NATIONAL UNIVERSITY OF LIFE AND ENVIRONMENTAL SCIENCES OF UKRAINE

Department of General, Organic and Physical Chemistry

"APPROVED"
Dean of the Faculty
Plant protection, biotechnology and ecology
Kolomiets Yu.V.

"REWIED and APPROVED"
at a meeting of the Department of General,
organic and physical chemistry
Protocol 7 of 12 May 2022
Head of Department
(Lydia Kovshun)

" REWIED "
Garant OP
_____ (Volodymyr BOGOLYUBOV)

WORK PROGRAM OF ACADEMIC DISCIPLINE

«Organic, bioorganic, physical and colloid chemistry»

specialty _____101 Ecology _____
educational program _ Ecology _____
Faculty of Plant Protection, Biotechnology and Ecology
Author: ____ Ph.D., Associate Professor Viktoria Krotenko, Associate Professor of department of General, Organic and Physical Chemistry

Kyiv – 2022

1. Academic discipline description

« Organic, bioorganic, physical and colloid chemistry»

Branch of knowledge, specialty, educational program, Educational qualification		
Educational qualification	«Bachelor»	
Specialty	101 «Ecology»	
Educational program	«Ecology»	
Characteristics of training programme		
Type	Ordinary (standard)	
The total number of academic hours	90	
Number of ECTS credits allocated	3	
Number of modules	3	
Forms of control	Exam	
Indicators of academic discipline for full-time and part-time forms of training course		
	Full-time	Part-time
Year of study (course)	1	
Semester	2	
Number of lecture, hours	15	
Number of seminars, practical classes	-	
Laboratory sessions (activities)	30	
Independent study	45	
Individual lessons	-	
Number of weekly in-class academic hours for full-time forms of training	3	

2. Purpose, tasks and competencies of the discipline

Purpose: formation of students' theoretical foundations of chemistry, practical skills in working with different types of organic compounds, study of specific features of their behavior in chemical reactions, gaining experience in a chemical laboratory to solve specific practical problems, ability to work with scientific literature .

The course of chemistry should be the basis for the study of special disciplines: biochemistry, genetics, etc.

Task:

- to form a base of chemical knowledge about organic substances;
- identification of patterns of the relationship between the structure and structure of chemical compounds;

- learn to establish the relationship between the constituent parts of the substance, as well as individual components in mixtures;
- learn to describe the basic laws of chemical processes;
- to develop skills and abilities to use modern achievements of organic chemistry in veterinary medicine.

As a result of studying the discipline the student must

know: - the subject and objectives of organic chemistry, prospects for its development, the importance of organic chemistry for the practical activities of specialists;
- basic concepts and sections of organic chemistry, chemical reagents, chemical utensils;

be able to: - work independently with educational and reference books;
- have the technique to perform all operations in the analysis of organic matter;
- perform calculations related to practical tasks.

Acquisition of competencies:

General competencies (GC):
GC1. Ability to abstract thinking, analysis and synthesis.
GC 2. Ability to apply knowledge in practical situations.
GC 7. Ability to conduct research at the appropriate level.
GC 11. Ability to assess and ensure the quality of work performed.

Professional (special) competencies (PC):
PC 7. Ability to organize and conduct laboratory and special diagnostic tests and analyze their results.

3. Structure of discipline _____ « Organic chemistry » _____

Modules and themes	hours											
	full-time learning						Part-time					
	Total	including					Total	including				
		Lec	Pr	Lab	Ind	Ind		Lec	Pr	Lab	Ind	Ind
1	2	3	4	5	6	7	8	9	10	11	12	13
Module 1. The most important theoretical principles of organic chemistry. Aliphatic and carbocyclic hydrocarbons. Oxygen-containing organic compounds												
Topic 1. Introduction. The most important theoretical principles of organic chemistry. Arenas.	12	2		4		6						
Topic 2 Hydroxyl organic substances: alcohols, phenols Carbonyl and carboxyl compounds: aldehydes, ketones	10	2		4		4						
Topic 3 Carboxylic acids, fats	10	2		4		4						
Total for module	32	6		12		14						
Module 2												
Topic 1. Carbohydrates	14	2		4		8						
Topic 2. Amines. Amino alcohols. Amino acids. Proteins. Heterocyclic compounds. Nucleic acids	14	2		4		8						
Total for module	28	4		8		16						
Module 3. Fundamentals of physical and colloidal chemistry												
Topic 1. Fundamentals of physical chemistry	16	2		6		8						
Topic2. Fundamentals of Coloid Chemistry	14	3		4		7						
Total for module	30	5		10		19						
Total	15	30		30		45						

4. Topics of seminars - not provided

5. Topics of practical training - not provided

6. Title themes laboratory studies, hours

№	Title theme	Hours
Module 1. The most important theoretical principles of organic chemistry.Aliphatic and carbocyclic hydrocarbons.		
1	Basics of safety. Methods of isolation and purification of organic matter. Qualitative elemental analysis.	2
2	Hydrocarbons. Obtaining and studying the properties of methane, ethylene.	2
3	Arenes. Terpenes . Study of properties.	2
4	Study of the properties of alcohols and phenols.	2
5	Aldehydes and ketones. Study of properties Study of the properties of carboxylic acids. Lipids (fats)	2
6	Properties of halogenated hydrocarbons. Test work "Hydrocarbons/ Oxygen-containing organic compounds "	2
Module 2. Nitrogen-containing organic substances. Heterocyclic compounds.		
7	Study of the properties of mono- and disaccharides. Study of the properties of polysaccharides.	2
8	Nitrogen-containing organic substances	2
9	Amines, amides. Study of the properties of amino acids and proteins	2
10	Heterocyclic compounds Test work ""	2
Module 3. Fundamentals of physical and colloidal chemistry		
11	Designation of the heat of the reaction of salt crystallization and the heat of the reaction of neutralization	2
12	Acid-base power differences. pH-metry	2
13	Follow-up adsorption of octic acid on activated carbonum	2
14	cleaning and properties of colloidal systems	2
15	Test work. Fundamentals of physical and colloidal chemistry	2

7. Questions, test to determine the level of students learning

1.History of organic chemistry development. Role of the national and foreign scientists in organic chemistry development. Modern situation. Structural theory of organic compounds developed by O.M.Butlerov (basic provisions).

2.Fatty amines. Their preparation, properties and application.

3.Write down equations of the following chemical transformations:
calcium carbide → acetylene carbide → acetaldehyde → acetic acid → acetamide

4.Isomerism and nomenclature of monocarboxylic acids. Acetic acid, its preparation, chemical properties and application

5.Reducing and non-reducing sugars (maltose, saccharose). Their structure and difference in chemical properties

6.Write down equations of the following chemical transformations:
methyl chloride → ethane → ethyl chloride → ethyl alcohol → acetaldehyde

7.Polysaccharides, their general characteristic. Structure of starch, glycogen and celluloses. Their chemical properties and biological importance.

8.Alkynes. Preparation and chemical properties of acetylene. Application of acetylene.

9.Write down equations of the following chemical transformations:
benzene → benzenesulfonic acid → sodium phenolate → phenol

10.Aldehydes. Their isomerism and nomenclature. Preparation, chemical properties and application of acetaldehyde.

11.Saturated monoacids. Nomenclature, separate representatives and trivial names of saturated monoacids. Their physical and chemical properties.

12.Write down equations of the following chemical transformations:
benzene → toluene → benzoic acid → methyl benzoate

13.Chemical properties of arenes. Rule of substitutent orientation in a benzene ring: first kind and second kind orientants, explanation of this effect. Examples of electrophylic substitution reactions.

14.Carbohydrates and their classification: monosaccharides, disaccharides and polysaccharides. Their physical properties and natural sources. Structural formulas of carbohydrates.

15.Write down equations of the following chemical transformations:
1,2,3-trichloropropane → glycerol → triolein

16.Dibasic carboxylic acids. Oxalic and succine acids, their preparation and chemical properties.

17.Aliphatic halogen derivatives. Their nomenclature, methods of preparation and chemical properties. Separate representatives of alkyl halides.

18.Write down equations of the following chemical transformations:
acetaldehyde → lactic acid → ether of lactic acid

19.Saturated hydrocarbons. Alkanes. Homologous series of methane. General characteristic of these compounds, their representatives, nomenclature of alkanes. Physical and chemical properties of alkanes. Radicals. Hydrocarbon chain isomerism.

20.Carbohydrates, their natural sources and biological role. Classification of carbohydrates. Isomerism and chemical properties of glucose.

21.Write down equations of the following chemical transformations:
ethane → ethyl alcohol → ester of ethyl alcohol → ethyl alcohol

22.Ketones, their isomerism and nomenclature. Preparation and chemical properties of acetone. Application of acetone.

23.Acid derivatives. Salts, anhydrides, esters, nitriles. Their nomenclature and methods of preparation.

24.Write down equations of the following chemical transformations:
benzene → toluene → benzoic acid → metyl benzoate
25.Saturated hydrocarbons. Alkanes. Homologous series of methane. General characteristic of these compounds, their representatives, nomenclature of alkanes. Physical and chemical properties of alkanes. Radicals. Hydrocarbon chain isomerism.
26.Dihydroxy and trihydroxy alcohols. Their representatives: ethylene glycol, glycerol. Methods of preparation, physical and chemical properties, application.
27.Write down equations of the following chemical transformations:
methane → methyl iodide → methylamine → dimethylamine → trimethylamine
28.Alkenes. Types of isomerism and nomenclature. Preparation and chemical properties of propene. Reactions of addition. Rule of Markovnikov.
29.Heterocyclic nitrogen compounds. Purine, pyrimidine. Derivatives of purine and pyrimidine (adenine, guanine, thymine, cytosine, uracyl). Their biological importance.
30.Write down equations of the following chemical transformations:
methane → acetic acid

Examples of tests

Module 1

Question 1

	Organic chemistry studies compounds of
1	nitrogen
2	sulphur
3	silicon
4	carbon

Question 2

	Carbon is always
1	monovalent
2	bivalent
3	trivalent
4	tetravalent

Question 3

	π-bond is a bond formed by
1	sp^3-hybridised molecular orbitals
2	sp^2-hybridised molecular orbitals
3	sp-hybridised molecular orbitals
4	unhybridised p-orbitals

Question 4

	a triple bond between carbon atoms consists of:
1	two σ- bonds and one π-bond
2	one σ- bond and two π-bonds
3	three σ-bonds
4	three π-bonds

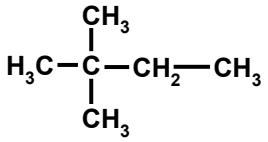
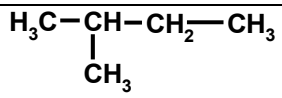
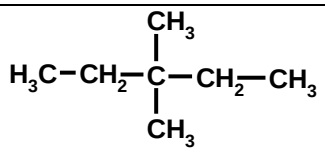
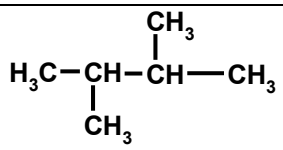
Question 5

	Isomers are compounds
1	with similar structure yet different number of CH_2- groups in a chain
2	with equivalent composition yet different sequence of bonds between atoms
3	with one and the same molecular geometry yet formed by elements of different nature
4	with one and the same functional group

Question 6

	Alkanes are compounds
1	of carbon and hydrogen with only single bonds between atoms
2	of carbon and hydrogen with, at least, one double bond in a chain
3	of carbon and hydrogen with one triple bond between neighbour carbon atoms
4	of carbon and hydrogen with cyclic geometry

Question 7

	Find formula of 2-methylbutane:
1	
2	
3	
4	

Question 8

	The basic natural source of hydrocarbons is
1	juice of fruits
2	petroleum
3	sea water
4	soil

Question 9

	Which of reactions below is used for synthesis of alkanes?
1	**$CH_3Cl + Na + CH_3Cl$**
2	**$CaC_2 + H_2O$**
3	**$CH_3–CH_2OH + Na$**
4	**$Ca(OH)_2 + CO_2$**

Question 10

	Reactions characteristic to alkanes are reactions of
1	substitution
2	elimination
3	addition
4	hydration

Question 11

	Which of compounds below is the basic component of natural gas
1	methane
2	acetylene
3	butene
4	cyclohexane

Question 12

	Which of compound listed below has no structural isomers?
1	ethane
2	hexane
3	methylpropane
4	pentane

Question 13

	Which of compounds below can be oxidised to ethylene glycol by an aqueous solution of potassium permanganate?
1	**$CH_3–CH_2–CH_3$;**
2	**$CH_2=CH_2$;**
3	**$CH_3–CH_2–CH_2–CH_3$;**
4	**CH_4.**

Question 14

	Find the name of compound in accordance with IUPAC: **$CH_3–C\equiv C–CH_3$**
1	dimethylbutane
2	but-2-yne
3	but-3-yne
4	but-2-ene

Question 15

	Alkenes are hydrocarbons
1	with one double bond in a chain
2	with two double bonds in a chain
3	with one triple bond in a chain
4	with alternating single and double bonds

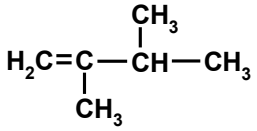
Question 16

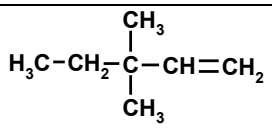
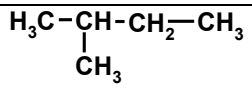
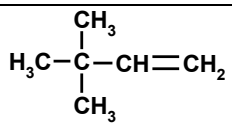
	Reaction of ethene hydrogenation produces:
1	**CH_4**
2	**$CH_3—CH_3$**
3	**$CH_2=CH_2$**
4	**$CH_3—CH_2—CH_3$**

Question 17

	According to IUPAC rules of nomenclature, propene is a name for an unsaturat hydrocarbon with:
1	three carbon atoms and one double bond in a chain
2	five carbon atoms and one double bond in a chain
3	three carbon atoms and one triple bond in a chain
4	five carbon atoms and one triple bond in a chain

Question 18

	Find formula corresponding to 2,3-dimethylbut-1-ene:
1	

2	
3	
4	

Question 19

	The product of ethylene polymerisation is:
1	rubber
2	polyethelene
3	polypropylene
4	polyacrylonitrile

Question 20

	Treatment of propene by bromine water results in:
1	1-bromopropane
2	1,2-dibromopropane
3	propane
4	1,1-dibromopropane

Question 21

	Acetylene is the simplest representative of
1	alkanes
2	alkenes
3	alkynes
4	alkadienes

Question 22

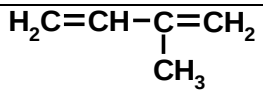
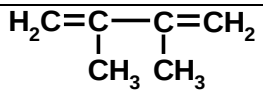
	Which of reactions shown below allows to produce acetylene?
1	**$CH_2CH_3OH + H_2SO_4$ (conc.) $\longrightarrow$**
2	**$CaC_2 + 2\ H_2O \longrightarrow$**
3	**$CH_2ClCH_2Cl + Zn \longrightarrow$**
4	**$2\ CH_2CH_3Cl + 2\ Na \longrightarrow$**

Question 23

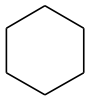
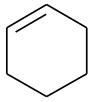
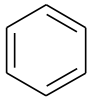
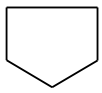
	Find the product of acetylene reaction with water in the presence of Hg^{2+} salts as catalyst (Kucherov's reaction):
1	ethylene glycol
2	acetaldehyde
3	ethyl alcohol

4	acetic acid

Question 24

	Which of compounds below is a structural unit of natural rubber?
1	**$CH_2=CH–CH=CH_2$**
2	**$CH_2=C=CH_2$**
3	
4	

Question 25

	Which of compounds below is aromatic?
1	
2	
3	
4	

Question 26

	Which of reactions shown below allows to produce benzene?
1	**$CH_2CH_3OH + H_2SO_4$ (conc.) $\longrightarrow$**
2	**$CaC_2 + H_2O \longrightarrow$**
3	**$CH_2ClCH_2Cl + Zn \longrightarrow$**
4	**3 H-C≡C-H $\longrightarrow$**

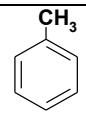
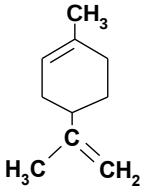
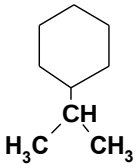
Question 27

	Which of compounds will be prevailing among the products of CH_3CH_2Br reaction with toluene?
1	meta-ethyltoluene
2	para-ethyltoluene
3	ethylbenzene
4	benzoic acid

Question 28

	Which of compounds below is the product of toluene oxidation by potassium permanganate solution?
1	benzene
2	benzyl alcohol
3	benzoic acid
4	phthalic acid

Question 29

	Which of compounds below is classified as a terpene?
1	
2	**$CH_3CH_2CH_2OH$**
3	
4	

Question 30

	The product of limonene oxidation is:
1	1,6,8,9-tetrabromomentane
2	1,6-dibromomentane
3	1,6,8,9-tetrahydroximentane
4	1,6-tetrahydroximentane

NATIONAL UNIVERSITY OF LIFE AND ENVIRONMENTAL SCIENCES OF UKRAINE

Faculty of Plant Protection, Biotechnology and Ecology
Speciality: Ecology
Form of education: full-time education
Semester 2 Year of education 1
Level of qualification: «Bachelor»
Department of General, Organic and Physical Chemistry
Discipline: Organic, bioorganic, physical and colloid chemistry
Lecturer: _____Krotenko V.V.

APPROVED by
Head of Department _____ L.O.Kovshun
Dated: 12/05/ 2022 protokol №7

SET OF TESTS No. 1

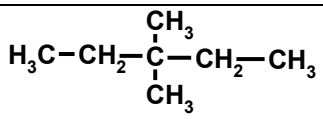
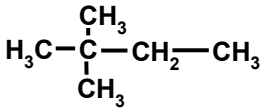
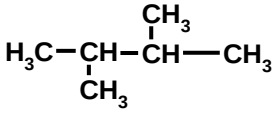
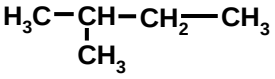
1. Benzene and toluene preparation and their chemical properties.

2. Write down equations of the following chemical transformations:
methyl chloride → ethane → ethyl chloride → ethyl alcohol → acetaldehyde

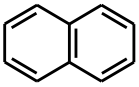
1. Complete the scheme of reaction occurring on heating:

CH_3COONa + NaOH →	(insert the products of reaction into the answer form)

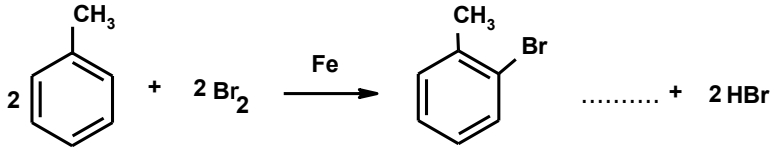
2. Which of the structural formulas below corresponds to 2,3-dimethylbutane?

1	
2	
3	
4	

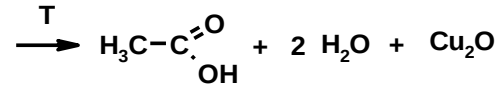
3. Which of compounds below are aromatic?

1	
2	
3	
4	

4. What product of reaction is omitted in the scheme?

	(insert the structural formula into the answer form)

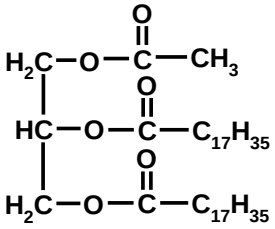
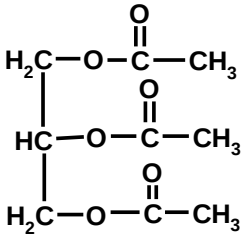
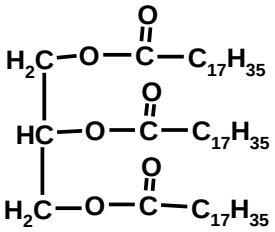
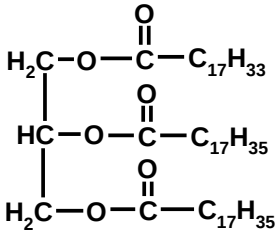
5. What compound should be added to the scheme of reaction?

	(insert the structural formula into the answer form)

6. Which of the acids shown in the right column are treated as:

A. Monobasic B. Dibasic C. Unsaturated D. Hydroxycarboxylic	**1. CH_3 – COOH** **2. HOOC–CH=CH–COOH** **3. CH_2(OH)–COOH** **4. HOOC– CH_2–CH(OH)COOH** **5. HOOC–COOH**

7. Find below oleodistearin:

1	
2	
3	
4	

8. Arrange carbohydrates listed in the right column into the groups of monosaccharides, disaccharides and polysaccharides:

A. monosaccharides B. disaccharides C. polysaccharides	1. Starch 2. Ribose 3. Sucrose 4. Cellulose 5. Glucose	6. Maltose 7. Deoxyribose 8. Fructose 9. Cellobiose

9. How many carbon atoms contains the molecule of ribose?

(insert one word into the answer form)

10. Find below one or more reactions specific for proteins:

1	Silver mirror reaction
2	Biuret reaction
3	Reaction with bromine water
4	Selivanov's test
5.	Xanthoproteic test
6.	Reaction with copper(II) hydroxide

8.TEACHING METHODS

The following teaching methods are used in the study of the discipline:
- methods of organization and implementation of educational and cognitive activities: verbal (story-explanation, conversation, lecture); visual (illustration, demonstration); - practical (laboratory works, abstracts);

- methods of stimulating and motivating educational and cognitive activities: stimulating interest in learning (creating a situation of interest in teaching material, educational discussions); stimulation of duty and responsibility (explanation of the purpose of the subject, disciplinary and organizational and pedagogical requirements for the study of the subject, encouragement and punishment in education);
- methods of control, correction of the effectiveness of educational and cognitive activities: current and intermediate surveys, tests, individual tasks, interviews.

9. FORMS OF CONTROL

The main forms of knowledge control are control at the lectures at labs and workshops, outside the classrooms, and the consultations, tests and exams.

I. Control of the lectures can be conducted as a selective oral questioning of students or tests using the previously laid material, particularly in sections of the course that are necessary for the understanding of the lecture topics, read, or to establish a degree of mastery of the material lectures (held by the manner of the late first or early second hour lectures). Testing during lectures designed to teach students to systematic elaboration covered material and prepare for the upcoming lectures, establish the degree of assimilation theory to identify the most difficult students to read chapters from the following explanation of them. Control of ther lectures has to subtract time. By spending time to conrol oral examination yields control, programmable for cards.

II. Current control on laboratory studies conducted to elucidate ready students for employment in the following forms:

1. Writing (30 min.). Control work.
2. Colloquium on separate sections of theoretical courses (modules or themes).

III. Credits. Some subjects (theoretical courses, practical training) is applied differential test of performance appraisal on a five point scale. In a lecture course or its individual parts, which are not accompanied by laboratory or practical classes, the teacher may conduct interviews or colloquium, offer oral or written questions.

IV. Examinations. Exam is a final step in the study of the whole or part of the discipline and are designed to test students' knowledge on the theory and identify the skills apply the acquired knowledge in solving practical problems, as well as independent work skills with educational and scientific literature.

Student's rating of knowledge of an academic discipline consists of training work rating – 70 points and final attestation – 30 points. Thus, rating of content modules, that are consistuents of an academic discipline, makes 70 points. Rating of content modules as well as attestation rating are also measured by 100-point-scale.

10. Distribution of points received by students.

Assessment of student knowledge is on a 100-point scale and is translated into national assessments according to table. 1 "Regulations on examinations and tests in NULES of Ukraine" (order of entry into force of 27.12.2019 №. 1371

Percentage score	National grade	
90-100	Excellent	Passed
74-89	Good	
60-73	Satisfactory	
0-59	Unsatisfactory	Non-passed

11. Methodological support

Krotenko V, Kovshun L., Khizhan O., Boiko P., Bobunov O. «Organic chemistry» Methodological guidelines for self-guided work of students specialising in 211 – Veterinary medicine(«Органічна хімія». Методичні вказівки для самостійної роботи студентів для спеціальності 211-Ветеринарна медицина. СО «Магістр». Англійською мовою). − Kyiv, 2021- 150 p.

12. REQUIRED AND RECOMMENDED LITERATURE

Basic

1. «Organic chemistry» («Органічна хімія», для спеціальності 211– Ветеринарна медицина). Berezhnyi E., Krotenko V., Kovshun L.,Zhyla R. NUBiP, 2021, -570 p.
2. «Organic, Bioorganic, Physical and Colloid Chemistry» Berezhnyi E., Krotenko V., Kovshun L., NUBiP 2020, 448p.
3. «Organic, Bioorganic, Physical and Colloid Chemistry» Berezhnyi E., Krotenko V., Kovshun L.) NUBiP 2018, 400 p.

Supplemental

1.Laboratory Practicum on Bioorganic Chemistry . Mitryasova Elena, K: Kondor, 2020, - 124p

2.MCAT Organic Chemistry Review 2020-2021, Kaplan,2021,- 352 p.

3.Бухтіяров В.К., Нестерова Л.О. Органічна хімія: Підручник. – К.:НУБіП України, 2017. – 689 с.

4.Біоорганічна хімія. Підручник/ Л.О.Нестерова, В.В.Кротенко, Р.С.Бойко. – К.: НУБіП України, 2017. – 299 с.

13.IT RESOURCES

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