MINISTRY OF EDUCATION AND SCIENCE OF UKRAINE
SUMY NATIONAL AGRARIAN UNIVERSITY

Therapy, Pharmacology, Clinical Diagnostics and Chemistry Department

Faculty of Veterinary Medicine

MODULE SYLLABUS

Bioinorganic and analytical chemistry

(compulsory)

Implemented in the "Veterinary Medicine " Academic Program

Area of specialization 211 "Veterinary Medicine"

at the second (master's) level of higher education

Sumy-2022

Author: _____ (V. Ivchenko)

Module syllabus agreed at the Therapy, Pharmacology, Clinical Diagnostics and Chemistry Department meeting	Minutes No 15 dated June 08, 2021
	Head of Therapy, Pharmacology, Clinical Diagnostics and Chemistry Department _____ (L.Ulko)

Approved by:

Guarantor of the Academic program _____ (L. Ulko)

Dean of the Faculty _____ (O. Nechyporenko)

Syllabus review (attached) is provided by : _____ (Dolianovo B.V.)

_____ (Ivanova O.L)

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Syllabus review data:

The academic year in which changes are made	The Academic program attachment number with changes description	Changes revised and approved		
		Minutes No and date of the department meeting	Head of Department	Guarantor of the Academic program

1. MODULE OVERVIEW

1.	Title	**09 Bioinorganic and Analytical Chemistry**			
2.	Faculty/Department	Veterinary Medicine /Therapy, Pharmacology, Clinical Diagnostics and Chemistry Department			
3.	Type (compulsory or optional)	compulsory			
4.	Program(s) to which module is attached (to be filled in for compulsory types)	21 Veterinary Medicine/ Area of specialization 211 Veterinary Medicine			
5.	Module can be suggested for (to be filled in for optional types)	-			
6.	Level of the National Qualifications Framework	7			
7.	Semester and duration of module	1 semester, 1-15 weeks			
8.	ECTS credits number	5			
9.	Total workload and time allotment	Directed study			Self-directed study
		Lectures	Practicals	Labs	
		14		60	76
10.	Language of instruction	English			
11.	Module leader	Viktoriia Ivchenko			
12.	Module leader contact information	Viktoriia Ivchenko Associate Professor of Therapy, Pharmacology, Clinical Diagnostics and Chemistry Department Workplace: building of veterinary medicine office 36 e-mail: ivchenkovd@gmail.com. Phone: +38 (097) 7722364 The time of consultations is every Monday from 13:00 to 14:00			
13.	Module description	"Bioinorganic and analytical chemistry" includes sections that are necessary for a deep understanding of the functioning of the animal's body. The chemical nature of the processes in the body determines their compliance with basic chemical laws. The subject of this course are chemical laws and concepts, properties of elements and compounds. The content of the discipline is adapted to the specialty of veterinary medicine. The study of the discipline involves the acquisition by students of practical skills of laboratory research, the ability to interpret their results and substantiate conclusions			
14.	Module aim	to form a scientific worldview on the issues of unity and interconnection of living and inorganic matter, distribution and role of chemical elements, processes in nature and living organisms; and to form experimental skills of the analysis of chemical compounds			
15.	Module Dependencies (prerequisites, co-requisites,	. 1. The educational module is based on knowledge of chemistry (terminology, basic laws and concepts, properties of ions depending on their location in the periodic table of DI			

	incompatible modules)	Mendeleev), physics (understanding of the basic laws of chemical reactions), basics of higher mathematics (calculations) , experimental techniques (knowledge of laboratory glassware, concentration of solutions). . 2. The educational module is the basis for studying the modules: "Organic Chemistry with Clinical Biochemistry", "Veterinary Pharmacology of Medicinal and Poisonous Plants", "Veterinary Toxicology", "Clinical and Laboratory Diagnosis of Animal Diseases"
16.	The policy of academic integrity	For violation of academic integrity, students may be held subject to the following academic liability: Academic plagiarism - grade 0, re-completion of the task. Academic fraud - cancellation of points; re-assessment re-performance of non-independently performed work; Use of electronic devices during the final control of knowledge - grade 0, re-passing the final control
17	Link in Moodle	https://cdn.snau.edu.ua/moodle/course/view.php?id=3424

2. CORRELATION BETWEEN MODULE LEARNING OUTCOMES (MLOs) AND PROGRAM LEARNING OUTCOMES (PLOs)

MLOs: On successful completion of the module the learner will be able to:	**PLOs**				**How assessed**
	PLOs 1	**PLOs 3**	**PLOs 9**	**PLOs 10**	
MLOs 1. Understand the chemical nature of the processes in the animal's body, which determines their compliance with basic chemical laws	+	+		+	Multiple choice tests**,** solving situational problems; exam
MLOs 2. Establish interrelations of passing of chemical and biological processes which occur in an organism of animals in norm and on pathology	+	+		+	Multiple choice tests**,** solving situational problems; exam
MLOs 3. Analyze the implementation of processes, properly using devices, laboratory glassware, reagents, materials, follow safety rules	+	+			Multiple choice tests, protocols of epy laboratory works; exam
MLOs 4. Apply optimal methods and tools for research, data collection and processing	+	+		+	Presentation with a report; exam
MLOs 5. Know the measures aimed at protecting the environment and the rules of disposal of chemicals and their waste	+		+		Oral interview; exam; solving situational problems

3. MODULE INDICATIVE CONTENT

Topics	Distribution of hours				Learning resources
	Directed study			Self-directed study	
	Lectures	Practicals	Labs		
Topic 1. Introduction. Safety rules and laboratory rules Rules of work in the laboratory, with reagents. Safety rules. First aid. Acquaintance with laboratory ware and other equipment. The simplest operations with substances			2	2	1,2,3,4
… Topic 2. Basic concepts and laws of chemistry. Basic concepts of atomic-molecular theory: molecule, atom, chemical element, simple and complex substance, relatively - atomic and molecular mass, mole, molar mass. The law of conservation of mass and energy. The law of equivalents. Avogadro's law. The law of constancy of the composition of chemical compounds. Chemistry in veterinary medicine.	1		2	4	1,2,3,4,8
Topic 3. The structure of the atom and the periodic law of DI Mendeleev. Chemical bond. Characteristics of the element by place in the periodic table. Periodic law. Atom structure: nucleus and electrons. Electron characteristics. Valence electrons. The composition of the nucleus. Nucleon, neutron and proton number. Energy level. Atom formulas: electronic, graphic. Schemes of atoms. Atomic states: normal and excited. Energy and length of chemical bond. The length of the chemical bond. Types of chemical bonds. Typical tasks and examples of their solution .	1		4	4	1,2,3,4,5
Topic 4. Classification and nomenclature of inorganic compounds Oxides. Chemical properties and methods of obtaining oxides. Peroxides. Foundations. Chemical			4	4	1,2,3,4

properties and methods of obtaining bases. Acids. Chemical properties and methods of obtaining acids. Salt. Chemical properties and methods of obtaining salts. Use and role in veterinary medicine**.**					
Topic 5. Fundamentals of thermochemistry Thermochemistry. Thermodynamic process. Exothermic and endothermic processes. Thermal effect of the reaction. Standard thermal effect. Heat of combustion and formation. Standard conditions. System: definition, classification, functions (enthalpy, entropy, internal energy, Gibbs energy), heat capacity, parameters (pressure, mass, temperature, volume). The first, second and third laws of thermodynamics. Regularities of the chemical reaction. Hess's law and its consequences. Law of Lavoisier and Laplace.	**2**		2	4	1,2,4,5,6,8
Topic 6. The rate of a chemical reaction Basic concepts of chemical kinetics. The rate of a chemical reaction, the factors influencing it. The law of active masses is the basic law of chemical kinetics. The rate constant of a chemical reaction. The concept of activation energy, the effect of temperature on the reaction rate. Vant-Goff's rule. The concept of catalysis and its nature. Enzymes as catalysts of chemical processes.	**1**		2	2	1,2,4,5,6,
Topic 7. Irreversible and reversible reactions. Chemical equilibrium. Equilibrium constant. Displacement of chemical equilibrium. Influence of external factors on chemical equilibrium. Principles of Le Chatelier.	**1**		2	2	1,2,3,4,5,6,7,8
Topic 8. General concepts of redox processes. The degree of oxidation of the element in the compounds. Typical oxidants and reducing agents. Change of redox properties of	**1**		2	2	1,3,4,5,6,8

elements depending on the structure of their atoms. Rules for compiling equations of redox reactions. Classification of redox reactions					
Topic 9. Classification of redox reactions (intermolecular, intramolecular and disproportionation). The influence of the environment on the nature of the reaction. Redox processes in a living organism	**1**		2	2	1,2,3,4,6,7
Topic 10. General ideas about solutions Solution and its components (solute, solvent). Dispersed phase. Classification of solutions according to the degree of dispersion, physical state (liquid, solid and gaseous) and the content of the reactant diluted, concentrated, saturated, supersaturated, unsaturated). Concentration of solutions (mass, molar, equivalent, molar). Mass fraction of solute. Normality. Caption. The value of solutions for veterinary medicine.	**2**		6	6	2,3,4,5,6,7
Topic 11. Physical properties of non-electrolyte solutions. The concept of electrolyte and non-electrolyte solutions and their properties. Osmotic pressure (Vant-Goff's law). Saturated vapor pressure of the solvent over the solution (Raoul's law). Boiling point and crystallization of solutions (Raoul's second law). Osmotic pressure of solutions. Solvent vapor pressure over the solution. Boiling and crystallization temperatures of solutions	**1**		2	4	2,3,4,7,8
Topic 12. Solutions of electrolytes. Mechanism of electrolytic dissociation. Quantitative characteristics of the dissociation process: the degree and constant of electrolytic dissociation. Strong and weak electrolytes. Weak electrolyte dissociation constant, its relationship with the degree of dissociation. Reactions in	**1**		2	2	2,3,4,5,6,7

electrolyte solutions. Ionic reaction equations. Water as a weak electrolyte. Ionic product of water. Hydrogen and hydroxyl indicators. Methods of measuring pH. General information about indicators. Characteristics of the solution medium by pH. The essence of hydrolysis of salts. Types of salt hydrolysis. Constant and degree of hydrolysis of salts. Properties of electrolyte solutions. Theory of electrolytic dissociation. Ionic product of water. Hydrogen index. Hydrolysis of salts. The degree and constant of dissociation. Hydrolysis of salts.					
Topic 13. Buffer solutions. Buffer system, buffer capacity, values of buffer solutions. Types of buffer systems. Buffer action. The value of buffer solutions for animals.			4	6	2,3,4,7,8
Topic 14. Coordination compounds Complex (coordination) compounds. Classification. Nomenclature. Internal, external sphere. Complexing agent. Ligands. Werner's theory. Coordination number. Coordination relations. Coordination capacity. Instability constant. Dissociation of complex compounds. Importance of coordination compounds for medicine (veterinary medicine).	**2**		4	6	3,4,5,6,7
Topic 15. Colloidal systems, their classification and properties. Colloidal chemistry. Classification of colloidal systems. Dispersed phase and medium. Examples of aerosols, suspensions, emulsions. Extraction of colloidal systems. Properties of colloidal systems. Diffusion. Brownian motion. Tyndall's cone. Adsorption. Schulze-Hardy rule. Electrokinetic potential. Dialysis. Ultrafiltration. The structure of the colloidal particle. Potential determining ions. Protions. Coagulation. Coagulation threshold. Granule. Mycelium**.**			4	6	3,4,5,6,7
Topic 16. General characteristics			2	4	3,4,5,6,7,8

and basic concepts of qualitative and quantitative analysis. Classification of chemical methods of quantitative analysis. Theoretical and experimental bases of quantitative and qualitative chemical analysis. The concept of reliability of chemical analysis results, systematic and random errors of analysis methods. Qualitative reactions on cations and anions.					
Topic 17. The method of acid-base titration (neutralization method). Indicators of their choice. Requirements for standard solutions. Preparation of standard and working solutions. Determination of the concentration of solutions of acids and alkalis.			4	2	2,3,4,5,6,7
Topic 18. Method of complexometric titration. Complexometric titration method. Theoretical foundations of complexometry. Characteristics of the method. Complex. General properties of complexones and complexonates. Method indicators. Determination of water hardness**.**			2	2	2,3,4,5,7,8
Topic 19. Redoxometry (redox titration). Permanganatometry. General characteristics of the method. Standard and working solutions. Preparation and determination of the concentration of solutions of oxalic acid and potassium permanganate. Determination of iron (II) in Mohr's salt solution.			2	4	2,3,4,5,7,8
Topic 20. Theoretical foundations of gravimetry (weight analysis) Features of the gravimetric method of analysis. Investigation of product moisture depending on the type, conditions and shelf life. Weighing, dry matter.			2	4	
Topic 21. Physico-chemical (instrumental) methods of analysis Physico-chemical (instrumental) methods in production control: a) optical methods of analysis; b)			4	4	1,2,4,5,7,8

electrochemical methods of analysis; c) chromatographic methods of analysis. Biological methods of analysis. Electrochemical methods of analysis, their classification. Spectral (optical) methods of analysis. Chromatography.					
Total hours of the course	**14**		**60**	**76**	

4. TEACHING AND LEARNING METHODS

MLOs	Teaching methods (directed study)	Hours	Learning methods (self-directed study)	Hours
MLOs 1. Understand the chemical nature of the processes in the animal's body, which determines their compliance with basic chemical laws	Explanatory-reproductive methods: lecture, story-explanation Using the platform MOODLE, Kahoot, ZOOM during the mixed form of training	22	Working with textbooks, manuals, materials of the Internet; , illustration, demonstration, performance of experiments, exercises, didactic tasks, independent works, etc.	
MLOs 2. Establish interrelations of passing of chemical and biological processes which occur in an organism of animals in norm and on pathology	Partial search methods: problem-dialogue, modeling, case method, etc. Using the platform MOODLE, Kahoot, ZOOM during the mixed form of training.	14	Independent searching of educational information, performance of laboratory works of partial-search content, complex didactic tasks	10
MLOs 3. Analyze the implementation of processes, properly using devices, laboratory glassware, reagents, materials, follow safety rules	Visual methods - demonstration of experiments Practical methods - work with reagents, laboratory glassware and devices in compliance with safety rules. Using the platform MOODLE, Kahoot, ZOOM during the mixed form of training.	14	Reading literature on the topic, watching videos on the Internet and on the Moodle platform	16

MLOs 4. Apply optimal methods and tools for research, data collection and processing	Research methods: conducting research, work in the laboratory. • Deductive method - built on generalizations. • Problem-searching methods when performing laboratory work Using of the MOODLE, Kahoot, ZOOM platform during the mixed form of training	14	Preparation of reports of laboratory works, searching information, writing the reports and presenting the results	17
MLOs 5. Know the measures aimed at protecting the environment and the rules of disposal of chemicals and their waste	Problematic - disputes over the studied material. Lecture-press conference. Using the MOODLE, ZOOM platform during a mixed form of learning	12	Reading literature on the topic, watching videos on the Internet and on the Moodle platform	15

5. ASSESSMENT

5.1. Diagnostic assessment

5.2. Summative assessment

5.2.1. Intended learning outcomes methods:

No	Summative assessment methods	Grades	Deadline
1.	*Oral interview*	*10 points / 10%*	Up to 15th week
2.	*Solving situational problems*	*10 points / 10%*	Up to 14-15th weeks
3	*Presentation with a report*	*15 points / 15%*	Up to 15th week
4	*Protocols of laboratory works*	*20 points / 20%*	Up to 15th week
5	*Multiple choice tests*	*15 points / 15%*	Up to 10th week
6	*Exam*	*30 points / 30%*	Examination week

5.2.2. Grading criteria

Summative assessment method	Unsatisfactory	Satisfactory	Good	Excellent
Oral interview	<3 points	3-5 points	6-8 points	9-10 points
	Task requirements not met	Most requirements are met, but some components are missing or insufficiently disclosed, there is no analysis of other approaches to the issue	All the requirements of the task are done	All requirements of the task are fulfilled, creativity, thoughtfulness is shown, own solution of a problem is offered
Solving situational problems	<3 points	3-5 points	6-8 points	9-10 points
	Task requirements not met	Most requirements are met, but some	All the requirements of	All requirements of the task are fulfilled,

		components are missing or insufficiently disclosed, there is no analysis of other approaches to the issue	the task are done, the situational task has solved	creativity, thoughtfulness is shown, own solution of a problem is offered
Presentation with a report	<3 points	3-5 points	6-9 points	10-15 points
	Task requirements not met	The presentation is prepared, but the report is not clear, not logical	All the requirements of the task are met, the report and presentation meet the requirements	All requirements of the task are fulfilled, creativity, thoughtfulness is shown, own solution of a problem is offered
Protocols of laboratory works	<5 points	5-10 points	11-15 points	16-20 points
	Task requirements not met	Most of the requirements are met, but there are minor violations of the methods	The task is done correctly	All requirements of the task are fulfilled, creativity, thoughtfulness is shown, own solution of a problem is offered
Multiple choice tests	<2 points	2-9 points	10-13 points	14-15 points
	Less than 3 correct answers	3-7 correct answers	8-9 correct answers	All answers are correct
Exam	<15 points	15-20 points	21-26 points	27-30 points
	There are not enough answers to the exam questions	Only test tasks completed, the answer to the theoretical question and the matter contain errors	All tasks of the examination ticket have been completed, but there are minor errors	All tasks of the examination ticket have been completed

5.3. Formative assessment

Formative exercises are designed to enable students to develop particular aspects of their learning, prior to summative assessments. Formative exercises are designed to help students use feedback and self-reflection to manage and develop their learning so that they can see how to improve their work.

No	Formative Assessment elements	Date
1.	*Written survey after studying the topics with feedback from the teacher*	15 minutes at the end of the lesson at the end of the study of the topic
2.	*Oral feedback from the teacher while working on situational tasks during classes*	next lesson after learning a new topic
3.	*Oral feedback from teachers and students after the presentation of the report*	every week
4.	*Final test control with feedback from the teacher*	At the end of each study section
5.	*Conducting research on the topic under the supervision of the teacher*	10-15 weeks
6.	*Solution of problems with group discussion*	30-45 minutes when studying each new topic

Self-assessment can be used both an element of formative and summative assessment.

6. LEARNING RESOURCES

6.1. Key resources

1. Bruce Averill, Patricia Eldredge, R.H. Hand General Chemistry: Principles, Patterns, and Applications https://open.umn.edu/opentextbooks/BookDetail.aspx?bookId=69#Reviews
2. An Introduction to Chemistry, Second Edition http://preparatorychemistry.com/Bishop_Chemistry_First.htm
3. Chemistry Textbook Online https://www.ck12.org/chemistry/

6.2. Guidelines

4. Ivchenko V.D., Shvets O.G., Ponomareva L.M. BIOINORGANIC CHEMISTRY: Course bookfor 1st year students of the faculty of veterinary medicine. Training direction: 211 "Veterinary Medicine. Compilers V.D. Ivchenko, O.G.Shvets, L.N.Ponomarova. – Sumy : Sumy National Agrarian University, 2019. – 100 p.

6.3. Additional resources

5. Chemical principles. Third edition. http://authors.library.caltech.edu/25050/
6. Edward W. Pitzer Introductory Chemistry http://bookboon.com/en/chemistry-ebooks
7. Romain Elsair Fundamentals of Chemistry Part I. Part II http://bookboon.com/en/chemistry-ebooks
8. Søren Prip Beier , Peter Dybdahl Hede Essentials of Chemistry http://bookboon.com/en/chemistry-ebooks

6.4. Computer Applications and soft

Software (to support distance learning (Moodle), Internet polls (Kahoot, Padlet), etc.