

**MINISTRY OF EDUCATION AND SCIENCE OF UKRAINE
VASYL STEFANYK PRECARPATHIAN NATIONAL UNIVERSITY»**



Faculty of Natural Sciences

Department of Chemistry

SYLLABUS OF THE COURSE

Processes of organic synthesis

Educational program chemistry

Specialty 102 chemistry

Field of knowledge 102 Natural sciences

Approved at a meeting of the Department of Chemistry
Protocol № __ from ““““29” 03 2023 p.

Ivano-Frankivsk - 2023

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1. General information	
1. Name of the discipline	Processes of organic synthesis
2. Educational program	"CHEMISTRY"
3. Specialty	102 Chemistry
4. Specialization	Master of Chemistry
5. Field of knowledge	10 Natural sciences
6. Educational level	The second level of higher education is a master's degree
7. The status of the discipline	Mandatory components of OP OK-10
8. Course / semester	5th year (10 semester, 1M)
9. Distribution by types of study	90 hours
9.1. Lectures - hours.	20 hours
9.2. Laboratory classes -	10 hours
9.3. Independent work.	60 ours
9.4. Form of final control	test
10. Language of instruction	English
11. Link to the site dis. trained	http://www.d-learn.pu.if.ua/
10. The scope of discipline	3 credits
11. Consultations	weekly

2. Description of the discipline

2.1. Annotation to the course

Processes and methods in organic synthesis as a scientific discipline includes a set of disciplines in chemistry and technology of production of various organic products and products from them. The production of organic products is based on the processing of oil and gas raw materials. The synthesis of organic matter is based on the processing of oil, gas, coal and other raw materials. These include: origin, main composition, performance characteristics and industrial methods of oil and gas refining. Chemistry and mechanisms of the main stages of oil refining, as well as the synthesis of high-octane components of gasoline and additives to them. The course provides an opportunity to acquaint in English Ukrainian and foreign English-speaking students with the development trends of this industry. The course provides mastery of the basics of such processes as oil production, its thermal and thermocatalytic refining, purification of oil fractions and synthesis of the most important components of petroleum and alternative types of motor fuels: bioethanol and biodiesel. The tasks of the discipline and its significance consist of the training of a specialist - chemist-analyst and technologist of basic organic and petrochemical synthesis. The structure of the discipline and its content includes: basic concepts and terms of organic chemistry and processes and methods of synthesis of organic compounds. The physical and chemical properties of oil, gas, coal, shale, and other organic and inorganic raw materials are studied. The culture of using organic products as a factor in the most environmentally friendly use of their useful properties. The historical overview, state and prospects of development of the oil and gas industry in the world and in Ukraine are given, and also achievements of science in the field of processes of synthesis of organic products are resulted.

The purpose and objectives of the course.

Purpose: acquaintance with theoretical and applied issues of processes and methods of synthesis of organic substances and products, as well as the fundamental foundations of modern processes in basic organic synthesis, taking into account the relationship of modern chemical science, processes and methods of synthesis and ecology, and main processes and methods of synthesis of organic substances of petrochemical productions and plants, the basic directions of application of organic products and processes and methods of their synthesis in the industry and innovative approaches to their rational use.

The purpose of lectures - to form in the future specialist-chemist of the industry of organic and petrochemical synthesis independence, system approach and ability to make optimal and rational decisions of a choice of necessary methods and processes of organic synthesis; the need and features of creative communication in the process of working with specialists in other specialties: mechanical engineers, power engineers, economists, ecologists, etc. She also prepares future chemists for work in research institutions and a chemistry teacher.

The task of the discipline is to form in the future specialist-chemist of oil and gas and chemical industry independence, system approach and ability to make optimal and rational decisions of scientific and technological direction in methods and processes of organic synthesis; identify the need and features of creative communication in the process of working with specialists in other specialties: chemists, mechanical engineers, power engineers, computer scientists and programmers, economists, environmentalists, etc. It also prepares future specialists for work in research institutions and secondary and higher education institutions.

• **As a result of studying the discipline, the student must have the following program learning outcomes (PR) in chemistry.**

- PRN4. Synthesize chemical compounds with specified properties, analyze them and assess compliance with specified requirements.
- PRN7. Fluent in English and (if possible) another foreign language on professional issues, orally and in writing to present the results of research in chemistry in a foreign language, to participate in the discussion of chemistry.

As a result of studying the discipline the student must:

- Know and understand the basic facts, concepts, principles and theories related to the subject area mastered during the master's program. in the processes and methods of synthesis of organic products and properties of different types of organic products and substances;
- Apply the acquired knowledge and understanding to solve qualitative and quantitative problems in chemistry in accordance with the requirements of standards for basic raw materials for the chemical industry, where organic substances are used in processes and methods of synthesis, taking into account oil grades and production zones, auxiliary raw materials on target products of production;
- Know the methods of synthesis and analysis of chemical compounds, as well as factors that determine the quality of organic products, technological processes of extraction and processing that occur from minerals of natural origin, during their processing into organic products;
- Know the methodology and organization of scientific research, scientific bases and modern methods of transportation and storage of mineral and natural raw materials, as well as its processing into organic products;
- Plan, organize and carry out experimental work independently and autonomously carry out processes and methods of synthesis of organic compounds in the practice of their application in production
- Conduct chemical research using modern laboratory instruments and methods of chemical-technological, qualitative and quantitative analytical control of raw materials and organic products, as well as have an idea of the system of product certification and production certification;
- Know the current state and ways of development of processes and methods of organic synthesis, technological schemes of refineries with partial or complete production of raw materials for organic synthesis;
- Process research results using special software for calculations of basic equipment and processes in organic synthesis;

As a result of studying the discipline the student must be able to:

- Work alone or in a group, get results within a limited time with an emphasis on professional integrity and scientific integrity, and be able to analyze theoretical and experimental data in methods and processes of organic synthesis in the processing of oil, gas and coal;
- Compile terms of reference for the project, allocate time, organize their work, compile a report, rationally use scientific methods of cognition to substantiate the practical value of the results obtained in the performance of research work in organic synthesis;

- Be able to use catalysts and explain the mechanism of homogeneous and heterogeneous catalysis in the processes of organic synthesis;
- Use the basic knowledge of the course for the development and selection of technological schemes for the production of petrochemical synthesis products;
- Explain the chemistry of basic processes in basic organic synthesis;
- Solve the problem of compiling the material balance of the processes of organic synthesis of products;
- Analyze petroleum products for compliance with quality standards
- Carry out the technological process in accordance with current regulations;
- Assess the quality of the target products of the oil and gas industry, as well as by-products derived from its waste, according to current standards;

2.3. Learning outcomes (general competencies of (GC) Processes of organic synthesis

GC 1. Knowledge and understanding of the subject area and understanding of professional activity.

GC 4. Ability to apply knowledge in practical situations.

GC 7. Ability to use information and communication technologies.

GC 10. Ability to communicate in English and (if possible) another foreign language, both orally and in writing.

GC. 13. Ability to actively preserve the environment.

2.4. Special (professional, subject) competencies (PC)

PC2. Ability to build adequate models of chemical phenomena, to study them to obtain new conclusions and to deepen the understanding of nature, including using the methods of molecular, mathematical and computer modeling.

PC3. Ability to organize, plan and implement a chemical experiment.

PC6. Ability to acquire new knowledge in the field of chemistry and integrate them with existing ones.

Socio-personal competencies:

- Knowledge and understanding of the subject area and understanding of professional activity in chemistry and chemical technology;
- Scientific worldview and creative thinking;
- Ability to think abstractly, analyze and synthesize.
- Ability to apply knowledge in practical situations.
- Ability to critically evaluate the results of their own research.
- Ability to generate new ideas (creativity), as well as formulate judgments with incomplete or limited information.
- Ability to work autonomously, participate in teamwork, carry out project activities under the guidance of chemistry and chemical technology;:

Professional competencies:

- Ability to improve one's own learning and performance, including the development of teaching and research skills.
- Ability to use laws, scientific theories and practical concepts in combination with appropriate mathematical tools to describe natural phenomena in the field of chemistry and chemical technology;
- Acquisition of flexible thinking, openness to the application of knowledge of natural sciences and competencies in a wide range of possible jobs and everyday life;
- Ability to build adequate models of chemical phenomena, to study them to obtain new conclusions and deepen understanding of nature, including using methods of molecular, mathematical and computer modeling in the field of chemistry and chemical technology;

<ul style="list-style-type: none"> • Ability to think critically, thinking skills; strong knowledge of the profession of chemist in practice; • Ability to organize, plan and implement a chemical experiment and analyze chemical objects and phenomena of both natural and technological origin, in terms of fundamental physicochemical principles and knowledge, as well as on the basis of appropriate physicochemical and mathematical methods in chemistry and chemical technology; • Ability to interpret, objectively evaluate and present the results of their research and evaluate the order of magnitude and find appropriate solutions with a clear definition of assumptions and the use of special and limit cases in theoretical and applied chemistry; 					
3. Course structure Processes of organic synthesis					
The volume of the course is 90 years					
Type of lesson				Total number of hours	
lectures				20	
seminars / practical / laboratory				10	
individual work				60	
Course signs					
Semester	Specialty	Course (year of study)	Normative / selective		
II	102 хімія	I	Mandatory components of OP OK-10		
Course topics					
Topic, plan Deadline	Form of lesson	Literature	Tasks, h.	Evaluation weight	Deadline
Content module 1. Lectures of Processes of organic synthesis					
Topic 1. Modern methods and processes in organic synthesis	lecture	1-4	2 hour	2	weekly
Topic 2. Characteristics of oil and its fractions as raw materials for the synthesis of organic matter	lecture	1-4	2 hour	2	weekly
Topic 3. Fundamentals of chemistry and technology of motor fuels	lecture	1-4	2 hour	2	weekly
Topic 4. Production and technological equipment of chemical synthesis enterprises in industry	lecture	1-4	2 hour	2	weekly
Topic 5. Theoretical foundations of chemistry and technology of primary and secondary oil refining	lecture	1-4	2 hour	2	weekly
	Control work		Total 10 hour	10	March

Content module 2. Lectures of Processes of organic synthesis					
Topic 6. New processes and methods of refining crude oil, coal and gas.	lecture	1-4	2 hour	2	weekly
Topic 7. Catalytic processes in basic organic synthesis and their varieties	lecture	1-4	2 hour	2	weekly
Topic 8. Thermo catalytic processes of oil and other raw materials processing.	lecture	1-4	2 hour	2	weekly
Topic 9. Non-catalytic processes and methods of oil refining, natural gas and coal	lecture	1-4	2 hour	2	weekly
Topic 10. Hydrocatalytic processes of processing in organic synthesis of products	lecture	1-4	2 hour	2	weekly
	Control work		Total 20 hour	10	May
Content module 3. Laboratory workshop on Processes of organic synthesis					
Topic 1. Modern types and current problems of synthesis of organic compounds	Laboratory work	Met. BK. 1,2,3	1 hour	2	weekly
Topic 2. Analysis of products and raw materials for the synthesis of organic products	Laboratory work	Met. BK. 1,2,3	3 hour	2	weekly
Topic 3. Characteristics of catalysts for organic synthesis	Laboratory work	Met. BK. 1,2,3	3 hour	2	weekly
Topic 4. Features of process technology in organic synthesis	Laboratory work	Met. BK. 1,2,3	3 hour	2	weekly
Final control (credit)			Total 10 hour	50	May
4. Course evaluation system (accumulation of points during the study of the discipline)					
Types of educational work		Maximum number of points			
1. Lecture		8			
2. Seminar		28			
3. Independent work		10			
4. Individual task		4			
5. Credit / Exam		50			
6. The maximum number of points		100			

General course evaluation system	<p><i>Current control is carried out during lectures, laboratory, individual classes and aims to test students' knowledge of certain topics of the discipline and the level of their readiness to perform specific work. Grades on the national scale ("excellent" - 5, "good" - 4, "satisfactory" - 3, "unsatisfactory" - 2), received by students, are displayed in the journals of attendance and academic group performance.</i></p> <p><i>Modular control (the sum of points for a particular content module) is carried out (set) on the basis of assessing the results of students' knowledge after studying the material from the logically completed part of the discipline - the content module.</i></p> <p><i>The task of modular control is to test understanding and mastering of certain material (topics), developing skills of calculation work, ability to solve specific situational problems, independently process texts, ability to comprehend the content of this part of the discipline, ability to present certain material publicly or in writing.</i></p> <p><i>Semester (final) control is conducted in the form of an exam.</i></p> <p><i>Credit - a form of final control, which involves checking the student's understanding of theoretical and practical program material in the whole discipline, the ability to creatively use the acquired knowledge and skills, to form their own attitude to a particular problem and more.</i></p>
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5. Assessment in accordance with the schedule of the educational process

Types of educational work	Training weeks																	Together
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	
Lecture	1	1	1	1	1	1	1	1	1	1	1	1						
Seminar (laboratory classes)					4	4	4	4	4	4	4	4	4	4	4			
Individual work															10			
Individual task																4		
Credit / Exam																	50	50
In just a week	1	1	1	1	5	5	5	5	5	5	5	5	4	2	10		50	100
Requirements for written work	Conditions of admission to the final control. The final written work is performed in the form of an examination ticket. The number of questions in the task - 4, including two theoretical and two practical.																	
Conditions of admission to the final control	<p>A student is allowed to take the exam if during the semester he scored a total of 25 points or more for the content modules.</p> <p>A student is not allowed to take the exam if he scored less than 25 points during the semester. In this case, the student is recorded in the statement "not allowed" and set the number of points scored. As an exception, with the permission of the dean of the faculty on the application agreed with the relevant department, one-time performance by the student of additional types of work in the discipline (completion of missed classes, rearrangement of content modules, individual tasks, etc.) to increase grades for content modules.</p> <p>On the eve of the exam, the teacher submits a report to the dean on the non-admission of students of the academic group (groups). A note of non-admission in the statement is made in the presence of the order of the dean.</p>																	

6. Resource provision.

6.1.Main literature

1. Курта С.А. «Основи сучасної нафтохімії». Навчальний посібник.// Навчальний посібник //Свідоцтво про реєстрацію авторського права на твір.№95904 від 10.02.2020р. ст.1.Рішення Мінекономіки торг. Та сільс. Госп.. України.м. Київ. 01008 вул. Грушевського 12\2..
2. Курта С.А.,Лучкевич Е.Р., Матківський М.П. Хімія органічних сполук. Підручник для вищих навчальних закладів.Видав.»Плай»,Прикарп. нац. У-ту.м.Івано-Франківськ ,Україна, 2011 р., – 650с., тир.400 екз.
3. Піх З.Г. Теорія хімічних процесів органічного синтезу : Підручник. – Львів: Вид-во НУ «Львівська політехніка», 2002. – 396 с.
4. Піх З.Г. Теорія хімічних процесів органічного синтезу : Електронний навчальний посібник ВНС ЛП (<http://vns.lp.edu.ua/moodl/course/view.php?id=9379>). – Зареєстровано НМУ НУ «ЛП» (№ Е41-216-3/2011 від 17.03.2011 р.).
5. Піх З.Г., Реутський В.В., Івасів В.В., Іващук О.С. Хімія і технологія органічних речовин : Електронний навчальн. посібник ВНС ЛП (<http://vns.lp.edu.ua/moodl/course/view.php?id=9369>). – Зареєстровано НМУ НУ «ЛП» (№ Е41-216-2/2011 від 10.03.2011 р.).
6. Ластухін Ю.О., Воронов С.А. Органічна хімія. Підручник для вищих навчальних закладів.ч.1.– Л: Центр Європи, 2001.– 864 с.

6.2.Additional literature:

1. Ластухін Ю.О., Воронов С.А. Органічна хімія / Ю.О. Ластухін, С.А. Воронов. – Л ч.2., 2000. – 586 с.
2. Курта С.А.,Лучкевич Є.Р., Матківський М.П. Хімія органічних сполук. Підручник для вищих навчальних закладів. м. Івано-Франківськ: Прикарпат.нац.ун-т ім. В.Стефаника, 2013. – 599 с. вид-во. Прикарпат. нац. у-ту. Авторські права захищені свідоцтвом про реєстрацію авторського права на твір № 52578 від 13.12.2013 р. державним департаментом інтелектуальної власності МОН України.
3. Курта С.А., Курганський В.С. Хімія і технологія ВМС, навчальний посібник, рекомендовано МОН України, Івано-Франківськ: Видав. «Плай» ЦІТ Прикарпатського національного університету імені Василя Стефаника, 2010. – 291 с., ISBN 966-640-164-9. II доповнене видання. Свідоцтво про реєстрацію авторського права на твір в Україні, № 25394 від 20.08.2008р.
4. Братичак М. М., Баб'як Л. В. Моторні палива з альтернативної сировини: навч. посіб. Львів: видавництво Львівської політехніки, 2017. – 144 с.
5. Кириченко В. І., Сіренко Г. О., Бойченко С. В, сучасні паливно-мастильні матеріал: стан та поступ розвитку. Частина І. Паливні матеріали: монографія. Івано-Франківськ: Супрун В. П., 2016. – 208 с.
6. Братичак М. М., Гунько В. М. Хімія нафти та газу: навч. посіб. Львів: Видавництво Львівської політехніки, 2017. – 448 с.

6.3.List of guidelines:

1. Інструкції до лабораторних робіт з органічної хімії. (№1-4).Курта С.А.,Воронич О.Л. Терит. Друк. Ів-Франк.2015р.-45с.
2. Карташевич А. Н.Методы опрееления цетанового числа и периода задержки воспламенения топлив/ А. Н. Карташевич, С. А. Плотников// Агропанарама. – 2008. - №4. –С. 4-7.

3. Карташевич А. Н. Расчет показателей процесса сгорания этанолсодержащих топлив в дизеле / А. Н. Карташевич, Г. Н. Гурков, С. А. Плотников//Вестник БГСХА. – 2011.- №3. – С. 156-159.
4. Стельмах Г.І., Микитин І.М., Курта С.А., Лясковська М.Р., Методичні вказівки до лабораторних та практичних робіт з курсу «Хімія ВМС». МОН ДВНЗ «Прикарпатський національний університет імені Василя Стефаника, Івано-Франківськ 2019, – 92 с.
5. Серняк І.М., Микитин І.М., Курта С.А., Лясковська М.Р., Методичні вказівки до лабораторних робіт з Органічної хімії (ароматичні вуглеводні). МОН ДВНЗ «Прикарпатський національний університет імені Василя Стефаника, Івано-Франківськ 2019, – 119 с.

7. Contact information	
Teacher (s)	Professor of the Department of Chemistry, Faculty of Natural Sciences, PNU, room 220. Doctor of Technical Sciences Sergiy Kurta
Teacher's contact phone number	0509685163
Teacher's e-mail	sergiykurta@pnu.edu.ua
Link to the distance learning site	http://www.d-learn.pu.if.ua/
8. Discipline policy	
<p>1. During the semester, home tests, written works, essay writing, and assessments for complete and submitted laboratory work are used to test students' knowledge and control the student independent work. Intermediate control includes conducting two modules in the form of test tasks, which combine closed-ended questions with open-ended questions with short and long answers. Modular control is conducted in writing during laboratory classes and includes assignments from one or more sections of the lecture course. The maximum score that a student can get for all types of control - 100 points, it consists of intermediate modules and assessments for laboratory work. The assessment for laboratory work consists of an assessment for an express survey for admission to laboratory work, an assessment for the results of laboratory work obtained during the performance of work and an assessment for the defense of laboratory work. During the defense of laboratory work, the student must know the purpose, objective procedure for laboratory work and answers to control questions given for independent study of theoretical material on this topic. The student must independently perform educational tasks, tasks of current and final control. It is considered fraudulent to copy another test, spy on another student's work, write off, use a textbook, notebook or mobile phone while writing a module or final work or laboratory work, use cheat sheets, allow others to copy your work.</p> <p>2. Omissions of laboratory works are not allowed. If a student misses a laboratory work for good reasons, which are documented, he has the right to practice it with the permission of the head of the department (upon request).</p> <p>3. At the end of the semester, the semester rating is calculated and the overall rating is calculated, which is translated into a grade according to the grading scale.</p>	
1. Academic integrity	+10 mark
2. Skipping classes (working off)	-10 mark
3. Perform the task later set. term	-5 mark
4. Inappropriate behavior during the lesson	-5 mark
5. Additional points	+10 mark
6. Non-formal education	Possibility of credit Recommended fees.

Lecturer KS Professor of Chemistry, Ph.D. Kurta S.A. ““29” 03 2023 p.