



## **COMPLEX PROCESSING OF PLANT MATERIALS**

### **Work program of the discipline (Syllabus)**

<b>Details of the discipline</b>	
<b>Level of higher education</b>	<i>First (bachelor's)</i>
<b>Field of knowledge</b>	<i>16 Chemical and bioengineering</i>
<b>Speciality</b>	<i>161 Chemical technologies and engineering</i>
<b>Educational program</b>	<i>Industrial ecology and resource-efficient clean technologies</i>
<b>Discipline status</b>	<i>Optional educational components</i>
<b>Form of study</b>	<i>full-time/remote/mixed</i>
<b>Year of preparation, semester</b>	<i>3rd year, spring semester</i>
<b>Scope of discipline</b>	<i>4 credits (120 h)</i>
<b>Semester control/ control measures</b>	<i>Test</i>
<b>Schedule of classes</b>	<i>3 hours per week (2 hours of lectures and 1 hour of practical classes)</i>
<b>Language of instruction</b>	<i>Ukrainian</i>
<b>Information about the course / teachers</b>	Lecturer: <a href="https://eco-paper.kpi.ua/pro-kafedru/vykladachi/vizytyky/galish-vita-vasilivna.html">https://eco-paper.kpi.ua/pro-kafedru/vykladachi/vizytyky/galish-vita-vasilivna.html</a> Practical /Seminar: <a href="https://eco-paper.kpi.ua/pro-kafedru/vykladachi/vizytyky/galish-vita-vasilivna.html">https://eco-paper.kpi.ua/pro-kafedru/vykladachi/vizytyky/galish-vita-vasilivna.html</a>
<b>Course placement</b>	<a href="https://do.ipk.kpi.ua/">https://do.ipk.kpi.ua/</a>

### **The program of the discipline**

#### **1. Description of the discipline, its purpose, subject of study and learning outcomes**

*The integrated use of natural resources is one of the important tasks of chemical technology and ecology. Plant materials are one of the most important types of raw materials and occupy an important place among oil, gas and coal. which today are the result of petrochemical synthesis.*

*An important factor in the organization of an effective process of processing plant materials is to take into account its structure and composition. Knowledge of technology and complex processing of plant materials will allow to introduce effective ways to dispose of plant waste and by-products of woodworking processes, production of fibrous semi-finished products, paper and cardboard, agriculture and food industry with the production of valuable multifunctional multipurpose products.*

*The subject of the discipline "Complex processing of plant materials" is the implementation of approaches to chemical and physico-chemical processing of plant raw materials, namely wood, non-wood plant raw materials, waste of the agro-industrial complex with the production of a wide range of products for various purposes.*

### ***The purpose of the discipline "Complex processing of plant materials"***

*The purpose of studying the discipline is necessary to manage the existing technological processes of complex chemical processing of plant materials and improve these processes, to create new, environmentally friendly, more efficient technologies and industries that allow rational use of available resources, as well as those that reduce the load on the environment there. In accordance with the goal, the preparation of students in this specialty requires the strengthening of the competencies formed by students:*

- The ability to use methods of observation, description, identification, classification of objects of chemical technology and industrial products;*
- The ability to determine the directions of use of plant raw materials and fibrous semi-finished products, to design and implement technologies for their processing;*
- The ability to use the theoretical fundamentals of ecology, environmental protection and sustainable nature management, the basic principles and components of environmental management.*

*According to the requirements of the program of the discipline "Complex processing of plant materials", students after its mastery must demonstrate the following programmatic learning outcomes:*

- To understand the basic properties of structural materials, principles and limitations of their use in chemical engineering;*
- To substantiate the choice of technological schemes of production on the basis of rational use of raw materials, energy, obtaining quality products, achieving high productivity while solving environmental issues, calculate material and thermal balances of processes, based on them to find costs of raw materials and energy resources;*
- To participate in the development and implementation of projects aimed at optimal management and treatment of industrial waste.*

## **2. Prerequisites and post-requisitions of disciplines (place in the structural and logical scheme of education according to the relevant educational program)**

*The study of the discipline "Complex processing of plant materials" is based on the principles of integration of various knowledge gained by students during the bachelor's degree in the study of disciplines of the cycle of general and professional training. The discipline "Complex processing of plant materials" ensures the implementation of the bachelor's project.*

## **3. Contents**

### ***Section 1. General characteristics and history of the development of complex processing of plant materials***

*Topic 1. The need for complex processing of plant materials*

*Topic 2. Physical and chemical properties of plant materials, its structure and properties.*

### ***Section 2. Processing of waste solutions of the process of delignification of plant materials***

*Topic 3. Processing of sulfate waste solutions.*

*Topic 4. Processing of sulfite waste solutions.*

### ***Section 3. Basics of complex processing of wood and non-wood plant raw materials***

*Topic 5. Thermchemical processing of plant materials*

*Topic 6. Technical hydrolysis of plant materials*

*Topic 7. Processing of extractive substances*

### ***Section 4. Recycling bark and woody greens***

*Topic 8. Chemical and structural characteristics of the bark*

*Topic 9. Method and disposal of bark*

*Topic 10. Processing of needles*

*Topic 11. Prospects for leaf processing*

### ***Section 5. Use of secondary plant resources***

*Topic 12. Pellet production*

#### 4. Learning materials and resources

##### **Basic literature**

1. *Non-wood resources: textbook. posib. / compiled by: A.V. Migal, V.V. Bokoch. – Uzhhorod: Publishing house of Uzhhorod National University "Hoverla", 2017. – 128 p.*
2. *V.A. Barbash, I.M. Deikun Chemistry of plant polymers. Tutorial. 2nd edition revised. and additions. – Kyiv.: Caravel, 2018. – 440 p.*
3. *Innovative technologies of plant resource saving / Barbash V.A. Textbook. Manual, Kyiv: Caravel, 2016.- 288 p.*
4. *Galish V.V., Yashchenko O.V., Trembus I.V. Complex processing of plant raw materials. Complex chemical processing of wood / training for stud. specialty 161 "Chemical Technologies and Engineering" / V.V. Galish, O.V. Yashchenko, I.V. Trembus. – Kyiv : Igor Sikorsky Kyiv Polytechnic Institute, 2022.*

##### **Further reading**

5. *L.P. Antonenko, I.M. Deikun, I.V. Trembus Technology of production of mechanical mass. Tutorial. – Kyiv. NTUU "KPI", 2015. – 534 p.*
6. *Cheryopkina R.I., Trembus I.V., Deykun I.M., Barbash V.A. Technology of non-wood fiber semi-finished products: a textbook for studs. Special. 161 "Chemical technologies and engineering", educational and professional program "Industrial ecology and resource-efficient clean technologies". – Kyiv: KPI them. Igor Sikorsky, 2021. – 229 p.*
7. *Hydrolysis production technology. Laboratory workshop on the discipline [Electronic resource]: textbook. posib. for stud. specialty 161 "Chemical technologies and engineering", specialization "Chemical technologies of technology of processing of wood and vegetable raw materials"/ KPI them. Igor Sikorsky; compiled by: R.I. Cheryopkina. – Electronic text data (1 file: 813 KB). – Kyiv : KPI them. Igor Sikorsky, 2019. – 46 p.*

##### **Information resources on the Internet**

7. *Ministry of Environmental Protection and Natural Resources of Ukraine - <https://mepr.gov.ua/>*
8. *Professional Association of Ecologists of Ukraine (PAEU) - <https://paeu.com.ua/>*

**5. Methods of mastering the discipline (educational component)**

**Lectures**

*Lectures are aimed at:*

- *providing modern knowledge of the discipline "Complex processing of plant materials", the level of which is determined by the target installation for each specific topic;*
- *ensuring in the process of the lecture the creative work of the student together with the teacher;*
- *reflection of the methodological processing of the material (selection of the main provisions, conclusions, recommendations, clear and adequate to their formulations);*
- *formation of students' necessary interest and providing direction for independent work;*
- *use for demonstration of visual materials, combination, if possible, them with a demonstration of results and samples;*
- *teaching material in a clear and high-quality language in compliance with structural and logical connections, explanation of all newly introduced terms and concepts;*
- *accessibility for perception by this audience.*

<b>No s/n</b>	<b>The title of the lecture topic and the list of main issues (list of didactic tools, references to literature and tasks for the IWS)</b>	<b>Hours</b>
1	<p><b><i>The need for complex processing of plant materials</i></b> <i>The need for the integrated use of plant materials. types of wood-chemical production and products of their processing, basic concepts and definitions.</i></p> <p><i>Literature: [1, 3, 5]</i></p> <p><i>Tasks on the IWS:</i></p> <p><i>The use of wood in energy-chemical production.</i></p>	2
2	<p><b><i>Physical and chemical properties of plant materials, its structure and structure</i></b></p> <p><i>General information about the physical properties of roslinnova raw materials - porosity, specific and volumetric weight, relative and absolute humidity. chemical composition of wood of various species and non-wood plant raw materials (cellulose content, hemicellulose, lignin, terpenes and resin acids, tannins, fats, gums, coloring substances, ash).</i></p> <p><i>Literature: [1, 2, 5, 6]</i></p> <p><i>Tasks on the IWS:</i></p> <p><i>Wood reserves in Ukraine and world stocks of free wood. Stocks of non-wood plant materials.</i></p>	2

3	<p><b>Recycling of sulfate waste solutions</b></p> <p>The composition of the spent sulfate waste. Regeneration of spent sulfate waste. Utilization of organic substances</p> <p>Literature: [4]</p> <p>Tasks on the IWS:</p> <p>The main technological equipment of the recycling process of spent sulfate waste.</p>	4
4	<p><b>Processing of sulfite waste solutions</b></p> <p>The composition of the spent sulfite waste. Biochemical processing of sulfite waste. Preparation of ethanol. Obtaining fodder yeast.</p> <p>Recycling and using sulfonates.</p> <p>Literature: [4]</p> <p>Tasks on the IWS:</p> <p>The main technological equipment of the recycling process of spent sulfite waste.</p>	4
5	<p><b>Thermochemical processing of plant materials</b></p> <p>Pyrolysis technology of non-wood plant raw materials. Scheme of pyrolysis of wood. Products of thermal processing and areas of their use.</p> <p>Literature: [4]</p> <p>Tasks on the IWS:</p> <p>Retort classification.</p>	4
6	<p><b>Technical hydrolysis of plant materials</b></p> <p>Methods of hydrolysis of plant raw materials. Obtaining furfural. Output of hydrolysis production. Technological scheme of hydrolysis with dilute acid, preparation of hydrolyzate, ethyl alcohol and fodder yeast. Processing of spent delignifying solutions.</p> <p>Literature: [4]</p> <p>Tasks on the IWS:</p> <p>Technological scheme of hydrolysis of plant materials with concentrated acid.</p>	4
7	<p><b>Processing of extractive substances</b></p> <p>Turpentine. Rosin. Rosin-turpentine production. Rosin extraction production. Resin-turpentine production</p> <p>Literature: [4]</p> <p>Tasks on the IWS:</p> <p>Characteristics of equipment for the processing of extractive substances.</p>	4
8	<p><b>Chemical and structural characteristics of the bark</b></p> <p>Anatomical structure of the cortex and chemical composition. Features of obtaining bark and methods of its refinement.</p> <p>Literature: [4].</p> <p>Tasks on the IWS:</p> <p>Equipment for improving the bark.</p>	2
9	<p><b>Ways to dispose of bark</b></p> <p>The use of bark in agriculture. Production of tannins. Burning bark. Tar smoking production.</p> <p>Literature: [1].</p> <p>Tasks on the IWS:</p> <p>Equipment for tar smoking.</p>	2

10	<p><b>Processing of needles</b>  <i>The composition of coniferous foot. Processing of coniferous foot. Obtaining coniferous essential oils.</i>  <i>Literature: [4].</i>  <i>Tasks on the IWS:</i>  <i>The technology of obtaining chlorophyll-carotene paste.</i></p>	2
11	<p><b>Prospects for leaf processing</b>  <i>The chemical composition of woody leaves. Processing of leaves.</i>  <i>Literature: [1, 4, 6].</i>  <i>Tasks on the IWS:</i>  <i>The use of leaves for the needs of the pulp and paper industry</i></p>	2
12	<p><b>Pellet production</b>  <i>Classification of secondary plant resources. The volume of formation of secondary plant resources. Pellet manufacturing technology.</i>  <i>Literature: [4].</i>  <i>Tasks on the IWS:</i>  <i>Equipment for the manufacture of pellets.</i></p>	2
13	<p><b>Production of wood slabs</b>  <i>Methods of production of wood-fiber plates. Preparation of raw materials. Excipients in the production of wood-fiber plates.</i>  <i>Literature: [4].</i>  <i>Tasks on the IWS:</i>  <i>Equipment for the manufacture of wood plates.</i></p>	2
	<b>Total</b>	<b>36</b>

### Practical classes

*In the system of professional training of bachelors in this discipline, practical classes occupy 50% of the classroom load. This type of work is an important means of operational feedback.*

*The main objectives of the cycle of practical classes:*

- to help students systematize, consolidate and deepen knowledge of a theoretical nature in the field of technologies for complex wood processing;*
- teach them to work with scientific and reference literature, documentation and technological schemes;*
- to form the ability to learn independently, that is, to master the methods, methods and techniques of self-learning, self-development and self-control.*

No s/n	Topic name	Hours
1	<i>The need for complex processing of wood, types of wood-chemical production and products of their processing</i>	3
2	<i>Physical and chemical properties of wood, micro- and macroscopic structure</i>	3
3	<i>Thermal processing of wood</i>	2
4	<i>Technical hydrolysis of wood</i>	2
5	<i>Rosin-turpentine production</i>	2
6	<i>Processing of woody greens</i>	2
7	<i>Performing a modular test</i>	2
8	<i>Test</i>	2
<b>Total</b>		<b>18</b>

## 6. Independent work of a student / postgraduate student

Independent work takes 70% of the time to study the credit module, including preparation for the test. The main task of independent work is to master scientific knowledge in areas that are not included in the list of lecture questions through personal search for information, the formation of an active interest in a creative approach in educational work. In the process of independent work within the educational component, the student must learn to deeply analyze modern approaches to the complex processing of plant materials.

No s/n	The name of the topic submitted for independent study	Number of hours of IWS
<b>Section 1. General characteristics and history of the development of complex processing of plant materials</b>		
1	<b>The need for complex processing of plant materials</b> The use of wood in energy-chemical production. <i>Літєратура: [1, 3, 5].</i>	5
2	<b>Physical and chemical properties of plant materials, its structure and structure</b> Wood reserves in Ukraine and world stocks of free wood. Stocks of non-wood plant materials. <i>Literature: [1, 2, 5, 6].</i>	5
<b>Section 2. Processing of waste solutions of the process of delignification of plant materials</b>		
3	<b>Recycling of sulfate waste solutions</b> The main technological equipment of the recycling process of spent sulfate cheek. <i>Literature: [4].</i>	6
4	<b>Processing of sulfite waste solutions</b> The main technological equipment of the recycling process of spent sulfite cheek. <i>Literature: [4].</i>	4
<b>Section 3. Basics of complex processing of wood and non-wood plant raw materials</b>		
5	<b>Thermochemical processing of plant materials</b> Retort classification. <i>Literature: [4].</i>	3
6	<b>Technical hydrolysis of plant materials</b> Technological scheme of hydrolysis of plant materials with concentrated acid. <i>Literature: [4].</i>	4
7	<b>Processing of extractive substances</b> Characteristics of equipment for the processing of extractive substances. <i>Literature: [4].</i>	3
<b>Section 4. Recycling bark and woody greens</b>		
8	<b>Chemical and structural characteristics of the bark</b> Equipment for improving the bark. <i>Literature: [4].</i>	4
9	<b>Ways to dispose of bark</b>	4

	<i>Equipment for tar smoking. Literature: [1].</i>	
10	<b>Processing of needles</b> <i>The technology of obtaining chlorophyll-carotene paste. Literature: [4].</i>	3
11	<b>Prospects for leaf processing</b> <i>The use of leaves for the needs of the pulp and paper industry Literature: [1, 4, 6]</i>	3
<b>Section 5. Use of secondary plant resources</b>		
12	<b>Pellet production</b> <i>Equipment for the manufacture of pellets. Literature: [4].</i>	4
13	<b>Production of wood slabs</b> <i>Equipment for the manufacture of wood plates. Literature: [4].</i>	4
14	<i>Preparation for a modular test</i>	2
15	<i>Execution of OCD</i>	10
16	<i>Preparation for the test</i>	2
17	<i>Total hours</i>	66

## Policy and control

### 7. Policy of the discipline (educational component)

#### Rules for attending classes and behavior in the classroom

*Attendance is a mandatory component of the assessment. Students are obliged to take an active part in the educational process, not to be late for classes and not to miss them without a good reason, not to interfere with the teacher to conduct classes, not to be distracted by actions that are not related to the educational process.*

#### Rules for assigning incentive and penalty points

- *incentive points can be awarded by the teacher solely for performing creative work in the discipline or additional completion of online specialized courses with the receipt of the appropriate certificate. But their amount cannot exceed 10 % of the rating scale.*
- *penalty points in the framework of the discipline are not provided.*

#### Theethics of deadlines and rescheduling

*In case of debts in the discipline or any force majeure circumstances, students should contact the teacher through the available (provided by the teacher) communication channels to solve problematic issues and agree on an algorithm of actions for working out.*

#### Academic Integrity Policy

*Plagiarism and other forms of dishonest work are unacceptable. Plagiarism includes the lack of links when using printed and electronic materials, quotes, opinions of other authors. Unacceptable hints and write-offs when writing tests, conducting classes; passing the test for another student; copying materials protected by the copyright system without the permission of the author of the work.*

*The policy and principles of academic integrity are defined in Chapter 3 of the Code of Honor of the National Technical University of Ukraine "Igor Sikorsky Kyiv Polytechnic Institute". Read more: <https://kpi.ua/code>*

#### Academic Conduct and Ethics Policy

*Students should be tolerant, respect the opinions of others, formulate objections in the correct form, constructively maintain feedback in the classroom.*



The norms of ethical behavior of students and employees are defined in Chapter 2 of the Code of Honor of the National Technical University of Ukraine "Igor Sikorsky Kyiv Polytechnic Institute". Read more: <https://kpi.ua/code>

## 8. Types of control and rating system for evaluating learning outcomes (RSO)

Distribution of study time by types of classes and tasks in the discipline in accordance with the working curriculum:

Semester	Study time		Distribution of study hours				Control measures		
	Credits	acad. year.	Lecture	Practical	Labs	IWS	MCT	HSW	Semester control
6	4	120	36	18	–	66	1	1	Passed

### The student's rating on the discipline consists of points that he receives for:

- 1) speeches with a report on the topic that is submitted for practical classes.
- 2) active participation in the work of practical classes – 3 marks
- 3) performing a modular control work.

Semester control is test.

### The system of rating (weight) points and evaluation criteria

#### 1. Work in practical classes

##### 1.1. Deliverance with a substantiated report:

Weight score – 15. The maximum number of points in all practical classes is 15 points  $\times 2 = 30$  points.

Criteria for evaluating the report:

<i>The quality of the report and its protection</i>	<i>Bali</i>
<i>The topic of the report is fully disclosed; the student thoroughly explains all aspects of the relevant topic, draws the necessary conclusions and generalizations, and clearly answers the questions posed</i>	<i>15</i>
<i>The report does not provide enough facts and examples; no proper analysis has been carried out; insufficiently clearly formulated conclusions; the answers to the questions are fuzzy or have some inaccuracies</i>	<i>14... 10</i>
<i>The topic of the report is not sufficiently disclosed; there are no conclusions; no answers to individual questions</i>	<i>9... 5</i>
<i>The report does not correspond to the formulated topic; all the questions asked remained unanswered. Report not credited</i>	<i>0</i>

##### 1.2. Participation in practical classes:

Weight score – 5. The maximum number of points in all practical classes is 5 points  $\times 3 = 15$  points.

Criteria for assessing students' knowledge:

<i>Completeness and signs of response</i>	<i>Bali</i>
<i>Active participation in the discussion of all questions, the correctness and correctness of the answers and the implementation of all the tasks</i>	<i>5</i>
<i>Domitted some minor errors when performing tasks or when discussing the material</i>	<i>3... 4</i>

<i>This fuzzy answer; gross mistakes were made; there is no specific wording of laws and terms</i>	<i>1... 2</i>
<i>The answer is not credited, there is no activity or preparedness for the practical lesson</i>	<i>0</i>

## **2. Home test:**

*Weight score – 15. The maximum number of points in all practical classes is 15 points  $\times 1 = 15$  points.*

*Criteria for evaluating the report:*

<b><i>The quality of the report and its protection</i></b>	<b><i>Bali</i></b>
<i>The topic of OCD is fully disclosed; the student thoroughly explains all aspects of the relevant topic, draws the necessary conclusions and generalizations, and also clearly answers the questions posed</i>	<i>15</i>
<i>The SCR does not provide a sufficient number of facts and examples; no proper analysis has been carried out; conclusions are not clearly formulated enough; the answers to the questions are fuzzy or have some inaccuracies</i>	<i>10... 14</i>
<i>DKR is not sufficiently disclosed; there are no conclusions; no answers to individual questions</i>	<i>5... 9</i>
<i>DKR does not correspond to the formulated topic; all the questions posed remained unanswered. OCD not credited</i>	<i>0</i>

## **3. Modular control work:**

*Modular test work is carried out in the form of testing.*

*In total, students must answer 80 questions related to different sections and topics of the discipline.*

*The weight score for each correct answer is 0.5. Each of the answers is evaluated separately, after which the points received are summed up.*

*The maximum number of points for writing a modular test is 0.5 points  $\times 80 = 40$  points.*

### ***Calculation of the scale (R) of the rating***

*The rating scale of the discipline (RD) is 100 points and is formed as the sum of all rating points received by the student based on the results of current control measures:*

$$R = 15 \times 2 + 5 \times 3 + 15 \times 1 + 0.5 \times 80 = 100 \text{ балів.}$$

*A necessary condition for admission to the test is the enrollment of the reportand, the performance of home test work, the performance of a modular test , as well as the starting rating of at least 40% of R, that is, 40 points.*

*Students who score less than 0.6 R during the semester perform a test paper. The test task contains questions that relate to different sections of the program.*

*In order for a student to receive a credit grades, the sum of all rating points earned during the semester **R** is transferred according to the table:*

<b><i>Score</i></b>	<b><i>AboutTsinka</i></b>
<i>95... 100</i>	<i>Perfectly</i>
<i>85... 94</i>	<i>very good</i>
<i>75...84</i>	<i>well</i>
<i>65... 74</i>	<i>Satisfactory</i>
<i>60...64</i>	<i>enough</i>
<i>RD 60&lt;</i>	<i>Disappointing</i>
<i>Conditions of admission have not been met</i>	<i>is not allowed to</i>

## **9. Additional information on the discipline (educational component)**

### **An approximate list of questions that are submitted to the MKR**

1. Which of the following industries belong to forest chemistry:

- (a) Cellulose;
- b) hydrolysis;
- c) furniture;
- d) rosin-terpentine.

2. The main process on which hydrolysis production is based is:

- a) catalytic transformation of natural polysaccharides into monosaccharides;
- b) lignin release;
- c) hydrolysis of hexosans to hexoses.

### **Topics of reports**

1. Formation of scum at paper production and its impact on the environment.
2. Disposal of a lot of paper production.
3. Prospects of using energy plants.
4. Production of cellulose from vegetable agricultural waste.
5. Production of microcrystalline cellulose from plant waste.
6. Structural components of plant raw materials as carriers of medicinal products.
7. Use of lignin in medicine.
8. Production of sorbents from technical lignin.
9. Use of non-wood pulp in the production of paper and cardboard.
10. Production of sorbents from nut shells.
11. Production of sorbents from waste processing of fruit and berry crops.
12. Production of furfural from agricultural waste.
13. Production of xylose from agricultural waste.
14. Production of biodiesel.
15. Use of tree bark in the production of building and finishing materials.
16. Production of first-generation biofuel.
17. Production of second-generation biofuel.
18. Production of third-generation biofuel.
19. Production of fourth-generation biofuel.

### **Approximate tasks submitted to the DKR**

1. Technology of acid hydrolysis of agricultural waste.
2. Technology of wood waste processing by the gasification method.
3. Pellet production technology from oilseed processing waste
4. Technology of obtaining biogas from plant waste.
5. Technology of obtaining bioethanol from plant waste.
6. Technology for obtaining biobutanol from plant waste.
7. Third generation biofuel production technology.
8. Fourth generation biofuel production technology.
9. Technology of obtaining fertilizers from plant waste of agriculture.
10. Technology of obtaining carbon sorbents from plant waste of the agro-industrial complex.
11. Technology of obtaining furfural from plant waste.
12. Technology of azeotropic distillation of acetic acid.
13. Technology of obtaining nanocellulose from plant waste.
14. Technology of obtaining xylose from plant waste.
15. Technology of production of sulfite turpentine.

### **The work program of the discipline (syllabus):**

*Warehouse Assoc. Prof, PhD Vita Halysh*

**Approved** by Department E and TPP (Protocol No. 14 of 18.05.2023)

**Approved** by the Methodical Commission of the ICF (Protocol No. 10 dated 26.05.2023)