



СИЛАБУС ДИСЦИПЛІНИ «Biochemistry»

Ступінь вищої освіти -
 Спеціальність **162 «Біотехнології та біоінженерія»**
 Освітня програма **«Бакалавр»**
 Рік навчання **3, семестр 5**
 Форма навчання **денна**
 Кількість кредитів ЄКТС **4**
 Мова викладання **англійська**

Лектор курсу
Контактна інформація
лектора (e-mail)
Сторінка курсу в eLearn

д.б.н., ст.н.с. Прилуцька Світлана Володимирівна
тел. (044) 527-89-66
psvit_1977@ukr.net
<https://elearn.nubip.edu.ua/course/view.php?id=3693>

ОПИС ДИСЦИПЛІНИ

(до 1000 друкованих знаків)

The aim of this discipline is studying the structure, chemical composition of organisms, including plants, determining the general regularities of different metabolic pathways and the interconnections between them, as in cells in the organism as a whole.

Tasks are familiarize of students with the basic classes of bioorganic molecules, their functions, properties and pathways; forming of students' understanding of the metabolic pathways convert organic compounds, the relationship between them and the possibility of regulation of metabolic processes topography.

The theoretical aspects of the discipline are fixed on laboratory studies, so students need to obtain and consolidate skills at work in biochemical laboratories that allow in the further will plan the research and analyze experimental data.

СТРУКТУРА КУРСУ

Тема	Години (лекції/лабораторні)	Результати навчання	Завдання	Оцінювання
5 семестр				
Module I “Intoduction to the Biochemistry. Modern biochemical methods. The molecular and chemical composition of living organisms. The molecular and supramolecular organization of cells”				
Theme 1. <u>Introduction to the Biochemistry.</u>	3/3	Subject and objectives, main parts (static, dynamic, biochemistry of organs and tissues) and types of Biochemistry (human and animals, plants, microorganisms, viruses, medical, molecular, etc.). History of development the Biochemistry. The contribution of	Choose one of the personalities listed in the e-course according to your serial number in the journal and prepare an essay on the life and scientific achievements of the scientist.	Максимальний бал за л/р – 7; Максимальний бал за с/р – 7.

		<p>outstanding scientists in the development of biochemistry as a science.</p> <p>Get acquainted with the safety and rules of work in the biochemical laboratory.</p>		
<p>Theme 2. <u>Modern biochemical methods</u></p>	3/3	<p>Qualitative and quantitative estimation of the chemical composition of substances.</p> <p>Methods for extraction and purification of protein - separation and salting, electrophoresis, chromatography and so on (UV-Visible, IR, electronic, fluorescence spectroscopy, gel electrophoresis, gas-liquid chromatography, HPLC, Western-, Northern-blot analyzes, etc.).</p>	<p>Methods of quantitative determination of protein. Biological material - selection and storage.</p>	<p>Максималън ий бал за л/р – 7; Максималън ий бал за с/р – 7.</p>
<p>Theme 3. <u>The molecular and chemical composition of living organisms.</u></p>	3/3	<p>Functional groups of biological molecules.</p> <p>Hydrocarbons (acyclic, aromatic, homo-, heterocyclic) carboxylic acid.</p> <p>Bioorganic compounds of nitrogen.</p> <p>Heterofunctional compounds (COOH + NH₂ + OH group).</p> <p>Heterocyclic compounds - low physiologically active substances (alkaloids). Macro- and microelements.</p>	<p>The role of water in the life of living organisms. The molecular structure, physicochemical properties (boiling point, heat of vaporization). Main regularities of water absorption cell - osmosis. Minerals.</p>	<p>Максималън ий бал за л/р – 7; Максималън ий бал за с/р – 7.</p>

		Lab – Qualitative determination of minerals		
Theme 4. <u>The molecular and supramolecular organization of cells.</u>	3/3	Characteristic features of the plant cell. The extracellular matrix. Lab - Selecting of proteins from plant material	Differences between prokaryotes and eukaryotes cell.	Максималън ий бал за л/р – 7; Максималън ий бал за с/р – 7.
Навчальна работа				70
Модульний тест				30
Module II “Static biochemistry”				
Thema 1. <u>Proteins</u>	3/3	Structure, biological functions, clasiffication and properties of proteins. The chemical composition of proteins. Classification of proteins: simple and complex. Characteristics chromo-, nucleo-, glyco- and lipoproteind. Lab - Color reactions on proteins	Vegetable proteins. Representatives. Sources of vegetable proteins. Characteristics of vegetable proteins and their significance. Foods containing vegetable proteins. Completeness of vegetable protein. Differences between animal and plant proteins. Advantages of vegetable proteins in nutrition. The use of vegetable proteins in the technology of meat products. Substitute of animal protein in the diet of vegetables, advantages and disadvantages of nutrition.	Максималън ий бал за л/р – 7; Максималън ий бал за с/р – 7.
Thema 2. <u>Amino acids</u>	3/3	Monomer units of proteins. Characteristics of amino acids. Classification of amino acids: essential and nonessential amino acids, polarity of radicals, acyclic and cyclic amino acids. Physical - chemical properties of proteins and amino	Amino acid composition of vegetable proteins. The role of amino acids in protecting crops from stress.	Максималън ий бал за л/р – 7; Максималън ий бал за с/р – 7.

		acids (Amphoteric, colloidal properties, denaturation and renaturation, isoelectric point). Lab - Color (qualitative) reactions on amino acids		
Thema 3. <u>Structural organization of protein.</u>	3/3	Primary, secondary, tertiary, quaternary structure of proteins. Types of bonds in the polypeptide chain and forces that are stabilized the conformation of proteins (covalent, hydrogen, ionic, hydrophobic). Lab - Reactions precipitation of proteins.	Characteristics of the peptide and disulfide bonds. Physical and chemical properties of proteins. Denaturation and renaturation of proteins.	Максималнь ий бал за л/р – 7; Максималнь ий бал за с/р – 7.
Thema 4. <u>Carbohydrates</u>	3/3	Main properties and classification of carbohydrates, structure and biological role. Characteristics of mono-, oligo-, polysaccharides and their main representatives. The stereochemistry of monosaccharides (D-, L- and α -, β -form). Lab - Qualitative reactions to monosaccharides	Derivatives of carbohydrates, the sugar acid (aldaric, aldonic, uronic acids) aminosaccharides, glycosides. Polysaccharides of cell walls.	Максималнь ий бал за л/р – 7; Максималнь ий бал за с/р – 7.
Thema 5. <u>Nucleic acid.</u>	3/3	Chemical composition of nucleic acids. Purine and pyrimidine bases, nucleosides and nucleotides. Physical - chemical properties of nucleic acids. Lab - Selecting of nucleoproteides from yeast	Derivative nucleotides and their importance in the biosynthetic processes.	Максималнь ий бал за л/р – 7; Максималнь ий бал за с/р – 7.

<p>Thema 6. <u>Structure and properties of DNA and RNA.</u></p>	<p>3/3</p>	<p>Levels of organization of DNA (the primary structure, secondary structure, rules of complementarity, tertiary structure of DNA). The structure of RNA. Types of RNA: information, transport, ribosomal. Lab - Qualitative reactions on components of nucleoproteins (proteins, monosaccharides (ribose and deoxyribose), purine bases, phosphoric acid)</p>	<p>The structure of chromosomes. Features nucleotide composition, molecular weight, biological role. The genetic apparatus of the cell. Basic regularities of the genetic apparatus and its features of structure in eukaryotes and prokaryotes. The concept of gene, genome, gene expression. Structure and functions of chromosomes. Genetic engineering. Molecular engineering. Gene cloning.</p>	<p>Максималнь ий бал за л/р – 7; Максималнь ий бал за с/р – 7.</p>
<p>Thema 7. <u>Lipids</u></p>	<p>3/3</p>	<p>Structure, properties and functions of lipids. Main properties, functions and structural components of lipids. Classification of lipids: fatty acids - structure, properties. Higher fatty alcohols and aldehydes, classification, structure and properties. Neutral lipids, neutral glycolipids, phospholipids - glycerides, classification, structure and properties. Sphingolipids, structure, properties, classification.</p>	<p>Characteristics of the most important representatives of lipids. Structure and function of cholesterol. Characteristics of the most important representatives of lipids. Waxes and lipid polymers (cutin and suberin).</p>	<p>Максималнь ий бал за л/р – 7; Максималнь ий бал за с/р – 7.</p>

		Lab - Determination of chemical parameters of fats		
Навчальна робота				70
Модульний тест				30
Module III “Dynamic biochemistry. Metabolic processes in the cell. Biological and coenzymatic the role of vitamins. Enzymatic processes”				
Theme 1. <u>Metabolism of substances and energy.</u>	3/3	Major differences between the reactions of synthesis and degradation compounds. Catabolism and anabolism of compounds. Lab - Qualitative reactions on the nonprotein nitrogen compounds	Nitrogen metabolism. Nitrogen cycle in nature. Features of fixing atmospheric nitrogen, in particular by bacteria. Nitrogen cycle (fixation of atmospheric nitrogen, ammonium formation, oxidation of ammonium to nitrates and nitrites, nitrification and denitrification reactions). Nitrification of ammonium by microorganisms with the formation of nitrates, the conversion of nitrates to ammonium in the cells of higher plants; synthesis of amino acids from ammonium in cells of all organisms, conversion of nitrates into N ₂ by denitrifying bacteria. Enzymes of the nitrogenase complex. Glutamate and glutamine as a source of ammonium. Glutamine synthesis its role in nitrogen metabolism.	Максимальний бал за л/р – 7; Максимальний бал за с/р – 7.

			Nitrogen-containing harmful substances in food. Characteristics of nitrates, nitrites, nitrosamines.	
Theme 2. <u>Vitamins.</u>	3/3	<p>Characteristics and classification of vitamins.</p> <p>Enzymatic role of vitamins.</p> <p>Characteristics of water-soluble vitamins: thiamine (B1), riboflavin (B2), niacin (PP), pantothenic acid (B3), pyridoxine (B6), biotin (H), folic acid, ascorbic acid (C). Fat-soluble vitamins: vitamin A, vitamin D, vitamin E, vitamin K.</p> <p>Lab - Quantitative determination of vitamin C (ascorbic acid) and vitamin A in plant material</p>	<p>History of discovery of vitamins. The role of vitamins in the functioning of enzymes and coenzymes.</p> <p>Vitamin-like substances (carnitine, inositol, lipoic acid, rutin, catechin, orotic acid - B13, pangamic acid - B15).</p>	<p>Максималън ий бал за л/р – 7;</p> <p>Максималън ий бал за с/р – 7.</p>
Theme 3. <u>Enzymes.</u>	3/3	<p>Structure and properties of enzymes.</p> <p>Classification and nomenclature of enzymes. The specificity of enzymes.</p> <p>Kinetics of enzymatic catalysis. The general idea of the mechanism of action of enzymes.</p> <p>Inhibitors and activators of enzymatic reactions.</p> <p>Labs - Study of enzymes (amylase and catalase).</p> <p>Properties of enzymes (termolability, pH)</p>	<p>Coenzymes and their biological role. Isoenzymes. Multi-enzyme systems. Competitive and non competitive inhibition. Working and systematic name of enzymes.</p> <p>Units of enzyme activity.</p> <p>Compartmentalization of enzymes and metabolic pathways in the cell.</p>	<p>Максималън ий бал за л/р – 7;</p> <p>Максималън ий бал за с/р – 7.</p>

<p>Theme 4. <u>Metabolism of proteins and amino acids.</u></p>	<p>3/3</p>	<p>Hydrolysis of proteins. Pathways of metabolism of amino acids - catabolism (the breakdown) of amino acids – reactions of transamination, deamination and decarboxylation. The end products of metabolism of amino acids. Lab - Chromatographic method for determination of amino acids (distributive chromatography on the paper)</p>	<p>Glyco- and ketogenic amino acids. Biosynthesis of amino acids. Glycolat pathway of synthesis of amino acids. The enzymes participating in these reactions.</p>	<p>Максималън ий бал за л/р – 7; Максималън ий бал за с/р – 7.</p>
<p>Theme 5. <u>Metabolism of nucleic acids.</u> <u>DNA replication.</u> <u>RNA transcription.</u></p>	<p>3/3</p>	<p>Cleavage of nucleic acids to end products. Metabolic disintegration of nitrogenous bases - purines and pyrimidines bases. Biosynthesis of nucleotides (purine and pyrimidine) and its regulation. The formation of deoxyribonucleotides, nucleotide coenzymes. Characteristics nucleases, their specificity (restrictases). The main stages. DNA modification and restriction. Characterization of DNA polymerases. The main stages. Characterization of RNA polymerase. Lab - Electrophoresis of nitrogenous components of nucleic acids on paper</p>	<p>End products of nucleic acids decay. Formation of deoxyribonucleotides, nucleotide coenzymes. Characteristics of nucleases, their specificity of action. Enzymes of DNA replication and transcription of RNA.</p>	<p>Максималън ий бал за л/р – 7; Максималън ий бал за с/р – 7.</p>

Theme 6. <u>Biosynthesis of proteins.</u>	3/3	The main stage. Post-translation maturation of RNA transcript. Modifications newly synthesized proteins. The structure and function of ribosomes. Types of ribosomes and their role in the biosynthesis of proteins. Features of the genetic code. Lab - Spectrophotometric determination deoxyribonuclease activity	The structure of ribosomes. Differences of proteins biosynthesis in eukaryotes and prokaryotes. The genetic device of cells.	Максималън ий бал за л/р – 7; Максималън ий бал за с/р – 7.
Навчальна работа				70
Модульний тест				30
Module IV “Bioenergetic processes in cells”				
Theme 1. <u>Metabolism of carbohydrates.</u> <u>Biosynthesis of carbohydrates in plants.</u>	3/3	Catabolism of carbohydrates. Intracellular conversion of carbohydrates - aerobic and anaerobic pathways. Glycolysis and glycolytic enzymes. Alcoholic fermentation. Aerobic transformation of carbohydrates. The energy balance transformation of carbohydrates. Gluconeogenesis. Pentose phosphate pathway of glucose oxidation, its value. Lab - Determination of glucose concentration in plant material	The value of photosynthesis. Leaf as organ of photosynthesis. Chloroplasts. Characteristics and properties of photosynthetic pigments. Photosynthetic unit. Photosystem I and II. Light and dark phase of photosynthesis. Calvin cycle. Hatch-Slack cycle. Photorespiration.	Максималън ий бал за л/р – 7; Максималън ий бал за с/р – 7.
Theme 2. <u>Metabolism of lipids.</u>	3/3	Characterization of lipases. Metabolism of saturated and unsaturated fatty	The metabolism of phospholipids, sphingolipids. Enzymes and coenzymes,	Максималън ий бал за л/р – 7;

		acids. β -oxidation of fatty acids - localization, the main reaction end products. Biosynthesis of fatty acids - localization, the main reaction end products. Lab - Determination of fat due to the oxidation (micromethod)	multienzymes participating in the metabolism of lipids.	Максималън ий бал за с/р – 7.
Theme 3. <u>Biological membranes.</u> <u>Participation of biological membranes in metabolism and energy.</u>	3/3	The functions, structure and structural components of membranes. Structural organization of membranes. Mechanisms of penetration of substances through the membrane. Membranes and intercellular interactions. Electron transfer and oxidative phosphorylation. Lab - Quantitative determination of chlorophyll	Respiratory chain. Cytochromes. The coupling of oxidative phosphorylation with the electron transfer process. Chemiosmotic theory of oxidation and phosphorylation energy coupling. The functions of gradient of electrochemical potential of hydrogen ions. Enzymes, chemical compounds and energy balance of reactions.	Максималън ий бал за л/р – 7; Максималън ий бал за с/р – 7.
Theme 4. <u>Krebs cycle.</u>	3/3	Lemon cycle (cycle of three carboxylic acids, Krebs cycle), its biological significance. Localization, function and biological role of the Krebs cycle. Enzymes, chemical compounds and energy balance of reactions. Lab - Qualitative reactions on mitochondrial respiratory chain enzymes	Features of the functioning of the respiratory chain in aerobic bacteria and thylakoids of chloroplasts of plants.	Максималън ий бал за л/р – 7; Максималън ий бал за с/р – 7.

Theme 5. <u>Phytohormones.</u>	3/3	Classification of phytohormones. Molecular mechanisms of action of phytohormones. The main representatives (auxins, cytokinins, gibberellins, abscisic acid and ethylene), their structure, properties and biological effects. Lab - Selecting of folic acid (vitamin Bc) from yeast	History of discovery of phytohormones. Interaction and plurality of phytohormones. Application of phytohormones in biotechnology.	Максимальний бал за л/р – 7; Максимальний бал за с/р – 7.
Навчальна робота				70
Модульний тест				30
Всього за 5 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 СТУДЕНТІВ

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