NATIONAL UNIVERSITY OF LIFE AND ENVIRONMENTAL SCIENCES OF UKRAINE

Department of Biochemistry named after academician Maxim Gulyi

«APPROVED»
Faculty of Veterinary Medicine
"4" June 2025

CURRICULUM OF ACADEMIC DISCIPLINE

Veterinary clinical biochemistry

Area of knowledge 21 "Veterinary Medicine"
Specialty 211 "Veterinary Medicine"
Academic programmer Veterinary Medicine
Faculty Veterinary Medicine
Developed by:

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Description of the discipline Veterinary clinical biochemistry

The discipline "Veterinary Clinical Biochemistry" is a mandatory component of the educational program "Veterinary Medicine". It gives students an understanding of the relationship between abnormal laboratory data and specific organ dysfunctions; diagnosis and prognostic value of laboratory tests; mastery of the technique of correct sampling and interpretation of results for hematological and clinical chemical evaluation.

The study of the discipline "Veterinary Clinical Biochemistry" provides the acquisition of such general competencies as knowledge and understanding of the subject area, the ability to search, process and analyze information from various sources and the ability to apply knowledge in practical situations.

Academic degree, specialty, academic programme	
Academic degree	*Master's*
Specialty	211 – "Veterinary Medicine"
Academic programme	Veterinary Medicine
Characteristics of the discipline	
Type	Compulsory
Total number of hours	120
Number of ECTS credits	4
Number of modules	2
Course project (work) (if any)	
Form of assessment	*Credit*
Indicators of the discipline for full-time and part-time forms of university study	
	Full-time
Year of study	4
Semester	7
Lectures	*15 hours*
Laboratory classes	*45 hours*
Self-study	*60 hours*
Number of hours per week for full-time students	*4 hours*

1. Aim, competences and expected learning outcomes of the discipline

Aim of the course – to give students the necessary theoretical knowledge and practical skills for obtaining equipment and learning diverse biological material obtained from sick animals for clinical and biological research and laboratory analysis, including for a correct interpretation of the results of these studies.

Day 1 Competencies

1. Demonstrate an understanding of the ethical and legal framework within which a veterinarian must work, including professional, animal welfare, animal owner, public health, social and environmental aspects related to professional activities.
2. Understand research methods, the contribution of basic and applied research to science and the implementation of the 3Rs principle (Replacement, Reduction, Refinement).
3. Implement the principles of effective interpersonal interaction, including communication, leadership, management, teamwork, mutual respect and other "soft" skills.
4. Be able to think critically, review and evaluate literature and presentations.
5. Demonstrate the ability to critically analyse evidence, deal with incomplete information, deal with contingencies and adapt knowledge, skills and practical abilities to different work situations.
6. Use professional abilities to contribute to the development of veterinary knowledge and the implementation of the One Health concept in order to promote the health, safety and welfare of animals, humans and the environment, and to achieve the UN Sustainable Development Goals.
7. Demonstrate a commitment to lifelong learning, personal improvement and professional development. This includes recording and reflecting on professional experience, and taking steps to improve professionalism and competence.
8. Participate regularly in self-assessment and peer assessment processes to improve the effectiveness of one's own work and that of the entire team.
9. Collect, store and transport specimens, select appropriate diagnostic tests, interpret and understand the limitations of test results.
10. Use basic diagnostic equipment and effectively conduct animal examinations as appropriate, in accordance with good health and biosafety practices and applicable regulations. Understand the contribution of digital tools and artificial intelligence to the theory and practice of veterinary medicine.

Competences acquired:

Integrated competency (IC):

Ability to solve complex tasks and problems in the industry of veterinary medicine, which involves carrying out research and/or implementation of innovations and is characterized uncertainty of conditions and requirements.

General competencies (GC):

1. Ability to abstract thinking, analysis and synthesis.
2. Ability to apply knowledge in practical situations.
3. Knowledge and understanding of the subject area and profession.
4. Ability to communicate in the state language both orally and in writing.
5. Ability to conduct research at the appropriate level.
6. Ability to make informed decisions.
7. The desire to preserve the environment.

Special (professional) competencies (SC):

1. Ability to use tools, special devices, instruments, laboratory equipment and other technical means to carry out the necessary manipulations during professional activities.
2. Ability to follow the rules of labor protection, asepsis and antiseptics during professional activities.
3. Ability to take, pack, record and send samples of biological material for laboratory research.
4. Ability to organize and conduct laboratory and special diagnostic tests and analyze their results.
5. Ability to apply knowledge of biosafety, bioethics and animal welfare in professional activities.
6. Ability to develop and implement measures to protect the population from diseases common to animals and humans.
7. Ability to protect the environment from contamination by livestock waste, as well as materials and veterinary products.
8. Ability to use specialized software to perform professional tasks.
9. Ability to organize, implement and control the flow of documents during professional activities.

Expected Learning Outcomes (ELO):

Attestation is carried out in the form of a single state qualifying exam.

2. Programme and structure of the discipline for:

Names of content modules and topic	Nomber of hours						
	Full-time form						
	Weeks	Total	including				
			L	P	Lab	Ind	Self
1	2	3	4	5	6	7	8
Content module 1. General veterinary clinical biochemistry							

Topic 1. Objects and methods in clinical biochemistry.	1	11	1	-	2	-	8
Topic 2. Disorders of protein metabolism in the case of diseases of the internal organs of animals.	2-3	17	2	-	8	-	7
Topic 3. Laboratory diagnosis of disorders of carbohydrate metabolism in the case of diseases of the internal organs of animals.	4-5	15	2	-	6	-	7
Topic 4. Laboratory diagnosis of disorders lipid metabolism in the case of diseases of the internal organs of animals.	6-7	16	2		6		8
Total for content module 1	*	59	7	-	22	-	30
Content module 2. Special clinical biochemistry							
Topic 5. Clinical fermentologia. Enzymodiagnostics in the pathology of the internal organs of animals.	8-9	16	2	-	6	-	8
Topic 6. Clinical chemistry with the pathology of the digestive system, liver and pancreas.	10-11	16	2	-	6	-	8
Topic 7. Biochemistry and pathobiochemistry blood system in animals in the pathology of internal organs.	12-13	15	2	-	6	-	7
Topic 8. Laboratory diagnosis in the pathology of the urinary system	14-15	14	2	-	5	-	7
Total for content modules 2	*	61	8	-	23	-	30
Total hours	15	120	15	-	45		60

3. Topics of laboratory class

№	Topic title	Hours
1	Safety at work in biochemical laboratories. Preparation of biological material for the clinical and biochemical studies. Laboratory examination of gastric juice.	3
2	Studies of total protein and protein fractions of blood serum, the interpretation of changes.	6
3	Proteinuria, qualitative and quantitative methods for	4

	determination of protein in the urine. The remaining (non-protein) nitrogen and its components, the clinical significance of their research.	
4	Metabolism of carbohydrates and clinical significance of study parameters of carbohydrate metabolism. Glycosuria, clinical and diagnostic value of research available glucose in the urine.	4
5	Metabolism of lipids and clinical diagnostic value of the study of lipid metabolism. Investigation of ketone bodies in urine.	4
6	Studies of water and electrolyte metabolism and clinical diagnostic value of these studies.	4
7	Investigation of serum enzymes and their significance in the diagnosis of diseases of the internal organs.	6
8	Hemoglobinopathies. Clinical significance study of hemoglobin in the blood	4
9	Clinical biochemistry with liver disease. Determination of total bilirubin and its fractions in biological material.	6
10	Thymol test. Biochemical methods immunodeficient state of the animals. Electrophoresis of serum proteins in polyacrylamide gels.	4
Total		45

4.Topics for self-study

№	Topic title	Hours
1	Rules for taking samples of biological material.	12
2	Peculiarities of protein metabolism in liver, lung, heart and kidney tissues.	12
3	Peculiarities of carbohydrate metabolism in liver, lung, heart and kidney tissues.	12
4	Peculiarities of lipid metabolism in liver, lung, heart and kidney tissues.	12
5	Organ-specific enzymes of organs and tissues for the diagnosis of diseases	12
Total		60

5. **Methods and means of diagnosing learning outcomes:**

- oral and written interviews;
- testing;
- defense of laboratory work;
- defense of independent work
- defense of essays.

6. Teaching methods:

- problem-based learning;
- practice-oriented learning;
- case method;
- project-based learning;
- learning through research;
- educational discussions and debates;
- teamwork;
- gamification.

7. Results assessment.

The assessment of the knowledge of a higher education applicant is carried out on a 100-point scale and is translated into national grades in accordance with Table 1 of the current "Regulations on Examinations and Tests at the NUBiP of Ukraine".

7.1. Distribution of points by types of educational activities

Educational activity	**Results**	**Assessment**
Module 1. General veterinary clinical biochemistry		
Lecture 1	*Know:* methods of obtaining and preparing for the study of blood, urine, saliva, scar content, digestive juices, bile, cerebrospinal fluid, synovial fluid and other biological fluids of domestic and farm animals, physico-chemical methods of clinical biochemistry and instrumentation; species, breed and age features of biochemical parameters (blood, urine, cerebrospinal fluid, digestive juices, saliva, etc.) in healthy animals and their dependence on physiological condition, type of feeding and productivity; international system of SI units in clinical laboratory diagnostics. *Be able* to receive plasma and blood serum, to determine the pH of body fluids. *Use* centrifuges, homogenizers, pH meters, photoelectrocolorimeters and other modern laboratory devices for laboratory studies of the animal body.	
Laboratory work 1		**14**
Independent work 1		**3**
Lecture 2	*Know:* violation of protein homeostasis; etiology of hypo- and hyperproteinemia, dysproteinemia, paraproteinemia and proteinuria; clinical interpretation of the results of determining the content of total protein and protein fractions; the importance	
Laboratory work 2		**14**
Independent work 2		**3**

	of colloidal sediment tests in the diagnosis of disorders of protein metabolism in pathology of the liver and other organs; biochemical methods for diagnosing pathology of protein metabolism in the body; methods and clinical and diagnostic value of determination in blood and urine of components of residual Nitrogen (urea, variable Nitrogen, uric acid, ammonia, creatine, creatinine, indican, etc.); azotemia (relative and absolute, productive and retention). *Be able* to determine total protein and its blood fractions and non-protein nitrogenous compounds in blood and urine. *Use* centrifuges, photoelectrocolorimeters, spectrophotometers and other modern laboratory devices for laboratory research.	
Lecture 3	Know: disorders of intermediate carbohydrate metabolism (synthesis and breakdown of monosaccharides, oligosaccharides, glycogen); disorders of gluconeogenesis; clinical interpretation of hypo- and hyperglycemia, glucosuria, fructosuria and galactosuria; disorders of heteropolysaccharide metabolism; disorders of intermediate lipid metabolism in the case of diseases of the intestines, liver and pancreas; adiposity. lipomobilization syndrome; fatty infiltration of the liver, atherosclerosis; ketogenesis and its disorders; indicators of lipid peroxidation and antioxidant defense system of the body; biochemical methods for diagnosing disorders of carbohydrate and lipid metabolism. Be able to determine glucose and its derivatives, cholesterol, ketone bodies in the blood and urine. Use centrifuges, photoelectrocolorimeters, spectrophotometers and other modern laboratory devices for laboratory research.	
Laboratory work 3		**14**
Independent work 3		**4**
Lecture 4	Know: disorders of intermediate carbohydrate metabolism (synthesis and breakdown of monosaccharides, oligosaccharides, glycogen); disorders of gluconeogenesis; clinical interpretation of hypo- and hyperglycemia, glucosuria, fructosuria and galactosuria; disorders of heteropolysaccharide metabolism; disorders of intermediate lipid metabolism in the case of diseases of the intestines, liver and pancreas; adiposity. lipomobilization syndrome; fatty infiltration of the liver, atherosclerosis;	
Laboratory work 4		**14**
Independent work 4		**4**

	ketogenesis and its disorders; indicators of lipid peroxidation and antioxidant defense system of the body; biochemical methods for diagnosing disorders of carbohydrate and lipid metabolism. Be able to determine glucose and its derivatives, cholesterol, ketone bodies in the blood and urine. Use centrifuges, photoelectrocolorimeters, spectrophotometers and other modern laboratory devices for laboratory research.	
Modular test 1		**30**
Total by module 1		**100**
Module 2. Special clinical biochemistry		
Lecture 5	*Know:* mechanisms of hyperenzymemia; types of enzymopathies; enzyme diagnostics and enzyme therapy; indicator enzymes and their role in the diagnosis of diseases of various organs and systems; determination of enzyme spectrum activity of enzymes (aspartate aminotransferase, alanine aminotransferase, lactate dehydrogenase, gamma-glutamyltranspeptidase, alkaline and acid phosphatases, glutamate dehydrogenase, creatine phosphokinase, alpha-amylase; clinical interpretation of the obtained results. *Be able* to determine aspartate aminotransferase, alanine aminotransferase, gamma-glutamyltranspeptidase in the blood. *Use* centrifuges, photoelectrocolorimeters, spectrophotometers and other modern laboratory devices for laboratory research.	
Laboratory work 5		**14**
Independent work 5		**4**
Lecture 6	*Know:* mechanisms of hyperenzymemia; types of enzymopathies; enzyme diagnostics and enzyme therapy; indicator enzymes and their role in the diagnosis of diseases of various organs and systems; determination of enzyme spectrum activity of enzymes (aspartate aminotransferase, alanine aminotransferase, lactate dehydrogenase, gamma-glutamyltranspeptidase, alkaline and acid phosphatases, glutamate dehydrogenase, creatine phosphokinase, alpha-amylase; clinical interpretation of the obtained results. *Be able* to determine aspartate aminotransferase, alanine aminotransferase, gamma-glutamyltranspeptidase in the blood. *Use* centrifuges, photoelectrocolorimeters, spectrophotometers and other modern laboratory devices for laboratory research.	
Laboratory work 6		**14**
Independent work 6		**4**
Lecture 7	*Know:* laboratory diagnosis of metabolic	

Laboratory work 7	disorders during pancreatic dystonia in ruminants, acidosis and scar alkalosis; laboratory diagnosis of disorders of metabolic processes in diseases of the stomach and intestines of different species of animals; disorders of carbohydrate, lipid and protein metabolism in liver pathology; biochemistry and pathobiochemistry of bilirubin metabolism in the liver; biochemical methods for diagnosing liver dysfunction and monitoring its recovery. *Be able* to determine total and direct bilirubin, vitamin A in serum (plasma). *Use* centrifuges, photoelectrocolorimeters, spectrophotometers and other modern laboratory devices for laboratory research.	**14**
Independent work 7		**3**
Lecture 8	*Know*: features of metabolism in the kidneys and in pathology; glomerular filtration rates and their diagnostic value; biochemical methods of diagnosis in case of kidney pathology; changes in the chemical composition of urine in diseases of the urinary system (glomerulonephritis, pyelonephritis, nephrotic syndrome, nephrosclerosis, renal failure, urolithiasis and urocystitis); pathological components of urine and their diagnostic value; biochemical mechanisms of urolithiasis. *Be able* to determine urea and creatinine in the blood and urine. *Use* centrifuges, photoelectrocolorimeters, spectrophotometers and other modern laboratory instruments and equipment for laboratory research	
Laboratory work 8		**14**
Independent work 8		**3**
Modular test 2		**30**
Total by module 2		**100**
Educational work	**(M1 + M2)/2*0,7 ≤ 70**	
Test	**30**	
Total per course	**(Educational work + Test) ≤ 100**	

7.2 Scale for assessing student's knowledge

Student's rating, points	National grading system(exams/credits)
90-100	excellent
74-89	good
60-73	satisfactory
0-59	unsatisfactory

7.3 Assessment Policy

Deadlines and exam retaking rules	works that are submitted late without valid reasons will be assessed with a lower grade. Module tests may be retaken with the permission of the lecturer if there are valid reasons (e.g. a sick leave).
Academic integrity rules	cheating during tests and exams is prohibited (including using mobile devices). Term papers and essays must have correct references to the literature used
Attendance rules	Attendance is compulsory. For good reasons (e.g. illness, international internship), training can take place individually (online by the faculty dean's consent)

8. Teaching and learning aids

- e-learning course of the discipline (https://elearn.nubip.edu.ua/course/view.php?id=1345);
- lectures and presentations (in electronic form);
- textbooks, manuals, tutorials;
- guidelines for studying a discipline by full-time and part-time students;
- internship programmes of the discipline (if included in the curriculum).

9. Recommended sources of information

1. Gryshchenko, V. A., Danchenko, O. O., Tkachuk, S. A., Fotina, T. I., Zazharskyi, V. V., & Brygadyrenko, V. V. (2023). Lipid composition of blood plasma and epithelium of the jejunal mucosa in calves with dyspepsia and its correction. Regulatory Mechanisms in Biosystems, 14(2), 319-324.
2. Gryshchenko, V., & Pototskyi, A. (2024). Blood lipid profile in rats with tetracycline-induced liver damage. Scientific Reports of the National University of Life and Environmental Sciences of Ukraine, 5(20), 34-48.
3. Illek, J., Veselskyi, S., Pototskyi, A., Gryshchenko, V., & Reshetnik, Y. (2024). Bilirubin derivatives in bile, blood, and liver of rats upon correction of experimental fatty hepatosis. Ukrainian Journal of Veterinary Sciences, 15(2).
4. Korolova, D., Gryshchenko, V., Chernyshenko, T., Platonov, O., Hornytska, O., Chernyshenko, V., ... & Platonova, T. (2023). Blood coagulation factors and platelet response to drug-induced hepatitis and hepatosis in rats. Animal models and experimental medicine, 6(1), 66-73.
5. Kovalchuk, O. O., Tomchuk, V. A., Danchuk, V. O., Khymynets, P. S., Gutyj, B. V., Kravchuk, S. V., ... & Zhurenko, V. V. (2024). The intensity of carbohydrate metabolism in the body of sows under the action of ferrum and germanium nanocompounds. Scientific Messenger of LNU of Veterinary Medicine and Biotechnologies. Series: Veterinary Sciences, 26(113), 179-183.

6. Tomchuk V., Gryshchenko V., Tsvilikhovskyi V. Veterinary Clinical Biochemistry. Підручник. К: NULES of Ukraine Publishing House,2023, 327 p.

7. Veselskyi, S., Pototskyi, A., Tomchuk, V., Gryshchenko, V., & Reshetnik, Y. (2023). Phospholipid composition of bile and blood in rats under correction of experimental fatty hepatosis. Ukrainian Journal of Veterinary Sciences, 14(3).

8. Vlizlo, V., Ostapiv, D., Simonov, M., Baumgartner, W., & Tomchuk, V. (2022). Hormonal regulation of the concentration of glucose and its derivatives in the blood of dairy cows during the transit period. Ukrainian Journal of Veterinary Sciences, 13(4).

9. Біохімія тварин з основами фізичної і колоїдної хімії: підручник / [Томчук В.А., Грищенко В.А., Калачнюк Л.Г. та ін.] – К.: НУБіП України, 2020. – 447 с.

10. Ветеринарна клінічна біохімія / Левченко В. І., та ін. ; 2-ге видання, перероб. та доп. Біла Церква: Аграрна наука, 2019. 416 с.

11. Томчук В.А., Калачнюк Л.Г., Грищенко В.А., Кліх Л.В., Калінін І.В., Тупицька О.М., Цвіліховський В.І., Арнаута О.В, Ткаченко Т.А. Біохімія тварин з основами фізичної і колоїдної хімії: підручник. Підручник. 2 вид., перероб. та доп. Київ: НУБіП України, 2023. – *512 с.*