

National University of Life and Environmental Sciences of Ukraine

Department of physiology, biochemistry plants and bioenergetic

"APPROVED"

Dean of Faculty of Plant protection,
Biotechnology and Ecology



Kolomiets Y.V.

23 " May 2024

"APPROVED"

at the meeting of the department
physiology, biochemistry plants and bioenergetic
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Head of department
(Prylutska S.V.)

"APPROVED"

Garant of EP 162 «Biotechnology and bioengineering»

Kvasko O.Yu.

Garant of EP

WORK PROGRAM OF THE DISCIPLINE
BIOCHEMISTRY

Specialty 162 «Biotechnology and bioengineering»

Field of knowledge «Biotechnology and bioengineering»

Faculty Plant protection, Biotechnology and Ecology

Developer: Head of department, Dr of Sci., Prof. *Prylutska S.V.*, ass. Prof. *Tkachenko T.A.*

Description of discipline «BIOCHEMISTRY»

Field of knowledge, direction of training, specialty, education and qualification level		
Education degree	«Bachelor»	
Speciality	<u>162 «Biotechnology and bioengineering»</u>	
Field of knowledge	<u>«Biotechnology and bioengineering»</u>	
Characteristics of discipline		
Kind	Normative	
Total number of hours	<u>120</u>	
Number of ECTS	<u>4</u>	
Number of content modules	<u>2</u>	
Form of control	Exam	
Indicators discipline for full-time students		
	Full-time	Part-time
Year of training	3	2
Semester	5	4
Lectures	30 h	4 h
Practical, seminars	30 h	-
Labs	45 h	6 h
Independent work	15 h	100 h
Individual task	-	-
Number of weekly hours for full-time students: classroom	7 h	

1. The aim, tasks, competencies and program results of the educational discipline

The purpose of the discipline "Biochemistry" is to study and clarify the general patterns of the flow of various metabolic pathways and the relationships between them, both at the level of the cell and at the level of the whole organism of various biological objects.

The task of the course is to acquaint students with the main pathways of metabolism; formation of students' ideas about the metabolic ways of transformation of organic compounds, the relationship between them and the possibility of their regulation, the topography of metabolic processes.

Theoretical aspects of the discipline are consolidated in laboratory classes, so students need to acquire and consolidate skills when working in a biochemical laboratory, which will allow them to plan scientific research and analyze the obtained experimental data in the future.

Competencies of the academic discipline:

Integral Competence (IC):

The ability to solve complex specialized tasks and practical problems characterized by complexity and uncertainty in biotechnology and bioengineering, or in a learning process involving the application of theories and methods of biotechnology and bioengineering.

General competences (GC):

GC 01. Ability to apply knowledge in practical situations

GC 03. Ability to communicate in a foreign language

GC 04. Skills in using information and communication technologies

GC 05. Ability to learn and master modern knowledge

GC 09. The ability to preserve and multiply moral, cultural, scientific values and achievements of society based on an understanding of the history and patterns of development of the subject area, its place in the general system of knowledge about nature and society and in the development of society, technology and technologies, to use various types and forms of motor activity for active recreation and leading a healthy lifestyle.

Special (professional, subject) competences (SK):

SK 11. Ability to use thorough knowledge of chemistry and biology to the extent necessary to achieve other outcomes of the educational program

SK 13. Ability to work with biological agents used in biotechnological processes (microorganisms, fungi, plants, animals, viruses, their individual components)

SK 14. The ability to carry out experimental research on the improvement of biological agents, including causing changes in the structure of the hereditary apparatus and the functional activity of biological agents

Program learning results (PR):

PR02. To be able to carry out qualitative and quantitative analysis of substances of inorganic, organic and biological origin, using appropriate methods.

PR06. Be able to determine and analyze the main physicochemical properties of organic compounds that are part of biological agents (proteins, nucleic acids, carbohydrates, lipids).

PR11. Be able to carry out basic genetic and cytological research on improving and increasing the biosynthetic capacity of biological agents, taking into account the principles of biosafety, bioprotection and bioethics (induced mutagenesis using physical and chemical mutagenic factors, selection and accumulation of auxotrophic mutants, transfer of genetic information, etc.).

PR12. Using microbiological, chemical, physical, physicochemical and biochemical methods, be able to carry out chemical control (determining the concentration of disinfectant solutions, titration agents, concentration of nutrient medium components, etc.), technological control (concentrations of carbon and nitrogen sources in the culture liquid during the process; concentrations target product); microbiological control (determination of microbiological purity of nutrient media after sterilization, microbiological purity of biological agent, etc.), microbiological purity and sterility of biotechnological products for various purposes.

PR22. Be able to take into account social, ecological, ethical, economic aspects, requirements of labor protection, industrial sanitation and fire safety during the formation of technical solutions. To be able to use different types and forms of motor activity for active recreation and leading a healthy lifestyle.

PR25. To be able to use methods of microscopic studies, technologies of monoclonal antibodies, antigens, immunodiagnosics, identification of antigens in plant tissues, isoenzymes and spare proteins, DNA markers, basic principles of PCR, DNA probes, molecular genetic markers.

2. The program and structure of the educational discipline for:

- full-time full-time (full-time) form of higher education;
- shortened period of full-time (part-time) higher education.

The names of content modules and themes	Number, hours												
	full-time							part-time					
	week	number	total					number	total				
			1	sem	lab	ind	indep.		1	pr	lab	ind	indep
1	2	3	4	5	6	7	8	9	10	11	12	13	
Thematic module I. Dynamic biochemistry. Metabolic processes in the cell. Biological and coenzyme for the role of vitamins. Enzymatic processes. Exchange of proteins and amino acids. DNA replication. RNA transcription. Biosynthesis of proteins.													
Theme 1. Exchange of substances and energy.	1	8	2	2	3	-	1	2					2
Theme 2. Vitamins.	2	8	2	2	3	-	1	2					2
Theme 3. Enzymes.	3	8	2	2	3	-	1	2					2
Theme 4. Enzymatic catalysis	4	8	2	2	3	-	1	2					2
Theme 5. Protein metabolism.	5	8	2	2	3	-	1	3					3
Theme 6. Amino acid metabolism.	6	8	2	2	3	-	1						
Theme 7. Nucleic acids metabolism.	7	8	2	2	3	-	1	3					3
Theme 8. DNA replication.	8	8	2	2	3	-	1	4					4
Theme 9. RNA transcription.	9	8	2	2	3	-	1	4					4
Theme 10. Biosynthesis of proteins.	10	8	2	2	3	-	1	4					4
Number for thematic module 1	80		20	20	30		10	26					26
Thematic Module II. "Bioenergetic processes in the cell. Carbohydrate metabolism. Ways of decomposition and synthesis of carbohydrates. Photosynthetic processes in plants. Lipid metabolism (β -oxidation of fatty acids and synthesis of fatty acids). Structure of biological membranes. Respiratory chain of mitochondria. Oxidative phosphorylation. Krebs cycle. Phytohormones"													
Theme 11. Carbohydrate metabolism.	11	8	2	2	3		1	3					4

Biosynthesis of carbohydrates in plants.													
Theme 12. Lipid metabolism.	12	8	2	2	3		2	3					4
Theme 13. Biological membranes. Participation of biological membranes in the metabolism of substances and energy.	13	8	2	2	3		2	3					4
Theme 14. Krebs cycle.	14	8	2	2	3		1	4					4
Theme 15. Phytohormones	15	8	2	2	3		1	4					4
Number for thematic module 2	40		10	10	15		5	29					36
Total number	120		30	30	45		15	100	4		6		100

3. Themes of seminars

№	Name of theme	Number of hours
1	Modern methods of isolation and purification, separation of proteins - salting out, electrophoresis, chromatography, Western blot analysis, PCR, etc.	2
2	Enzymatic apparatus of the cell	2
3	Biochemical mechanisms of cell death	2
4	Biochemical mechanisms of plant resistance to the action of stressful abiotic and biotic factors	2
5	Source of vegetable proteins. Characteristics of plant proteins and their importance. Amino acid composition of plant proteins	2
6	The role of amino acids in the protection of agricultural crops from stress	2
7	Biologically active substances of plant origin. Their role in the processes of photosynthesis and respiration.	2
8	Phytohormones and their regulatory role.	2
9	Plant antibiotics - anticipins. Representatives, classification, role and functions	2

10	Selective accumulation of chemical and radioactive elements by plant organs and tissues. Consequences	2
11	Oxidative stress under the action of xenobiotics	2
12	Plant antibiotics - classification, mechanism of action and role.	2
13	Molecular biological and biochemical mechanisms of action of chemical carcinogens. Stages, metabolic transformations, cell penetration, etc.	2
14	Plant tumors and their causes. Methods of preventing the development of the tumor process and fighting it.	2
15	Chemical composition of medicinal plants.	2
	Total	30

4. Theme of Labs

№	Name of theme	Number of hours
1	Qualitative reactions to the components of nucleoproteins (proteins, monosaccharides (ribose and deoxyribose), purine bases, phosphoric acid)	3
2	Construction of a calibration curve for determination of protein concentration by the Lowry method using calf serum albumin	4
3	Quantitative determination of protein concentration with biuret reagent	4
4	Effect of activators and inhibitors on enzyme activity	2
5	Isolation of folic acid (vitamin B) from yeast	3
6	Quantitative determination of vitamin C (ascorbic acid) in plant material	3
7	Quantitative determination of vitamin A in plant material	3
8	Quantitative determination of vitamin P in tea (according to Leventhal's method)	3
9	Qualitative reactions to enzymes of the respiratory chain of mitochondria	4
10	Determination of glucose concentration in plant material	4
11	Quantitative determination of the content of photosynthetic pigments	4
12	Determination of catalase activity	4
13	Determination of ascorbate peroxidase activity	4
	Total	45

5. Theme of independent work

№	Name of theme	Number of hours
1	The history of the development of biochemistry. The contribution of outstanding domestic and foreign scientists to the development of biochemistry as a science.	2
2	Scientific discoveries in the field of Biochemistry. Nobel laureates.	2
3	Technologies for the selection and storage of biological materials (cell suspensions, tissues, blood, etc.).	2
4	Accumulation of nutrients in plant cells and tissues.	3
5	Ways of entry of substances into the cell and mechanisms of removal from the cell.	3
6	Structural, biochemical and physiological features/differences of plant and animal cells.	3
	Total	15

6. Means of diagnosing learning outcomes:

- exam;
- modular tests;
- essays;
- protection of laboratory work;
- presentations.

7. Teaching methods:

- verbal method (lecture, discussion, interview, etc.);
- practical method (laboratory, practical classes);
- visual method (illustration method, demonstration method);
- working with educational and methodical literature (summarizing, summarizing, annotating, reviewing, writing an essay, preparing a presentation and report);
- video method (remote, multimedia, web-oriented, etc.);
- independent work (task performance).

8. Evaluation methods:

- exam;
- oral or written survey;
- modular testing;
- team projects;
- abstracts, essays;
- laboratory protection;
- presentations and speeches at scientific events.

9. Distribution of points,

which are received by those obtaining higher education. The assessment of the knowledge of a higher education student takes place on a 100-point scale and is translated into national assessments according to the table. 1 of the current "Regulations on examinations and assessments at NUBiP of Ukraine"

Student rating, points	National assessment based on the results of the compilation	
	exam	credit
90-100	excellent	Credited
74-89	good	
60-73	Satisfactorily	
0-59	Non-Satisfactorily	Non-Credited

To determine the rating of the student (listener) for mastering the discipline R_{DIS} (up to 100 points) the obtained rating for certification (up to 30 points) is added to the rating of the student (listener) for academic work R_{EW} (up to 70 points): $R_{DIS} = R_{EW} + R_{AT}$.

10. Educational and methodological support:

- electronic educational course of the educational discipline (on the eLearn educational portal of NUBiP of Ukraine -<https://elearn.nubip.edu.ua/course/view.php?id=3693>);
- abstracts of lectures and their presentations (in electronic form);
- textbooks, training aids, workshops;
- methodical materials on the study of the academic discipline for students of higher education full-time and part-time forms of higher education.

11. Recommended sources of information

Basic:

1. D.L. Nelson, M.M. Cox. Lehninger Principles of Biochemistry. Publisher: W.H. Freeman (15th Edition), 2009, ISBN-10: 0-7167-7108-X. ISBN-13: 978-0-7167-7108-1. 1100 p.
2. Біологічна і біоорганічна хімія. Підручник у 2 томах/ Л.І. Остапченко, В.К. Рибальченко /– К.: Видавничо-поліграфічний центр «Київський університет», 2015. – 918 с.
3. Біохімія. Підручник / Л.І. Остапченко, Т.Р. Андрійчук, Ю.Д. Бабенюк та ін. / За ред. Л.І. Остапченко – К.: Видавничо-поліграфічний центр «Київський університет», 2012. – 796 с.
4. Біохімія. Підручник / Кучеренко М.Є., Бабенюк Ю.Д., Васильєв О.М., Виноградова Р.П., Войціцький В.М., Курський М.Д., Рибальченко В.К., Цудзевич Б.О. – К.: ВПЦ «Київський університет», 2002. – 480 с.
- 5 Молекулярна біологія. Підручник / Сиволоб А.В. – К: ВПЦ «Київський університет», 2008. – 384 с.

6. Кучеренко М.Є., Бабенюк Ю.Д., Войціцький В.М. Сучасні методи біохімічних досліджень. К.: Фітосоціоцентр, 2001. – 424 с.

Additional:

1. Thomas D. Pollard, William C. Earnshaw, Ph. D. Cell biology. – Elsevier Science (USA), 2002. – 804 p.

2. Тарасенко Л.М., Непорада К.С., Григоренко В.К. Функціональна біохімія. – Вінниця, Нова книга, 2007. – 378с.

3. Губський Ю.І. Біологічна хімія. – Київ-Вінниця:, Нова книга, 2007. – 656с.

Information Resources.

1. Electronic bases of books, publications, encyclopedias, etc. (PubMed, HighWire).

<http://review3d.ru/lehninger-a-nelson-d-l-cox-m-m-lenindzher-a-nelson-d-l-koks-m-m-principles-of-biochemistry-osnovy-bioximii>.

2. Electronic library: <http://review3d.ru/>.

3. <https://www.youtube.com/watch?v=ojhdTFmkY1c>

<https://www.youtube.com/user/amritacreate/videos>

<https://www.youtube.com/watch?v=FUo428guKt0>

<https://www.youtube.com/watch?v=CC3t67e2GsU>

<https://www.youtube.com/watch?v=QacQmS3aaTI>

<https://www.youtube.com/watch?v=HSGlfbV7W84>

<https://www.youtube.com/watch?v=JdXbTWfOc18>

https://www.youtube.com/watch?v=ZuhQtTX6_4U

https://www.youtube.com/watch?v=23W5Z_redfs