

**ANDREI KRUPYNSKYI LVIV MEDICAL ACADEMY**

**Faculty № 1**

*Department of Laboratory Medicine*

**APPROVED**

**Vice-Rector for Educational Work**

\_\_\_\_\_ *Ph.D. in Chemistry Soika L.D.*

«\_\_\_» \_\_\_\_\_ *2021*

**SYLLABUS**

**of the discipline**

**“BIOLOGICAL CHEMISTRY”**

**for training of specialists for the Bachelor degree of higher education**

**branch of knowledge: 22 “Health care”**

**Specialty: 223 “Nursing”**

**Discussed and approved at the meeting of Department of Laboratory Medicine**

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Protocol № \_\_\_ from «\_\_\_» August, 2021

Head of the Department \_\_\_\_\_ Fedorovych U.M.



## Syllabus of the discipline “Biological Chemistry”

<b>Branch of knowledge</b>	22 “Health care”
<b>Specialty</b>	223 “Nursing”
<b>Specialization</b>	Nursing
<b>Academic degree</b>	Bachelor
<b>Discipline status</b>	<b>Normative</b>
<b>Group</b>	<b>I MCI-21, I MCI-22</b>
<b>The language of instruction</b>	English
<b>The department to which the discipline is assigned</b>	Department of Laboratory Medicine
<b>Teacher of the discipline</b>	Sushko Olha, Ph.D. in Biology
<b>Teacher’s contact information</b>	E-mail: <a href="mailto:o.sushko@lma.edu.ua">o.sushko@lma.edu.ua</a> The presence of the group in the Telegram and Hangouts ( <a href="mailto:o.sushko@lma.edu.ua">o.sushko@lma.edu.ua</a> )
<b>Consultations</b>	According to the consultation schedule. Online consultations are possible through ZOOM, Meet, or similar resources. To agree on the time of online consultations students should write to the teacher's e-mail or call.
<b>Discipline page</b>	<a href="https://vl.lma.edu.ua/course/view.php?id=331">https://vl.lma.edu.ua/course/view.php?id=331</a>
<b>Information scope of academic discipline</b>	The amount of credits – 3 credits The amount of total hours – 90 hours Modules – 2 The year of training – 2nd Semester – 3rd Lectures – 18 hours Practical classes – 26 hours Self-study – 46 hours
<b>Short annotation of the discipline</b>	<p>Syllabus of the discipline “ Biological Chemistry ” is developed according to the requirements of the Academic Standard of Bachelor of Science in Nursing (branch of knowledge: 22 “Health care”, 223 “Nursing”).</p> <p>The educational discipline is designed in such a way that to provide students of professional preliminary education with the necessary knowledge about the regularities of functions and processes in the whole organism and its parts (systems, organs, tissues, cells), to identify the causes, mechanisms and regularities of the organism's vital activity at various stages of the organism's development in interaction with the environment in dynamics life processes.</p> <p>The subject of study of the academic discipline is the composition, structure, properties of substances of living nature and basic methods of biochemical research.</p>

<p><b>Purpose and goals of the discipline</b></p>	<p>The <i>purpose</i> of teaching the course «Biological chemistry»: is the formation of students' knowledge and new competencies about the course of biochemical processes and peculiarities of the metabolism of organic substances synthesized or supplied with food; mastering the methods of biochemical research; evaluation of research results.</p> <p>The <i>main tasks</i> of studying the discipline «Biological chemistry» are:</p> <ul style="list-style-type: none"> <li>✓ mastering the features of the chemistry of the main biomolecules in the human body in normal and pathological conditions; biochemical characteristics of protein, carbohydrate, lipid, water-salt and mineral metabolism, hemostasis;</li> <li>✓ combination of theoretical knowledge of biochemistry and their use in clinical practice;</li> <li>✓ assessment of informativeness and prognosticity of biochemical research results.</li> </ul> <p>As a result of studying the discipline, the student must <i>know</i>:</p> <ul style="list-style-type: none"> <li>✓ structure, functions and metabolism of proteins, nucleic acids, amino acids, carbohydrates, lipids, vitamins, hormones, enzymes and modern methods of their determination;</li> <li>✓ general characteristics of all metabolism;</li> <li>✓ basic mechanisms of bioenergetic processes and biological oxidation;</li> <li>✓ modern ideas about the hemostasis system;</li> <li>✓ biochemical mechanisms of pathological processes in the human body;</li> <li>✓ normal biochemical indicators of blood and urine, their clinical and diagnostic significance;</li> <li>✓ the principle of operation of equipment used in practical biochemistry;</li> <li>✓ theoretical foundations of physical and chemical research methods;</li> </ul> <p><i>be able to</i>:</p> <ul style="list-style-type: none"> <li>✓ to analyze the significance of biochemical processes of metabolism and its regulation in ensuring the functioning of organs, systems and the entire human body;</li> <li>✓ carry out quantitative and qualitative determination of substances in accordance with research methods;</li> <li>✓ work with dangerous chemicals (acids, alkalis, organic solvents);</li> <li>✓ to evaluate the physiological state of the body and the development of pathological processes on the basis of biochemical studies;</li> <li>✓ to dispose of used material;</li> <li>✓ to observe safety and occupational health and safety rules while working in a biochemical laboratory.</li> </ul>
<p><b>Program learning outcomes</b></p>	<p>PLO 15. Be able to prepare the patient, collect and direct biological material for laboratory and instrumental research</p>
<p><b>Course police</b></p>	<p><b>Adherence to the principles of academic integrity</b>  No forms of violation of academic integrity are tolerated. It is expected that students' works should be independent, with their own original research or thinking. For people with special educational needs, this requirement is applied to their individual needs and abilities. The use of external sources is prohibited during the performance of written tests, module works, testing, during preparation for the answer at the exam. Detection of signs of violation of academic integrity in student's written work is the basis for its non-enrollment by the teacher.</p> <p><b>Adherence to the principles and norms of ethics and professional deontology</b>  During classes students of higher education act from the positions of academic integrity, professional ethics and deontology, follow the rules of internal regulations of the Academy. During the fight against the COVID-19 pandemic students should follow all the guidelines of the anti-epidemiological regime: wear masks,</p>

adhere to social distance, use antiseptics. Students should behave tolerantly and friendly in communication between themselves and teachers.

**Attending classes**

Students should attend all lectures, practical classes and laboratory works of the course and inform the teacher about the inability to attend classes.

**Deadline policy**

Students are required to adhere to the deadlines determined by the course in general and all types of work in particular.

**The procedure of working off missed classes**

Students can work off classes which were missed without a significant reason in accordance with the schedule of working off and consultations. Classes which were missed for a significant reason can be worked out at any time convenient for the teacher.

Reassignment of the final grade in order to increase it is not allowed, except situations provided by the regulations of the Academy, or non-appearance for the final control for a significant reason.

**Structure of the discipline**

**TOPICS OF LECTURES**

<b>№</b>	<b>Name topics</b>	<b>Number of hours</b>
1.	Introduction. Biomolecules, proteins. Physico-chemical and structural properties of proteins. Classification of proteins	2
2.	Protein metabolism and their final products	2
3.	Enzymes and their properties. Enzymodiagnosis, enzymopathology and enzyme replacement therapy	2
4.	Vitamins as components of human nutrition. Hormonal regulation of metabolism	2
5.	Characteristics of carbohydrates. Metabolism of carbohydrates in the human body	2
6.	Biochemical characteristics of lipids. Lipid metabolism in normal and pathological conditions	2
7.	Interrelationship between various metabolic pathways. The role of the liver in metabolism	2
8.	Water and mineral metabolism	2
9.	Modern concepts of hemostasis system. Pathology of the hemostasis system	2
	<b>Total:</b>	<b>18</b>

**TOPICS OF PRACTICAL CLASSES**

<b>№</b>	<b>Name topics</b>	<b>Number of hours</b>
1.	Organization of work in the biochemical laboratory. Study of physico-chemical properties of amino acids and proteins	2
2.	Determination of the total protein content	2
3.	Determination of urea, creatine kinin and uric acid	2
4.	Determination of vitamins and hormones	2
5.	Study of the functional features of the human eye	2
6.	<b>Control work on Sections 1 and 2.</b> Proteins. Enzymes. Vitamins. Hormones.	2
7.	Determination of glucose	2
8.	Determination of cholesterol and $\beta$ -lipoproteins	2
9.	Determination of bilirubin and its fractions	2
10.	Determination of Sodium and Potassium	2

11.	Coagulogram	2
12.	Determination of individual indicators of the hemostasis system	2
13.	<b>Control work on Sections 3 and 4.</b> Carbohydrates. Lipids. Water and mineral metabolism. The hemostatic system.	2
	<b>Total:</b>	<b>26</b>

### TOPICS FOR STUDENT'S SELF-STUDY

№	Name topics	Number of hours
1.	The history of the development of biochemistry, famous scientists, its place among other medical and biological disciplines. The role of biochemistry in clinical medicine	3
2.	Dysproteinemia. Proteinograms	3
3.	Qualitative reactions to protein and amino acids	4
4.	Influence of temperature, medium pH, activators and inhibitors on the speed of the enzymatic reaction	3
5.	The biological role of vitamins and the effect of hormones on the body	3
6.	<b>Preparation for control work 1</b>	4
7.	Conducting a glucose tolerance test. Construction of glycemic curves	4
8.	Biochemical characteristics of indicators in atherosclerosis, obesity and fatty infiltration of the liver	3
9.	Make a table of differential diagnosis of jaundice	3
10.	Analysis of the results of the study in the pathology of the kidneys, water-salt and mineral metabolism	4
11.	Thrombocytopenia, thrombocytopenia and vasopathies	4
12.	Analysis of the results of the study in the pathology of the hemostasis system	4
13.	<b>Preparation for control work 2</b>	4
	<b>Total:</b>	<b>46</b>

#### List of recommended literature

##### *Basic sources:*

1. Біологічна хімія з біохімічними методами дослідження / О.Я. Склярів, Н.В. Фартушок, Л.Д., Сойка, І.С. Смачило. – К.: Медицина, 2009. – 352 с.
2. Механізми біохімічних реакцій / Н.О. Сибірня, Я.П. Чайка, Н.І. Климишин, Л.С. Старикович, Г.Я. Клевета, К.П. Дудок – Львів: Видавничий центр ЛНУ ім. Івана Франка, 2009. – 316 с.
3. Біохімічні показники в нормі і при патології / За ред. О.Я. Склярів. – К.: Медицина, 2007. – 320 с.
4. Губський Ю.І. Біологічна хімія. Підручник. – Київ - Вінниця: Нова книга, 2007. – 656 с.
5. Іваницька Г.І., Люленко Л.В., Іваницька М.В. Практикум з клінічної біохімії: навч. посіб. – К.: Медицина, 2010. – 184 с.
6. Великий практикум з біохімії. Методи дослідження системи крові. Частина IV: навчальний посібник для студентів біологічного факультету / М.Р. Нагалецька, І. В. Бродяк, Н. О. Сибірня – Львів: Львівський національний університет імені Івана Франка, 2019. – 104 с.

##### *Additional sources:*

1. Горячковский А.М. Клиническая биохимия в лабораторной диагностике. – Одесса: Экология, 2005. – 607 с.
2. Кучеренко М.Є., Бабенюк Ю.Д., Войціцький В.М. Сучасні методи біохімічних досліджень. – К.: Фітосоціоцентр, 2001. – 424 с.
3. Гонський Я.І., Максимчук Т.П. Біохімія людини. – Тернопіль: Укрмедкнига, 2001. – 736 с.

<b>Control methods</b>	<p><b>Current control</b> is realized on the basis of the control of theoretical knowledge, skills and abilities.</p> <p><i>Forms of current control.</i></p> <ol style="list-style-type: none"> <li>1. Oral survey (frontal, individual, combined survey);</li> <li>2. Practical test of formed professional skills;</li> <li>3. Test control (open and closed tests).</li> </ol> <p><b>Individual work</b> of students is evaluated on practical classes and is part of the final grade of the student.</p> <p><b>Final control</b> is carried out in the form of a written exam.</p>
<b>Teaching methods</b>	<ul style="list-style-type: none"> <li>✓ verbal methods (lectures, discussion);</li> <li>✓ visual methods (illustration, demonstration, frontal experiment);</li> <li>✓ practical methods (laboratory work and solving of problems with professional content);</li> <li>✓ individual work of students with comprehension and learning of material;</li> <li>✓ use of control and training computer software in the discipline;</li> <li>✓ use of project method for interdisciplinary integration.</li> </ul>
<b>Necessary equipment</b>	<p><b>In normal training mode.</b> Studying the course involves joining each student to the learning environment MOODLE, or Google Classroom.</p> <p><b>In the distance learning mode during quarantine,</b> the study of the course additionally involves joining each student to the programs ZOOM, or Meet (for classes in video conferencing). In this case, the student must take care of the quality of Internet access.</p>
<b>List of questions for final module control</b>	<ol style="list-style-type: none"> <li>1. Acoustics. Physical characteristics of sound. Physics of hearing, the characteristics of acoustical sensation. Weber-Fechner law.</li> <li>2. Audiometry. The scale of intensity and scale of loudness of sound, units. Thresholds of audibility and painful sensation. Audiogram.</li> <li>3. Ultrasound. The basic properties of propagation of ultrasound. Infrasound, physical characteristics of an infrasound. Action of ultrasound and infrasound on biological tissues and organs of a human body.</li> <li>4. Deformations, their kinds. Elasticity and plasticity. Hooke's law. Young's modulus. Poisson's coefficient. Deformation properties of biological tissue.</li> <li>5. Nature of surface tension. Coefficient of surface tension and methods of its determination.</li> <li>6. What substances are named the surface-active? Their influence on the coefficient of surface tension.</li> <li>7. Laminar and turbulent flow. Reynolds number. Bernoulli equation. Flow of viscous liquids. Poiseuille formula. Hydraulic resistance.</li> <li>8. The structural organization of biological membranes. Physical properties of membranes. A liquid crystal state of biomembranes. Dynamic properties of membranes.</li> <li>9. Passive transport of substances through membrane structures. Fick's equation. Speed of diffusion. Nernst- Planck's equation. Electrochemical gradient and potential. Theorell's equation.</li> <li>10. Active transport, the main kinds. The molecular organization of active transport using the example of work K-Na pump. Conjugation of flows.</li> <li>11. The nature of membrane potential of rest (equilibrium Nernst's potentials for different ions, diffusion, Donnan's potential).</li> <li>12. Potential of action (PA). Hypothesis of occurrence of PA. The equivalent electric circuit of a membrane. Phenomenological equations of Hodgkin-Haksley. Concept about goal ionic currents.</li> <li>13. Electric characteristics of biological tissues. The Ohm's law in the differential form. Conductivity of biological tissues. Capacitance properties . The equivalent electric schemes.</li> <li>14. Biophysical bases of electrography. Concept of the equivalent electric generator. Einthoven conception about electrocardiogram (an integrated</li> </ol>

- electric vector of heart, dipole potential, system of leads).
15. Magnetic field and its characteristics. Biot-Savart-Laplace law. Magnetic properties of substances. Physical bases of magnetobiology.
  16. Physical bases of therapeutic methods (galvanization, franklinization, diathermy, inductothermy, d'arsonvalisation, UHF- and SHF- therapy, microwave resonant therapy). Thermal and specific action.
  17. Quantum mechanical model of hydrogen atom. The Schrodinger's equation. Quantum numbers. Energy levels. Pauli's principle.
  18. Radiation and absorption of light by atoms and molecules. Spectra of radiation and absorption. Spectrophotometry.
  19. Thermal radiation of bodies, its characteristics. Absolute black and grey bodies. Kirchhoff's law. Thermal radiation of a human body. Thermography.
  20. Luminescence: types, the basic regularities, properties. Stoke's law. Application of luminescence in medicine.
  21. Stimulated radiation. Equilibrium and inverse population of energy levels. Lasers, a principle of action and applications in medicine.
  22. Elements of geometrical optics. Centred optical system. Optical microscopy. Characteristics of a microscope.
  23. Polarization of light. Ways of obtaining of polarized light. Double refraction. Nicol's prism. Malus' law.
  24. Optically active substances. Angle of rotation of the plane of polarization. Biot law. Concentration polarization.
  25. Absorption of light. Bouguer's law. Absorption of light by solutions. Bouguer-Lambert-Beer's law. Concentration colorimetry.
  26. Scattering of light in disperse mediums. Molecular scattering of light. Rayleigh's law. Nephelometry.
  27. Thermal radiation of bodies, its characteristics. Absolute black and grey bodies. Kirchhoff's law. Thermal radiation of a human body. Thermography.
  28. The law of radiation of absolute black body: the law of radiation of Planck, Stephan-Boltzmann's law, Wien displacement law.
  29. Luminescence: types, the basic regularities, properties. Stoke's law. Application of luminescence in medicine.
  30. X-ray radiation, a spectrum and characteristics, application in medicine. Interaction of X-ray radiation with substance. The law of damping of X-ray radiation.
  31. Radioactivity. Kinds of a radioactivity. The main law of radioactive decay. A half-life time. Activity, units of activity.
  32. Ionizing radiation and its kinds. Interaction of ionizing radiation with substance. Protection against action of ionizing radiation. Biophysical bases of interaction of ionizing radiation.
  33. Dosimetry of ionizing radiation. The exposure and absorbed dozes. Biological action of radiation, biological equivalent doze. Power of doze. Units of dozes and powers of dozes.

**Survey**

A questionnaire to assess the quality of the course will be provided upon completion of the course