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: PHARMACEUTICAL AND FINE CHEMICAL TECHNOLOGY

(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
B.Sc. (Pharmaceutical and Fine Chemical Technology)
Program Preamble

The Bachelor of Science (BSc) in **Pharmaceutical and Fine Chemical Technology** 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:** This program integrates medicinal chemistry, organic synthesis, analytical techniques, and pharmaceutical regulatory sciences to prepare students for careers in the pharmaceutical and fine chemical industries. Through comprehensive theoretical instruction and extensive hands-on laboratory training, graduates develop expertise in drug synthesis, quality control, process validation, and regulatory compliance.
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 Pharmaceutical and Fine Chemical Technology 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 Pharmaceutical and Fine Chemical Technology**.
- **Year 2:**
  After two years, students may choose to exit with a **Diploma in Pharmaceutical and Fine Chemical Technology**.
- **Year 3:**
  Completion of the third year qualifies students for a **BSc Degree in Pharmaceutical and Fine Chemical Technology**.
- **Year 4:**
  The fourth year offers an advanced curriculum with a focus on research, allowing students to graduate with an **Honors Degree in Pharmaceutical and Fine Chemical Technology**.

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
B.Sc. (Pharmaceutical and Fine Chemical Technology)
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 knowledge of medicinal chemistry principles to drug design and development, Perform qualitative and quantitative analysis of biomolecules and drug substances.

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

B.Sc. (Pharmaceutical and Fine Chemical Technology)

Program Specific Outcomes (PSOs)

Students graduating from B.Sc. (Chemistry) will able to:

PSO1. Apply principles of medicinal chemistry, SAR, and QSAR to design and develop small molecule drugs targeting specific molecular targets.

PSO2. Execute multi-step organic synthesis of pharmaceutical compounds with proficiency in reaction mechanisms, yield calculation, and process scale-up.

PSO3. Perform qualitative and quantitative analysis of drugs and biomolecules using physicochemical and instrumental techniques for quality assessment.

PSO4. Implement GMP, QbD, validation protocols, and regulatory guidelines (USFDA, ICH, NDCT Rules) in pharmaceutical product development and manufacturing.

Punyashlok Ahilyadevi Holkar Solapur University, Solapur

Faculty of Science and Technology

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

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

Level/ Difficulty	Sem.	Faculty			Generic/ Open Elective GE/ OE	Vocational and Skill Enhancement Courses (SEC/VSC)	Ability Enhancement Course (AEC), IKS, VEC	Field Project/ RP/CC/Internship/Apprenticeship/ Community Engagement & Services	Credits	Cumulative Credits
		Major		Minor						
		DSC	DSE							
4.5 100-200	I	DSC1-1 (2+2)#	--		GE1/ OE1(2)	SEC1 (2)	L1-1(2) IKS (2) VEC1(2) (Indian Constitution And Democracy)	--	22	**44 UG Certificate (44)**
		DSC2-1 (2+2)#	--							
		DSC3-1 (2+2)#	--							
	II	DSC1-2 (2+2)#	--		GE2/ OE2(2)	SEC 2 (2)	L1-2(2) VEC2(2) (Environmental Studies)	CC1 (2)	22	
		DSC2-2 (2+2)#	--							
		DSC3-2 (2+2)#	--							
Exit option: Award of UG Certificate in Major with 44 credits and an additional 4 credits core NSQF course/ Internship OR Continue with Major and Minor										
5.0/200	III	DSC1-3 (2+1)	---	DSC2-3 (2+1)	GE3 / OE3(2)	VSC1 (2) (DSC1) VSC2(2) (DSC2)	L2-1 (2)	CC2 (2)	22	**44 UG Diploma (88)**
		DSC1-4 (2+1)	---	DSC-2-4 (2+1)						
	IV	DSC1-5 (2+1)	---	DSC2-5 (2+1)	GE4/ OE4 (2)	VSC3 (2) (DSC1) VSC4(2) (DSC2)	L2 -2(2)	FP1/CEP1(2)	22	
		DSC1-6 (2+1)	--	DSC2-6 (2+1)						
Exit option: Award of UG Diploma in Major with 88 credits and an additional 4 credits core NSQF course/ Internship OR Continue with Major										
5.5/300	V	DSC1-7 (3+2) 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 Pharmaceutical and Fine Chemical Technology NEP 2020 Structure							
SEM	**Faculty**		**GE/OE**	**VSC**	**IKS**	**Field Project**	**Credits**
	DSC	**DSE**					
V	DSC1-7 (3+2) **Medicinal Chemistry-I** (45 Period) DSC1-8 (3+2) **Validation & Regulatory Requirements** (45 Period) DSC1-9 (3+2) **Organic Chemistry-I** (45 Period)	DSE1-1 (2+1) **Applied Analytical Chemistry I** (30 Period) or DSE1-2 (2+1) **Chemistry and Technology of Fine Chemicals** (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) **Medicinal Chemistry-II** (45 Period) DSC1-11 (3+2) **Pharmaceutical Formulation Technology** (45 Period) DSC1-12 (3+2) **Organic Chemistry-II** (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: Pharmaceutical and Fine Chemical Technology

[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	Medicinal Chemistry-I	3	2	30	20	45	30
	DSC 1-8	Validation & Regulatory Requirements	3	2	30	20	45	30
	DSC 1-9	Organic Chemistry-I	3	2	30	20	45	30
	DSE 1-1 A	Applied Analytical Chemistry I	2	1	20	10	30	15
	DSE 1-1 B	Chemistry and Technology of Fine Chemicals	2	1	20	10	30	15
	VSC 5	Hands on training related to DSE	---	2	--	20	--	30
	IKS 2	Traditional Indian Chemical Technology	2	---	20	---	30	---
VI	DSC 1-10	Medicinal Chemistry-II	3	2	30	20	45	30
	DSC 1-11	Pharmaceutical Formulation Technology	3	2	30	20	45	30
	DSC 1-12	Organic Chemistry-II	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

Punyashlok Ahilyadevi Holkar Solapur University, Solapur

Third Year B.Sc. (Pharmaceutical and Fine Chemical Technology) Semester-V

Vertical: DSC1-7

Course Code: G04-DSC1-0543

Course Name: Medicinal Chemistry-I

*Teaching Scheme	*Examination Scheme
Lectures:03 Hours/week, 03 Credits	UA: 45 Marks CA: 30 Marks

Course Preamble
This course provides a comprehensive exploration of medicinal chemistry, bridging classical drug design principles with modern, sustainable synthetic methodologies. Students will systematically investigate the classification, mechanism of action, and structure-activity relationships (SAR) of antimicrobial, anticancer, and antiviral agents, while emphasizing green chemistry approaches including microwave-assisted synthesis, solvent-free reactions, and waste minimization strategies.

Course Objectives
1. To acquaint the students with therapeutic category of drugs 2. To acquaint the students with it's classification & Mechanism of Action of drugs 3. To acquaint the students with Structure-Activity Relationship (SAR) of drugs 4. To acquaint the students with the concept of green chemistry 5. To acquaint the students with alternative methods of chemical synthesis

Course Outcomes After completion of the course students will be able to
1. Understand and appreciate the molecular design principles by studying Structure-Activity Relationship (SAR) and molecular mechanism of action 2. Follow the unmet medical need for newer agents for treating various infectious diseases such as COVID-19 and multidrug-resistant microbial infections 3. Understand the concept of green chemistry and alternative methods of chemical synthesis 4. Study the synthetic approaches for various APIs and New Chemical Entities (NCEs)

Unit	Contents	Lectures	Weightage
I.	**1. General Introduction to Medicinal Chemistry** 1.1 Definitions and explanation of terms used in Medicinal Chemistry 1.2 Introduction to Green Chemistry 1.3 Green Chemistry Principles 1.4 minimization of waste generation and waste prevention, 1.5 Case studies, 1.6 Introduction to Alternative Methods of Chemical Synthesis, 1.7 Photochemistry 1.8 Microwave-Assisted Organic Synthesis (MAOS) 1.9 Schrodinger wave equation- (Derivation not expected) 1.10 Solvent free synthesis 1.11 Electrochemistry and Sonochemistry.	**15**	**25**
II.	**2. Classification, Mechanism of action, SAR** 2.1 Antibacterial Agents 2.2 Antibiotics: β-lactam antibiotics including Penicillins, Cephalosporins, Carbapenems, Monobactams, Tetracyclincs, Marcolides, Aminoglcosides Miscellaneous. 2.3 Synthetic Antibacterials: Sulfonamides and DHFR inhibitors, Quinolones, Oxazolidinediones and other miscellaneous agents. 2.4 Antifungal Agents: Azoles, Polyene antibiotics Miscellaneous agents 2.5 Antimycobacterial Agents: Antitubercular agents, Antileprotic agents.	**15**	**25**
III.	**3. Classification, Mechanism of action, SAR** 3.1 Anticancer Agents: Alkylating agents, Nitrosoureas: Procarbazines, Triazines and miscellaneous, 4.2 Organoplatinum agents Antibiotics, Antimetabolites including DNA polymerase inhibitors, Pyrimidine and purine antagonists and miscellaneous agents. 4.3 Antiviral Agents: General aspects, Nucleic acid synthesis inhibitors Amantidine and its analogs, Interferons (IFNs) and its inducers Neuraminidase inhibitors Antiretroviral drugs including NRTI, NNRTI and protease inhibitors. 4.4 Drugs against Emerging Viral Infections, e.g., Coronaviruses.	**15**	**25**

Reference Books:

1. Lemke, T. L., Zito, S. W., Roche, V. F., Williams, D. A. Essentials of Foye's Principles of Medicinal Chemistry; Wolters Kluwer (2017)
2. Lemke, T. L., Williams, D. A., Roche, V. F., Zito, S. W. Foye's Principles of Medicinal Chemistry; 7th ed.; Wolters Kluwer (2013)
3. Wilson and Gisvold's Textbook of Organic Medicinal and Pharmaceutical Chemistry; Beale, J. M., Jr.,

Block, J. H., Eds.; 12th ed.; Wolters Kluwer (2011)
4. Burger's Medicinal Chemistry & Drug Discovery, Vol. 1- 6; Abraham, D. J., Ed.; 6th ed.; John Wiley & Sons - New Jersey (2003)
5. Kleeman, A., Engel, J., Kutscher, B., Reichert, D. Pharmaceutical Substances: Syntheses, Patents and Applications of the Most Relevant APIs; 5th ed.; Thieme Medical Publishers Inc. (2009)
6. Lednicer, D. The Organic Chemistry of Drug Synthesis; Vol. 1 - 7); John Wiley & Sons, INC. (2008)
7. Silverman, R. B., Holladay, M. W. The Organic Chemistry of Drug Design and Drug Action; 3rd ed.; Elsevier (2014) 8 Warren, S., Wyatt, P. Organic Synthesis: The Disconnection Approach; 2nd ed.; Wiley; (2008)
8. Handbook of Green Chemistry, Vol. 11: Green Metrics; Anastas, P. T., Constable, D. J. C., Jimenez-Gonzalez, C., Eds.; Wiley-VCH, (2018)
9. ACS Green Chemistry Institute. https://www.acs.org/content/acs/en/greenchemistry/about.html
10. Green Chemistry in Industry: Green Chemical Processing.; Benvenuto, M. A., Plaumann, H., Eds.; de Gruyter, Berlin, GmbH (2018)
11. Brahmachari, G. Catalyst-free Oganic Synthesis. Green Chemistry Series 51; RSC, Cryodon, UK (2018)
12. Albini, A., Protti, S. Paradigms in Green Chemistry and Technology. SpringerBriefs in Molecular Science: Green Chemistry for Sustainability; Sharma, S. K., Ed.; Springer, London, UK (2016)
13. Green Chemistry Strategies in Drug Discovery. RSC Drug Discovery Series 46; Peterson, E. A., Manley, J. B. Eds.; RSC, Cambridge, UK (2015)
14. Worldwide Trends in Green Chemistry Education; Zuin, V. G., Mammino, L., Eds.; RSC, Cambridge, UK (2015)

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Third Year B.Sc. (Pharmaceutical and Fine Chemical Technology) Semester-V

Vertical: DSC1-7 P

Course Code: G04-DSC1-0543P

Course Name: Pharmaceutical and Fine Chemical Technology Practical Lab VII

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

Course Preamble
This laboratory course provides hands-on training in the synthesis of pharmaceutically important organic compounds, bridging theoretical medicinal chemistry with practical laboratory skills. Students will gain expertise in executing multi-step syntheses, understanding reaction mechanisms, calculating theoretical yields, and handling diverse reagents preparing them for industrial and research applications in drug development.

Course Objectives
1. Understanding of the synthesis of drugs 2. Understanding of synthesized drugs with their reaction mechanism 3. Understanding of calculating theoretical yield 4. Knowledge of different reagents and products

Course Outcomes After completion of the course students will be able to
1. Apply knowledge of synthesis in in industry 2. Hands on training with drug synthesis reactions 3. Apply knowledge of reaction mechanism 4. Understanding of laboratory practices in drug synthesis

Contents
1. Synthesis Of Phenytoin 2. Synthesis Of Benzocaine [Ethyl Para Amino Benzoate] 3. Synthesis Of 2,3-Diphenyl Quinoxaline 4. Synthesis Of Benzotriazole 5. Synthesis Of Benzimidazole 6. Synthesis of Phenothiazine 7. Synthesis of Barbituric acid 8. Synthesis of 3-methyl-1-phenyl pyrazole-5-one. 9. Synthesis of 4-benzylidene-2-phenyl oxazole-5-one 10. (Any other relevant experiments)

Reference Books :

1. B.S. Furniss, A.J. Hannaford, P.W.G. Smith, A.R. Tatchell, Vogel's Textbook of Practical Organic Chemistry, 5th Edition, Pg. 1162.
2. B.S. Furniss, A.J. Hannaford, P.W.G. Smith, A.R. Tatchell, Vogel's Textbook of Practical Organic Chemistry, 5th Edition, Pg. 1163.
3. Siddiqui AA, Siddiqui S., Experimental Pharmaceutical Chemistry, 3rd Edition, CBS Publishers & Distributors Pvt. Ltd., New Delhi, 2019, 230-231.
4. Tiwari, R. Kumar, A practical book of Medicinal Chemistry, Nirali Prakashan, Pune, 2019, 1.
5. Tiwari, R. Kumar, A practical book of Medicinal Chemistry, Nirali Prakashan, Pune, 2019, 5-6.
6. Kar, Advanced Practical Medicinal Chemistry, New Age International Publishers, New Delhi, 3rd edition, Pg. 337-339.
7. G. Devala Rao, Practical Medicinal Chemistry, 1st edition, Birla Publications Pvt. Ltd., Delhi, 2007-2008, 12-13.
8. P. Mondal, S. Mondal, Handbook of Practical, Pharmaceutical Organic, Inorganic and Medicinal Chemistry, Educreation Publishing, New Delhi, 2019, 189-190.

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Third Year B.Sc. (Pharmaceutical and Fine Chemical Technology) Semester-V

Vertical: DSC 1-8

Course Code: G04-DSC1-0544

Course Name: Validation & Regulatory Requirements

*Teaching Scheme	*Examination Scheme
Lectures:03 Hours/week, 03 Credits	UA: 45 Marks CA: 30 Marks

Course Preamble
This course provides a comprehensive understanding of the regulatory and quality frameworks governing pharmaceutical manufacturing and product development. Students will explore Good Manufacturing Practices (GMP), Quality by Design (QbD), validation principles, and global regulatory pathways equipping them with the knowledge to ensure product quality, safety, and regulatory compliance in the pharmaceutical industry.

Course Objectives
The course is designed to train the students in understanding the principles behind Good Manufacturing Practices (GMP), scientific and risk-based product development approaches, and validation and regulatory requirements for Pharmaceuticals.

Course Outcomes After completion of the course students will be able to
1. Explain regulatory concepts such as Qbd, GMP and many others. 2. Comprehend product and process validation and documentation required for the same. 3. Analyze the regulatory pathways for new drug application and generic product development for various products.

4. Comprehend relevant regulations and laws governing the pharmaceutical manufacturing.

Unit	Contents	Lectures	Weightage
I.	**Good Manufacturing Practices (GMP) and Facility Design** 1.1. GMP: Personnel, Facility, Environmental and manufacturing factors Quality assurance Quality audits 1.2. Regulations governing Pharmaceutical Product Development: New Drugs and Clinical Trial Rules, 2019 1.3. Pilot Plant Scale-up: Introduction, Pilot Plant Scale-up Techniques – Group responsibilities, Facilities, General considerations, Case studies (solid, liquid, semisolid dosage forms). 1.4. Quality by Design (QbD): QbD elements, Design of experiments, Examples of scaling up of Liquid, Solid oral formulations, Semisolids, Parenteral preparations using QbD approach.	**15**	**25**
II.	**Validation** 2.1 Introduction to validation, process validation and scope, Priority order for pharmaceutical validation, Types of validation (prospective, retrospective. concurrent and revalidation), Steps in validation. 2.2 Case studies (solid, liquid, semisolid dosage forms), Case Studies on validation of Processes, Equipments and Products, 2.3 Documentation for Pharmaceuticals	**15**	**25**
III.	**Introduction to Regulatory Aspects of Pharmaceuticals.** 3.1 Introduction to regulatory aspects of pharmaceuticals, need, advantages and limitations, 3.2 Introduction to major regulatory bodies worldwide. Rationale for regulatory harmonization and introduction of ICH 3.3 Introduction to Common Technical Document (CTD) Modules. 3.4 Comparison of Indian and European guidelines w.r.t. USFDA guideline, 3.5 Regulatory Procedures for Pharmaceutical Product Market Approval as per USFDA Guidelines: Investigational New Drug (IND), New Drug Application (NDA) [505(b) (1) and (b)(2)], Abbreviated New Drug Application (ANDA) 505 (j) filing, Review and Approval process 3.6 Legal Acts: Drugs and Cosmetics Act, 1940 and Drugs and Cosmetics Rules, 1945 Drug Price Control Order (DPCO) 1955	**15**	**25**

Reference Books :

1. Beotra's Law of Drugs Medicins and Cosmetics K. K. Singh, L. R. Bugga for the Law Book Co. Pvt. Ltd., Allahabad
2. Modern Pharmaceutics, G. S. Banker, New York, Marcel Dekker (1990)
3. Fundamentals of Pharmacy, Blome H. E., Philadelphia, Fea and Febiger (1985)
4. Pharmaceutical Production Facilities: Design and Applications, G. C. Cole, New York, Ellis, Horwood (1990)
5. Drug Delivery Devices: Fundamentals and Applications. Tyle, New York, Marcel Dekker (1988) Microbial Quality Assurance in Pharmaceuticals Cosmetics and Toiletries, S. F. Bloomfield, Chichester, Ellis, Horwood (1998)
6. Encyclopedia of Pharmaceutical Technology, J. Swarbrick, New York, Marcel Dekker (1993) Remington's Pharmaceutical Sciences, A. R. Gennaro Mac Pub. Co. Easton, Pennsylvania (1990) Pharmaceutical Product Development: Insights into Pharmaceutical Processes, Management and Regulatory Affairs, Patravale V, Rustomjee M, Dsouza J., CRC Press (2016)
7. Latest Editions of Indian Pharmacopoeia (IP), British Pharmacopoeia (BP), United States Pharmacopoeia (USP), Japanese Pharmacopoeia (JP), European Pharmacopoeia (Ph. Eur.)
8. Oral Mucosal Drug Delivery, Rathbone, New York, Marcel Dekker (1996)
9. Good Laboratory Practice Regulations, A. F. Hirsch, New York, Marcel Dekker (1989)
10. Good Laboratory Practice Regulations, Weinberg, New York, Marcel Dekker (1995).

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Third Year B.Sc. (Pharmaceutical and Fine Chemical Technology) Semester-V

Vertical: DSC1-8 P

Course Code: G04-DSC1-0544P

Course Name: Pharmaceutical and Fine Chemical Technology Practical Lab VIII

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

Course Preamble
This laboratory course provides hands-on training in the qualitative and quantitative analysis of biomolecules and physicochemical properties of drugs. Students will develop practical skills in determining critical parameters such as moisture content, partition coefficient, pKa, surface tension, and stability constants building a strong foundation in analytical techniques essential for pharmaceutical research and quality control.

Course Objectives
1. Understanding of qualitative and quantitative tests of biomolecules 2. Understanding of determination of moisture content 3. Understanding of determination of Partition co- efficient 4. Understanding of determination of different physicochemical parameters of drugs.

Course Outcomes After completion of the course students will be able to
Apply various analytical techniques for qualitative and quantitative analyses. phytochemical screening of aqueous /alcoholic extract of different crude drugs

Contents
1. Preliminary phytochemical screening of aqueous /alcoholic extract of different crude drugs. (Azadirachta indica (Leaf)) 2. Determination of moisture content and loss on drying. 3. Determination the solubility of drug at room temperature 4. Determination of pKa value by Half Neutralization/ Henderson Hasselbalch equation. 5. Determination of Partition co- efficient of benzoic acid in benzene and water 6. Determination of Partition co- efficient of Iodine in CCl4 and water 7. Determination of % composition of NaCl in a solution using phenol-water system by CST method 8. Determination of surface tension of given liquids by drop count and drop weight method 9. Determination of HLB number of a surfactant by saponification method 10. Determination of Freundlich and Langmuir constants using activated char coal 11. Determination of critical micellar concentration of surfactants 12. Determination of stability constant and donor acceptor ratio of PABA-Caffeine complex by solubility method 13. Determination of stability constant and donor acceptor ratio of Cupric-Glycine complex by pH titration method

Reference Books :

1. Physical Pharmacy by Alfred Martin
2. Experimental Pharmaceutics by Eugene, Parott.
3. Tutorial Pharmacy by Cooper and Gunn.
4. Stocklosam J. Pharmaceutical Calculations, Lea & Febiger, Philadelphia.
5. Liberman H.A, Lachman C., Pharmaceutical Dosage forms, Tablets, Volume-1 to 3, Marcel Dekkar Inc.
6. Liberman H.A, Lachman C, Pharmaceutical Dosage forms. Disperse systems, volume 1, 2, 3. Marcel Dekkar Inc.
7. Physical Pharmaceutics by Ramasamy C and Manavalan R.
8. Laboratory Manual of Physical Pharmaceutics, C.V.S. Subramanyam, J. Thimma settee
9. Physical Pharmaceutics by C.V.S. Subramanyam
10. Test book of Physical Pharmacy, by Gaurav Jain & Roop K. Khar

Punyashlok Ahilyadevi Holkar Solapur University, Solapur

Third Year B.Sc. (Pharmaceutical and Fine Chemical Technology) Semester-V

Vertical: DSC 1-9

Course Code: G04-DSC1-0545

Course Name: IX (Organic Chemistry I)

*Teaching Scheme	*Examination Scheme
Lectures:03 Hours/week, 03 Credits	UA:45 Marks CA: 30 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**	**13** **12**

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**	**25**
III.	**5. 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**	**12**

	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) **6. 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**	**13**

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. (Pharmaceutical and Fine Chemical Technology) Semester-V

Vertical: DSC1-9 P

Course Code: G04-DSC1-0545P

Course Name: 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. (Pharmaceutical and Fine Chemical Technology) Semester-V** **Vertical: DSE 1-1** **Course Code: G04-DSE1-515** **Course Name: DSE-1-1 (Applied Analytical Chemistry I)**
***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. Apply the principles of sampling to design an optimum analytical protocol
2. Identify conditions to minimize the error and increase the sensitivity of analysis
3. Explain the principles of electrochemical methods
4. Understand the principles of chromatographic separations

Unit	Contents	Lectures	Weightage
I.	Introduction to chemical analysis, terminology (technique / method / procedure / protocol), broad classification of analytical techniques, good laboratory practices Criteria for selecting analytical methods – accuracy, precision, sensitivity, selectivity, and detection limit Calibration and validation Data analysis: errors – systematic and random errors, statistical treatment of experimental results (F, Q and t tests, rejection of data, and confidence intervals), least square method, correlation coefficients	**15**	**23**
II.	Electrochemical methods: General principle, instrumentation and applications of Conductometry Potentiometry Chromatographic methods: General principle, instrumentation and applications of Gas chromatography (GC) HPLC	**08** **07**	**12** **11**

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. David Harvey. Modern Analytical Chemistry; McGraw-Hill (1999)
4. R. A. Day and A. L. Underwood. Quantitative Analysis, Prentice Hall of India (2001)
5. H. H. Willard, L. L. Merritt, J. A. Dean and F. A. Settle. Instrumental Methods of Analysis, 7th ed.;
6. Wadsworth Publishing, USA (2004)
7. D. A. Skoog, D. M. West, F. James Holler and S. R. Crouch. Fundamentals of Analytical Chemistry; 9th ed.; Cengage Learning (2013)
8. D. A. Skoog, F. James Holler and S. R. Crouch. Principles of Instrumental Analysis; 6th ed.; Cengage Learning (2016) 1
9. Vogel's text book of Quantitative Inorganic Analysis by Basssett and Denny etc. ELBS and Longman 4th Edition.
10. Principles of Physical Chemistry by Puri, Sharma, Pathania, Shobhanlal Nagin Chand

and Company, Jalandar.
11. Text Book of Physical Chemistry by S. Glasstone, McMillan India Ltd.
12. Elements of Physical Chemistry by D. Lewis and S. Glasstone (McMillan).
13. Principles of Physical Chemistry by Maron and Lando (Amerind).
14. An Introduction to Electrochemistry by S. Glasstone.
15. Physical Chemistry by W. J. Moore.
16. Essentials of Physical Chemistry, Bahl and Tuli (S. Chand).
17. R. A. Day and A. L. Underwood. Quantitative Analysis, Prentice Hall of India (2001)

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. (Pharmaceutical and Fine Chemical Technology) Semester-V** **Vertical: DSE 1-1 P** **Course Code: G04-DSE1-515P** **Course Name: DSE- 1-1 P**
***Teaching Scheme** **Lectures:02 Hours/week, 01 Credits**	***Examination Scheme** **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 Outcomes After completion of the course students will be able to
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

Contents
Perform the following experiments 1. Determination of dissociation constants of a polybasic acid potentiometrically 2. Determination of critical micelle concentration (CMC) of the given surfactant conductometrically 3. Study of weak and strong electrolytes 4. Determination of water quality (hardness / BOD / COD) 5. Determination of standard electrode potential of Zn/Zn^{++}, Cu/Cu^{++}, Ag/Ag^{+} (Any two). 6. Determination of solubility and solubility product of AgCl. 7. 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).

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).
7. Practical Physical Chemistry – B.Viswanthan and P.S. Raghavan, 2005

Punyashlok Ahilyadevi Holkar Solapur University, Solapur

Second Year B.Sc. (Pharmaceutical and Fine Chemical Technology) Semester-V

Vertical: DSE 1-2

Course Code: G04-DSE2-515

Course Name: DSE-1-2 (Chemistry and Technology of Fine Chemicals)

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

Course Preamble
The course is designed to provide the learner a foundation for understanding of both Basic and Applied Chemistry. It gives the learner a bridge between Industrial Chemistry and Pure Chemistry. This course helps to develop a strong thinking process amongst the learners both in technical and applied chemistry which will prepare them for employment and advanced study

Course Outcomes After completion of the course students will be able to
CO1 Explain the very basics of small scale industry right from its setting to the various operations and processes used in different chemical manufacturing processes. CO2 Differentiate between heavy and fine chemicals and state their various applications in industry and daily life. CO3 Explore the process of manufacture of variety of fine chemicals. CO4 Demonstrate the process of preparation of solutions and adapt a method of the planning and implementation of organic and inorganic reactions.

Unit	Contents	Lectures	Weightage
1.	The Chemical Industry: A Brief History, Fine vs Bulk Vs specialty Chemicals Production of Fine Chemicals Introduction, Role of Catalysis, Atom Economy, Alternative Reagents and Catalysts, Novel Reaction Routes, Selectivity, Solvents, Conventional Solvents, Alternative Solvent, Production Plants, Multiproduct and Multipurpose Plants (MMPs) , Dedicated Continuous Plants, Batch Reactor Selection, Reactors for Liquid and Gas–Liquid Systems, Reactors for Gas–Liquid–Solid Systems, Batch Reactor Scale-up Effects, Temperature Control, Summary of the Scale-up of Batch Reactors, Safety Aspects of Fine Chemicals, Thermal Risks, Safety and Process Development.	**15**	**23**
II.	Understanding Fine Chemicals: Selected Fine Chemical Technologies with examples: Alkylation, Halogenation, Oxidation, Reduction, Esterification, Nitration, and Hydrogenation	**15**	**23**

Reference Books :

1. UNIT PROCESSES IN ORGANIC SYNTHESIS P. H. Groggins, Editor-in-Chief, Fifth Edition. McGraw-Hill Book Co., Inc., New York (1952)
2 Chemical Process Technology SECOND EDITION JACOB A. MOULIJN MICHIEL MAKKEE ANNELIES E. VAN DIEPEN
3 Fine Chemicals: The Industry and the Business, 2nd ed., Peter Pollak, Wiley

4. T. B. of Inorganic analysis - A. I. Vogel.
5. Organometallic Chemistry by R. C. Mahrotra A. Sing, Wiley Eastern Ltd. New Delhi.
6. Organometallic Chemistry by P. L.Pauson.
7. Industrial chemistry part I and II by A. K. De
8. Industrial chemistry by B. K. Sharma

Punyashlok Ahilyadevi Holkar Solapur University, Solapur

Third Year B.Sc. (Pharmaceutical and Fine Chemical Technology) Semester-V

Vertical: DSE 1-2 P

Course Code: G04-DSE2-515P

Course Name: 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).

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Third Year B.Sc. (Pharmaceutical and Fine Chemical Technology) Semester-V

Vertical: IKS-2

Course Code: G04-IKS-515

Course Name: Traditional Indian Chemical Technology

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

Course Preamble
To acquaint the students with major chronological developments in Indian science and technology. To review the ancient discoveries and research related to chemicals in Pharmaceuticals, flavours and fragrances, metallurgy, architecture, textile, agriculture and Ayurveda etc. To know the fundamental principles of Indian health systems such as Ayurveda, which is useful in maintaining well-being. To facilitate the students to identify and develop interest in the ancient knowledge systems to make meaningful contributions to the development of science today. To develop respect and pride about Indigenous Knowledge thereby to assist the learners' understanding about conclusions/products from ancient Indian knowledge system for verifying them on modern scientific and technological footings.

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. 2. Traditional Indian Pharmaceutical Sciences and Technology: Alternative systems of Medicine/ Welfare of the society: Principles of Ayurveda - Medicinal plants and crude drugs - Reappraisal of Ayurvedic Phytochemistry - Ayurvedic Dosage forms and similarity to that of modern dosage forms - Extraction of herbs in Ayurvedic System and comparison to that of modern extraction process - Detoxification of poisonous plants (Shodhan Prakriya) Ancient perspective of Adulterants and Substitutes	**07** **08**	**11** **12**
II.	**1. 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 **2. 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**	**8** **15**

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. (Pharmaceutical and Fine Chemical Technology) Semester-V

Vertical: VSC-V

Course Code: G04-VSC-515

Course Name: VSC-V (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 methodand (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 colorimetrically.
4. To estimate the amount of silver from silver coin gravimetrically.
5. To estimate the amount of copper from brass metal alloy colorimetrically.

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. (Pharmaceutical and Fine Chemical Technology) Semester-VI** **Vertical: DSC1-10** **Course Code: G04-DSC1-0643** **Course Name: Medicinal Chemistry II**
***Teaching Scheme** **Lectures:03 Hours/week, 03 Credits**	***Examination Scheme** **UA:45 Marks** **CA: 30 Marks**

Course Preamble
This course introduces students to the fundamental principles of medicinal chemistry, covering molecular drug targets, small molecule drug discovery, and key organic chemistry reactions. Students will explore drug-receptor interactions, physicochemical properties, hit identification, lead optimization strategies, and electrophilic aromatic substitution reactions building a strong foundation for understanding drug design and development at the molecular level.

Course Objectives
1. To acquaint the students with general principles of Medicinal Chemistry 2. To acquaint the students with drug discovery of small molecules 3. To acquaint the students with molecular targets 4. To acquaint the students with Electrophillic Aromatic Substitution Reactions

Course Outcomes After completion of the course students will be able to
1. Apply basic knowledge on physicochemical properties of drugs for understanding design principles. 2. Extract SAR and MOA of drugs at the molecular level of understanding. 3. Apply principles of drug discovery from hit to lead to preclinical molecules. 4. Apply knowledge of modern drug discovery.

Unit	Contents	Lectures	Weightage
I.	**1. Molecular targets** 1.1 General Aspects: drug targets, concepts of drug binding, affinity, selectivity a) Types of bonds in ligand receptor interactions, role of functional groups b) Types drug-target interaction: competitive, uncompetitive, allosteric interactions c) Concept of druggable targets 1.2 Enzymes as Drug Targets: a) definitions and concepts-enzyme, apoenzyme, holoenzyme, coenzyme b) targeting human enzymes in physiological conditions c) targeting enzymes selective to pathogens. 1.3 Receptors as Drug Targets: d) Types and properties of receptors: GPCRs, Ligand gated ion channels, nuclear receptors, voltage gated ion channels, receptors with intrinsic, enzyme activity, receptors coupled to cytosolic proteins e) Cellular responses to ligand-receptor interactions.	**15**	**25**
II.	**2. Small molecules as drugs** 2.1 Physicochemical Properties: Passage of molecule through biological barriers: membrane transport (paracellular, transcellular), drug ionization, pKa, acids and bases used for salt formation, physicochemical properties, log P and log D, 2.2 Strategies for hit identification: Strategies for identification of hits: natural product based, serendipity, design of analogs, systematic and random screening, development of new leads from old drugs, introduction to concept of chemical space. 2.3 Lead Optimization: lead likeness and drug likeness, determination of compound, drug biological, biochemical properties, metabolic information using internet, homologs, concepts of bioisosterism. SAR, QSAR: Concept of SAR, effects of substituents and functional groups, introduction to QSAR 2.	**15**	**25**
III.	**3. Electrophilic Aromatic Substitution Reactions** Nitration, Halogenation, Alkylation, Acylation and Sulfonation Activating, deactivating and orienting effects of functional groups in mono- and poly-substituted benzenes Friedel-Crafts alkylation, Acylation, Gattermann, Gattermann-Koch, Riemer Tiemann reactions	**15**	**25**

Reference Books :

1. Lemke, T. L., Zito, S. W., Roche, V. F., Williams, D. A. Essentials of Foye's Principles of Medicinal Chemistry; Wolters Kluwer (2017)
2. Lemke, T. L., Williams, D. A., Roche, V. F., Zito, S. W. Foye's Principles of Medicinal Chemistry; 7th ed.; Wolters Kluwer (2013)
3. Wilson and Gisvold's Textbook of Organic Medicinal and Pharmaceutical Chemistry; Beale, J. M., Jr., Block, J. H., Eds.; 12th ed.; Wolters Kluwer (2011)
4. Burger's Medicinal Chemistry & Drug Discovery, Vol. 1- 6; Abraham, D. J., Ed.; 6th ed.; John Wiley & Sons - New Jersey (2003)
5. Kleeman, A., Engel, J., Kutscher, B., Reichert, D. Pharmaceutical Substances: Syntheses, Patents and Applications of the Most Relevant APIs; 5th ed.; Thieme Medical Publishers Inc. (2009)
6. Lednicer, D. The Organic Chemistry of Drug Synthesis; Vol. 1 - 7); John Wiley & Sons, INC. (2008)
7. 7 Silverman, R. B., Holladay, M. W. The Organic Chemistry of Drug Design and Drug Action; 3 rd ed.; Elsevier (2014)

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. (Pharmaceutical and Fine Chemical Technology) Semester-VI** **Vertical: DSC1-10 P** **Course Code: G04-DSC1-0643P** **Course Name: Pharmaceutical and Fine Chemical Technology Practical Lab -X**
***Teaching Scheme** **Lectures:04 Hours/week, 02 Credits**	***Examination Scheme** **UA:30 Marks** **CA: 20 Marks**

Course Preamble
This laboratory course trains students in standard organic synthesis techniques with emphasis on safety and qualitative analysis. Through hands-on experiments including esterification, condensation, bromination, nitration, heterocyclic synthesis, and other key transformations, students develop practical skills in reaction mechanisms, yield optimization, and product quality assessment.

Course Objectives
To train the students in standard laboratory practices with respect to safety, understand qualitative analysis of organic molecules

Course Outcomes After completion of the course students will be able to
1. Work safely in the organic chemistry laboratory. 2. Implement techniques for synthetic reactions. 3. Design and carry out experiments for simple organic transformations 4. Understand and apply reaction mechanisms and their practical implications. 5. Analyzing of the synthetic process with respect to yield and quality.

Contents
1. Techniques in organic synthesis 2. Esterification 3. Hydrolysis 4. Amide formation (acetylation, benzoylation) 5. Diazotization and coupling 6. Bromination 7. Nitration and Sulfonation in aromatic rings 8. Simple oxidation and reduction reactions 9. Synthesis of Heterocycles (e.g., Hydantoin, Benzimidazole) 10. Aliphatic substitution reactions 11. Claisen/Aldol condensation 12. (Any other relevant you can take)

Reference Books :

1. Arthur, Vogel. Textbook of practical organic chemistry, 5thedition, publishers Longman group Ltd. (1989)
2. J. Leonard, trvor P. Toube, B. Lygo, G Advanced Practical Organic Chemistry. Proctor, 2nd edition, Stanley Thornes (1990)
3. Keese, R, Martin P. B, and Trevor P. Toube. Practical organic synthesis: a student's guide. John Wiley &Sons (2006).

Punyashlok Ahilyadevi Holkar Solapur University, Solapur

Third Year B.Sc. (Pharmaceutical and Fine Chemical Technology) Semester-VI

Vertical: DSC1-11

Course Code: G04-DSC1-0644

Course Name: Pharmaceutical Formulation Technology

*Teaching Scheme	*Examination Scheme
Lectures:03 Hours/week, 03 Credits	UA:45 Marks CA: 30 Marks

Course Preamble
This course provides comprehensive training in the technology of sterile pharmaceuticals, ophthalmic products, blood products, and novel drug delivery systems. Students will explore pre-formulation, formulation, evaluation, and large-scale manufacturing of parenteral, ophthalmic, and controlled-release dosage forms—with emphasis on facility design, sterilization, quality control, and regulatory compliance to ensure product safety and efficacy.

Course Objectives
1. To train the students with respect to basics and application of technology of sterile pharmaceuticals, ophthalmic products, blood products and substitutes and sutures and ligatures. 2. To introduce novel drug delivery systems.

Course Outcomes After completion of the course students will be able to
1. Apply concepts related to pre-formulation, formulation, evaluation, packaging, large scale manufacturing and facility design of parenteral products. 2. Apply the principles of dosage form design to various formulations of different dosage forms, their evaluation and packaging. 3. Evaluate importance of facility requirements, stringent testing norms and

extreme care during manufacturing to ensure safety and efficacy of the parenteral dosage forms.

Unit	Contents	Lectures	Weightage
I.	**Microencapsulation** 1.1 Fabrication techniques, Evaluation, Large scale manufacture and packaging with focus on equipment, Oral Sustained-release and Controlled-release Formulations, 1.2 Preformulation: Formulation of matrix and reservoir type systems, Quality Control Parameters 1.3 Novel Drug Delivery Systems Introduction to Transdermal and Transmucosal (buccal, sublingual, nasal, vaginal, rectal) drug delivery systems 1.4 Overview of Cosmetic Products: Definition of cosmetics; historical background, classification of cosmetics and primary functions Brief overview of types of cosmetics [Skin care, haircare, nail care, eye care, dental products] Formulation.	**15**	**25**
II.	**Sterile Pharmaceuticals** 2.1 Introduction to sterile dosage forms, routes of parenteral administration Pre-formulation considerations for sterile dosage forms: small-volume parenterals, large volume parenterals Small-volume Parenterals: Formulation, quality control, Large-Volume Parenterals: Formulation, quality control . 2.2 Facility Design: HEPA filters, environmental classes for manufacture of parenterals Methods of sterilization, Water for Injection, quality control tests, storage. 2.3 Containers and Closures for Parenteral Formulations: Glass and plastic as a container material; ampoules, vials, bottles, rubber closures manufacturing, sterilization, quality control.	**15**	**25**

III.	**Ophthalmics** 3.1 Introduction to Ophthalmic dosage form, anatomy of eye, factors affecting ophthalmic drug absorption, Pre-formulation considerations for ophthalmic dosage forms, dosage forms: discuss various dosage forms like solutions suspensions, ointments, gels, films, inserts, lenses etc. w.r.t advantages and limitations, excipients, methods, equipments, advances, problems and solutions thereof, quality control of ophthalmics. 3.2 Blood Products and Glandular Products: Blood products Introduction, advantages and limitations Collections and storage techniques for whole blood Methods of blood and plasma fractionation into individual components, quality control Plasma substitutes Introduction, advantages and limitations, methods of preparation Quality control Insulin and insulin products	**15**	**25**

Reference Books :

1. Therapeutic Systems: Pattern-Specific Drug Delivery, Heilmann, Struttgart, G. Thiense Pub. (1978)
2. Encyclopedia of Pharmaceutical Technology, J. Swarbrick, New York, Marcel Dekker (1993) Remington's Pharmaceutical Sciences, A. R. Gennaro Mac Pub. Co. Easton, Pennsylvania (1990) Indian Pharmacopoeia, British Pharmacopoeia, United States Pharmacopoeia.
3. Theory & Practice of Industrial Pharmacy. L. Lachman, Herbert A. Lieberman& J. Kanig, Lea & Febiger, Philadelphia (1987)
4. Pharmaceutical Dosage Form: Dispersed Systems (Vol.1 & 2) Herber A. Lieberman, Martin A. Rieger, G. S. Ban, Marcel Dekker Inc. (1993)
5. Modern Pharmaceutics. Gilbert S.Banker, C.T. Rhodes, Marcel Dekker Inc. (1990)
6. Pharmaceutics: The Science of Dosage Form Design. Michael E.Aulton, Churchill-Livingstone (1998)
7. Pharmaceutical Dosage forms: Parenteral Medications in Three volumes, Kenneth E. Avis, Herbert A. Lieberman, Leon Lachman, Marcel Dekker Inc. (1993)

Punyashlok Ahilyadevi Holkar Solapur University, Solapur

Third Year B.Sc. (Pharmaceutical and Fine Chemical Technology) Semester-VI

Vertical: DSC1-11 P

Course Code: G04-DSC1-0644P

Course Name: Pharmaceutical and Fine Chemical Technology Practical Lab -XI

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

Course Preamble
This laboratory course provides hands-on training in the formulation, preparation, evaluation, and packaging of monophasic, biphasic, and topical semisolid pharmaceutical dosage forms. Students will gain practical experience in developing pharmacopoeial and non-pharmacopoeial formulations including liquids, emulsions, suspensions, ointments, creams, gels, suppositories, and aerosols with emphasis on quality control, large-scale manufacturing considerations, and appropriate container selection for product application.

Course Objectives
To train the students with respect to practical aspects of monophasic, biphasic and topical Semisolid pharmaceutical formulation development and quality control thereof.

Course Outcomes After completion of the course students will be able to
1. Basic understanding of formulation technology 2. Prepare, evaluate and label Pharmacopoeial and non-Pharmacopoeial monophasic liquid oral formulations. 3. Prepare, evaluate and label Pharmacopoeial and non-Pharmacopoeial biphasic formulations. 4. Prepare, evaluate and label Pharmacopoeial and non-Pharmacopoeial semisolid formulations 5. Prepare, evaluate and label Pharmacopoeial and non-Pharmacopoeial suppository formulations 6. Propose unit operations in large scale manufacturing and type of container specific to product application.

Contents
1. Representative examples of monophasic liquids (Preparation, packaging and evaluation) Representative examples of emulsions (Preparation, packaging and evaluation) 2. Representative examples of suspensions (Preparation, packaging and evaluation) 3. Large-scale manufacture of one monophasic and one biphasic liquids (Preparation, packaging and evaluation) 4. Representative examples of semisolid dosage forms e.g. ointments, creams, gels etc. (Preparation, packaging and evaluation) 5. Representative examples of suppositories and aerosols (Preparation, packaging and evaluation) 6. (Any other relevant you can take)

Reference Books :

1. Latest Indian Pharmacopoeia, British Pharmacopoeia, United States Pharmacopoeia Pharmaceutical Production Facilities: Design and Applications G. C. Cole, New York Ellis Horwood (1990)
2. Husa's Pharmaceutical Dispensing Martin E. W. Easton Mack Pub. Co. (1971)
3. Transdermal Delivery of Drug A. Kydonieus Florida, CRC Press (1987)
4. Transdermal Controlled System Medications Y. W. Chien, New York, Marcel Dekker (1987) The Theory and Practice of Industrial Pharmacy, Lachman Bombay, K. M. Warghese Co. (1976)
5. Pharmaceutical Dosage Forms Vol. I & II, Liebermann, New York, Marcel Dekker (1996) Drug Delivery Devices: Fundamentals and Applications, Tyle New York, Marcel Dekker (1988)

Punyashlok Ahilyadevi Holkar Solapur University, Solapur

Third Year B.Sc. (Pharmaceutical and Fine Chemical Technology) Semester-VI

Vertical: DSC1-12

Course Code: G04-DSC1-0645

Course Name: XII (Organic Chemistry II)

*Teaching Scheme	*Examination Scheme
Lectures:03 Hours/week, 03 Credits	UA:45 Marks CA: 30 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	**09**	**15**

	sulphonation. ii) Nucleophilic substitution reactions – Reactions with sodamide, alkyl lithium and aryl lithium iii) Reduction **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	**06**	**10**
II.	**3. Carbohydrates** 3.1 Introduction, 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**	**15** **10**
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	**08**	**13**

	iv) Antidiabetics -Tolbutamide v) Anti-inflammatory drugs -Ibuprofen vi) Antibiotics -Chloromycetin vii) Anticancer drugs: Chlorambucil (Leukeran) **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**	**12**

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.

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. (Pharmaceutical and Fine Chemical Technology) Semester-VI** **Vertical: DSC1-12 P** **Course Code: G04-DSC1-0645P** **Course Name: Practical Lab -XII**
***Teaching Scheme** **Lectures:04 Hours/week, 02 Credits**	***Examination Scheme** **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.

Punyashlok Ahilyadevi Holkar Solapur University, Solapur

Third Year B.Sc. (Pharmaceutical and Fine Chemical Technology) Semester-VI

Vertical: DSE1-3

Course Code: G04-DSE3-615

Course Name: DSE1-3 (Analytical and Industrial Organic Chemistry)

*Teaching Scheme	*Examination Scheme
Lectures:02 Hours/week, 02 Credits	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**	**11** **12**
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 i) Paper Chromatography ii) Column chromatography iii) Thin layer chromatography iv) Gas chromatography	**07** **08**	**11** **12**

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. (Pharmaceutical and Fine Chemical Technology) Semester-VI

Vertical: DSE1-3

Course Code: G04-DSE3-615P

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.

Punyashlok Ahilyadevi Holkar Solapur University, Solapur

Third Year B.Sc. (Pharmaceutical and Fine Chemical Technology) Semester-VI

Vertical: DSE1-4

Course Code: G04-DSE4-615

Course Name: 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**	**12** **11**
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**	**12** **11**

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. (Pharmaceutical and Fine Chemical Technology) Semester-VI

Vertical: DSE1-4

Course Code: G04-DSE4-615P

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. (Pharmaceutical and Fine Chemical Technology) Semester-VI

Vertical: VSC-VI

Course Code: G04-VSC-615

Course Name: VSC-VI (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.