



**SYLLABUS
OF THE EDUCATIONAL COMPONENT
BIOLOGICAL CHEMISTRY**
for applicants for higher education of 2-3 year
of study full-time form of education
of educational program "Pharmacy",
specialization 226.01 Pharmacy,
in specialty "226 Pharmacy, Industrial Pharmacy",
field of knowledge "22 Public Health"
training for Master`s (second) level of higher education

TEACHER

Information about the teacher

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- 1. The name of higher education establishment and department:** National University of Pharmacy, Department of Clinical Laboratory Diagnostics, Microbiology and Biological Chemistry.
- 2. Address of the department:** Kharkiv, Kulikovska str., 12, ground floor, т. 057-706-30-99.
- 3. Web site of the department:** <https://biochem.nuph.edu.ua/?lang=en>
- 4. Consultations:** on-line on the ZOOM platform after a class with your teacher.
- 5. Abstract of the educational component:** the educational component "Biological Chemistry" Module 2 include in compulsory subjects for specialty 226 "Pharmacy, Industrial Pharmacy", educational program "Pharmacy" for applicants for higher education at the 3rd year of study in 5th semester. Final control – semester credit, semester exam (Note! Educational component "Biological Chemistry" Module 1 supposed to be at the 2nd year of study in the 4th semesters. Final control – semester credit).
- 6. The purpose statement** of studying the educational component: the formation of concepts of: structure biochemical functions about the of compounds that make up living organisms and the relationship with their; the formation of a modern understanding of the principles of the structural organization of the main classes of biomacromolecules – proteins, nucleic acids, etc.; formation of knowledge of the patterns of release, accumulation and energy consumption in biological systems; the formation of knowledge about the main metabolic pathways in the body, their interrelation and molecular mechanisms of regulation; formation of knowledge of the molecular basis of the transfer of genetic information, protein biosynthesis and mechanisms of their regulation; acquaintance with modern methods of biochemical diagnostics of the state of body metabolism; the formation of the skills of scientific analysis and synthesis of phenomena and facts observed; providing a theoretical basis for the study of other biomedical disciplines: pharmacology, pharmacotherapy with pharmacokinetics, clinical pharmacology, and individual pharmaceutical disciplines.
- 7. Competences in accordance with the educational program:** conducting lectures and practical classes for a better understanding of topics.

Hard-skills / Professional (special) competences (PC):

PC 4 The ability to ensure the rational use of prescription and nonprescription medications and other products of the pharmacy assortment in accordance with physico-chemical, pharmacologic characteristics, biochemical, pathophysiological characteristics of a particular disease and pharmacotherapeutic schemes of its treatment.

8. The program learning outcomes: (PLO):

PLO 14 Determine advantages and disadvantages of medicinal products of various pharmacological groups, taking into account their chemical, biopharmaceutical, pharmacokinetics and pharmacodynamic properties.

PLO 16 Determine the influence of factors affecting the processes of absorption, distribution, deposition, metabolism, and excretion of the medicinal product and are determined by the condition, features of the human body, and the physicochemical properties of medicinal products.

PLO 18 Choose biological objects of analysis, determine xenobiotics and their metabolites in biological environments and evaluate the results obtained taking into account their distribution in the body.

9. Status of the educational component: *compulsory*.

10. Prerequisites of the educational component: “Biological Chemistry” as educational component is based on students’ knowledge of inorganic, analytic, physical and colloid, organic chemistry, botany, physiology and microbiology, and is integrated with such disciplines; supplies students with basic information on clinical biochemistry, laboratory diagnostics, biotechnology, pharmacology that supposes certain integration of teaching with these disciplines and formation of skills to apply knowledge on biochemistry in the process of further education and in professional activity.

11. The volume of the educational component: 210 hours, 7 ECTS credits, 122 hours of classroom classes, including 17 hours of lectures, 93 hours of practical classes, 100 hours of self-work

12. Organization of training:

Teaching methods:

- Explanatory (information and reproductive) method: Lecture-based learning – lectures, video materials;
- reproductive method: traditional practical classes;
- problem-based teaching: Brainstorming – brainstorming method;
- research method: Research-based learning – participation in research work, preparation of abstracts at conferences, scientific articles

Content of the educational component:

MODULE 1. GENERAL METABOLIC PATHWAYS IN THE CELLS

Content Module 1. Structure and functions of biomolecules

Topic 1. Amino Acids, Peptides, and Proteins. Tree-dimensional Structure of Proteins. Physical-chemical Properties of Proteins.

Topic 2. Conjugated Proteins: Hemoproteins, Glycoproteins, Proteoglycans, Lipoproteins, Metalloproteins, Phosphoproteins. Nucleoproteins and Nucleic Acids. Structure, Functions, Biological Role.

Topic 3. Enzymes. Structure. Classification and Functions. Vitamins as Coenzymes. Kinetics of Enzymatic Reactions. Mechanism of action. Specificity and Regulation of Enzyme Activity.
Content module control CM1.

Content Module 2. The major metabolic pathways

Topic 4. Introduction into Metabolism. High-energy Bond Compounds and ATP Synthesis. Citric Acid Cycle. Biological Oxidation. Regulation of Energetic Processes in the Cell. Other Types of Oxidations.

Topic 5. Carbohydrate Metabolism: Carbohydrate Structure, Digestion and Absorption. The Major Pathways of Carbohydrate Metabolism and its Regulation. Carbohydrate Metabolism Disorders.

Topic 6. Lipid Metabolism: Lipid Structure, Digestion and Absorption. The Major Pathways of Lipid Metabolism and its Regulation. Lipid Metabolism Disorders.

Topic 7. Protein Digestion and Amino Acid Absorption. Amino acid Putrefaction in Intestine and Detoxication its Products. General Amino Acid Pathways and their Regulation. Ammonium Detoxication. Specific Pathways of Amino Acid Metabolism and its Disorders.

Content module control CM2.

Semester module control 1

MODULE 2. METABOLISM AND ITS REGULATION

Content Module 3. Fundamentals of molecular biology

Topic 8. Conjugated proteins metabolism. Metabolism of nucleotides and nucleic acids. Metabolism of Hemoproteins.

Topic 9. Transfer of Genetic Information. Protein Bio-synthesis in the Cell. Mechanisms of Protein Biosynthesis Regulation. Antibiotics.

Content module control CM3.

Content Module 4. Some metabolic processes

Topic 10. Vitamins. Nomenclature and Classification of Vitamins, Chemical Structure and Vitamin's Action Molecular Basis. Vitamin Deficiency.

Topic 11. Biochemical bases of reception. Mechanisms of signal transmission inside the cell. General characteristics and classification of hormones and neuro-transmitters. Mechanisms of action of hormones. Endocrine dysfunction and their pharmacocorrection.

Topic 12. Liver biochemistry. Biochemical transformation of drugs in the body. Pharmaceutical Biochemistry. Content module control CM4.

Semester module control 2

Semester Exam

Organization of self-study:

Independent work includes the study of issues on the topics of the educational component that are not included in classroom classes and the completion of tasks on these issues in order to consolidate theoretical material.

13. Types and forms of control:

Current control:

Control of knowledge at each lesson: oral questioning, written assignments, solving situational problems, passing tests.

Control of content modules: oral questioning, test tasks, solving situational (calculation) problems.

Conditions for admission to the control of content modules: to be admitted to the control of a content module, you must score a minimum number of points on the topics of the relevant content module.

Semester control:

Form of semester control: semester credit.

Conditions for admission to the semester control: current rating of more than 60 points, no unexcused absences from practical classes, fulfillment of all requirements provided by the work program of the educational component.

Semester exam.

The form of examination is written control.

Conditions for admission to the semester exam: higher education applicants who have received two semester credits are admitted to the semester exam.

14. Evaluation system of the educational component:

Assessment of mastering the topics of the educational component during classes:

Number of the educational component topic	Maximal number of points per topic	Distribution of the maximum number of points per topic by type of work	Types of work for which the student receives points
Content module 1.			
Topic 1.	11	7	oral answer
		4	solving situational tasks
Topic 2.	12	8	oral answer
		4	solving situational tasks
Topic 3.	12	8	oral answer
		4	solving situational tasks
Total points for content module 1:		35	
Content module 2.			
Topic 4.	11	7	oral answer
		4	solving situational tasks
Topic 5.	11	7	oral answer
		4	solving situational tasks
Topic 6.	11	7	oral answer
		4	solving situational tasks
Topic 7.	12	8	oral answer
		4	solving situational tasks
Total points for content module 2:		45	
Всього балів за модуль:		80	
Content module 3.			

Topic 8.	14	10	oral answer
		4	solving situational tasks
Topic 9.	6	4	oral answer
		2	solving situational tasks
Total points for content module 3:		20	
Content module 4.			
Topic 10.	14	10	oral answer
		4	solving situational tasks
Topic 11.	14	10	oral answer
		4	solving situational tasks
Topic 12.	12	8	oral answer
		4	solving situational tasks
Total points for content module 4:		40	
Total points per module:		60	

The study of the educational component by higher education students is possible through non-formal education. Instead of performing types of work on any topic of the educational component, the following types of work of a higher education applicant may be credited:

- participation in master classes, forums, conferences, seminars, webinars on the topic of the educational component (with the preparation of essays, abstracts, information messages, etc., which is confirmed by the program of the event, or abstracts, or the relevant certificate)
- participation in research and applied studies on the topic of the educational component (in the development of questionnaires, conducting experimental studies, processing research results, preparing a report, presenting results, etc., as evidenced by the demonstration of relevant materials).

Assessment of students by type of work during classes:

Types of work for which the student gets points	Maximum number of points
answers to theoretical questions	94
solving situational tasks	46
Total points:	140

Assessment during the control of content modules:

Types of work for which the student gets points	Distribution of the maximum number of points for the control of the content module by type of work	The maximum number of points for the control of the content module
Content module 1		
answers to practical questions	4	10
answers to theoretical questions	6	
Content module 2		
answers to practical questions	4	10
answers to theoretical questions	6	
Total points for the control of content modules:		20
Content module 3.		
answers to practical questions	5	20
answers to theoretical questions	15	
Content module 4.		
answers to practical questions	5	20
answers to theoretical questions	15	
Total points for the control of content modules:		40

Student's independent work assessment:

- during the control of content module 1: tickets for content module 1 include theoretical questions on topics 1-3
- during the control of content module 2: tickets for content module 2 include theoretical questions on topics 4-7
- during the control of content module 1: tickets for content module 1 include theoretical questions on topics 8-9
- during the control of the content module 2: tickets for the content module 2 include theoretical questions on topics 10-12.

Several grading scales are used in the study of the educational component: 100-point scale, undifferentiated (“passed”, “failed”) two-point scale and ECTS rating scale.

The semester exam is conducted in writing. The ticket consists of 4 theoretical questions and 1 practical question (situational task, creating graphs, writing process chemistry, etc.) For each theoretical question, a higher education student can receive from 0 to 15 points, up to a total of 60 points. The practical question is worth 40 points. The semester exam is considered to be successfully passed if the student has received from 60 to 100 points.

A higher education student can automatically pass a semester exam (at the discretion of the head of the department) if in each semester he or she had from 91 to 100 points for each module of the educational component. In this case, the grade is assigned as an average for the two semesters in which the educational component was studied.

ASSESSMENT SCALE

Sum of points on a 100-point scale	ECTS scale	Grade on a four-point scale	Grade on an undifferentiated scale
90-100	A	excellent	credited
82-89	B	good	
74-81	C		
64-73	D	satisfactorily	
60-63	E		
35-59	FX	unsatisfactory	Not credited
1-34	F		

The results are converted from one scale to another according to the table.

15. Academic policies of the educational component:

Policy on academic integrity. It is based on the principles of academic integrity provided in the Regulations “On measures to prevent cases of academic plagiarism in the NUPh”. Cheating in assessing the progress of a higher education student during control measures in practical (seminar, laboratory) classes, control of content modules and semester exams is prohibited (including the use of mobile devices). Abstracts must have correct textual references to the literature used. Detection of signs of academic dishonesty in the written work of the student is the basis for its non-acceptance by the teacher.

Attendance policy. The applicant for higher education is obliged to attend classes (Policy “On the organization of the educational process of the NUPh”) according to the schedule (<https://nuph.edu.ua/rozklad-zanyat/>), to adhere to ethical standards of behavior.

Policy on deadlines, working off, improving the rating, eliminating academic debt. Students make up missed classes in accordance with the Policy on Making Up Missed Classes and the Procedure for Eliminating Academic Differences in Curricula at the NUPh in accordance with the schedule of making up missed classes established by the department. Increasing the rating and eliminating academic debt from the educational component is carried out by applicants for education in accordance with the procedure specified in the Policy “On the procedure for assessing the results of training of applicants for higher education at the NUPh”. Higher education applicants are obliged to comply with all deadlines set by the department for completing the types of written work on the educational component. Works that are submitted in violation of the deadlines without valid reasons are evaluated at a lower grade - up to 20% of the maximum number of points for this type of work.

Policy on appealing the grade of the educational component (appeals). Higher education applicants have the right to appeal (appeal) the grade of the educational component received during the control measures. The appeal is carried out in accordance with the Policy on Appealing the Results of Semester Control of Knowledge of Higher Education Applicants at NUPh.

Policy on the recognition of learning outcomes obtained through non-formal and/or informal education by higher education applicants. Higher education applicants have the right to recognize learning outcomes acquired in non-formal and informal education in accordance with the Policy “On the Procedure for Recognition of Learning Outcomes Acquired through Non-formal and/or Informal Education by Higher Education Applicants at NUPh”.

Within the framework of the academic freedom of the teacher, instead of performing types of work on the topic of the educational component, it is possible to credit the non-formal education of a higher education applicant.

16. Information and educational and methodical support of the educational component:

The main reading suggestions	Biological chemistry : textbook for the self-training of higher education student / V. M. Kravchenko, G. B. Kravchenko, O. A. Krasilnikova, I. V. Seniuk. – Independent electronic edition. – Kharkiv : National University of Pharmacy, 2023. – 392 p.
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<p>Supplementary reading suggestions for in-depth study of the educational component</p>	<p>David L. Nelson; Michael M. Cox. Lehninger Principles of Biochemistry. Eighth Edition. 2021.</p> <ol style="list-style-type: none"> 1. Lieberman M., Marks A. Marks' basic medical biochemistry: a clinical approach. – Lippincott Williams & Wilkins, a Wolters Kluwer business., 2009. – 1011p. 2. Bhagavan N.V., Chung-Eun H. Essentials of medical biochemistry: with clinical cases. – ELSEVIER Inc., 2011. – 581p. 3. David M. Nelson and Michael M. Cox Leininger Principles of Biochemistry, 7th edition, 2017. – 572 p. 4. Biological chemistry: methodical recommendations for organizing self-training work of a higher education student / V. M. Kravchenko, I. V. Seniuk, G. B. Kravchenko [et al.] – Kharkiv : NUPh; 2023. – 47 p.
<p>Current electronic information resources (magazines, websites) for in- depth study of the educational component</p>	<ol style="list-style-type: none"> 1. Department of Biological chemistry and Veterinary medicine Site: http://biochem.nuph.edu.ua/ . 2. NPhU Library: e-mail library@nuph.edu.ua 3. The Medical Biochemistry Page by Michael W. King: https://themedicalbiochemistrypage.org/ 4. Biochemistry Online: An Approach Based on Chemical Logic by Henry Jakubowsky: https://employees.csbsju.edu/hjakubowski/classes/ch331/bcintro/default.html
<p>Moodle distance learning system</p>	<p>for the 2*nd year: https://pharmel.kharkiv.edu/moodle/course/view.php?id=4002 for the 3rd year: https://pharmel.kharkiv.edu/moodle/course/view.php?id=3982 for the 2 nd year: https://pharmel.kharkiv.edu/moodle/course/view.php?id=5513</p>

17. Material, technical and software support of the educational component: LabAnalyt SP-V1000 spectrophotometer, aqua distiller DI-10, LabAnalyt DM 0412 clinical centrifuge, pH meter pH-305, R-Line personal computer with Intel Core i3-8100 processor, Philips 223V5LSB, R-Line workstation with IntelCore i5-7400 processor, EPSON EB-X05 projector, TC-80 thermostats, Application software and online services: a set of services for organising online and distance learning - Google Workspace for Education Standard, licence type – free licence for education, unlimited; software for organising video conferences ZOOM, licence type - free license for education for 1 year with the possibility of extension; modular object-oriented dynamic learning environment MOODLE 3.9.8, licence type - Open Source.