Punyashlok Ahilyadevi Holkar Solapur University, Solapur

पुण्यश्लोक अहिल्यादेवी होळकर
सोलापूर विद्यापीठ
।। विद्यया संपन्नता ।।
NAAC Accredited-2022
'B++' Grade (CGPA-2.96)

Name of the Faculty: Science & Technology

Syllabus: CHEMISTRY

(As per New Education Policy NEP 2020)

Name of the Course: B.Sc. Part- III (Sem V & VI)

[Syllabus to be implemented from June- 2026]

Punyashlok Ahilyadevi Holkar Solapur University, Solapur
Faculty of Science & Technology
NEP 2020 Compliant Curriculum
B.Sc. (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. III Chemistry: The candidate must be passed B.Sc. Part I (sem I and II). At B. Sc. II year (Sem III and IV) student should be passed or ATKT and the student must have Chemistry as a major subject.

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Faculty of Science & Technology
NEP 2020 Compliant Curriculum
B.Sc. (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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Punyashlok Ahilyadevi Holkar Solapur University, Solapur

Faculty of Science & Technology

NEP 2020 Compliant Curriculum

B.Sc. (Chemistry)

Program Specific Outcomes (PSOs)

Students graduating from B.Sc. (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)# DSC2-1 (2+2)# DSC3-1 (2+2)#	-- -- --		GE1/ OE1(2)	SEC1 (2)	L1-1(2) IKS (2) VEC1(2) (Indian Constitution And Democracy)	--	22	**44 UG Certificate (44)**
	II	DSC1-2 (2+2)# DSC2-2 (2+2)# DSC3-2 (2+2)#	-- -- --		GE2/ OE2(2)	SEC 2 (2)	L1-2(2) VEC2(2) (Environmental Studies)	CC1 (2)	22	
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) DSC1-4 (2+1)	--- ---	DSC2-3 (2+1) DSC-2-4 (2+1)	GE3 / OE3(2)	VSC1 (2) (DSC1) VSC2(2) (DSC2)	L2-1 (2)	CC2 (2)	22	**44 UG Diploma (88)**
	IV	DSC1-5 (2+1) DSC1-6 (2+1)	--- --	DSC2-5 (2+1) DSC2-6 (2+1)	GE4/ OE4 (2)	VSC3 (2) (DSC1) VSC4(2) (DSC2)	L2 -2(2)	FP1/CEP1(2)	22	
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) DSC1-8 (3+2) DSC1-9 (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)**
	VI	DSC1-10 (3+2) DSC1-11 (3+2) DSC1-12 (3+2)	DSE1-3 (2+1) or DSE1-4 (2+1)	----	---	VSC4 (2) (Hands on Training related to DSE)		FP2/CEP2/OJT1 (2)	22	
	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) DSC1-14 (4+2)	DSE1-5 (4+2)	Research Methodology (4)	------	----	----	---	22	**44 UG Honours Degree in Main faculty (176)**
	VIII	DSC1-15 (4+2) DSC1-16 (4+2)	DSE1-6 (4+2)		----	-----	----	OJT/In-house Project/ Internship/ Apprenticeship (4)	22	
	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.

B.Sc. Part- III Chemistry NEP 2020 Structure							
SEM	**Faculty**		**GE/OE**	**VSC**	**IKS**	**Field Project**	**Credits**
	DSC	**DSE**					
V	DSC1-7 (3+2) **Physical Chemistry** (45 Period) DSC1-8 (3+2) **Inorganic Chemistry** (45 Period) DSC1-9 (3+2) **Organic Chemistry** (45 Period)	DSE1-1 (2+1) **Analytical and Industrial Physical Chemistry** (30 Period) or DSE1-2 (2+1) **Applied Analytical Chemistry I** (30 Period)	---	VSC 5 (2) (Hands on training related to DSE)	IKS 2 (2) IKS in Chemistry (Related to Major subject)	---	22
VI	DSC1-10 (3+2) **Physical Chemistry** (45 Period) DSC1-11 (3+2) **Inorganic Chemistry** (45 Period) DSC1-12 (3+2) **Organic Chemistry** (45 Period)	DSE1-3 (2+1) **Analytical and Industrial Organic Chemistry** (30 Period) or DSE1-4 (2+1) **Applied Analytical Chemistry II** (30 Period)	---	VSC 6 (2) (Hands on training related to DSE)	---	FP2/CEP2/ OJT1 (2)	22

B.Sc. Part- III Subject: Chemistry

[According to NEP 2020 W.E.F. June 2026]

Sem.	Paper	Title of Paper	Credits		Marks			
			T	PR	T-CA	PR-CA	T-UA	PR-UA
V	DSC 1-7	Physical Chemistry	3	2	30	20	45	30
	DSC 1-8	Inorganic Chemistry	3	2	30	20	45	30
	DSC 1-9	Organic Chemistry	3	2	30	20	45	30
	DSE 1-1 A	Analytical and Industrial Physical Chemistry	2	1	20	10	30	15
	DSE 1-1 B	Applied Analytical Chemistry I	2	1	20	10	30	15
	VSC 5	Hands on training related to DSE	---	2	--	20	--	30
	IKS 2	IKS in Chemistry	2	---	20	---	30	---
VI	DSC 1-10	Physical Chemistry	3	2	30	20	45	30
	DSC 1-11	Inorganic Chemistry	3	2	30	20	45	30
	DSC 1-12	Organic Chemistry	3	2	30	20	45	30
	DSE 1-2 A	Analytical and Industrial Organic Chemistry	2	1	20	10	30	15
	DSE 1-2 B	Applied Analytical Chemistry II	2	1	20	10	30	15
	VSC 6	Hands on training related to DSE	---	2	--	20	--	30
	FP2/CEP2/OJT1	FP2/CEP2/OJT1	---	2	--	20	--	30

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Third Year B.Sc. (Chemistry) Semester-V

Vertical: DSC1-7

Course Code: G04-DSC1-0504

Course Name: Chemistry-VII (Physical Chemistry)

*Teaching Scheme	*Examination Scheme
Lectures:03 Hours/week, 03 Credits	UA: 45 Marks CA: 25 Marks

Course Preamble
Physical Chemistry is one of the major course in the Chemistry curriculum. This course helps in understanding the fundamental principles of physical chemistry, including Quantum mechanics, phase equlibria, and the electrochemistry (electromotive force). This course also helps do develop problem solving skills among the students.

Course Objectives
1. To understand the fundamentals of wave mechanics 2. To understand the fundamentals of quantum mechanics 3. To know the basics of phase diagram 4. To solve the mathematical problems on quantum mechanics and electrochemistry 5. To draw the phase diagrams

Course Outcomes After completion of the course students will be able to
1. Understand the failures of classical mechanics 2. Know about the origin of quantum mechanics 3. Able to sketch one and two component phase diagrams 4. Understand different types of electrodes 5. Solve the mathematical problems based on electromotive force

Unit	Contents	Lectures	Weightage
I.	**1. Introduction to Quantum Mechanics** 1.1 Introduction 1.2 Failures of classical mechanics, origin of quantum mechanics 1.3 Black body radiation, Stefan-Boltzmann law, Wein's displacement law, 1.4 Planck's quantum theory of black body radiation distribution, 1.5 Photoelectric effect, explanation on the basis of quantum theory, 1.6 Compton effect 1.7 de-Broglie hypothesis 1.8 Heisenberg's uncertainty principle (statement explanation) 1.9 Schrodinger wave equation- (Derivation not expected) 1.10 Physical significance of wave function ψ and ψ^2 **2. Phase Equilibria.** 2.1 Introduction 2.2 Gibbs phase rule : Phase rule equation and explanation of terms involved in the equation. Phase diagram, true and metastable equilibria. 2.3 One component systems : (i) Water system (ii) Sulphur system with explanation forpolymorphism. 2.4 Two component systems : (i) Eutectic system : (Ag - Pb system); Desilverisation of lead (ii) Formation of compound with congruent melting point ($FeCl_3$ - H_2O)	**09** **06**	
II.	**3. Electromotive force** **(Convention : Reduction potentials to be used)** 3.1 Introduction 3.2 Thermodynamics of electrode potentials, Nernst equation for electrode and cell potentials in terms of activities. 3.3 Types of electrodes : Description in terms of construction, representation, half cellreaction and emf equation for, i) Metal - metal ion electrode. ii) Amalgam electrode. iii) Metal insoluble salt electrode. iv) Gas electrode. v) Oxidation – Reduction electrode. 3.4 i) Reversible and Irreversible cells. ii) Chemical cells without transference. iii) Concentration cells a. Electrode concentration cell I) Reversible to cation II) Reversible to anion b. Electrolyte concentration cells without transference 3.5 Equilibrium constant from cell emf, determination of the thermodynamic parameterssuch as ΔG, ΔH and ΔS. 3.6 Applications of emf measurements: i) Determination of pH of solution using Hydrogen electrode. ii) Solubility and solubility product of sparingly soluble salts (based on concentration cell). 3.7 Numerical problems.	**15**	

III.	**4. Photochemistry** 4.1 Introduction 4.2 Difference between thermal and photochemical processes. 4.3 Laws of photochemistry : Grotthus - Draper law, Lambert law, Lambert - Beer's law (with derivation), Stark – Einstein law. 4.4 Quantum yield, Reasons for high quantum yield (e.g. H_2 - Cl_2) and low quantum yield. (e.g. Decomposition of HI and HBr). 4.5 Photosensitized reactions - Dissociation of H_2, Photosynthesis. 4.6 Photodimerisation of anthracene. 4.7 Jablonski diagram depicting various radiative and non-radiative processes occurring in the excited state, description of fluorescence and phosphorescence phenomena. 4.8 Chemiluminescence. 4.9 Numerical problems.	**15**	

Reference Books:

1. Physical Chemistry by G. M. Barrow, International student Edition, Mc Graw Hill.
2. University General Chemistry by C.N.R. Rao, Macmillan.
3. Physical Chemistry by, R. A. Alberty, Wiley EasternLtd.
4. The Elements of Physical Chemistry by P. W. Atkins, Oxford.
5. Principles of Physical Chemistry by S. H. Maron, C. H. Prutton, 4thEdition.
6. Fundamentals of Photochemistry by K. K. Rohatgi-Mukerjee.
7. Principles of Physical Chemistry by Puri, Sharma, Pathania, Shobhanlal Naginchand and Company, Jalandar.
8. Text Book of Physical Chemistry by S. Glasstone, Macmillan India Ltd.
9. Elements of Physical Chemistry by D. Lewis and S. Glasstone (Macmillan).
10. Principles of Physical Chemistry by Maron and Lando (Amerind).
11. An Introduction to Electrochemistry by S. Glasstone.
12. Physical Chemistry by W. J. Moore.
13. Essentials of Physical Chemistry, Bahl and Tuli (S.Chand).
14. Quantum Chemistry: R. K. Prasad
15. Quantum Chemistry: D. A. MacQuerrey

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Third Year B.Sc. (Chemistry) Semester-V

Vertical: Major DSC1-7 P

Course Code: G04-DSC1-0504-P

Course Name: Chemistry Practical Lab VII

*Teaching Scheme	*Examination Scheme
Practical: 04 Hours/week, 02Credit	UA: 30 Marks CA: 20 Marks

Course Preamble
This is a practical course designed for the students to deal with the practicals based on different potentiometry and conductometry. This course will help students to understand about potentiometric and conductometric titrations, standard electrode potential determination and determination of important physical parameters of weak electrolyte using conductometry, This basic practical course develops laboratory skills in physical chemistry, including experimentation, data analysis, and interpretation.

Course Objectives
1. To familiarize potentiometer instrument 2. To familiarize conductometer instrument 3. To plot the graphs related to obtained data 4. To know about sparingly soluble salts 5. To understand Henderson equation

Course Outcomes After completion of the course students will be able to
1. Titration of acid-base using conductometry 2. Determination of standard electrode potentials of Zn and Cu electrodes 3. Understand Henderson equation for evaluating pH of buffer solutions 4. Evaluation of dissociation constant of weak acid conductometrically 5. Determination of solubility and solubility product of sparingly soluble salts

Contents

Non instrumental Experiments (Any four) :

1. To determine the equilibrium constant of the reaction, $KI + I_2 = KI_3$ by the distribution method.
2. To determine the partition coefficient of CH_3COOH between H_2O and CCl_4.
3. To determine the partial molar volume of ethanol in dilute aqueous solutions.
4. Critical Solution Temperature: To determine the CST for phenol – water system.
5. The study of energy of activation of first order reaction i.e. hydrolysis of methylacetate in presence of 0.5 N HCl.
6. The study of energy of activation of first order reaction i.e. hydrolysis of methylacetate in presence of 0.5 N H_2SO_4.

Instrumental Experiments

A. Potentiometry (Any two)

1. Determination of standard electrode potential of Zn/Zn^{++}, Cu/Cu^{++}, Ag/Ag^{+} (Any two).
2. Determination of solubility and solubility product of AgCl.
3. Titration of ferrous ammonium sulphate using $K_2Cr_2O_7$ solution and to calculate redox potential of Fe^{++}, Fe^{+++}system

B. Conductometry

1. To study the effect of substituent on dissociation constant of weak acid with respect to acetic acid and monochloro acetic acid (cell constant to be given).
2. To determine the velocity constant of hydrolysis of ethyl acetate by NaOH solution by conductometric method.

Reference Books :

1. Findlay's Practical Physical Chemistry (Longman)
2. Advanced Practical Physical Chemistry by J. B. Yadav, Goel publishing house.
3. Practical Physical Chemistry by B. D. Khosla, V. C. Garg (R. Chand and Co.)
4. Systematic experimental Physical Chemistry by Rajbhoj, Chandekar (Anjali Publication)
5. Practical Physical Chemistry : Nandkumari, Kothari and Lavande.
6. Practical Physical Chemistry by Gurtu (S. Chand).

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Third Year B.Sc. (Chemistry) Semester-V

Vertical: DSC 1-8

Course Code: G04-DSC1-0505

Course Name: Chemistry-VIII (Inorganic Chemistry)

*Teaching Scheme	*Examination Scheme
Lectures:03 Hours/week, 03 Credits	UA: 45 Marks CA: 25 Marks

Course Preamble
Inorganic Chemistry is one of the major course in the Chemistry curriculum. This course helps in understanding metal-ligand bonding in transition metal complexes, nuclear chemistry, bioinorganic chemistry and terms with mechanism of catalysis. This course also enhance the skills of separation and estimations of metals OR common anions by gravimetric estimations along with preparation of metal complexes and their double salts.

Course Objectives
1. To understand the nature of metal-ligand bonding. 2. To understand the splitting of d-orbitals and color of complexes. 3. To know the basics concepts in nuclear transmutation. 4. To know the applications of nuclear reaction. 5. To understand the role of metals in biological process. 6. To know the basics concepts in catalysis.

Course Outcomes After completion of the course students will be able to
1. Understand the splitting of d-orbitals and color of complexes. 2. Know about the applications of nuclear transmutations. 3. Understand the oxygen transport mechanism and ion transfer cycles. 4. Understand different types of catalyst and catalysis. 5. Know about the mechanism of catalysis.

Unit	Contents	Lectures	Weightage
I.	**Metal Ligand Bonding in Transition Metal Complexes** **A) Crystal Field Theory CFT).** 1.1. Introduction - What is CFT? 1.2. Basic concept of FT. 1.3. Formation of complexes with Crystal field splitting of 'd' orbitals i. Shapes of d orbitals and their electron density region ii. Formation of octahedral Complex with Crystal field splitting of 'd' orbitals, e.g. High spin and low spin octahedral complexes of Co(III): $[CoF_6]^{3-}$, $[Co(NH_3)_6]^{3+}$. iii. Formation of tetrahedral Complex with Crystal field splitting of 'd' orbitals, e.g.$[CoCl_4]^{2-}$. iv. Formation of square planer Complex with Crystal field splitting of 'd' orbitals e.g. $[Co(CN)_4]^{2-}$. 1.4. Jahn–Tellar distortion. 1.5. Factors affecting the Crystal – field splitting. 1.6. Crystal field stabilization energy (Δ): Calculation for octahedral complexes only. 1.7. Applications and limitations of CFT. **B) Molecular Orbital Theory (MOT).** 1.8 Introduction. 1.9 Basic concept 1.10 Symmetry classes of atomic orbitals 1.11 Formation of octahedral complex a) Assumptions b) M.O. energy level diagram for hypothetical octahedral complex. 1.12 Examples: octahedral complexes with sigma bonding only such as – e.g. $[Ti(H_2O)_6]^{3+}$, $[FeF_6]^{3-}$, $[Fe(CN)_6]^{3-}$, $[CoF_6]^{3-}$,$[Co(NH_3)_6]^{3+}$, $[Ni(NH_3)_6]^{2+}$. 1.13 Applications and limitations of MOT. 1.14 Comparison between CFT and MOT.	**15**	
II.	**Nuclear Chemistry** 2.1 Nuclear reaction and energetics of nuclear reactions. 2.2 Classification of nuclear reactions and Types of nuclear reactions: i) Artificial transmutation. ii) Artificial radioactivity. iii) Projectile capture reaction. iv) Projectile capture - particle emission reaction. v) Nuclear fission.	**15**	

	vi) Nuclear fusion. 2.3 Use of Uranium, Thorium and Plutonium for: a. Nuclear reactor b. Atomic Bomb. 2.4 Applications of radioisotopes as tracers. i) Chemical investigation -Esterification. ii) Structural determination – Phosphorus pentachloride. iii) Analytical Chemistry - isotopic dilution method for determination of volume of blood. iv) Age determination - Dating by14C.		
III.	**A)Bioinorganic Chemistry.** 3.1 Essential and trace elements in biological process. i) Essential elements a) Macro / major elements b) Micro/trace/minor elements ii) Non-essential elements 3.2 Metalloporphyrins with special reference to haemoglobin and myoglobin. i) Structure and function of Haemoglobin (Hb) ii) Structure and function of Myoglobin (Mb) iii) Co-operativity iv) Oxygen binding curve v) Difference between Haemoglobin (Hb) and Myoglobin (Mb) 3.3 Role of alkali and alkaline earth metal ions with special reference to Na^+, K^+ and Ca^{2+}. i) Role of Na^+ and K^+ ii) Role of Ca^2 **B)Catalysis** 4.1 Introduction 4.2 Classification of catalytic reactions: Homogeneous &Heterogeneous 4.3 Types of catalysis 4.4 Characteristics of catalytic reactions 4.5 Mechanism of catalysis: i) Intermediate compound theory ii) Adsorption theory. 4.6 Industrial Applications of Catalysis.	**08** **07**	

Reference Books :

1. Concise Inorganic Chemistry (ELBS, 5th Edition) - J. D. Lee.
2. Inorganic Chemistry (ELBS, 3rd Edition) D. F. Shriver, P. W. Atkins, C. H. Lang Ford, Oxford University Press, 2ndEdition.
3. Inorganic Chemistry (Harper International, 3rd edition) J. E. Huheey Harper and Row.
4. Basic Inorganic Chemistry : Cotton and Wilkinson.
5. Advanced Inorganic Chemistry (4th Edn.) Cotton and Wilkinson.
6. Concepts and Models of Inorganic Chemistry : Douglas and Mc. Daniel. 3rd Edition. John

Wiley publication.
7. Fundamental concepts of Inorganic Chemistry by E. S. Gilreath.
8. Structural principles in inorganic compounds. W. E. Addison.
9. T. B. of Inorganic analysis - A. I. Vogel.
10. Theoretical principles of Inorganic Chemistry - G. S. Manku.
11. Theoretical Inorganic Chemistry by Day and Selbin.
12. Co-ordination compounds S F A Kettle.
13. Modern Aspects of Inorganic Chemistry. E. Sharpe.
14. New guide to Modern Valence Theory by G. I. Brown.
15. Essentials of Nuclear Chemistry by H. J. Arnikar.
16. Organometallic Chemistry by R. C. Mahrotra A. Sing, Wiley Eastern Ltd. New Delhi.
17. Inorganic Chemistry by A. G. Sharpe, Addision - Wisley Longman -Inc.
18. Principles of Inorganic Chemistry by Puri, Sharma and Kalia, Vallabh Publication. Pitampur Delhi.
19. Text book of Inorganic Chemistry by K. N. UpadhyayaVikas Publishing House – New Delhi.
20. Progress in inorganic polymer by Laport and Leigh.
21. Co-ordination compounds by Baselo and Pearson.
22. Organometallic Chemistry by P. L.Pauson.
23. Advanced inorganic chemistry, Vol. I and II Satyaprakash, G. D. Tuli, S. K. Basu and Madan
24. Selected Topics in inorganic chemistry by W U Malik, G. D. Tuli, R. D.Madan. (S. Chand)
25. Industrial chemistry part I and II by A. K. De
26. Industrial chemistry by B. K. Sharma

Punyashlok Ahilyadevi Holkar Solapur University, Solapur

Third Year B.Sc. (Chemistry) Semester-V

Vertical: DSC1-8 P

Course Code: G04-DSC1-0505-P

Course Name: Chemistry Practical Lab VIII

*Teaching Scheme	*Examination Scheme
Practical: 04 Hours/week, 02Credit	UA: 30 Marks CA: 20 Marks

Course Preamble
This practical course is designed for the students to deal with the practicals based on different gravimetric estimation and preparation of inorganic compounds. This course will help students to understand about separation techniques for metals and their quantitative estimation. This basic practical course develops laboratory skills in inorganic chemistry, including experimentation, data analysis, and interpretation.

Course Objectives
1. To familiarize existence of metal in nature. 2. To familiarize precipitations of inorganic salts. 3. To know about selection of precipitating agents. 4. To know about purification of inorganic salts. 5. To understand structural chemistry of complex salts.

Course Outcomes After completion of the course students will be able to
1. Separation of metals from their common solution. 2. Determination of amount of metals correlating with their salts. 3. Precipitation of one metal in the presence of other metals. 4. Preparation of complex salts of metals. 5. Determination of percentage yield of inorganic salts.

Contents
Gravimetric Estimations (Any Three) G1. Gravimetric estimation of iron as ferric oxide from the given solution containing ferrous ammonium sulphate, copper sulphate and free sulphuric acid. G2. Gravimetric estimation of barium as barium chromate from the given solution

containing barium chloride, ferric chloride and free hydrochloride acid.

G3. Gravimetric estimation of Aluminium as Aluminiumoxinate i.e.

Tris-(8-hydroxyquinolinato) aluminate (III) from a given solution containing potash alum, copper sulphate and free sulphuric acid.

G4. Gravimetric estimation of sulphate ions as barium sulphate from the given solution of copper sulphate and free hydrochloric acid.

[For the gravimetric experiments, stock solution should be given in the range of 10 to 15 cm
and asked to dilute to 100 cc(or the stock solution should be given in the range of 20 to 30 cc and asked to dilute to 250 cc). Use 50 cc of this diluted solution for estimation.]

Inorganic Preparation (Any Four)

N. B.–1. Calculations of % yield is expected.

2. After preparation, physico-chemical characterization is expected with 5(Five) marks weightage in terms of:

a) Name of central metal ion

b) Oxidation number of metal ion

c) Nature of ligand

d) Nature of bonding

e) Type of hybridization

f) Inner orbital or outer orbital complex

g) Geometry of the complex with structure

h) Magnetic property of the compound

i) Color of the compound

j) Nature: Crystalline /Amorphous.

P1. Preparation of nickel ammonium sulphate

P2. Preparation of potassium trioxalatoaluminate (III)

P3. Preparation of tris(ethylenediamine)nickel (II) thiosulphate

P4. Preparation of sodium hexanitrocobaltate (III)

P5. Preparation of ammonium diamminetetrathiocynatochromate(III) (Reineck's salt)

P6. Preparation of nickel ferrite.

P7. Preparation of tris(thiourea)cuprous(I) sulphate

P8. Preparation of hexa-amminecobalt(III) chloride

Reference Books :

1. Findlay's Practical Physical Chemistry (Longman)
2. Advanced Practical Physical Chemistry by J. B. Yadav, Goel publishing house.
3. Practical Physical Chemistry by B. D. Khosla, V. C. Garg (R. Chand and Co.)
4. Systematic experimental Physical Chemistry by Rajbhoj, Chandekar (Anjali Publication)
5. Practical Physical Chemistry : Nandkumari, Kothari and Lavande.
6. Practical Physical Chemistry by Gurtu (S. Chand).

Punyashlok Ahilyadevi Holkar Solapur University, Solapur

Third Year B.Sc. (Chemistry) Semester-V

Vertical: DSC 1-9

Course Code: G04-DSC1-0506

Course Name: Chemistry-IX (Organic Chemistry)

*Teaching Scheme	*Examination Scheme
Lectures:03 Hours/week, 03 Credits	UA:45 Marks CA: 25 Marks

Course Preamble

Organic chemistry is one of the most applicative, significant and major portion of chemistry curriculum. This course develops student's interest in organic chemistry as a basic science and prepare them for academic and research exposure. It helps to acquire different spectroscopic methods, synthetic methodologies via enolates, stereochemistry and some well-known name reactions with their mechanism.

Course Objectives

1. This course helps to understand different spectroscopic methods like IR, NMR and mass spectra.
2. To study identification of unknown compounds by using spectral data.
3. To know the stereochemistry of alicyclic compounds in detail.
4. To study some important name reactions with their mechanism.
5. To understand some active methylene compounds and their applications.

Course Outcomes

After completion of the course students will be able to

1. Understand spectroscopic techniques like IR, NMR and mass.
2. Solve problems based spectral analysis.
3. Know conformation and stability of cyclohexane
4. Understand mechanism of some important name reactions.
5. Grasp some synthetic methods through formation of carbanion (enolate).

Unit	Contents	Lectures	Weightage
I.	**1. Infrared Spectroscopy** 1.1 Introduction. 1.2 Principle of IR spectroscopy. 1.3 Double beam IR spectrophotometer- Schematic diagram. 1.4 Fundamental modes of vibrations. 1.5 Types of vibrations. 1.6 Hooke's law. 1.7 Factors affecting values of vibrational frequencies. 1.8 Conditions for absorption of radiation and selection rule. 1.9 Fundamental group regions of IR spectrum. 1.10 Functional group region, Finger print region, Aromatic region. 1.11 Characteristic absorption of various functional groups. 1.12 Applications of IR spectroscopy – Determination of structure, Identification of functional groups, spectral problems based on IR. **2. Organic synthesis via Enolates** 2.1 Introduction - Reactive methylene group. 2.2 Ethyl acetoacetate - Synthesis by Claisen condensation, acidity of methylene hydrogen, Keto- enol tautomerism, synthetic applications – Synthesis of alkyl and dialkyl derivatives, monobasic, dibasic and α- β-unsaturated acid, heterocyclic compound. 2.3 Diethyl malonate - Synthesis, acidity of methylene hydrogen (salt formation). Synthetic applications - Synthesis of alkyl and dialkyl derivatives, monobasic, dibasic acid, α-β- unsaturated acid, α-amino acid and heterocyclic compound	**08** **07**	

II.	**3. NMR Spectroscopy** 3.1 Introduction. 3.2 Proton magnetic resonance (1H) spectroscopy (PMR). 3.3 Principles of PMR spectroscopy. 3.4 Magnetic and non-magnetic nuclei. 3.5 Theory of PMR spectroscopy - spinning nuclei, magnetic moment and magnetic field, processional motion of nuclei without mathematical details, nuclear resonance. 3.6 NMR - Instrument. Schematic diagram. 3.7 Shielding and deshielding effect. 3.8 Chemical shift, measurement of chemical shift by delta scale and tau scale. 3.9 TMS as reference. Advantages of TMS. 3.10 Peak area (integration). 3.11 Spin - spin splitting (n + 1rule). 3.12 Definition of coupling constant (J value) of first order coupling. 3.13 PMR spectra of ethanol, ethyl bromide, acetaldehyde, 1, 1, 2 - tribromoethane, ethyl acetate, acetophenone, benzaldehyde, propanoic acid and benzoic acid. 3.14 Problems pertaining to the structure elucidation of simple organic compounds using PMR spectroscopic data (supporting IR and UV data to be given). **4 Mass spectroscopy** 4.1 Introduction. 4.2 Theory of mass spectroscopy 4.3 Mass spectrometer – schematic diagram 4.4 Formation of ions by ionization 4.5 Types of ions with examples. 4.6 Applications of mass spectroscopy. 4.6.1 Determination of molecular weight. 4.6.2 Determination of molecular formula.	**15**	
III.	**3. Stereochemistry** 5.1 Introduction. 5.2 Baeyer's strain theory. 5.3 Theory of strainless rings. 5.4 Conformation and stability of cyclohexane and	**07**	

	monosubstituted cyclohexane (methyl cyclohexane). 5.5 Locking of conformation in t-butyl cyclohexane. 5.6 Stereoselective and stereospecific reactions: 5.6.1 Stereochemistry of addition of halogens to alkenes: syn- and anti-addition. Example - Addition of bromine to 2-butene. (mechanism not expected) 5.6.2 Alkaline hydrolysis of 2-chlorobutane to 2-butanol (Example of SN2reaction) 4. **Name reactions** Mechanism and applications of following reactions: 6.1 Stobbe condensation. 6.2 Oppenauer oxidation. 6.3 Meerwein Ponndorf Verley reduction. 6.4 Reformatsky reaction. 6.5 Wagner –Meerwein Rearrangement 6.6 Hoffman rearrangement reaction 6.7 Witting reaction 6.8 Related problems	**08**	

Reference Books:

1. Spectroscopy of Organic compounds: P. S. Kalsi.
2. Modern Methods of Organic Synthesis, W Carruthers, Iain Coldham, Cambridge University Press
3. Organic Chemistry: Fieser and Fieser.
4. Organic Chemistry: I. L. Finar, The English Language Book Society, London.
5. A Guide Book to mechanism in Organic Chemistry: Peter Sykes, Longman Green and Co. Ltd. London 6thEdition.
6. Organic Chemistry: R. T. Morrison and R. N. Boyd, Prentice Hall of India Private Limited, New Delhi. 6thEdition.
7. Text book of organic Chemistry: L. N. Ferguson, N. D. Van Nostrand Company Indian Edition, Affiliated East west press private Ltd. New Delhi.
8. Organic Chemistry Vol. I, II and III: S. M. Mukharji, S. P. Singh, R. P. Kapoor Wile Eastern, Limited, New Delhi.
9. A text book of organic Chemistry: K. S. Tewari, S. N. Mehrotra, N.K. Vishnoi Vikas Publishing House Private Ltd. New Delhi.
10. A text book of Organic Chemistry: Arun Bahl and B. S. Bahl , S. Chand and Company Ltd. 6thEdition.
11. Heterocyclic Chemistry Synthesis, Reactions and Mechanism: Raj K. Bansal, Wiley Easter

Ltd., New Delhi.
12. Stereochemistry conformation and mechanism: P. S. Kalsi, New Age International Publishers, 4th Edition.
13. Organic Chemistry Volume I and II: I. L. Finar ELBS with Longman 6thEdition.
14. Organic Chemistry Volume I and II : William Kemp, ELBS with Mc. Million 3rd Edition.
15. Advanced Organic Chemistry: Jerry March, Wiley Eastern Ltd.
16. Principles of Organic Chemistry: English and Cassidy.
17. Elementary Organic Absorption Spectroscopy: Y. R. Sharma.
18. Spectroscopy: V. M. Parikh.
19. Stereochemistry of Carbon Chemistry: Eliel.
20. Principles of Organic Chemistry: M. K. Jain.
21. Organic Chemistry by Clayden, Greeves, Warren and Wothers Oxford press.
22. Organic Chemistry: A Comprehensive degree text and source book by Hanes Baeyers and Wolfgang Walter Albion Chemical Science Series.

Punyashlok Ahilyadevi Holkar Solapur University, Solapur

Third Year B.Sc. (Chemistry) Semester-V

Vertical: Major DSC1-9 P

Course Code: G04-DSC1-0506-P

Course Name: Chemistry Practical Lab IX

*Teaching Scheme	*Examination Scheme
Practical: 04 Hours/week, 02Credit	UA: 30 Marks CA: 20 Marks

Course Preamble

A practical course in organic chemistry is designed to balance theoretical knowledge by educating vital laboratory skills, scientific perceptive and an experimental approach. The purpose of this course is to provide hands-on experience in the preparation of some organic compounds, their recrystallization and characterization. Students will learn to apply theoretical principles to laboratory exercise, so help them to understand reaction mechanism.

Course Objectives

1. This course helps to apply theoretical principles to laboratory experiments.
2. To understand laboratory skills involved in preparation of some organic compounds.
3. To recrystallize synthesized compounds.
4. To calculate percentage practical yield of synthesized compounds.
5. To learn practical techniques for synthesizing derivatives

Course Outcomes

After completion of the course students will be able to

1. Implement theoretical concepts in laboratory practice.
2. Gain proficiency in laboratory procedures involved in organic compound preparation.
3. Acquire practical skills in recrystallization of synthesized compounds.
4. Understand calculation for percentage yield of organic reactions.
5. Learn hands-on skills in laboratory preparations of organic derivatives.

Contents

A) Organic Preparations (any four)

N.B.: a) Calculation of percentage practical yield.
b) Recrystallisation of crude product and its melting point.

1) Preparation of benzene azo-β-naphthol.
2) Preparation of p-iodo nitrobenzene from p-nitro aniline.
3) Preparation of nerolin from β-naphthol.
4) Preparation of benzoic acid from cinnamic acid.
5) Preparation of aspirin from salicylic acid.
6) Preparation of m-nitroaniline from m-dinitrobenzene.

B) Preparation of Derivatives (Any Eight)

N.B.: a) During practical course, name of the organic compound should not to be given.
b) Recrystallisation of crude product and its melting point.

1) Bromo derivative of cinnamic acid.
2) Bromo derivative of aniline.
3) Nitro derivative of nitrobenzene.
4) Nitro derivative of salicylic acid.
5) Benzoyl derivative of β-naphthol.
6) Benzoyl derivative of aniline
7) Picrate derivative of β-naphthol.
8) Picrate derivative of anthracene.
9) Oxalate and nitro derivatives of urea.
10) Anhydride derivative of phthalic acid.
11) Oxime derivatives of acetone.
12) Oxime derivatives of acetophenone.
13) 2: 4 DNP of acetophenone.

Reference Books:

1. Practical Organic Chemistry by A. I. Vogel.
2. Practical Organic Chemistry by F.G. Mann and B.C. Saunders. Low-priced Text Book. ELBS. Longman.
3. Experiments in General Chemistry by C. N. R. Rao. Affiliated East-West Press Pvt. Ltd. Delhi.
4. Advanced Practical Organic Chemistry by N. K. Vishnoi. Vikas Publishing House Private Limited.
5. Comprehensive Practical Organic Chemistry Preparation and Quantitative Analysis by V.K. Ahluwalia, Renu Agarwal. University Press. Distributor-Orient Longmann Ltd.
6. Practical Chemistry-Physical-Inorganic-Organic and Viva-voce by Balwant Rai Satija. Allied Publishers PrivateLimited.

7. College Practical Chemistry by H. N. Patel, S. R. Jakali, H. P. Subhedar, Miss. S. P. Turakhia. Himalaya Publishing House, Mumbai.
8. College Practical Chemistry by Patel, Jakali, Mohandas, Israney Turakhia. Himalaya Publishing House, Mumbai.

पुण्यश्लोक अहिल्यादेवी होळकर सोलापूर विद्यापीठ ।। विद्यया संपन्नता ।। NAAC Accredited-2022 'B++' Grade (CGPA-2.96)	**Punyashlok Ahilyadevi Holkar Solapur University, Solapur** **Third Year B.Sc.(Chemistry) Semester-V** **Vertical: DSE 1-1** **Course Code: G04-DSE1-502** **Course Name: Chemistry-DSE-1-1 (Analytical and Industrial Physical Chemistry)**
***Teaching Scheme** **Lectures:02 Hours/week, 02 Credits**	***Examination Scheme** **UA: 30 Marks** **CA: 20 Marks**

Course Preamble
This course is designed to understand basic instrumentation like colorimetry, potentiometry and conductometery. This course also introduces the topic electroplating. Students will get familiar about the key components of the above mentioned instruments. Electroplating topic deals with the fundamental principles involved in electroplating and also study nickel and chromium electroplating process.

Course Objectives
1. To understand the basic principle involved in potentiometry 2. To understand the basic principle involved in conductometry 3. To understand the basic principle involved in colorimetry 4. To know the fundamental principles of electroplating 5. To understand anodizing process

Course Outcomes
After completion of the course students will be able to

1. Understand the basis of colorimetric, potentiometric and conductometric techniques.
2. Understand the key components of these instruments
3. Know and verification of the fundamental laws of absorption and transmission of light
4. Understand the equipments used in electroplating industry
5. Experimental determination of specific, equivalent and molar conductance.

Unit	Contents	Lectures	Weightage
I.	**1. Colorimetry** 1.1 Introduction 1.2 General discussion of theory of colorimetry : Lambert law, Beer's law (Derivation not expected), Terms used in Colorimetry, Application of Beer's law, Deviation from Beer's law. 1.3 Classification of methods of color measurement or comparison, Photoelectric photometer method - single cell photo-electric colorimeter. **2. Electroplating** 2.1 Introduction. 2.2 Electrolysis: Faraday's laws of electrolysis 2.3 Basic principles of electroplating 2.4 Electroplating equipments 2.5 Cleaning of articles. 2.6 Electroplating of Nickel and Chromium. 2.7 Anodising - Introduction 5.8 Anodising of aluminium	**06** **09**	
II.	**3. Potentiometry** 3.1. Introduction. 3.2. Detail study of calomel, quinhydrone and glass electrodes and their use in determination of pH. 3.3. Basic circuit diagram of direct reading potentiometer 3.4 Potentiometric titrations : Classical and analytical methods for locating endpoints, i) Acid – Base titrations. ii) Redox - titrations. iii) Precipitation titrations. 3.5 Advantages of potentiometric titrations. **4. Conductometry:** 4.1 Basic circuit of D.C. Wheatstone bridge, Measurement of conductance by Wheatstone bridge, use of alternating current, conductivity water, Different types of conductivity cells, cell constant and its determination. 4.2 Experimental determination of specific, equivalent and molar conductance. 4.3 Conductometric acid-base titrations i. Strong acid against strong base ii. Strong acid against weak base iii. Weak acid against strong base.	**08** **07**	

	iv. Weak acid against weak base. 4.4 Advantages of conductometric titrations		

Reference Books :

1. Text book of Quantitative Inorganic Analysis - By A. I. Vogel (ELBS and Longman 3rdEdition).
2. Instrumental methods of Chemical analysis by Willard, Merit and Dean.
3. Instrumental methods of Chemical analysis by Chatwal and Anand (Himalaya Publication).
4. Principles of electroplating and eletroforming by Blum and Hogaboom,Mac Graw - Hill Book Co. 3rdEdn.
5. Vogel's text book of Quantitative Inorganic Analysis by Basssett and Denny etc. ELBS and Longman 4^{th} Edition.
6. Principles of Physical Chemistry by Puri, Sharma, Pathania, Shobhanlal Nagin Chand and Company, Jalandar.
7. Text Book of Physical Chemistry by S. Glasstone, McMillan India Ltd.
8. Elements of Physical Chemistry by D. Lewis and S. Glasstone (McMillan).
9. Principles of Physical Chemistry by Maron and Lando (Amerind).
10. An Introduction to Electrochemistry by S. Glasstone.
11. Physical Chemistry by W. J. Moore.
12. Essentials of Physical Chemistry, Bahl and Tuli (S. Chand).

Punyashlok Ahilyadevi Holkar Solapur University, Solapur

Third Year B.Sc. (Chemistry) Semester-V

Vertical: DSE 1-1 P

Course Code: G04-DSE1-502-P

Course Name: Chemistry-DSE- 1-1 P

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

Course Preamble
This practical course was designed to get hands on training on colorimeter, Students will know about standardization of the colorimeter instruments. They will get training about analysis of experimental data and plotting of graphs based on the observations.

Course Objectives
1. To standardize colorimeter 2. To know about the Beer's law 3. To verify Beer's law 4. To know the basic components of colorimeter

Course Outcomes After completion of the course students will be able to
1. Plotting the graphs based on the data obtained from the experiments 2. Unknown concentration determination from Beer's law plot 3. Determination of the λmax of prepared solutions 4. Know about preparation of different types of metal-ligand complexes

Contents
Perform the following experiments 1. To verify Lambert - Beer's law using $CuSO_4$ solution colorimetrically. 2. To estimate Fe^{+++} ions by thiocynate method colorimetrically. 3. To estimate Fe^{+++} ions using salicylic acid by colorimetric titration colorimetrically.

Reference Books :

1. Findlay's Practical Physical Chemistry (Longman)
2. Advanced Practical Physical Chemistry by J. B. Yadav, Goel publishing house.
3. Practical Physical Chemistry by B. D. Khosla, V. C. Garg (R. Chand and Co.)
4. Systematic experimental Physical Chemistry by Rajbhoj, Chandekar (Anjali Publication)
5. Practical Physical Chemistry : Nandkumari, Kothari and Lavande.
6. Practical Physical Chemistry by Gurtu (S. Chand).

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-V** **Vertical: DSE 1-2** **Course Code: G04-DSE2-502** **Course Name: Chemistry-DSE-1-2 (Applied Analytical Chemistry-I)**
***Teaching Scheme** **Lectures:02 Hours/week, 02 Credits**	***Examination Scheme** **UA:30 Marks** **CA: 20 Marks**

Course Preamble
Applied Analytical Chemistry is one of the important papers in the Chemistry curriculum. This paper helps in understanding the practical and industrial applications of analytical principles. It covers topics such as fertilizers, corrosion and passivity, and non-aqueous solvents. This paper also helps to develop analytical thinking, laboratory skills, and problem-solving abilities among students, preparing them for industrial, environmental, and research fields.

Course Objectives
1. To acquire knowledge about fertilizers. 2. To study types of fertilizers and their environmental impact. 3. To learn the types, mechanisms, and prevention methods of corrosion. 4. To understand the concept, types, and applications of passivity. 5. To gain knowledge of non-aqueous solvents.

Course Outcomes After completion of the course students will be able to
1. Understand the role of essential nutrients and fertilizers. 2. Understand the environmental impact of fertilizers and their proper use. 3. Know the types, mechanisms, and factors affecting corrosion and methods of its prevention. 4. Learn about concept of passivity, its types, and practical applications. 5. Understand the properties, classification, and reactions of non-aqueous solvents.

Unit	Contents	Lectures	Weightage
1.	**Fertilizers** 1.1 Nutrient Functions in plant growth: Nitrogen, Phosphorous, Potassium, Calcium, Magnesium, Sulphur, Boron, Iron, Zinc, Manganese, Copper, Molybdenum, Chlorine, 1.2 Role of these nutrients as : Functions, Excess supply and Deficiency. 1.3 Definition and qualities of an ideal fertilizers: 1.4 Classification or types of fertilizers: 1.5 Manufacture of fertilizers, eg. Urea, Ammonium sulphate, Superphosphate, Triple superphosphate, Ammonium phosphate. 1.6 Mixed fertilizers, Compound or complex fertilizers. 1.7 Pollution caused by fertilizers	**15**	
II.	**A) Corrosion and Passivity.** **I) Corrosion:-** 2.1 Introduction	**09**	

	2.2 Types of corrosion 2.3 Electrochemical theory of corrosion 2.4 Factors affecting the corrosion a) Position of metal in emf series. b) Purity of metal. c) Effect of moisture. d) Effect of oxygen. e) Hydrogen overvoltage. 2.5 Methods of protection of metals from corrosion. **II) Passivity:-** 2.6 Definition. 2.7 Types of passivity. 2.8 Oxide film theory. 2.9 Application of passivity. **Unit-II:B) Study of Non-Aqueous Solvents** 3.1 Introduction 3.2 Characteristics of solvents 3.3 Classification of solvents 3.4 Reactions in non-aqueous solvents with reference to i) liquid NH_3 ii) liquid SO_2	**06**	

Reference Books :

1. Concise Inorganic Chemistry (ELBS, 5th Edition) - J. D. Lee.
2. Inorganic Chemistry (ELBS, 3rd Edition) D. F. Shriver, P. W. Atkins, C. H. Lang Ford, Oxford University Press, 2ndEdition.
3. Inorganic Chemistry (Harper International, 3rd edition) J. E. Huheey Harper and Row.
4. Basic Inorganic Chemistry : Cotton and Wilkinson.
5. Advanced Inorganic Chemistry (4th Edn.) Cotton and Wilkinson.
6. Concepts and Models of Inorganic Chemistry : Douglas and Mc. Daniel. 3rd Edition. John Wiley publication.
7. Fundamental concepts of Inorganic Chemistry by E. S. Gilreath.
8. Structural principles in inorganic compounds. W. E. Addison.
9. T. B. of Inorganic analysis - A. I. Vogel.
10. Theoretical principles of Inorganic Chemistry - G. S. Manku.
11. Theoretical Inorganic Chemistry by Day and Selbin.
12. Co-ordination compounds S F A Kettle.
13. Modern Aspects of Inorganic Chemistry. E. Sharpe.
14. New guide to Modern Valence Theory by G. I. Brown.
15. Essentials of Nuclear Chemistry by H. J. Arnikar.
16. Organometallic Chemistry by R. C. Mahrotra A. Sing, Wiley Eastern Ltd. New Delhi.
17. Inorganic Chemistry by A. G. Sharpe, Addision - Wisley Longman -Inc.
18. Principles of Inorganic Chemistry by Puri, Sharma and Kalia, Vallabh Publication. Pitampur Delhi.
19. Text book of Inorganic Chemistry by K. N. UpadhyayaVikas Publishing House – New Delhi.
20. Progress in inorganic polymer by Laport and Leigh.

21. Co-ordination compounds by Baselo and Pearson.
22. Organometallic Chemistry by P. L.Pauson.
23. Advanced inorganic chemistry, Vol. I and II Satyaprakash, G. D. Tuli, S. K. Basu and Madan
24. Selected Topics in inorganic chemistry by W U Malik, G. D. Tuli, R. D.Madan. (S. Chand)
25. Industrial chemistry part I and II by A. K. De
26. Industrial chemistry by B. K. Sharma

Punyashlok Ahilyadevi Holkar Solapur University, Solapur

Third Year B.Sc. (Chemistry) Semester-V

Vertical: DSE 1-2 P

Course Code: G04-DSE2-502-P

Course Name: Chemistry-DSE- 1-2 P

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

Course Preamble
This practical course focuses on the quantitative estimation of commercial samples using volumetric and ion-exchange techniques. It provides hands-on training in redox, acid–base, and Complexometric titrations for the analysis of metal ions, ammonia, fertilizers, and industrial effluents. The course enhances practical laboratory skills, accuracy, and understanding of analytical methods used in industrial and environmental applications.

Course Objectives
1. To develop practical skills in volumetric analysis. 2. To understand analytical methods for estimation of metals and ions. 3. To learn the principles and applications of ion-exchange techniques. 4. To determine Chemical Oxygen Demand (COD).

Course Outcomes After completion of the course students will be able to
1. Understand the redox, acid–base, and complexometric titrations accurately. 2. Know the estimation of metal ions and other constituents in commercial samples. 3. Understand the ion-exchange methods for separation and quantitative determination of ions. 4. Experimental determination of COD and evaluate pollution levels in industrial effluents.

Contents
Estimation of commercial samples (Any Three) 1. Determination of percentage purity of ferrous ammonium sulphate by redox titration. 2. Determination of amount of aluminium in the given solution of potash alum by volumetric estimation. 3. Determination of Chemical Oxygen Demand of the given sample of industrial effluent by dichromate method by volumetric estimation. 4. Estimation of amount of ammonia from the given ammonium salt by indirect method. 5. Determination of amount of sodium present in the given solution of fertilizer using cation exchange resin (By Acid Base titration). 6. Determination of amount of magnesium and zinc in the given solution mixed fertilizer containing ($Mg^{++}$and Zn^{++}) using anion exchange resin and standard solution of EDTA (By complexometric titration).

Punyashlok Ahilyadevi Holkar Solapur University, Solapur

Third Year B.Sc. (Chemistry) Semester-V

Vertical: IKS-2

Course Code: G04-IKS-502

Course Name: IKS in Chemistry

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

Course Preamble
This course is designed to understand the ancient Indian metallurgy and ancient dyes. This course will introduce the rich ancient Indian science behind dyes, their archeological significance.

Course Objectives
1. To know about ancient metallurgy 2. To understand types of dyes 3. To know various ancient specimens of iron in India 4. To illustrate archeological significance of dyes

Course Outcomes After completion of the course students will be able to
1. Know about the iron in ancient age 2. Understand concepts of minerals and ores 3. Explain non ferrous metallurgy 4. Understand chemistry of dyes 5. Illustrate different types of dyes

Unit	Contents	Lectures	Weightage
I.	**1. Ancient Indian Metallurgy** Iron in Vedic age, Iron in Epic age, technical studies of ancient iron object, ancient specimen of iron in India, general method smelting operations, Indian steel or wootz, concepts of minerals and ores, Non-ferrous metallurgy.	15	

II.	**2. Historical background of dyes** Introduction, Archaeological significance of dyes, types of fabric dye used in textile, Dyes in ancient Indian textile, Colour and chemical constitution, Red and blue shift, Classification of dyes, Different types of chromophores **3. Azo dyes** Diazotisation and coupling reactions, azoic colours, acid dyes, mono azo dye; diphenylamine and anthraquinone dyes; acid mordant dyes, direct dyes, dying process of textiles.	**05** **10**	

Reference Books:

1. Iron in Ancient India by Panchanan Neogi, 1914, publisher Indian association for cultivation of science
2. The early use of Iron in India by Delip K. Chakrabarti, Oxford University Press 1992
3. Ancient Indian Metallurgy by Ashoka K. Mishra 2010
4. The Art of Dyeing in the History of India- Jasleen Dhamija.
5. The Chemistry of Synthetic dyes Vol.I-IX, Edited by K. Venkataraman, Academic Press (1971) Textile Auxiliaries, By J. W. Batty
6. Advances in colour chemistry series - Vol.3, Modern colorants : synthesis and structure, Edited by A.T. Peters and H.S. Freeman, Blackie Academic & Professional (1995)
7. Colour Chemistry : Synthesis, Properties and applications of Organic dyes and pigments Heinrich Zollinger VCH, Germany (1987)
8. Organic Chemistry in colour, P.F. Gordon, P.Gregory, Springer-Verlag (1983)
9. Infrared Absorbing Dyes, Edited by Masaru Matsuoka, Plenum Press (1990)
10. The Chemistry of Synthetic dyes and pigments, by H.A. Lubs, Reinhold Publication (1955)

Punyashlok Ahilyadevi Holkar Solapur University, Solapur

Third Year B.Sc. (Chemistry) Semester-V

Vertical: VSC-III

Course Code: G04-VSC-502

Course Name: VSC-III (Hands-on Training related to DSE-1-1)

*Teaching Scheme	*Examination Scheme
Lectures:04 Hours/week, 02 Credits	UA:30 Marks CA: 20 Marks

Course Preamble
This course is designed to provide hands-on-training to the students. This course includes practical based on pHmetry and Refractometry. This course also trains in alloy analysis.

Course Objectives
1. To understand the basis of Refractometry 2. To understand the basis of pHmetry 3. To understand the basis of Colorimetry 4. To calibrate the analytical instruments 5. To estimate alloys colorimetrically and gravimeterically

Course Outcomes After completion of the course students will be able to
1. Calibrate the analytical instruments like refractometer and pHmeter 2. Understand the basic components of refractometer, pHmeter and colorimeter 3. Know the composition of various alloys 4. Understand the gravimetric technique of analysis 5. Handle the analytical instruments

Contents

A) (Any Three)

1. To determine the percentage composition of unknown mixture by (i) graphical method and (ii) by composition law (Densities of pure liquids A and B be given) refractometrically.
2. To determine the molar refractivity of methyl acetate, ethyl acetate, n-hexane and carbontetrachloride and calculate the refraction equivalents of C, H and Cl atoms refractometrically.
3. To determine the dissociation constant of monobasic acid (Acetic acid) pHmetrically.
4. To determine the dissociation constant of dibasic acid (Malonic acid) pHmetrically

B) Alloy Analysis (Any Three)

1. To estimate the amount of tin from solder alloy gravimetrically.
2. To estimate the amount of lead from type metal alloy gravimetrically.
3. To estimate the amount of nickel from cupronickel alloy calorimetrically.
4. To estimate the amount of silver from silver coin gravimetrically.
5. To estimate the amount of copper from brass metal alloy calorimetrically.

SEMESTER VI

पुण्यश्लोक अहिल्यादेवी होळकर सोलापूर विद्यापीठ ॥ विद्यया संपन्नता ॥ NAAC Accredited-2022 'B++' Grade (CGPA-2.96)	**Punyashlok Ahilyadevi Holkar Solapur University, Solapur** **Third Year B.Sc. (Chemistry) Semester-VI** **Vertical: DSC1-10** **Course Code: G04-DSC1-0604** **Course Name: Chemistry-X (Physical Chemistry)**
***Teaching Scheme** **Lectures:03 Hours/week, 03 Credits**	***Examination Scheme** **UA:45 Marks** **CA: 25 Marks**

Course Preamble
This course deals with important topics of physical chemistry like spectroscopy, solutions, thermodynamics and chemical kinetics. The spectroscopy topic deals with rotational, vibrational and Raman spectroscopy of diatomic molecules. The basic thermodynamic parameter, free energy, and their relations with other properties, and some fundamental equations are discussed in the topic thermodynamics while complex reaction kinetics and basic reaction rate theories are discussed in the topic chemical kinetics.

Course Objectives
1. To understand the basics of molecular spectroscopy 2. To get information regarding free energy 3. To understand zeotropic and azeotropic solutions 4. To know about distillation process 5. To study the basics of complex reactions

Course Outcomes After completion of the course students will be able to
1. Understand the atomic and molecular energies 2. Know the fundamental rotational, vibrational energies of diatomic molecules 3. Understand the Stokes and anti-Stokes lines appeared in Raman spectrum 4. Understand Vapour pressure and boiling point diagrams of miscible liquids 5. Understand various theories of reaction rates.

Unit	Contents	Lectures	Weightage
I.	**1. Spectroscopy** 1.1 Introduction 1.2 Electromagnetic radiation. 1.3 Electromagnetic spectrum, Energy level diagram. 1.4 Rotational spectra of diatomic molecules : Rigid rotor model; moment of inertia (derivation not expected); energy levels of rigid rotor, selection rule; spectral intensity; distribution using population distribution (Maxwell - Boltzmann distribution), determination of bond length; isotope effect. Interaction of radiation with rotating molecule. 1.5 Vibrational spectra of diatomic molecules: Simple Harmonic oscillator model, Vibrationalenergies of diatomic molecules, Determination of force constant, zero point energy. The Anharmonic oscillator, overtones and hot band. Interaction of radiation with vibrating molecules. 1.6 Raman spectroscopy: Introduction, Rayleigh scattering. Raman Scattering, classical theory of Raman effect and quantum theories of Raman effect. Polarization of light and the Raman effect. Mutual exclusion principle. 1.7 Numerical problems.	**15**	
II.	**2. Solutions** 2.1 Introduction 2.2 Ideal solutions, Raoult's law, vapour pressure of ideal and non ideal solutions of miscibleliquids. 2.3 Vapour pressure and boiling point diagrams of miscible liquids. Type I : Systems with intermediate total vapour pressure. (i.e. System in which B.P. increases regularly - Zeotropic) Type II : Systems with a maximum in the total vapour pressure.(i.e. System with a B.P. minimum - Azeotropic) Type III :Systems with a minimum in the total vapour pressure.(i.e. System with a B.P. Maximum - Azeotropic) 2.4 Distillation of miscible liquid pairs. 2.5 Solubility of partially miscible liquids. (i) Maximum solution temperature type : Phenol – water system. (ii) Minimum solution temperature type :Triethyl amine – water system. (iii) Maximum and minimum solution temperature type : Nicotine – water system.	**15**	

III.	**3. Thermodynamics** 3.1 Introduction 3.2 Free energy : Helmholtz free energy (A), Gibbs free energy (G) and Criteria for thermodynamic equilibrium and spontaneity. 3.3 Relation between G and H : Gibbs Helmholtz equation. 3.4 Phase equilibria : Clapeyron – Clausius equation. 3.5 Thermodynamic derivation of law of mass action, van't Hoff isotherm and isochore. 3.6 Fugacity and activity concepts. 3.7 Numerical problems. **4. Chemical Kinetics** 4.1 Introduction, simultaneous reactions such as opposing reactions, side reactions, consecutive reactions and chain reactions. [Derivations of rate Equations for these reactions are not expected.] 4.2 Effect of temperature on the rate of reaction. 4.2.1 Temperature coefficient 4.2.2 Arrhenius equation 4.2.3 Energy of activation 4.2.4 Transition state theory 4.3 Theories of reaction rate 4.3.1 Collision theory 4.3.2 Transition state theory 4.4 Third order reaction with equal concentration of all reactants, their characteristics and examples 4.5 Numerical problems.	**09** **06**	

Reference Books :

1. Principles of Physical Chemistry by Maron and Pruton 4th edition.
2. Principles of Physical Chemistry by Puri, Sharma, Pathania, Shobhanlal Nagin chand and Company, Jalandar.
3. Text Book of Physical Chemistry by S. Glasstone, McMillan India Ltd.
4. Elements of Physical Chemistry by D. Lewis and S. Glasstone (McMillan).
5. Principles of Physical Chemistry by Maron and Lando (Amerind).
6. Thermodynamics for chemists by S Glasstone.
7. Physical Chemistry by W. J. Moore.
8. Essentials of Physical Chemistry, Bahl and Tuli (S.Chand).
9. Basic Chemical Thermodynamics by V V Rao (McMillan)
10. An introduction to chemical thermodynamics by R. R. Mishra and R. P. Rastogi.
11. Fundamentals of molecular spectroscopy by C. N. Banwell and McCash- Tata McGraw Hill

Punyashlok Ahilyadevi Holkar Solapur University, Solapur

Third Year B.Sc. (Chemistry) Semester-VI

Vertical: DSC1-10 P

Course Code: G04-DSC1-0604-P

Course Name: Chemistry Practical Lab -X

*Teaching Scheme	*Examination Scheme
Lectures:04 Hours/week, 02 Credits	UA:30 Marks CA: 20 Marks

Course Preamble

This practical course was designed to get hands on training regarding determination of reaction rates, their orders and energy of activation required for the reactions. Some phase equilibria experiments are included to understand the distribution study of the components. Partial molar property like volume determination experiment also included in this course.

Course Objectives

1. To understand the fundamentals of chemical reactions
2. To study the effect of salt addition and temperature on rate of chemical reactions
3. To under partial molar property
4. To know the distribution of solute in solvent
5. To study first and second order reactions

Course Outcomes

After completion of the course students will be able to

1. Understand the Nernst's distribution law
2. Know the factors affecting on reaction rate
3. understand the concepts like molecularity and order of chemical reactions
4. Evaluate activation energy using estimated rate constants
5. Understand salt effect on rate of chemical reaction

Contents

Non instrumental Experiments (Any Three) :

1. The study of energy of activation of second order reaction i.e. reaction between $K_2S_2O_8$ and KI (Equal concentrations).
2. The study of energy of activation of second order reaction i.e. reaction between $K_2S_2O_8$ and KI (Unequal concentrations).
3. To study the hydrolysis of methyl acetate by using its two concentrations

inpresence of 0.5 N HCl and hence find velocity constant of the reaction.

4. To study the effect of addition of electrolyte (KCl) on the reaction between $K_2S_2O_8$ and KI (Equal concentrations).

Instrumental Experiments

A. Potentiometry

1. Titration of strong acid with strong alkali.
2. Preparation of buffer solution and determination of their pH (Any five buffer solutions), -Theoretical calculation of pH values by using Henderson's equation.

B. Conductometry

1. To study the effect of substituent on dissociation constant of weak acid with respect to acetic acid and monochloro acetic acid (cell constant to be given).
2. To determine the velocity constant of hydrolysis of ethyl acetate by NaOH solution by conductometric method.

Reference Books :

1. Findlay's Practical Physical Chemistry (Longman)
2. Advanced Practical Physical Chemistry by J. B. Yadav, Goel publishing house.
3. Practical Physical Chemistry by B. D. Khosla, V. C. Garg (R. Chand and Co.)
4. Systematic experimental Physical Chemistry by Rajbhoj, Chandekar (Anjali Publicaiton)
5. Practical Physical Chemistry : Nandkumari, Kothari and Lavande.
6. Practical Physical Chemistry by Gurtu (S. Chand).

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Third Year B.Sc. (Chemistry) Semester-VI

Vertical: DSC1-11

Course Code: G04-DSC1-0605

Course Name: Chemistry-XI (Inorganic Chemistry)

*Teaching Scheme	*Examination Scheme
Lectures:03 Hours/week, 03 Credits	UA:45 Marks CA: 25 Marks

Course Preamble
Inorganic Chemistry is one of the major course in the Chemistry curriculum. This course helps in understanding study of f-block elements, metals and semiconductors, structural chemistry of inorganic covalent compounds and organometallic compounds. This course also enhance the skills of separation and estimations of metals OR common anions by gravimetric estimations along with preparation of metal complexes and their double salts.

Course Objectives
1. To understand the electronic configuration of extraction of f-block elements. 2. To understand the characteristics of metallic solids. 3. To know the basics concepts in semiconductors and superconductors. 4. To know the structures of inorganic covalent compounds. 5. To know the structure and bonding in organometallic compounds.

Course Outcomes After completion of the course students will be able to
1. Understand the electronic configuration of extraction of f-block elements. 2. Know about the applications of basic concepts and applications of Semiconductors. 3. Understand the preparation and structure of ceramic superconductors. 4. Understand structure and bonding in covalent inorganic compounds. 5. Know about the structure and bonding in organometallic compounds.

Unit	Contents	Lectures	Weightage
I.	**Study of F-block Elements** 1.1 Lanthanides:- I) Introduction II) Electronic configuration III) Occurrence IV) Separation of Lanthanides i) Bulk separation methods ii) Individual separation of lanthanides- Mention names of methods only (Ion exchange method in detail) 1.2 Actinides:- I) Introduction II) Electronic configuration III) General Methods of preparation– a. Neutron-capture followed byβ-decay. b. Accelerated projectile bombardment method. c. Heavy-ion bombardment method.	**15**	
II.	**Metals and Semiconductors** 2.1 Introduction. 2.2 Properties of metallic solids. 2.3 Theories of bonding in metal. a) Free electron theory. b) Molecular orbital theory (Band theory). 2.4 Classification of solids as conductor, insulators and semiconductors on the basis of band theory. 2.5 Semiconductors: a) Types of semiconductors - intrinsic and extrinsic semiconductors. b) Applications of semiconductors. 2.6 Superconductors: a) Ceramic superconductors - Preparation and structures of mixed oxide $YBa_2Cu_3O_{7-x}$ b) Applications of superconductors.	**15**	

III.	**A) Structural Chemistry** 3.1 Structural study of following compounds. i) Diborane. ii) Borazine. iii) Xenon compounds →XeF_6 and XeO_4 (w.r.t. VBT only.) 3.2 Structural study of Oxides of Sulphur and Phosphorous: i) Oxides of Sulphur: SO_2 andSO_3 ii) Oxides of Phosphorous: P_4O_6 andP_4O_{10} **B) Organometallic Chemistry.** 4.1 Introduction -Definition, 4.2 Nomenclature of organometallic compounds. 4.3 Synthesis and structural study of alkyl and aryl compounds of Li and Al. 4.4 Mononuclear carbonyl and nature of bonding in simple metal carbonyls.	**08** **07**	

Reference Books :

1. Concise Inorganic Chemistry (ELBS, 5th Edition) - J. D. Lee.
2. Inorganic Chemistry (ELBS, 3rd Edition) D. F. Shriver, P. W. Atkins, C. H. Lang Ford, Oxford University Press, 2ndEdition.
3. Inorganic Chemistry (Harper International, 3rd edition) J. E. Huheey Harper and Row.
4. Basic Inorganic Chemistry : Cotton and Wilkinson.
5. Advanced Inorganic Chemistry (4th Edn.) Cotton and Wilkinson.
6. Concepts and Models of Inorganic Chemistry : Douglas and Mc. Daniel. 3rd Edition.
7. Fundamental concepts of Inorganic Chemistry by E. S. Gilreath.
8. Structural principles in inorganic compounds. W. E. Addison.
9. T. B. of Inorganic analysis - A. I. Vogel.
10. Theoretical principles of Inorganic Chemistry - G. S. Manku.
11. Theoretical Inorganic Chemistry by Day and Selbin.
12. Co-ordination compounds S F A Kettle.
13. Modern Aspects of Inorganic Chemistry. E. Sharpe.
14. New guide to Modern Valence Theory by G. I. Brown.
15. Essentials of Nuclear Chemistry by H. J. Arnikar.
16. Organometallic Chemistry by R. C. Mahrotra A. Sing, Wiley Eastern Ltd. New Delhi.
17. Inorganic Chemistry by A. G. Sharpe, Addision - Wisley Longman -Inc.
18. Principles of Inorganic Chemistry by Puri, Sharma and Kalia, Vallabh Publication.
19. Text book of Inorganic Chemistry by K. N. UpadhyayaVikas Publishing House – New Delhi.
20. Progress in inorganic polymer by Laport and Leigh.
21. Co-ordination compounds by Baselo and Pearson.
22. Organometallic Chemistry by P. L.Pauson.
23. Advanced inorganic chemistry, Vol. I and II Satyaprakash, G. D. Tuli, S. K. Basu and Madan
24. Selected Topics in inorganic chemistry by W U Malik, G. D. Tuli, R. D.Madan. (S. Chand)
25. Industrial chemistry part I and II by A. K. De
26. Industrial chemistry by B. K. Sharma

Punyashlok Ahilyadevi Holkar Solapur University, Solapur

Third Year B.Sc.(Chemistry) Semester-VI

Vertical: DSC1-11 P

Course Code: G04-DSC1-0605-P

Course Name: Chemistry Practical Lab -XI

*Teaching Scheme	*Examination Scheme
Lectures:04 Hours/week, 02 Credits	UA:30 Marks CA: 20 Marks

Course Preamble
This practical course is designed for the students to deal with the practicals based on different gravimetric estimation and volumetric estimation of inorganic salts. This course will help students to understand about separation techniques for metals and their quantitative estimation. This basic practical course develops laboratory skills in inorganic chemistry, including experimentation, data analysis, and interpretation.

Course Objectives
1. To familiarize existence of metal in nature. 2. To familiarize precipitations of inorganic salts. 3. To know about selection of titrating agents. 4. To know about purity of inorganic salts. 5. To understand structural chemistry of complex salts.

Course Outcomes After completion of the course students will be able to
1. Separation of metals from their common solution. 2. Determination of amount of metals correlating with their salts. 3. Precipitation of one metal in the presence of other metals. 4. Dissolution of complex salts of metals. 5. Determination of percentage purity of inorganic salts.

Contents

Gravimetric Estimations (Any Three)

G1. Gravimetric estimation of barium as barium sulphate from the given solution containing barium chloride, ferric chloride and free hydrochloric acid.

G2. Gravimetric estimation of magnesium as magnesium pyrophosphate from the given solution containing magnesium sulphate, copper sulphate and free sulphuric acid.

G3. Gravimetric estimation of nickel as bis-(dimethylglyoximato) nickel (II) from the given solution containing nickel sulphate, ferrous ammonium sulphate and free sulphuric acid.

G4. Gravimetric estimation of chloride ions as silver chloride from the give solution of sodium chloride and free nitric acid.

[For the gravimetric experiments, stock solution should be given in the range of 10 to 15 cm
and asked to dilute to 100 cm (or the stock solution should be given in the range of 20 to 30 cm and asked to dilute to 250 cm). Use 50 cm of this diluted solution for estimation.]

Volumetric Estimation (Any Four)

V1. To estimate the amount of copper from the brass metal alloy.

V2. To estimate the amount of available chlorine (Cl_2) in the give sample of bleaching powder ($CaOCl_2.2H_2O$)

V3. Determination of percentage purity of boric acid using supplied sodium hydroxide.

V4. Determination of percentage purity of tetramminecopper (II) sulphate.

V5. Determination of percentage purity of potassium trioxalatoaluminate(III).

V6. Determination of percentage purity of potassium trioxalatoferrate (III).

V7. Determination of percentage of magnesium in the given sample of talcum powder.

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Third Year B.Sc.(Chemistry) Semester-VI

Vertical: DSC1-12

Course Code: G04-DSC1-0606

Course Name: Chemistry-XII (Organic Chemistry)

*Teaching Scheme	*Examination Scheme
Lectures:03 Hours/week, 03 Credits	UA:45 Marks CA: 25 Marks

Course Preamble

Organic chemistry forms a fundamental and highly applicative component of the chemistry curriculum, with wide-ranging significance in both academic study and industrial applications. This course aims to cultivate students' curiosity in organic chemistry as a core discipline while equipping them with the skills necessary for advanced academic study and research. This course helps students gain exposure to diverse applied fields including heterocyclic chemistry, biomolecules such as vitamins, hormones, and carbohydrates as well as industrially significant areas like synthetic dyes, pharmaceuticals and agrochemicals.

Course Objectives

1. This course will help to study various heterocyclic compounds.
2. To learn chemical properties and functions of biomolecules such as carbohydrates, vitamins and hormones.
3. To study classification and synthesis of some significant dyes.
4. To learn classification and chemistry of some important drugs.
5. To understand agrochemicals comprehensively.

Course Outcomes

After completion of the course students will be able to

1. Acquire knowledge of the structures, properties and reactivity of N-based heterocycles.
2. Learn structural features and chemical properties of carbohydrates, vitamins and hormones

3. Understand properties and preparation techniques of synthetic dyes.
4. Gain insight into the classification and synthesis of important pharmaceutical compounds.
5. Learn classification, chemistry and applications of agrochemicals.

Unit	Contents	Lectures	Weightage
I.	**1. Heterocyclic compounds** 1.1 Introduction and classification 1.2 Pyrrole 1.2.1 Methods of synthesis: i) From acetylene ii) From furan iii) From succinamide 1.2.2 Physical properties 1.2.3 Reactivity of pyrrole: i) Basic character ii) Acidic character iii) Electrophilic substitution with general mechanism 1.2.4 Chemical reactions: Reduction, Oxidation, Nitration, Sulphonation, Halogenation, Friedel Craft's reaction, Coupling reaction 1.3 Pyridine 1.3.1 Methods of synthesis: i) From acetylene and hydrogen cyanide ii) From piperidine 1.3.2 Physical properties 1.3.3 Chemical reactions i) Basic character ii) Electrophilic substitution reactions: Nitration, Sulphonation and Bromination iii) Nucleophilic substitution - General mechanism, Reactions with sodamide, sodium hydroxide and n-Butyllithium. 1.4 Quinoline 1.4.1 Synthesis - Skraup's synthesis 1.4.2 Physical properties. 1.4.3 Reactions of quinoline i) Electrophilic substitution reactions - Nitration and sulphonation. ii) Nucleophilic substitution reactions – Reactions with sodamide, alkyl lithium and aryl lithium iii) Reduction	**09** **06**	

	2. Vitamins and Hormones 2.1 General idea of vitamins, structure and synthesis of vitamin A General idea of hormones, structure and synthesis of Adrenaline and Thyroxin		
II.	**3. Carbohydrates** Introduction 3.1 Classification and nomenclature 3.2 Monosaccharide D-glucose - Open chain structure 3.3 Chain lengthening of Aldoses –Kiliani synthesis 3.4 Chain shortening of Aldoses - Weerman's reaction 3.5 Interconversion of glucose and fructose 3.6 Configuration of D-glucose from D-arabinose 3.7 Objections against open chain structure of D-glucose. 3.8 Mutarotation with mechanism. 3.9 Ring structure of D-glucose - Determination of size of ring by i) Methylation method. 3.10 Disaccharides - Introduction, sucrose and lactose - sources, structural formulae and uses. 3.11 Polysaccharides–Introduction, Starch and Cellulose - sources, structural formulae and uses **4. Synthetic dyes** 4.1 Introduction, Qualities of good dye /4.2. Classification based on constitution and methods of applications 4.3 Witt's theory - Colour and constitution 4.4 Synthesis of Orange IV, Malechite green, phenolphthalein	**09** **06**	
III.	**5. Pharmaceuticals** 5.1 Introduction 5.2 Qualities of ideal drug 5.3 Methods of classification of drugs - Classification based on the therapeutical action 5.4 Brief idea of pencillin-G (constitution, synthesis not expected) 5.5 Synthesis and uses of the following drugs: i) Antimalerials -Paludrin ii) Antituberculars - Isoniazide and Ethambutol iii) C. N. S. drugs -Phenobarbitone iv) Antidiabetics -Tolbutamide v) Anti-inflammatory drugs -Ibuprofen vi) Antibiotics -Chloromycetin vii) Anticancer drugs: Chlorambucil (Leukeran)	**08**	

	6. Agrochemicals 6.1 General idea of agrochemicals including pyrethroides. 6.2 Synthesis and uses of the following agrochemicals: i) Indole-3-acetic acid, ii) Monocrotophos, iii) Methoxychlor, iv) Ethophan v) Carbaryl, vi) Baygon.	**07**	

Reference Books:

1. Organic Chemistry - Finar I. L. The English Language Book Society, London.
2. A Guide Book to mechanism in Organic Chemistry - Peter Sykes Longman Green and Co. Ltd. London 6thEdition.
3. Organic Chemistry - R. T. Morrison and R. N. Boyd Prentice Hall of India private limited New Delhi. 6thEdition.
4. Text book of organic Chemistry - Ferguson L. N. D. Van Nostrand Company Indian Edition, Affiliated East West press private Ltd. New Delhi.
5. Organic Chemistry Vol. I, II and III - S. M. Mukharji, S. P. Singh, R. P. Kapoor Wiley Estern, Limited, New Delhi.
6. A text book of organic Chemistry - K. S. Tewari, S. N. Mehrotra, N. K. Vishnoi Vikas Publishing House Private Ltd. NewDelhi.
7. A text book of Organic Chemistry - ArunBahl and B. S. Bahl S. Chand and Company Ltd. 6thEdition.
8. Heterocyclic Chemistry Synthesis, Reactions and Mechanism - Raj K. Bansal Wiley Easter Ltd. New Delhi.
9. Reaction Mechanism and reagents in Organic Chemistry - G. R. Chatwal Himalaya Publishing House New Delhi.
10. Organic Chemistry Volume I and II - I. L. Finar ELBS with Longman 6thEdition.
11. Advanced Organic Chemistry - Jerry March Wiley Eastern Ltd.
12. Organic Chemistry – Fieser and Fieser.
13. Chemicals for crop improvement and pest management - Green, Hartly and West.
14. Chemistry of pesticides - K. H. Buchel (T.W.).
15. Chemistry of Insecticides – U.S. SreeRamulu.
16. Medicinal Chemistry- Ashitosh Kar.
17. Medical Chemistry -Burger.
18. Principles of Organic Chemistry - M. K. Jain.
19. Organic Chemistry by Clayden, Greeves, Warren and Wothers Oxford press.
20. Organic Chemistry - A Comprehensive degree text and source book by Hanes Baeyers and Wolfgang Walter Albion Chemical Science Series.
21. Synthetic Organic Chemistry-Kamlesh Bansal.
22. Synthetic Organic Chemistry-Gurudeep Chatwal.

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Third Year B.Sc.(Chemistry) Semester-VI

Vertical: DSC1-12 P

Course Code: G04-DSC1-0606-P

Course Name: Chemistry Practical Lab -XII

*Teaching Scheme	*Examination Scheme
Lectures:04 Hours/week, 02 Credits	UA:30 Marks CA: 20 Marks

Course Preamble

Practical organic chemistry is one of the most significant course of chemistry curriculum forming the foundation for understanding research and industrial applications. The goal of this course is to provide practical exercise in the separation of binary mixtures and identification of their components. The course trains students to translate theoretical concepts into laboratory work, helping them master techniques for separating and identifying compounds.

Course Objectives

1. Students will learn to connect theoretical concepts with practical laboratory work.
2. To determine the chemical and physical nature of an organic mixture.
3. To understand and practice laboratory procedures for the separation of binary organic mixtures.
4. To perform identification of organic compounds by applying preliminary tests, elemental detection, and functional group determination

Course Outcomes

After completion of the course students will be able to

1. Apply theoretical knowledge in hands-on laboratory work
2. Examine the chemical and physical nature of organic mixtures.
3. Study and perform experimental procedures used in the separation of binary organic mixtures
4. Analyze organic compounds through stepwise identification methods involving preliminary, elemental, and functional group assessments.

Contents

Organic Qualitative analysis

eparation of binary mixture and Identification of its components. 5 g of mixture is to be given for separation. At least 08 mixtures are to be separated.

ature 1) Solid - Solid: 5 mixtures

2) Solid - Liquid: 2 mixtures

3) Liquid - Liquid: 1 mixture

1) Solid - Solid Mixtures:

One mixture from each of the following types should be given:

i) Acid + Phenol ii) Acid + Base iii) Acid + Neutral

i) Phenol + Base v) Phenol + Neutral vi) Base +Neutral

2) Solid – Liquid Mixtures

One mixture of type Neutral + Neutral and One mixture of type Acid + Neutral should be given.

3) Liquid – Liquid Mixtures

One mixture of type Neutral + Neutral or one mixture of type Base + Neutral should be given.

ollowing compounds should be used for preparation of mixtures:

Acids: Benzoic acid, Phthalic acid, Salicylic acid, Cinnamic acid, Aspirin, Oxalic acid. Phenols: α-naphthol, β-naphthol

Bases: o -nitroaniline, m-nitroaniline, p-nitroaniline, aniline, o-toluidine and N, N-dimethyl aniline.

Neutrals: Naphthalene, acetanilide, m-dinitrobenzene, chloroform, carbon tetrachloride, acetone, nitrobenzene, ethyl acetate, ethyl benzoate, acetophenone, bromobenzene, urea and thiourea.

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. College Practical Chemistry by H. N. Patel, S. R. Jakali, H. P. Subhedar, Miss. S. P. Turakhia. Himalaya Publishing House, Mumbai.
9. College Practical Chemistry by Patel, Jakali, Mohandas, Israney Turakhia. Himalaya Publishing House, Mumbai.
10. Practice of thin layer chromatography by Joseph C. Touchstone, Murrell F. Dobbins. A Wiley - Interscience Publication John-Wiley &Sons.

पुण्यश्लोक अहिल्यादेवी होळकर सोलापूर विद्यापीठ ॥ विद्यया संपन्नता ॥ NAAC Accredited-2022 'B++' Grade (CGPA-2.96)	**Punyashlok Ahilyadevi Holkar Solapur University, Solapur** **Third Year B.Sc. (Chemistry) Semester-VI** **Vertical: DSE1-3** **Course Code: G04-DSE3-602** **Course Name: Chemistry-DSE1-3 (Analytical and Industrial Organic Chemistry)**
***Teaching Scheme** **Lectures:02 Hours/week, 02 Credits**	***Examination Scheme** **UA:30 Marks** **CA: 20 Marks**

Course Preamble
This course provides fundamental and industrial knowledge of synthetic polymers, sugar and alcohol industries, green chemistry, and chromatographic techniques. It covers the preparation and applications of polymers and rubbers, industrial manufacturing processes, sustainable chemical practices, and modern separation techniques. The course connects theoretical concepts with industrial, environmental, and analytical applications.

Course Objectives
1. To understand the synthetic polymers and rubbers. 2. To know basics of sugar and alcohol industries. 3. To learn the principles and applications of green chemistry. 4. To know about chromatographic techniques. 5. To get information regarding industrial awareness.

Course Outcomes After completion of the course students will be able to
1. Understand the preparation, properties, and uses of synthetic polymers and rubbers. 2. Know the processes involved in sugar and alcohol manufacture and identify their by-products. 3. Understand the principles of green chemistry. 4. Learn about paper, column, thin layer, and gas chromatography. 5. Understand the application of chemistry in industry, environment, and analysis.

Unit	Contents	Lectures	Weightage
	1. Synthetic Polymers Introduction Classification: i) According to origin, composition, method of preparation and general physical properties ii) Classification based upon structure Process of addition polymerisation - free radical polymerisation of alkenes and Dienes Ionic polymerisation Ziegler – Natta polymerisation Methods of preparation and uses of: i) Polystyrene ii) PVC iii) Phenol formaldehyde resin iv) Polyurethane tural rubber: General idea and vulcanisation Synthetic rubbers: Synthesis and uses of: i) Polychloroprene ii) Buna rubber - Buna N and Buna S **2.2. Sugar and Alcohol Industry** Manufacture of raw cane sugar Refining of raw sugar White sugar By-products of sugar industry Manufacture of ethyl alcohol from molasses Rectified spirit, Denatured spirit absolute alcohol and power alcohol By-products of alcohol industry	**07** **08**	
II	**3. Green Chemistry** Introduction - Twelve principles of green chemistry PTC: Introduction, Role in organic reactions catalysis Biocatalytic reactions - Hydroxylation and oxidation using enzymes Introduction to microwave assisted reactions Ionic liquids – Introduction and examples of ionic liquids **4. Chromatography** Introduction General principles Study of following chromatographic techniques with reference to principle, methodology and applications	**07** **08**	

	i) Paper Chromatography ii) Column chromatography iii) Thin layer chromatography iv) Gas chromatography		

Reference Books:

1. Introduction to Polymer Chemistry - Raymond B. Seymour.
2. Polymer Science - V. R. Gowarikar, N. V. Viswanathan and Jayadev Sreedhar Willey Eastern Limited.
3. Industrial Chemistry - R. K. Das, Asia Publishing, Mumbai.
4. Riegel's Handbook of Industrial Chemistry - J. A. Kent, Van. Nostrard, Londan.
5. Chemical Process Industries - Shreve and Brinic - Ostin, Magraw Hill, NewYork.
6. Advances in Green Chemistry: Chemical synthesis using MW-irradiation by R. S.Varma.
7. Green Chemistry: Environment Friendly alternatives-Rashmi Sanghiand M. M. Srivastava (Eds) (c) 2003 Narosa Publishing House, New Delhi, India.
8. Basic Concepts of Analytical Chemistry - S. M. Khopkar, Wiley Eastern Ltd. Bombay.
9. Analytical Chemistry- Walton.
10. 10. Biotechnology and Applied Microbiology - Alani and Moo-Young.
11. Text Book of Quantitative Organic Analysis - A. I. Vogel, Pearson Edn. Delhi.
12. Quantitative Organic Chemistry - A. I. Vogel, Pearson Edn. Delhi.
13. Hand Book of Organic Analysis - H. T. Clarke, Arnold Heinemann Pub. Delhi.

Punyashlok Ahilyadevi Holkar Solapur University, Solapur

Third Year B.Sc. (Chemistry) Semester-VI

Vertical: DSE1-3

Course Code: G04-DSE3-602-P

Course Name: Practical DSE1-3 P

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

Course Preamble

This practical course focuses on the quantitative estimation of organic compounds such as sucrose, nitro compounds, oils, acids, esters, amides, and formaldehyde using titrimetric methods. It develops laboratory skills, analytical accuracy, and understanding of functional group analysis relevant to industrial and pharmaceutical applications.

Course Objectives

1. To learn about quantitative estimation of organic compounds.

2. To understand the principles involved in titrimetric and functional group analysis.

3. To learn methods for analysis of sugars, oils, nitro compounds, acids, esters, amides, and aldehydes.

4. To improve accuracy, precision, and calculation skills in volumetric analysis.

Course Outcomes

After completion of the course students will be able to

1. Understand and perform accurate quantitative analysis of organic compounds.

2. Understand and apply principles of volumetric and functional group analysis.

3. Learn about saponification value and analyze mixtures of organic compounds.

4. Students should be able to estimate sucrose, nitro groups, and formaldehyde in given samples.

Contents
Estimations. (Any Four) a. To estimate the amount of sucrose in given solution using Fehling's solution. b. To estimate amount of nitro group from the solution of m-nitroaniline c. To determine sap value of oil d. To estimate the amount of acid and amide present in the given mixture of acid and amide e. To estimate the amount of acid and ester present in the given mixture of acid and ester f. To estimate the amount of formaldehyde from given formalin solution

Reference Books:

1. Vogel A. I., *Text Book of Quantitative Organic Analysis*, Pearson Edition, Delhi.
2. Khopkar S. M., *Basic Concepts of Analytical Chemistry*, Wiley Eastern Ltd., Bombay.
3. Vogel A. I., *Quantitative Organic Chemistry*, Pearson Edition, Delhi.
4. Clarke H. T., *Hand Book of Organic Analysis*, Arnold Heinemann Publishers, Delhi.
5. Sanyal S. N., Reactions, Rearrangements and Reagents.
6. College Practical Chemistry by H. N. Patel, S. R. Jakali, H. P. Subhedar, Miss. S. P. Turakhia. Himalaya Publishing House, Mumbai.
7. College Practical Chemistry by Patel, Jakali, Mohandas, Israney Turakhia. Himalaya Publishing House, Mumbai.

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Third Year B.Sc. (Chemistry) Semester-VI

Vertical: DSE1-4

Course Code: G04-DSE4-602

Course Name: Chemistry-DSE1-4 (Applied Analytical Chemistry II)

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

Course Preamble

This course covers the fundamentals and industrial applications of soaps and detergents, synthetic reagents, textile chemistry, and green chemistry. It focuses on manufacturing processes, organic transformations, textile treatment methods, and sustainable chemical practices, linking chemical principles with industrial and environmentally friendly applications.

Course Objectives

1. To understand about the soaps and detergents.
2. To study the role and applications synthetic reagents.
3. To acquire knowledge of textile processing techniques.
4. To understand the principles and applications of green chemistry.

Course Outcomes

After completion of the course students will be able to

1. Understand the manufacturing of soaps by Hot process.
2. Learn about reactions and applications of synthetic reagents.
3. Understand the processes involved in textile industry.
4. Understand about the zeolite and ultrasound assisted reactions, ionic liquids.

Unit	Contents	Lectures	Weightage
I.	1. **Soaps and Detergents** 1. Soaps i) Raw materials ii) Types of soaps iii) Manufacture of soap – Hot process iv)Cleansing action of soaps 2. Detergents i) Raw materials ii) Types of detergents - Cationic, anionic, amphoteric, neutral detergents iii) Preparation of teepol and deriphat Comparison between soaps and detergents **2. Synthetic Reagents** Synthetic Reagents Sodium borohydride: Use in reduction of aldehydes and ketones Lithium aluminum hydride: Use in reduction of aldehydes, ketones, acids, amides and esters Osmium tetroxide: Hydroxylation of alkenes 1,3-dithiane : Umpolung concept, reactions with alkyl halide and acyl halide Selenium dioxide: Oxidation of carbonyl compounds and allylic oxidation	**08** **07**	
II.	**3. Textile Chemistry** Introduction, classification of fibers Sizing: object of sizing, sizing ingredients and their functions General idea of processes: singeing, desizing, scouring Bleaching: Brief study of the outline of the process of bleaching cotton and synthetic material. Dyeing: Study of dyeing of cellulosic material and synthetic fibers with dyes like direct, vat, reactive and dispersed yes. **4. Green Chemistry** Introduction Twelve principles of green chemistry Zeolites as green catalysts Ultrasound assisted reactions Reactions in ionic liquids Solvent free reactions	**08** **07**	

Reference Books:

1. Basic Concepts of Analytical Chemistry - S. M. Khopkar, Wiley Eastern Ltd. Bombay.
2. Industrial Chemistry - R. K. Das, Asia Publishing, Mumbai.
3. Text Book of Quantitative Organic Analysis - A. I. Vogel, Pearson Edn. Delhi.
4. Quantitative Organic Chemistry - A. I. Vogel, Pearson Edn. Delhi.
5. Advanced Organic Chemistry - B. S. Bahl and Arun Bahl, S. Chand Comp. Delhi.
6. Riegel's Handbook of Industrial Chemistry - J. A. Kent, Van. Nostrard, Londan.
7. Chemical Process Industries - Shreve and Brinic - Ostin, Magraw Hill, NewYork.
8. Advances in Green Chemistry: Chemical synthesis using MW-irradiation by R. S. Varma.
9. Green Chemistry: Environment Friendly alternatives-Rashmi Sanghiand M. M. Srivastava (Eds) (c) 2003 Narosa Publishing House, New Delhi, India.
10. Reactions, rearrangements and reagents: S. N. Sanyal
11. Organic reaction mechanism: V. K. Ahluwalia and K.R. K. Parashar
12. Environment friendly synthesis using ionic liquids: Jairton Dupont, Toshiyuki Itoh and Sanjay V. Malhotra (CRC Press)

Industrial chemistry : B. K. Sharma (Goel Publishing House, Meerut)

13. Engineering Chemistry: P. C. Jain and M. Jain (Dhanpatrai and Sons., Delhi)
14. Practical Organic Chemistry: A. I. Vogel
16. A book of textile chemistry: A. J. Hall
17. Bleaching and Dyeing : Dr. V. Shenai
18. Sizing : D. B. Ajgaonkar
19. Chemical process industries : Shreve and Brinik (Ostin McGraw Hill Publication, New York)
20. Medicinal and Pharmaceutical Chemistry: Hakishan, V. K. Kapoor (Vallabh Prakashan Pimpura New Delhi)
21. Industrial Chemistry, Vol. I:E. Stocchi (Ellis Horwood Ltd, UK)

Punyashlok Ahilyadevi Holkar Solapur University, Solapur

Third Year B.Sc. (Chemistry) Semester-VI

Vertical: DSE1-4

Course Code: G04-DSE4-602-P

Course Name: Practical Lab-DSE1-4 P

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

Course Preamble

This practical course focuses on the quantitative estimation of organic compounds and pharmaceutical products using volumetric methods. It develops laboratory skills for determining molecular weight, unsaturation, drug content, sucrose, and saponification value, with applications in pharmaceutical and industrial analysis.

Course Objectives

1. To develop skills in volumetric estimation.

2. To understand the principles involved in determination of molecular weight and unsaturation.

3. To learn analytical methods for estimation of active pharmaceutical ingredients.

4. To determine saponification value and analyze food and oil samples.

Course Outcomes

After completion of the course students will be able to

1. Understand the molecular weight of mono- and dibasic acids using volumetric methods.

2. Know the unsaturation in olefinic compounds by bromination method.

3. Estimate the content of paracetamol and ibuprofen in tablets.

4. Learn about estimation of sucrose and saponification value of oils.

Contents
Estimations. (Any Four) **a.** Determination of Molecular weight of monobasic /dibasic acid by volumetric method **b.** Estimation of unsaturation of given olefinic compound by bromination method **c.** Estimation of Paracetamol in given tablet **d.** Estimation of Ibuprofen in given tablet **e.** Estimation of sucrose in given solution using Fehling's solution. **f.** Determination of saponification value of an oil

Reference Books:

1. Vogel A. I., Text Book of Quantitative Organic Analysis, Pearson Edition, Delhi.
2. Khopkar S. M., Basic Concepts of Analytical Chemistry, Wiley Eastern Ltd., Bombay.
3. Clarke H. T., Hand Book of Organic Analysis, Arnold Heinemann Publishers, Delhi.
4. Hakishan and Kapoor, V. K., Medicinal and Pharmaceutical Chemistry, Vallabh Prakashan, New Delhi.
5. Sanyal S. N., Reactions, Rearrangements and Reagents.
6. College Practical Chemistry by H. N. Patel, S. R. Jakali, H. P. Subhedar, Miss. S. P. Turakhia. Himalaya Publishing House, Mumbai.
7. College Practical Chemistry by Patel, Jakali, Mohandas, Israney Turakhia. Himalaya Publishing House, Mumbai.

Punyashlok Ahilyadevi Holkar Solapur University, Solapur

Third Year B.Sc. (Chemistry) Semester-VI

Vertical: VSC-IV

Course Code: G04-VSC-602

Course Name: VSC-IV (Hands-on Training related to DSE-1-2)

*Teaching Scheme	*Examination Scheme
Lectures:04 Hours/week, 02 Credits	UA:30 Marks CA: 20 Marks

Course Preamble
This course provides hands-on-training to the students. This course comprises organic estimation, organic preparation and the spectral analysis problems. Students will be provided the IR, NMR and Mass spectra and on the basis of these information, student has to confirm the structure of the given organic compound.

Course Objectives
1. To estimate the organic compounds 2. To prepare various derivatives of organic compounds 3. To read IR, NMR and Mass spectra 4. To predict the important function groups, kinds of protons present in the given organic compounds 5. To predict the probable structure of the organic compound.

Course Outcomes After completion of the course students will be able to
1. Estimate acetone, ibuprofen and ethyl benzoate 2. Prepare organic compounds and recrystallize them 3. Understand important organic reactions like aldol condensation, radical coupling reactions 4. Calculate the percentage practical yield of prepared compounds 5. Analyse the spectral data and confirm the structure of given organic compound

Contents
A) Organic Estimations (Any two) 1) Estimation of acetone 2) Estimation of ibuprofen from given ibuprofen tablet 3) Estimation of ethyl benzoate **B) Organic Preparations (Any two)** N.B.: a) Calculation of percentage practical yield. b) Recrystallisation of crude product and its melting point. 1) Base catalyzed Aldol condensation: Preparation of Dibenzal propanone from benzaldehyde and acetone. 2) Radical coupling reaction: Preparation of 1,1,2 bis-2naphthol from β-naphthol 3) Multicomponent reaction: Preparation of Dihydropyrimidone from benzaldehyde, ethyl acetoacetate and urea. **C) Spectral Analysis (Any Six)** Identification of unknown organic molecules by analysis of their spectra. Photocopies of IR, NMR and Mass spectra of standard compounds are to be interpreted to determine the structure of the compound. Ethanol, Benzyl alcohol, Acetophenone, Ethyl bromide, Ethyl acetate, Ethyl benzoate, Propanoic acid, Acetaldehyde, Butyraldehyde, n-Propyl cyanide, Isopropyl benzene, 2-Chloro butane. At the time of practical examination, candidates are expected to submit the Journal.

Reference Books:

1. Organic Spectroscopy by P. S. Kalsi.
2. Organic Spectroscopy by William Kemp
3. Spectrometric Identification of Organic Compounds by Robert Silverstein, Francis Webster, David Kiemle.
4. Introduction to Spectroscopy by Donald L. Pavia, Gary M. Lampman, George S. Kriz, and James R. Vyvyan
5. Practical Organic Chemistry by A. I. Vogel.
6. Hand book of Organic qualitative analysis by H. T. Clarke.
7. A laboratory Hand Book of Organic qualitative analysis and separation by V. S. Kulkarni. Dastane Ramchandra & Co.
8. Comprehensive Practical Organic Chemistry Preparation and Quantitative Analysis by V.K. Ahluwalia, Renu Agarwal. University Press. Distributor-Orient Longmann Ltd.
9. Practical Chemistry-Physical-Inorganic-Organic and Viva-voce by Balwant Rai Satija. Allied Publishers Private Limited.