. Reactions with potassium hydrogen sulphate, esterification, oxidation. Uses of glycerol
4.2	**B) Phenols:** Introduction, Reactions of phenol (carbolic acid) : 1.Acylation and Fries rearrangement 2.Ether formation and Claisen rearrangement 3.Gattermann Synthesis 4.Carboxylation – Kolbe's reaction 5.Reimer – Tiemann reaction and its mechanism
	Reference Books:
1.	Organic Chemistry: Hendrickson, Cram, Hammond.
2.	Organic Chemistry: Morrison and Boyd
3.	Organic Chemistry: Volume I and III. L. Finar
4.	Organic Chemistry: Pine
5.	Advanced Organic Chemistry: Sachin kumar Ghosh
6.	Advanced Organic Chemistry: B. S. Bahl and Arun Bahl
7.	A Guide book to Mechanism in Organic Chemistry: Peter Sykes
8.	Textbook of Organic Chemistry: P. L. Sony
9.	Practical Organic Chemistry: A. I. Vogel
10.	Advanced Organic Chemistry: Reactions, Mechanism and Structure: Jerry March
11.	Organic Chemistry: M. R. Jain
12.	Organic Chemistry: J. M. Shaigel
13.	Organic Synthesis: Smith

	Punyashlok Ahilyadevi Holkar Solapur University, Solapur **Second Year BSc(Chemistry) Semester-IV** **Vertical: DSC 2-5P** **Course Code:** **Course Name: General Chemistry Practical Lab-III (General Organic Chemistry)**
***Teaching Scheme** **Practical:02Hours/week, 01Credit**	***Examination Scheme** **UA: 15 Marks** **CA: 10 Marks**

Course Preamble: General Chemistry Practical is one of the minor practical courses in the Chemistry curriculum. This course provides an in-depth understanding of the Quantitative analysis. Combining the theoretical knowledge with hands on practicals will help students to develop practical skills in analyzing and optimizing the organic chemistry concepts.

	Course Objectives:
●	To develop practical skills in basic and conceptual Organic Chemistry.
●	To gain practical knowledge by applying the experimental methods to correlate with the theory.
●	Gain the knowledge of preparation of derivatives of organic compounds.
●	To know the type of reaction and mechanism involved in the preparation.
	Course Outcomes:
	On successful completion of this practical course student will be able to:
CO1	Understand practical skills.
CO2	Correlate theoretical concepts with experiments.
CO3	Prepare the organic compounds quantitatively
CO4	Understand the type of reaction and mechanism involved in the preparation.
	List of Experiments
	Organic Quantitative Analysis: Organic Preparations (Any Four) 1. Preparation of phthalimide from phthalic anhydride. 2. Preparation of p-bromo acetanilide from acetanilide. 3. Preparation of m-dinitrobenzene from nitrobenzene using $NaNO_2$ and conc. H_2SO_4. 4. Preparation of acetanilide from aniline using acetic acid and anhydrous zinc chloride.

	5. Preparation of p-nitro ethyl benzoate from p-nitrobenzoic acid
	Reference Books:
1	Practical Organic Chemistry by A.I. Vogel
2	Hand book of Organic qualitative analysis by H.T. Clarke
3	A laboratory Hand Book of Organic qualitative analysis and separation by V.S. Kulkarni. Dastane Ramchandra & Co.
4	Practical Organic Chemistry by F.G. Mann and B.C. Saunders. Low – priced Text Book. ELBS. Longman
5	Experiments in General Chemistry by C.N.R. Rao. Affiliated East-West Press Pvt. Ltd. Delhi
6	Advanced Practical Organic Chemistry by N.K. Vishnoi. Vikas Publishing House Private Limited
7	Comprehensive Practical Organic Chemistry Qualitative Analysis by V.K. Ahluwalia, Sunita Dhingra. University Press. Distributor-Orient Longman Ltd.
8	Practical Chemistry – Physical – Inorganic – Organic and Viva – voce by Balwant Rai Satija. Allied Publishers Private Limited.
9	Experimental organic chemistry by J. R. Norris, published by Sarup and sons, Delhi
10	Advanced practical chemistry by J. Singh, L. D. S. Yadav, R. K. P. singh, I. R. Siddiqui et.al, Pragati prakashan.

पुण्यश्लोक अहिल्यादेवी होळकर सोलापूर विद्यापीठ ।। विद्यया संपन्नता ।। NAAC Accredited-2022 'B++' Grade (CGPA-2.96)	**Punyashlok Ahilyadevi Holkar Solapur University, Solapur** **Second Year BSc(Chemistry) Semester-IV** **Vertical :DSC 2-6** **Course Code:** **Course Name: General Chemistry-IV (General Inorganic Chemistry)**
***Teaching Scheme** **Lectures:02 Hours/week, 02 Credits**	***Examination Scheme** **UA:30 Marks** **CA: 20 Marks**

Course Preamble: This is minor course designed for the students. This course consists of Atomic Structure and periodic properties, Acids and Bases, Inorganic Polymers and Study of non-aqueous solvents. It covers the basics of Inorganic Chemistry.

	Course Objectives:
●	It provides basic knowledge about quantum number, Shapes of s, p, d orbitals, principles, electronic configuration of s and p block elements and characteristics.

●	To acquire knowledge of Hard and soft acids and bases (HSAB)
●	To acquire information of basic concept, classification, homo and heteroatomic polymers
●	To acquire knowledge characteristics, classification, and reaction in non-aqueous solvent
	Course Outcomes: On successful completion of this practical course student will be able to:
CO1:	Solve the conceptual questions using the knowledge gained by studying the quantum mechanical model of the atom, quantum numbers, and.
CO2:	Know the electronic configuration, shapes of s, p, and d orbitals,
CO3:	Understand Role of periodicity in atomic radii, ionic radii, ionization energy and electron affinity of elements
CO4:	Understand the fact behind the Hard and soft acids and bases (HSAB) concepts
CO5:	Know the basic concept, classification, homo and heteroatomic polymers
CO6:	Understand the characteristics, classification, and reaction in non-aqueous solvent
Unit 1:	**15L**
1.	**Atomic Structure and periodic properties (08)**
1.1	Atomic Structure a) What is Quantum mechanics? Time independent Schrodinger equation and meaning of various terms in it. Significance of ψ and $\psi 2$ (Derivation not expected) b) Quantum numbers c) Shapes of s, p, d orbitals d) Aufbau and Pauli's exclusion principle, Hund's rule of maximum multiplicity Stability of half-filled and completely filled orbitals, exchange energy e) General electronic configuration of s and p block elements
1.2	General Characteristics of s and p block elements w.r.t. Atomic and Ionic radii, Ionization energy, Electron affinity, Electronegativity, Reactivity, Melting and Boiling point
2.	**Acids and Bases (07)**
2.1	Lewis Concept : A. Definition, B. classification C. merits and demerits.
2.2	Hard and soft acids and bases (HSAB) A. Classification of acids and bases as hard and soft, B. Pearson's HSAB concept, C. Acid-Base strength and hardness-softness, D. Applications and limitations of HSAB principle
Unit-II	**15L**
3.	**Inorganic Polymers (08)**
3.1	Introduction

3.2	Basics Concept and definition: i) Monomer ii) Polymer iii) Polymerization and Degree of polymerization iv) Chemical bonding in polymer
	Classification of polymers on the basis of : i) Origin ii) Composition iii) Preparation methods iv) Physical properties
	Polymer backbones
	Comparison between Inorganic and Organic Polymers
	Homoatomic Polymer containing Phosphorus
	Heteroatomic Polymer: i) Silicones ii) Phosphonitrilic compounds iii) Fluorocarbons
4.	**Study of Non-aqueous Solvents** **(07)**
4.1	Introduction
4.2	Characteristics of solvents
4.3	Classification of solvents
	Reactions in non-aqueous solvents with reference to i) liquid NH_3 ii) liquid SO_2
	Reference Books
1.	Chemistry in non-aqueous solvents by Harry H. Sisler New York Reinhold
2.	Basic Inorganic Chemistry by F.A. Cotton, G.Wilkinson and P.L. Gaus Wiley.
3.	Advanced Inorganic Chemistry by Satyaprakash, Tuli, Basu (S. Chand and Co.)
4.	Inorganic Chemistry by Puri and Sharma (S. Chand & Co.)
5.	Inorganic Polymers by Mario Gleria , Roger De Jaeger Publisher : Nova Science Publishers Inc
6.	Inorganic Chemistry by Agrawal.
7.	Industrial Chemistry by B.K. Sharma.
8.	Inorganic Chemistry by D.E. Shriver, P.W. Atkins and C.H. Longford, Oxford.
9.	Text book of Quantitative Inorganic Analysis by A.I. Vogel.
10.	Vogel's Text Book of Quantitative Inorganic Analysis – Bassett, Denny, Jeffery Mendham.
11	Inorganic Polymer Chemistry Sandhya Pimplapure Publisher: Pragati Prakashan Meerut

	Punyashlok Ahilyadevi Holkar Solapur University, Solapur **Second Year BSc(Chemistry) Semester-IV** **Vertical : DSC 2-6P** **Course Code:** **Course Name: General Chemistry Practical Lab-IV (General Inorganic Chemistry)**
***Teaching Scheme** **Lectures:02 Hours/week, 01 Credit**	***Examination Scheme** **UA: 15 Marks** **CA: 10 Marks**

Course Preamble: This is minor course designed for the students to enhance practical skills. These practical skills include the preparation, purity and yield of inorganic compounds.

	Course Objectives:
•	To prepare Inorganic compounds
•	The determine practical yield of compound
•	To acquire skills in handling the chemicals
	Course Outcomes: After completion of the course students will be able to
CO1:	Prepare the inorganic compound
CO2:	Determine the practical yield of the compound prepared
CO3:	Write the structures of the inorganic complexes
CO4:	Enhance the practical skill
	Inorganic Preparations (Any four)
1.	Preparation of sodium thiosulphate ($Na_2S_2O_3$)
2.	Preparation of cuprous oxide (Cu_2O)
3.	Preparation of ammonium ferric sulphate
4.	Preparation of cuprous chloride (Cu_2Cl_2)
5.	Preparation of hexamminenickel (II) chloride.
	Reference Books
1	Advanced Inorganic Analysis by Agrawal and Keemti Lal Pragati Prakashan
2	Practical Inorganic Chemistry by Shikha Gulati , JL Sharma, Shagun Manocha, CBS Publishers And Distributors Pvt Ltd

3	Practical Inorganic Chemistry (Paperback, Dr. L. Rakesh Sharma)
4	Inorganic Preparations – Alexander King George Allen & Unwind Ltd.

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***Teaching Scheme** **Lectures:02 Hours/week, 02 Credits**	***Examination Scheme** **UA:30 Marks** **CA: 20 Marks**

Course Preamble: Chemistry-GE/OE-4 is one of the courses in the Chemistry curriculum. This course provides basic knowledge of chemistry required for competitive examination. This course consists of four chapters which covers the topics like Periodic table, metals and non-metals, acids, bases and salt, and chemical reactions.

	Course Objectives:
●	To know the structure of periodic table
●	To understand the properties of elements
●	To know basics of metals and non-metals
●	To understand the chemical reactions
	Course Outcomes: After completion of the course students will be able
CO1:	To know the basic structure of periodic table
CO2:	To understand the periodic trends of properties in modern periodic table
CO3:	To understand the physical properties of metals and non-metals
CO4:	To know theories of acids and bases
CO5:	To write the balanced chemical reactions
Unit I	**15L**
1	**Periodic table: 07**
1.1	Introduction
1.2	Doberiener's triads, Newlands law of octaves
1.3	Mendeleev's periodic table, Merits and demerits of Mendeleev's periodic table
1.4	Modern periodic table: Groups and periods, Groups and electronic configuration, Periods and electronic configuration,
1.5	Periodic trends in modern periodic table
1.6	s-block elements, p-block elements, d-block elements and f-block elements.

2	**Metals and Non-metals:**	**08**
2.1	Classification of element: Metal, Non-metal and Metalloid.	
2.2	Metal: Physical properties, chemical properties and uses.	
2.3	Non-metal: Physical properties, chemical properties and uses.	
2.4	Metalloids: Physical properties, chemical properties and uses.	
2.5	Uses of Noble gas elements	
2.6	Metallurgy: Introduction, Occurrence of metal, 1) Concentration of ore 2) Extraction of metal	
Unit II		**15L**
3	**Acids, Bases and Salts:**	**07**
3.1	Introduction	
3.2	Arrhenius theory of acids and bases	
3.3	Classification of Acid and Bases: 1) Organic acid and mineral acid 2) strong and weak acids, bases and alkali 3) Dilute and concentrated acids and bases.	
3.4	Basicity and acidity,	
3.5	Concentration of acid and base, pH of solution	
3.6	Domestic and laboratory indicators, Universal indicators	
3.7	Reactions of acid and bases and Uses of some selected acid and bases	
3.8	Ionic compounds and electrical conductivity	
3.9	Salts, Types of salts: acidic, basic and neutral salts, Some important salts	
3.10	Buffer solutions	
4	**Chemical Reactions:**	**08**
4.1	Chemical reactions, Writing of chemical reactions	
4.2	Types of chemical reaction: Combination reaction, Decomposition reaction, Displacement reaction, Double displacement reaction, Oxidation reaction, Reduction reaction and Neutralization reaction.	
4.3	Endothermic and Exothermic Reactions	
4.4	Factors affecting on rate of reaction: 1) Nature of reactant 2) Size of the Particles of Reactants 3) Concentration of the reactants 4) Temperature of the Reaction 5) Catalyst.	
	Reference Books:	
1	General Chemistry- C. N. R. Rao	
2	Organic Chemistry - Pine	
3	Essentials of Physical Chemistry- Puri, Sharma and Pathania	
4	Inorganic Chemistry- Puri, Sharma and Pathania	
5	Essentials of Physical Chemistry- Bahl and Tuli	
6	Advanced Physical Chemistry- Gurudeep Raj	

पुण्यश्लोक अहिल्यादेवी होळकर सोलापूर विद्यापीठ ॥ विद्यया संपन्नता ॥ NAAC Accredited-2022 'B++' Grade (CGPA-2.96)	**Punyashlok Ahilyadevi Holkar Solapur University, Solapur** **Second Year BSc(Chemistry) Semester-IV** **Vertical :VSC 3P** **Course Code:** **Course Name: Chemistry-Practical Based on Major (Physical +Analytical and Industrial Inorganic Chemistry)**
***Teaching Scheme** **Lectures:02 Hours/week, 02 Credits**	***Examination Scheme** **UA:30 Marks** **CA: 20 Marks**

Course Preamble: This is VSC based on DSC major course designed for the students to develop the practical skills. It also delivers vision to the students for laboratory effort to train about the new learnings.

	Course Objectives:
•	To study the rates of chemical reactions
•	To find out the orders of chemical reactions
•	To determine the acidic and basic radicals from the given samples
	Course Outcomes: After completion of the course students will be able
CO1:	To determine the rate constants of a studied reactions
CO2:	To predict the order and molecularity of the chemical reactions
CO3:	To plot the graphs and find out the rate constants from the slope
CO4:	To analyze the samples for the acidic and basic radicals
I	**Physical Chemistry Practicals**
	Chemical Kinetics (ANY Three) 1. To study the hydrolysis of methyl acetate in presence of HCl and H_2SO_4 and to determine the relative strength of acids. 2. To study the effect of acid strength (0.5M and 0.25M HCl) on hydrolysis of an ester. 3. To study the reaction between $K_2S_2O_8$ and KI (unequal concentration) 4. To study the reaction between $KBrO_3$ and KI (equal concentrations)
II	**Analytical and Industrial Inorganic Chemistry Practicals**
	Semi-micro Qualitative Analysis : (Any Three)
	Cations : Co^{++}, Al^{+++}, Fe^{+++}, Mn^{++}, Zn^{++}, Ni^{++}, Ba^{++}, Ca^{++}, Mg^{++}, NH_4^+, K^+
	Anions : Cl^- , Br^-, I^-, SO_4^{2-}, NO_3^-, CO_3^{2-}

	Reference Books
1.	Advanced Inorganic Analysis by Agrawal and Keemti Lal Pragati Prakashan
2.	Practical Inorganic Chemistry by Shikha Gulati, JL Sharma, Shagun Manocha, CBS Publishers And Distributors Pvt Ltd
3.	Practical Inorganic Chemistry (Paperback, Dr. L. Rakesh Sharma)
4.	Introduction to Semimicro Qualitative Analysis Paperback – 26 October 2004 by Theodore Brown H. LeMay, Bruce Bursten, Catherine Murphy, Patrick Woodward, Matthew Stoltzfus Pearson; 8th edition (26 October 2004)
5.	Textbook of semimicro inorganic qualitative analysis (English, Paperback, Dr. K. Nagaraj) Notion Press

पुण्यश्लोक अहिल्यादेवी होळकर सोलापूर विद्यापीठ ॥ विद्यया संपन्नता ॥ NAAC Accredited-2022 'B++' Grade (CGPA-2.96)	**Punyashlok Ahilyadevi Holkar Solapur University, Solapur** **Second Year BSc(Chemistry) Semester-IV** **Vertical :VSC 4P** **Course Code:** **Course Name: General Chemistry-Practical Based on Minor (General Organic +General Inorganic Chemistry)**
***Teaching Scheme** **Lectures:02 Hours/week, 02 Credits**	***Examination Scheme** **UA: 30 Marks** **CA: 20 Marks**

Course Preamble: This is VSC based on DSC minor course designed for the students to excel the practical skills. It also delivers vision to the students for laboratory effort to train about the new learnings.

	Course Objectives:
●	To gain practical knowledge by applying the experimental methods to correlate with the theory.
●	Gain the knowledge of preparation of derivatives of organic compounds.
●	To know the type of reaction involved in the preparation.
●	To analyze the commercial sample
●	To determine the elements or compound present in the commercial samples.

	Course Outcomes: After completion of the course students will be able to
CO1:	Understand practical skills.
CO2:	Correlate theoretical concepts with experiments.
CO3:	Prepare the organic compounds quantitatively
CO4:	Understand the type of reaction involved in the preparation.
CO5:	Understand the method used to determine amount from the commercial samples.
CO6:	Comprehend the sample preparation for titrimetric analysis.
	Organic Chemistry
	A) Organic Qualitative Analysis: (Any four compounds) Identification of at least **four organic compounds** with reactions including two from acids, two from phenols, one from bases and one from neutrals. **Acids:** phthalic acid, salicylic acid, Succinic acid **Phenols:** α – naphthol, p-nitrophenol, o-nitrophenol **Bases:** m-nitroanilines, N, N-dimethylaniline **Neutral:** Urea, carbon tetrachloride, ethyl methyl ketone. **Note:** A systematic study of an organic compound involves the following operations which should be taught in details with reactions in the determination of elements and functional group. 1) Preliminary tests and physical examination 2) Determination of type 3) Determination of physical constant 4) Detection of elements 5) Determination of functional group 6) A search into the literature 7) Special test if any 8) Summary 9) Result.
	Inorganic Chemistry
	Volumetric Analysis(Any four)
1.	Analysis of commercial vinegar – To determine the percentage of acetic acid is a given commercial sample of vinegar.
2.	To prepare standard solution of calcium chloride from calcium carbonate and determine the total hardness of given water sample.
3.	Determination of percentage of magnesium in the given sample of talcum powder.
4.	Determination of titrable acidity in the given sample of milk
5.	Determination of percentage purity of ferrous ammonium sulphate.
	Reference books

1.	Practical Inorganic Chemistry by Shikha Gulati, JL Sharma, Shagun Manocha, CBS Publishers And Distributors Pvt Ltd
2.	Practical Inorganic Chemistry (Paperback, Dr. L. Rakesh Sharma)
3.	Introduction to Semimicro Qualitative Analysis Paperback – 26 October 2004 by Theodore BrownH. LeMay, Bruce Bursten, Catherine Murphy, Patrick Woodward, Matthew Stoltzfus Pearson; 8th edition (26 October 2004)
4.	Textbook of Semi-micro Inorganic Qualitative Analysis (English, Paperback, Dr. K. Nagaraj)Notional Press

Punyashlok Ahilyadevi Holkar Solapur University, Solapur **Second Year BSc(Chemistry) Semester-IV** **Vertical : AEC** **Course Code: ENG-201** **Course Name: English for Communication-Paper-II**	
***Teaching Scheme** **Lectures:02 Hours/week, 02 Credits**	***Examination Scheme** **UA:30 Marks** **CA: 20 Marks**

Punyashlok Ahilyadevi Holkar Solapur University, Solapur **Second Year BSc(Chemistry) Semester-IV** **Vertical : FP1/CEP1** **Course Code:** **Course Name: CC2**	
***Teaching Scheme** **Lectures:02 Hours/week, 02 Credits**	***Examination Scheme** **UA: 30 Marks** **CA: 20 Marks**

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UA (Theory)

Punyashlok Ahilyadevi Holkar Solapur University, Solapur.

Faculty of Science & Technology.

Nature of Question Paper for CBCS Pattern

B. Sc. (Part- II) w.e.f. AY 2025-26

Time: Total Marks: 30

Instructions

1) All Questions are compulsory

2) Figure to right indicate full marks.

Q.1 Choose correct alternative. (MCQ) 06 Marks

1)

a) b) c) d)

2)

a) b) c) d)

3)

a) b) c) d)

4)

a) b) c) d)

5)

a) b) c) d)

6)

a) b) c) d)

Q.2. Answer the following. (Any three) 6 (2+2+2)

A)

B)

C)

D)

E)

Q.3. Answer the following (Any two). 6 (3+3)

A)

B)

C)

Q.4. Answer the following (Any two). 6 (3+3)

A)

B)

C)

Q.5. Answer the following (Any one). 6 Marks

A)

B)

CA(Theory and Practical)and UA(Practicals)

Punyashlok Ahilyadevi Holkar Solapur University, Solapur.

Faculty of Science & Technology.

Nature of Question Paper for CBCS Pattern

B. Sc. (Part- I) w.e.f. AY 2024-25

Time: Total Marks: 20

- **Theory Internal Evaluation System for 20 Marks**
  - Choose any two of the following
  - Home Assignment / Unit Test / Tutorial /Seminar

- **Practical Internal Evaluation System for 20 Marks**
  - Any one practical from related paper

- **University Practical Evaluation System for 30 +30 Marks**
  - Students has to perform 4 allotted experiments in 2 days

- **Passing Criteria:**
  - University Theory Exam (UA) – 12 out of 30
  - University Practical Exam (UA) – 12 out of 30
  - College Theory Assessment (CA) – 08 out of 20
  - College Practical Assessment (CA) – 08 out of 20

Note: Theory and practical examiners should be appointed from the list provided by the BOS as per section 48(3) of Maharashtra Public University Act 2016.