

**MINISTRY OF EDUCATION AND SCIENCE OF UKRAINE  
SUMY NATIONAL AGRARIAN UNIVERSITY**

**Department of Therapy, Pharmacology, Clinical Diagnostics and Chemistry  
Faculty of Veterinary Medicine**



**MODULE SYLLABUS  
ORGANIC CHEMISTRY WITH CLINICAL BIOCHEMISTRY  
(compulsory)**

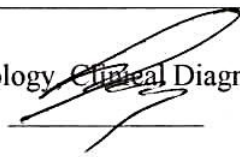
**Implemented in the “Veterinary Medicine” Academic Program**

**Area of specialization 211 “Veterinary Medicine”**


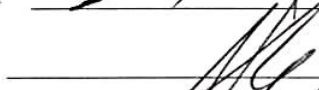
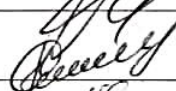

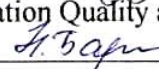
**at the second (master’s) level of higher education**

**Sumy-2021**

Author:  (O. Shvets)  
 (R. Dolbanosova)

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 <u></u> (L. Ulko)

**Approved by:**

Guarantor of the Academic program  (L. Ulko)  
Dean of the Faculty  (O. Nechyporenko)  
Syllabus review (attached) is provided by :  (R. Dolbanosova )  
 (V. Ivchenko)  
Representative of the Department of Education Quality assurance, licensing and accreditation  ( A. Baparik )  
Registered in electronic data base 01.09 2021

**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	Organic chemistry with clinical biochemistry		
2.	Faculty/Department	Department of Therapy, Pharmacology, Clinical Diagnostics and Chemistry		
3.	Type (compulsory or optional)	Obligatory		
4.	Program(s) to which module is attached (to be filled in for compulsory types)	211 "Veterinary Medicine"		
5.	Module can be suggested for (to be filled in for optional types)	-		
6.	Level of the National Qualifications Framework	7 level		
7.	Semester and duration of module	2 semester (1-15 weeks)		
8.	ECTS credits number	5		
9.	Total workload and time allotment 150	Directed study		Self-directed study
		Lectures	Practicals	Labs
		<b>16</b>		<b>60</b>
				<b>74</b>
10.	Language of instruction	English		
11.	Module leader	Shvets O.		
12.	Module leader contact information	Shvets Olha As. Prof. Department of Therapy, Pharmacology, Clinical Diagnostics and Chemistry Workplace: room 36 of veterinary medicine building Email <a href="mailto:olgvlasenko@gmail.com">olgvlasenko@gmail.com</a> Phone: 0995670333		
13.	Module description	<p>The educational component includes sections of organic chemistry and clinical biochemistry, which are necessary for a deep understanding of the essence of biochemical processes that occur in animals in normal and pathological conditions.</p> <p>The subject of this course is the chemical laws and concepts that underlie the physiological and biochemical functions of a living organism. The study of the discipline involves the practical mastery of students' methods of laboratory research of samples of biological material of animals, the ability to interpret their results and justify the diagnosis</p>		
14.	Module aim	<p>The purpose of the initial course is to master the theoretical and practical foundations of organic chemistry and clinical biochemistry, which will form a student's complex of chemical knowledge and skills aimed at actively forming professional competencies needed to understand the functioning of the animal.</p>		
15.	Module Dependencies (prerequisites, co-requisites, incompatible modules)	<p>1. The educational component is based on knowledge of chemistry (terminology, basic laws and concepts, atomic structure, types of chemical bonds), physics (understanding the basic laws of chemical reactions), experimental techniques (knowledge of chemical vessels, concentrations).</p> <p>2. The educational component is the basis for OK "Vetpharm of</p>		

		medicinal and poisonous plants", "Veterinary toxicology", "Clinical and laboratory diagnosis of animal diseases", "System of analysis of dangerous factors and control at critical points"
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	<a href="https://cdn.snau.edu.ua/moodle/course/view.php?id=3423">https://cdn.snau.edu.ua/moodle/course/view.php?id=3423</a>

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

MLOs:	PLOs				How assessed
	PLOs 1	PLOs 3	PLOs 7	PLOs 15	
On successful completion of the module the learner will be able to:					
MLOs 1. Understand the chemical nature of physiological processes in the animal with the participation of organic substances, which determines their subordination to 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. Be able to use laboratory equipment and chemical reagents in compliance with the rules of safe storage and use in specialized research				+	Multiple choice tests, protocols of epy laboratory works; exam
MLOs 4 Formulate conclusions, recommendations, advice on keeping, feeding and treatment of animals or establish a diagnosis based on the results of laboratory tests			+		Presentation with a report; exam

## MODULE INDICATIVE CONTENT

Topics	Distribution of hours			Learning resources	
	Directed study		Self-directed study		
	Lectures	Practicals	Labs		
<p><b>Topic 1: Theoretical foundations of organic chemistry</b></p> <p>Theory of structure of organic compounds O.M. Butlerova.</p> <p>The emergence of theoretical ideas in organic chemistry. The structure of the carbon atom. Hybridization. Chemical bond. Covalent bond. Chemical reaction. Types of chemical reactions. Classification of organic compounds.</p> <p>Qualitative analysis of organic compounds Laboratory work №1. Discovery of carbon, hydrogen, nitrogen, sulfur, halogens.</p>	2			2	1, 2, 4, 5, 6,
<p><b>Topic 2. Hydrocarbons</b></p> <p><b>Saturated hydrocarbons (Alkanes).</b> Homologous series of alkanes. Radicals. The nomenclature is rational and systematic. The concept of primary, secondary, tertiary carbon atom. Isomerism. Obtaining saturated: Wurtz reaction, from salts of carboxylic acids, from unsaturated hydrocarbons. Natural sources of saturated hydrocarbons. Oil refining. Physical and chemical properties of saturated hydrocarbons. Solubility. Substitution reaction. Halogenation reaction, nitration, sulfonation and sulfochlorination. Use of hydrocarbons.</p> <p><b>Ethylene hydrocarbons. Alkenes.</b> Homologous series. General formula. SP<sup>2</sup> - hybridization of the carbon atom. The structure of the double bond. The nomenclature is rational and systematic. Obtaining alkenes. Zaitsev's rule. Obtaining from alcohols by their dehydration, from halogen derivatives. Chemical properties of alkenes. Addition reaction: halogens, hydrogen halides, water. Reaction with aromatic hydrocarbons. Oxidation reaction - Wagner. Obtaining esters. Polymerization</p>	2		2	2	1, 2, 4, 5, 6, 7

<p>reactions.</p> <p><b>Acetylene hydrocarbons. Alkynes.</b> General characteristics. SP - hybridization of the carbon atom. The structure of acetylene from an electronic point of view. The nomenclature is rational and systematic. Preparation of compounds with a triple bond: from carbide, from dihalogen derivatives. Addition, substitution, di- and trimerization reactions. Application in industry.</p> <p>Laboratory work №2. Extraction and study of saturated and unsaturated hydrocarbons</p> <p><b>Aromatic hydrocarbons. Arenas.</b> Features of the structure of the benzene molecule. Aromaticity, Hückel's rule. Nomenclature: ortho, target, pair of positions. Obtaining aromatic compounds. Wurtz-Fittig reaction, dehydrogenation of carbonocyclic compounds. Physical properties. Chemical properties. Substitution rule; landmarks of the first and second kind. Nitration, halogenation, oxidation reaction.</p> <p>Laboratory work №3. Obtaining and studying the properties of aromatic compounds.</p> <p>Laboratory work №4. Study of the properties of halogenated hydrocarbons.</p>		<p>2</p> <p>2</p> <p>2</p> <p>2</p> <p>2</p>	<p>4</p> <p>4</p>	<p>1, 2, 4, 7</p> <p>1, 2, 4, 5, 6,</p>
<p><b>Topic 3. Oxygen organic compounds</b></p> <p><b>Alcohols.</b> Functional group. Classification of alcohols. Saturated monohydric alcohols. Nomenclature: radical, systematic, carbinal. General methods of production: from halogen-containing, from unsaturated, reduction of carbines. Physical properties. Chemical properties. Substitution of the hydroxyl group by halogen, reaction with acids (production of esters), intermolecular and intramolecular dehydration. The use of monohydric alcohols. Diatomic alcohols. Extraction. Physical and chemical properties.</p> <p>Laboratory work №5. Extraction and study of the properties of alcohols</p> <p><b>Phenols.</b> Phenol and its derivatives: Structure, isomerism, nomenclature.</p>	<p>2</p>	<p>2</p>	<p>2</p>	<p>1, 2, 5, 6, 7</p>

<p>Methods of obtaining. Physical and chemical properties of phenol: functional group reactions and gasoline ring. Polycondensation of phenol and methanol. Phenol-formaldehyde resins and their application. The concept of di- and triatomic phenols. Laboratory work №6. Phenol and its derivatives</p>			2	4	1, 2, 4, 5, 6
<p><b>Aldehydes and Ketones.</b> Definition. Electronic structure of carbonyl group. Methods of obtaining. Physical properties. Chemical properties: reactions of addition of hydrogen, hydrogen cyanide, sodium hydrogen sulfide, with phosphorus halides, oxidation, aldol and croton condensation. Individual representatives. Their application. Laboratory work №7. Obtaining and studying the properties of aldehydes and ketones.</p>			2	4	1, 2, 4, 5, 6
<p><b>Carboxylic acids and their functional derivatives.</b> Classification of acids. Monobasic saturated carboxylic acids, carboxyl group structure. Nomenclature. Extraction. Physical properties. Chemical properties: reactions involving hydrogen of the carboxyl group, reactions involving the OH group. Functional derivatives of carboxylic acids, esters, halides, anhydrides, acid amides. Their production and the most important properties. Higher carboxylic acids. Some representatives: palmitic, oleic, stearic, acids, their structure. Jury. Storage. Building. The difference between solid and liquid fats. Chemical properties: saponification, hydrogenation, fat burning, soap. Hydroxyacids. Nomenclature. Methods of obtaining. Chemical properties. The most important hydroxy acids are glycolic, lactic, malic, tartaric, citric acid. Phenoloxo acids: salicylic acid and its esters.</p>			2	4	1, 2, 4, 5, 6
<p>Laboratory work №8. Monobasic and polybasic carboxylic acids and their derivatives</p>			2		
<p><b>Topic 4. Carbohydrates</b></p> <p><b>Monosaccharides.</b> Classification of monosaccharides by the number of carbon atoms, by the main functional group. Optical isomerism (D- and L-</p>					1, 2, 3, 5



<p>isomers); <math>\alpha</math>- форми- forms. Structure of monosaccharides of Fisher's and Haworth's formula. Extraction, physical and chemical properties. Distribution in nature. The value of monosaccharides for living organisms</p> <p><b>Disaccharides.</b> Structure of disaccharides according to Fisher and Haworth. Reducing disaccharides (maltose, lactose), non-reducing (sucrose, trehalose). The value of disaccharides. Laboratory work №9. Chemical properties of mono- and disaccharides</p> <p><b>Polysaccharides.</b> The structure of the most important polysaccharides (starch, cellulose). Methods of obtaining. Physical and chemical properties of polysaccharides. Starch is an important food polysaccharide. Laboratory work №10. Chemical properties of polysaccharides</p>	2		2	2	1, 2, 3, 5
<p><b>Topic 5. Nitrogen-containing organic compounds</b></p> <p><b>Amines.</b> Classification of amines by radical structure (aliphatic, aromatic, heterocyclic). Acyclic amines. Classification (primary, secondary, tertiary), nomenclature. Extraction by the Hoffman reaction, reduction of nitro compounds. Chemical properties: salt formation, alkylation reaction, acylation Reaction with nitric acid. Aromatic amines. Nomenclature. Extraction of amine (Zinin reaction). Chemical properties of aniline: amino group reaction (alkylation, diazotization). Azo dyes.</p> <p>Laboratory work № 11. Amino, diazo and azo compounds</p> <p><b>Amino acids.</b> Nomenclature and isomerism of amino acids. Methods of obtaining. Classification: monoaminocarboxylic acids, monoaminodicarboxylic acids, cyclic amino acids. Methods of obtaining. Chemical properties. Amphoteric nature of amino acids. Essential and essential amino acids. Peptide bond. Synthesis of polypeptides.</p>	2		2	4	1, 2, 4, 5, 7  2, 3, 4, 5, 7
<p><b>Topic 6. Heterocyclic compounds.</b></p> <p>Classification: by the structure of heterocycles: by the type of atom that is part of the structure of the cycle O,</p>					1, 2, 5, 6

<p>S, N...), into groups (three-, four-, five-membered). The concept of aromaticity of hetero systems. Five-membered Nitrogen-containing heterocycles with one atom (pyrrole), distributed in nature (chlorophyll, hemin). Obtaining pyrrole. St. George's synthesis. Chemical properties.</p> <p>Oxygen-containing five-membered hetero systems are moray eels and their derivatives. Obtaining dry distillation of wood. Chemical properties: substitution reaction (nitration, sulfonation). Nicotinic acid. Nicotinamide is a vitamin PP. The concept of alkaloids.</p> <p>Laboratory work №12. Multinuclear and heterocyclic compounds</p>			2	6	
<p><b>Topic 7. Clinical and biochemical evaluation of protein metabolism in pathologies of internal organs.</b></p> <p>Disorders of simple protein metabolism in gastritis, enteritis and pancreatitis. Determination of total protein content in blood serum. Interpretation of the obtained results</p> <p>Methods for determining protein fractions of blood. Determination of serum albumin content Features of protein digestion in ruminants and its violation in rumen acidosis. Violation of general homeostasis protein and its fractions. Hypo, hyper- and diproteinemia in pathologies of internal organs.</p> <p>Non-protein nitrogenous components of blood in pathology of internal organs. Residual nitrogen and its components. Azotemia and its types. Diagnosis of disorders of protein metabolism. Dysproteinemia. Colloidal-sedimentary reactions: formolic, sulemic, zinc sulfate</p>	2		2	6	
<p><b>Topic 8. Metabolism of carbohydrates and lipids, their disorders in the pathology of internal organs</b></p> <p>Disorders of digestion and absorption of carbohydrates in pathology of internal organs. Features of carbohydrate digestion in ruminants and its violation in rumen acidosis. Intermediate metabolism of</p>	2		2		

<p>carbohydrates and its changes in pathology of the liver and pancreas. Diagnosis of carbohydrate metabolism disorders. Determination of plasma glucose (serum) by glucose oxidase enzymatic) and express method (glucometer)</p> <p>Disorders of digestion and absorption of lipids in the pathology of internal organs in monogastric and ruminants. Ketogenesis and peroxidation of lipids and its violation. Diagnosis of lipid metabolism disorders. Determination of total lipids and cholesterol in the serum of animals</p>			2	4	
<p><b>Topic 9. Clinical biochemistry for metabolic disorders of macro-, micronutrients and vitamins</b></p> <p>Metabolism of macronutrients in pathology of internal organs. Biochemical methods for the diagnosis of macronutrients (lack or excess of Ca, P, Mg, K, Na). Diagnosis of macronutrient metabolism disorders. Determination of calcium and inorganic phosphorus content in blood serum and clinical interpretation of the obtained results</p> <p>Metabolism of trace elements in pathology of internal organs. Biochemical methods of diagnosis of microelementosis. Diagnosis of micronutrient metabolism disorders. Determination of copper, zinc, iron, manganese, cobalt and selenium in the serum of animals and clinical interpretation of the results</p> <p>Clinical biochemistry for disorders of fat-soluble vitamins metabolism. Diagnosis of disorders of vitamin metabolism. Determination of vitamin A content in blood serum and interpretation of the obtained results. Determination of vitamin E content in blood serum and interpretation of the obtained results</p> <p>Determination of vitamin E content in blood serum and interpretation of the obtained results</p> <p>Biochemical aspects of disorders of water-soluble vitamins metabolism and methods of their diagnosis.</p> <p>Disorders of water-electrolyte</p>	2		2 2 2 2 2	10	

metabolism in animals.					
<b>Total hours of the course</b>	<b>14</b>		<b>60</b>	<b>76</b>	

#### 4. TEACHING AND LEARNING METHODS

<b>MLOs</b>	<b>Teaching methods (directed study)</b>	<b>Hours</b>	<b>Learning methods (self-directed study)</b>	<b>Hours</b>
MLOs 1. Understand the chemical nature of physiological processes in the animal with the participation of organic substances, which determines their subordination to basic chemical laws	Explanatory-reproductive methods: lecture, story-explanation  Using the platform MOODLE, Kahoot, ZOOM during the mixed form of training	20	Working with textbooks, manuals, materials of the Internet; , illustration, demonstration, performance of experiments, exercises, didactic tasks, independent works, etc.	20
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.	20	Independent searching of educational information, performance of laboratory works of partial-search content, complex didactic tasks	20
MLOs 3. Be able to use laboratory equipment and chemical reagents in compliance with the rules of safe storage and use in specialized research	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.	18	Reading literature on the topic, watching videos on the Internet and on the Moodle platform	18
MLOs 4. Formulate conclusions, recommendations, advice on keeping, feeding and treatment of animals or establish a diagnosis based on the results of laboratory tests	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	18	Preparation of reports of laboratory works, searching information, writing the reports and presenting the results	16

	training			
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## 5. ASSESSMENT

### 5.1. Diagnostic assessment

### 5.2. Summative assessment

#### 5.2.1. Intended learning outcomes methods:

No	Summative assessment methods	Grades	Deadline
1.	<i>Interactive testing to verify theoretical material</i>	15 points / 15%	8th week
2.	<i>Drawing up a comprehensive written control</i>	3*10 points / 30%	7 <sup>th</sup> , 10 <sup>th</sup> , 14 <sup>th</sup> weeks
3	<i>Protocols of laboratory works</i>	25 points / 25%	Up to 14 <sup>th</sup> -15 <sup>th</sup> week
4	<i>Exam</i>	30 points / 30%	Examination week

#### 5.2.2. Grading criteria

Summative assessment method	Unsatisfactory	Satisfactory	Good	Excellent
<i>Interactive testing to verify theoretical material</i>	<7 points	7-10 points	11-13 points	14-15 points
	In the multiple choice test, less than 60% of the correct answers are given	In the multiple choice test, from 60% to 74% of correct answers are given	In the multiple choice test, from 75% to 89% of correct answers are given	More than 90% of correct answers are given in the multiple choice test
<i>Drawing up a comprehensive written control</i>	<5 points	5-6 points	7-8 points	9-10 points
	The abbreviated condition of the problem is made, there are no equations of reactions and formulas	An abbreviated condition of the problems is made, the calculation is performed only according to the ready formula	The necessary formulas of substances and equations of reactions are given, the solutions of problems contain errors	The tasks are performed in full, the presentation is logical and rational, the conclusions and generalizations are substantiated
<i>Protocols of laboratory works</i>	<5 points	6-15 points	16-22 points	23-25 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
<i>Exam</i>	<14 points	15-20 points	21-26 points	27-30 points
	There are not enough answers to	Only test tasks completed, the answer to the	All tasks of the examination ticket have been	All tasks of the examination ticket

	the exam questions	theoretical question and the matter contain errors	completed, but there are minor errors	have been completed
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### 5.3. Formative assessment

To assess current learning progress and understand areas for further improvement

No	Formative Assessment elements	Date
1.	<i>Interactive testing to check the mastering of lecture material</i>	10 minutes at the end of the lesson at the end of the study of the topic
2.	<i>Checking individual homework, discussion with the teacher and self-correction of work done by students</i>	One week after completion
3.	<i>Oral feedback from teachers and students after the presentation of the report</i>	every week
4.	<i>Checking the results of experiments in laboratory work with feedback</i>	One week after completion

## 6. LEARNING RESOURCES

1. Organic Chemistry: Course book for 1st year students of the faculty of veterinary medicine. Training direction: 211 "Veterinary Medicine. Compilers: O.G.Shvets L.N. Ponomarova, V.D. Ivchenko, – Sumy : Sumy National Agrarian University, 2019. – 241 p

### Basic Books

2. Biological and Bioorganic Chemistry: textbook: in 2 books. Book 1. Bioorganic Chemistry / B.S. Zimenkovsky, V.A. Muzychenko, I.V. Nizhenkovska, G.O. Synova; edited by B.S. Zimenkovsky, I.V. Nizhenkovska. Kyiv: AUS Medicine Publishing, 2020. – 288 p.
3. Biological and Bioorganic Chemistry: textbook: in 2 books. Book 2. Biological Chemistry /Yu.I. Gubsky, I.V. Nizhenkovska, M.M. Korda et at. edited by Yu.I. Gubsky, I.V. Nizhenkovska. Kyiv: AUS Medicine Publishing, 2020. – 544 p.
4. John E. McMurry, Robert C. Fay. Chemistry, 6/E Cornell University. - Prentice Hall, 2012.

### Additional literature:

5. J. Clayden. Organic Chemistry - <http://web.uni-plovdiv.bg/plamenpenchev/mag/books/orgchem/Organic%20Chemistry%20-%20J%20Clayden.pdf>
6. Chemistry Textbook Online [https://www.ck12.org/chemistry/chem1\\_virtual\\_textbook](https://www.ck12.org/chemistry/chem1_virtual_textbook) <http://www.chem1.com/acad/webtext/virtualtextbook.html>
7. Laboratory Practicum on Bioorganic Chemistry / Olena Mitryasova. Kyiv: Publishing house "Condor", 2020. – 124 p.
8. Harper's Illustrated Biochemistry/ Robert Murray, Victor Rodwell, David Bender, Kathleen M. Botham, P. Anthony Weil,; Peter J. Kennelly. - - 28 th ed. – New York [etc.], cop. 2009. – 693 p.
9. Biochemistry / Reginald H. Garrett, Charles M. Grisham. Garrett, Reginald H. - 4th ed. - Brooks/Cole, Cengage Learning. 2010. – 1050 p.
10. Textbook of Veterinary Physiological Chemistry / Larry R Engelking. - 2nd ed. - ELSEVIER INC. 2011. – 596 p.