СИЛАБУС НАВЧАЛЬНОЇ ДИСЦИПЛІНИ
«Biochemistry»

Ступінь вищої освіти **«Бакалавр»**
Спеціальність **162 «Біотехнології та біоінженерія»**
Освітня програма **«Біотехнології та біоінженерія»**
Рік навчання **2**, **семестр** **4**
Форма навчання **денна**
Кількість кредитів ЄКТС 4
Мова викладання англійська

Лектор навчальної дисципліни	**д.б.н., проф. Прилуцька Світлана Володимирівна**
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ОПИС НАВЧАЛЬНОЇ ДИСЦИПЛІНИ
(до 1000 друкованих знаків)

The discipline "Biochemistry" studies the chemical composition of the living organisms and environment, as well as the relationships between them. Comprehensive knowledge of the structure, physical, chemical and biological properties of chemical and organic compounds, which are a component of the environment and all living things, their rational complementarity, are essential and necessary for the further application of the knowledge and skills of biotechnologists in their professional activities. In the living nature, there is a constant balance between diversity and stability due to the presence of numerous regulatory mechanisms and communications, which are based on complex biochemical transformations. Therefore, the study of biochemical foundations lays the foundation for understanding the deep processes of interaction between different living organisms, both among themselves and in ecosystems.

The task of the academic discipline Biochemistry consists in familiarizing students with the structure, properties of chemical elements and their compounds, the main classes of bioorganic compounds, their classification, functions and properties, biochemical mechanisms of adaptation of living organisms and the transformation of exo- and endogenous compounds. Theoretical aspects of the discipline are reinforced by students in laboratory classes in order to acquire and consolidate practical skills when working in a chemical, biochemical, biotechnological laboratory, which will allow them to plan scientific research and analyse 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 (SC):

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

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

SC 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, immunodiagnostics, identification of antigens in plant tissues, isoenzymes and spare proteins, DNA markers, basic principles of PCR, DNA probes, molecular genetic markers.

СТРУКТУРА КУРСУ

Тема	**Години** (лекції/лабораторні роботи)	**Результати навчання**	**Завдання**	**Оцінювання**
4 семестр				
Module 1. Molecular and chemical composition of living organisms				
Theme 1. Introduction to biochemistry	2/2	*Know:* Subject and tasks, main sections (static, dynamic, biochemistry of organs and tissues) and types of biochemistry (human and animal, plants, microorganisms, viruses, medical, molecular, etc.). The history of the development of biochemistry.	Perform and submit laboratory work	Completion and submission of laboratory and independent works, as well as Module control in the form of tests (on eLearn) and oral/written survey - according to the evaluation log in eLearn

		Understand: The contribution of outstanding scientists to the development of biochemistry as a science. *Familiarize yourself with:* safety and rules of work in a biochemical laboratory.		
Theme 2. Modern biochemical methods	4/2	*Know:* Qualitative and quantitative assessment of the chemical composition of substances. Understand: principles of pH-metry, conductometry, UV-Vis, IR, electron, NMR, confocal and fluorescence spectroscopy methods *Apply:* Methods of isolation and purification, separation of proteins - salting out, electrophoresis, chromatography, (UV-Vis, IR, electron, fluorescence spectroscopy, gel electrophoresis, HPLC, Western blot analysis, etc. spectroscopy, etc.	Perform and submit laboratory work	Completion and submission of laboratory and independent works, as well as Module control in the form of tests (on eLearn) and oral/written survey - according to the evaluation log in eLearn
Theme 3. Molecular and chemical composition of living organisms.	2/4	*Know:* Functional groups of biomolecules. Hydrocarbons and hydro compounds (acyclic, aromatic, homo-, heterocycles),	Perform and submit laboratory work	Completion and submission of laboratory and independent works, as well as Module control in the form of tests (on eLearn) and

		carboxylic acids. Bioorganic compounds of nitrogen (amines NO_2-NH_2 and amides COOH-NH_2). Heterofunctional compounds (COOH +NH_2 + OH groups. *Understand:* the structure of heterocyclic compounds, low molecular weight physiologically active substances (alkaloids). *Apply:* Ashing methods. Microchemical analysis of ash. Qualitative determination of mineral substances.		oral/written survey - according to the evaluation log in eLearn
Theme 4. Buffer systems.	2/4	*Know:* Macro- and microelements. *Understand:* the structure of biogenic elements. *Use:* methods for qualitative reactions to non-protein nitrogenous compounds.	Perform and submit laboratory work	Completion and submission of laboratory and independent works, as well as Module control in the form of tests (on eLearn) and oral/written survey - according to the evaluation log in eLearn
Theme 5. The role of water in the life of living organisms.	2/4	*Know:* The role of water in the vital activity of living organisms. *Understand:* Molecular structure, physical and chemical properties (boiling point, heat of vaporization). The main patterns of water absorption by the cell are osmosis. *Apply:*	Perform and submit laboratory work	Completion and submission of laboratory and independent works, as well as Module control in the form of tests (on eLearn) and oral/written survey - according to the evaluation log in eLearn

		Methods of estimating pH in buffer solutions, water, soil, biological fluids.		
Theme 6. Molecular and supramolecular organization of the cell.	2/2	*Know:* Characteristic features of a plant cell. Understand: Differences between eukaryotic and prokaryotic cells. Extracellular matrix. *Apply:* Qualitative reactions to non-protein nitrogenous compounds.	Perform and submit laboratory work	Completion and submission of laboratory and independent works, as well as Module control in the form of tests (on eLearn) and oral/written survey - according to the evaluation log in eLearn
Theme 7. Xenobiotics, bioactivity and biotransformation	4/2	*Know:* Classes of xenobiotics and mechanisms of their toxic action *Understand*: The influence of xenobiotics on structural elements of cells *Apply*: Qualitative reactions to heavy metals.	Perform and submit laboratory work	Completion and submission of laboratory and independent works, as well as Module control in the form of tests (on eLearn) and oral/written survey - according to the evaluation log in eLearn
Навчальна робота				**70**
Модульний тест				**30**
Module 2. Bioorganic compounds - structure and properties.				
Theme 1. Protien	2/4	*Know: Structure*, biological functions, classification and properties. Chemical composition of proteins. Classification of proteins: simple and complex. Characteristics of chromo-, nucleo-, glyco- and lipoproteins. *Distinguish:* Plant proteins. Representatives Sources of vegetable proteins. *Apply:* Qualitative reactions to	Perform and submit laboratory work	Completion and submission of laboratory and independent works, as well as Module control in the form of tests (on eLearn) and oral/written survey - according to the evaluation log in eLearn

		proteins and amino acids.		
Theme 2. Amino acids.	2/4	*Know:* Monomeric units of proteins. Characteristics of amino acids. Classification of amino acids: replaceable and essential amino acids, polarity of radicals, acyclic and cyclic amino acids. *Understand:* The role of amino acids in protecting crops from stress. *Apply:* Methods of protein isolation from plant material.	Perform and submit laboratory work	Completion and submission of laboratory and independent works, as well as Module control in the form of tests (on eLearn) and oral/written survey - according to the evaluation log in eLearn
Theme 3. Physico-chemical properties of proteins and amino acids	2/4	*Know:* properties of proteins and amino acids. *Understand:* amphotericity, denaturation and renaturation, colloidity, isoelectric point. *Apply:* Determination of the isoelectric point (IET) of proteins.	Perform and submit laboratory work	Completion and submission of laboratory and independent works, as well as Module control in the form of tests (on eLearn) and oral/written survey - according to the evaluation log in eLearn
Theme 4. The levels of structural organization of protein.	2/2	*Know:* Primary, secondary, tertiary, quaternary structure of proteins. Characteristics of peptide and disulfide bonds. *Understand:* Types of bonds in a polypeptide chain and forces that stabilize the conformation of proteins (covalent, hydrogen, ionic, hydrophobic). *Distinguish between:*	Perform and submit laboratory work	Completion and submission of laboratory and independent works, as well as Module control in the form of tests (on eLearn) and oral/written survey - according to the evaluation log in eLearn

		Denaturation and renaturation of proteins. *Apply:* Protein precipitation reactions.		
Theme 5. Plant proteins. Nitrogen cycle	2/2	*Know:* Classification of plant proteins, their characteristics and amino acid composition; the main stages of the nitrogen cycle in plants *Distinguish*: differences between animal and vegetable proteins, advantages of vegetable proteins in nutrition; nitrification and denitrification reactions). *Apply*: Qualitative and quantitative determination of nitrates in vegetable raw materials.	Perform and submit laboratory work	Completion and submission of laboratory and independent works, as well as Module control in the form of tests (on eLearn) and oral/written survey - according to the evaluation log in eLearn
Theme 6. Carbohydrates.	2/4	*Know:* General properties and classification of carbohydrates, structure and role in living nature. Characteristics of mono-, oligo-, polysaccharides and their main representatives. Stereochemistry of monosaccharides (D-, L- and a-, ß-forms). *Distinguish between:* Derivatives of carbohydrates: sugar acids (aldaric, aldonic, uronic), aminosaccharides,	Perform and submit laboratory work	Completion and submission of laboratory and independent works, as well as Module control in the form of tests (on eLearn) and oral/written survey - according to the evaluation log in eLearn

		glycosides. Cell wall polysaccharides. *Apply:* Qualitative reactions to monosaccharides.		
Theme 7. Nucleic acids.	2/4	*Know:* Chemical composition of nucleic acids. Purine and pyrimidine bases, nucleosides and nucleotides. *Understand:* Physico-chemical properties of nucleic acids. *Distinguish:* Derivatives of nucleotides and their importance in biosynthetic processes. *Apply:* methods of isolation of nucleoproteins from yeast.	Perform and submit laboratory work	Completion and submission of laboratory and independent works, as well as Module control in the form of tests (on eLearn) and oral/written survey - according to the evaluation log in eLearn
Theme 8. Structure and properties of DNA.	2/4	*Know:* Chemical composition of nucleic acids. Purine and pyrimidine bases, nucleosides and nucleotides. *Understand:* Physico-chemical properties of nucleic acids. *Distinguish:* Derivatives of nucleotides and their importance in biosynthetic processes. *Apply:* methods of isolation of nucleoproteins from yeast.	Perform and submit laboratory work	Completion and submission of laboratory and independent works, as well as Module control in the form of tests (on eLearn) and oral/written survey - according to the evaluation log in eLearn
Theme 9. Structure and properties of RNA.	2/4	*Know:* Types of RNA: informational, transport, ribosomal. *Understand:* The basic regularities of	Perform and submit laboratory work	Completion and submission of laboratory and independent works, as well as Module control in the form of tests

		the genetic apparatus and its structural features in eukaryotes and prokaryotes. Concepts of gene, genome, gene expression. The structure and functions of chromosomes. *Apply:* Methods of lipid solubility and emulsion formation.		(on eLearn) and oral/written survey - according to the evaluation log in eLearn
Theme 10. Lipids.	2/4	*Know:* Structure, properties, functions and structural components of lipids. Classification of lipids: fatty acids - structure, properties. Higher fatty alcohols and aldehydes, classification, structure and properties. *Understand:* Neutral lipids, neutral glycolipids, phospholipids - glycerides, classification, structure and properties. Sphingolipids, structure, properties, classification. *Apply:* Methods of determining the chemical parameters of fats.	Perform and submit laboratory work	Completion and submission of laboratory and independent works, as well as Module control in the form of tests (on eLearn) and oral/written survey - according to the evaluation log in eLearn
Theme 11. Biologically active substances of plants	2/4	*Know:* classification and main characteristics of BAS plants. *Understand*: the BAS value for the plant organism.	Perform and submit laboratory work	Completion and submission of laboratory and independent works, as well as Module control in the form of tests (on eLearn) and

		Apply: Methods of isolation and determination of BAS in plant material.		oral/written survey - according to the evaluation log in eLearn
Theme 12. Antioxidant system of living organisms	3/2	*Know:* the concept of antioxidant protection and its levels. *Understand*: The role of lipid peroxidation in the development of pathological conditions. *Apply*: Methods of determining the activity of antioxidant defense enzymes.	Perform and submit laboratory work	Completion and submission of laboratory and independent works, as well as Module control in the form of tests (on eLearn) and oral/written survey - according to the evaluation log in eLearn
Всього за 4 семестр				**70**
Екзамен				**30**
Всього за курс				**100**

ПОЛІТИКА ОЦІНЮВАННЯ

Політика щодо дедлайнів та перескладання:	Роботи, які здаються із порушенням термінів без поважних причин, оцінюються на нижчу оцінку. Перескладання модулів відбувається із дозволу лектора за наявності поважних причин (наприклад, лікарняний).
Політика щодо академічної доброчесності:	Списування під час контрольних робіт та екзаменів заборонені (в т.ч. із використанням мобільних девайсів). Самостійні роботи, реферати повинні мати коректні текстові посилання на використану літературу та/або електронні джерела.
Політика щодо відвідування:	Відвідування занять є обов'язковим. За об'єктивних причин (наприклад, хвороба, міжнародне стажування) навчання може відбуватись індивідуально (в он-лайн формі за погодженням із деканом факультету).

ШКАЛА ОЦІНЮВАННЯ ЗНАНЬ СТУДЕНТІВ

Рейтинг здобувача вищої освіти, бали	**Оцінка національна за результати складання екзаменів заліків**	
	екзамен	**залік**
90-100	відмінно	зараховано
74-89	добре	
60-73	задовільно	
0-59	незадовільно	не зараховано

Recommended sources of information

Basic

1. Біологічна і біоорганічна хімія. Підручник у 2 томах/ Л..І. Остапченко, В.К. Рибальченко /– К.: Видавничо-поліграфічний центр «Київський університет», 2015. – 918 с.

2. 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.
3. 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», 2012. – 480 с.
4. Молекулярна біологія. Підручник / Сиволоб А.В. – К: ВПЦ «Київський університет», 2018. – 384 с.
5. D.L. Nelson, M.M Cox. Lehninger Principles of Biochemistry. Publisher: W.H. Freeman (15th Edition), 2022, ISBN-10: 0-7167-7108-X. ISBN-13: 978-0-7167-7108-1. 1100 p.
6. Кучеренко М.Є., Бабенюк Ю.Д., Войціцький В.М. Сучасні методи біохімічних досліджень. К.: Фітосоціоцентр, 2021. – 424 с.
7. Прилуцька С.В., Гринюк І.І., Ткаченко Т.А. Біохімія. Навчальний посібник. - Київ: Редакційно-видавничий відділ НУБіП України. - 2022. - 192 с.

Additional:

1. Тарасенко Л.М., Непорада К.С., Григоренко В.К. Функціональна біохімія. – Вінниця, Нова книга, 2017. – 378с.
2. Губський Ю.І. Біологічна хімія. – Київ-Вінниця:, Нова книга, 2017. – 656с.
3. Thomas D. Pollard, William C. Earnshaw, Ph. D. Cell biology. – Elseviar Sciense (USA), 2022. – 804 p.
4. Прилуцька С.В., Демчук Т.Л., Бойко О.А., Коломієць Ю.В. Навчально-методичні рекомендації з «Біохімії». Видавничий центр НУБіП України. 44 с. 2012. Київ.
5. Григорюк І.П., Бойко О.А., Прилуцька С.В. Фізіологія рослин з основами біохімії. Практикум. Видавництво ТОВ «Аграр Медіа Груп». Київ. 2014. С. 148.