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**PEOPLES' FRIENDSHIP UNIVERSITY OF RUSSIA**  
**RUDN University**

**Organic Chemistry Department – Faculty of Science**

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educational division (faculty/institute/academy) as higher education programme developer

**COURSE SYLLABUS**

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**Organic Chemistry**

course title

**Recommended by the Didactic Council for the Education Field:**

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**36.05.01 Veterinary Medicine**

field of studies / speciality code and title

**The course instruction is implemented within the professional education programme of higher education:**

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**Clinical veterinary medicine**

higher education programme profile/specialisation title

**2025 г.**

## 1. THE OBJECTIVE OF MASTERING THE DISCIPLINE

The objective of the course of Organic chemistry is in the formation of the system of knowledge about the laws in the chemical behavior of the main classes of organic compounds in relation to their structure in order to use this knowledge as a basis for study at the molecular level, the processes occurring in the living organisms.

## 2. REQUIREMENTS FOR THE RESULTS OF MASTERING THE DISCIPLINE

Mastering the discipline "Organic Chemistry" is aimed at developing the following competencies (parts of competencies) among students:

*Table 2.1. The list of competencies formed by students in the course of mastering the discipline (the results of mastering the discipline)*

Code	Competencies	Competence achievement indicators (within this discipline)
GC-8	The ability to create and maintain safe living conditions in everyday life and in professional activities to preserve the natural environment, ensure the sustainable development of society, including in the event of a threat and the occurrence of emergencies and military conflicts	GC -8.1. To be able to analyze the factors of harmful influence on the life of the elements of the environment (technical means, technological processes, materials, buildings and structures, natural and social phenomena)
		GC -8.2. To be able to identify dangerous and harmful factors within the framework of the task being performed
GPC -4	Ability to use in professional activity methods of solving problems using modern equipment in the development of new technologies and to use modern professional methodology for conducting experimental research and interpreting their results.	GPC -4.1. To be able to own the conceptual and methodological apparatus of the basic natural sciences at a level sufficient for full-fledged professional activity at the modern level
		GPC -4.3 To be ready to use modern methodology in the development and conduct of experimental studies
		GPC -4.4. To be able to use modern professional methodology when interpreting research results

## 3. THE PLACE OF DISCIPLINE IN THE STRUCTURE OF OP HE

Discipline «Organic Chemistry» refers to the core component of (B1) block of the higher educational programme curriculum.

Within the higher education programme students also master other disciplines (modules) and / or internships that contribute to the achievement of the expected learning outcomes as results of the internship.

*Table 3.1. The list of the higher education programme components that contribute to the achievement of the expected learning outcomes as the course results.*

Code	Competencies	Preceding disciplines *	Subsequent disciplines (groups of disciplines), practice, modules*
GC-8	The ability to create and maintain safe living conditions in everyday life and in professional activities to preserve the natural environment, ensure the sustainable development of society, including in the event of a threat and the occurrence of emergencies and military conflicts	Inorganic and analytical chemistry; Fundamentals of military training. Life safety	Preparation and passing the state exam; Study practice; Veterinary Microbiology and Mycology; Virology and biotechnology; Veterinary radiobiology;
GPC-4	Ability to use in professional activity methods of solving problems using modern equipment in the development of new technologies and to use modern professional methodology for conducting experimental research and interpreting their results	Inorganic and analytical chemistry Maths	Physical and colloidal chemistry; Biological chemistry; Immunology; Preparation for passing and passing the state exam; Clinical production practice; Production (professional) practice**; Production and research practice**; Educational practice;

\* To be filled in according with the competence matrix of the higher education programme.

\*\*elective disciplines /practices

#### 4. THE VOLUME OF DISCIPLINES AND TYPES OF TRAINING ACTIVITY

Course workload of the discipline «Bioorganic Chemistry» is 2 credits/ 72 academic hours.

*Table 4.1. Types of educational work by periods of mastering EP VO for **FULL-TIME EDUCATION***

Types of academic activities		TOTAL, ac.h.	Semester			
			2			
Contact work ac.h.		34	34			
including:						
Lectures (LC)		17	17			
Laboratory Wokrs (LW)		17	17			
Practical/seminar classes (PC)		-	-			
Self-study, ac.h.		20	20			
Evaluation and assessment (exam or pass/fail grading), ac.h.		18	18			
Total labor intensity	ac.h.	72	72			
	ac.h.	2	2			

## 5. CONTENT OF THE DISCIPLINE

Table 5.1. The course content by type of academic program

Name of discipline section	Content of the section (themes)	Type of training activity *
Section 1. Introduction	Theme 1.1. Organic chemistry as a branch of science that studies the structure and mechanisms of biologically active molecules from the standpoint of organic chemistry. The main provisions of the theory of chemical structure. Isomers. Classes of organic compounds. Hybridization carbon atoms.	LC
Section 2. Hydrocarbons.	Theme 2.1. Alkanes Alkane (saturated hydrocarbon) and their functional derivatives. Rotational isomers. Radical substitution reactions. Reactivity of alkanes. Methods for preparations.	LC, LW
	Theme 2.2. Alkenes (olefins, unsaturated hydrocarbons). Structure of $\sigma$ - and $\pi$ -bonds. Structure of alkenes. Geometric isomerism. Reactivity of Addition reactions of alkenes. Regioselectivity of addition to alkenes (Markovnikov addition). Oxidation of olefins to epoxides and 1,2-diols. Ozonation. The polymerization reactions of alkenes. ....	LC, LW
	Theme 2.3. Alkynes. Structure and reactivity. Acetylene as CH-acid. Acetylides. Addition reactions of alkynes. Dienes. The conjugated diene. Their structure. Conjugation. 1,2- and 1,4-addition to the conjugated diene. The reaction mechanism. The polymerization of conjugated diene. Natural and synthetic rubbers.	LC, LW
	Theme 2.4. Dienes.	LC

Name of discipline section	Content of the section (themes)	Type of training activity *
	The conjugated diene. Their structure. Conjugation. 1,2- and 1,4-addition to the conjugated diene. The reaction mechanism. The polymerization of conjugated diene. Natural and synthetic rubbers.	
	Theme 2.5. The aromatic compounds. Aromatics. The concept of aromaticity. The energy stabilization. Electrophilic substitution reactions in an aromatic ring. The mechanism of these reactions; $\sigma$ - and $\pi$ -complex. Orientation rules. Halogenation of the aromatic ring and the side chain	LC, LW
Section 3. Monofunctional compounds	Theme 3.1. Alkyl halides. Reactions of nucleophilic substitution of halogen in alkyl halides and arenes. $S_N1$ and $S_N2$ - substitution mechanisms. Elimination reaction. Zaitsev rule. Organometallic compounds.	LC, LW
	Theme 3.2. Alcohols (alcohols and alkanols). Atomicity of alcohols. The hydrogen bond. Reactivity of alcohols. Preparation of ethers and esters. Ethylene glycol. Glycerol. Ethers and oils. Nitroglycerine. Phenol. The acidic properties of phenol. Methods for preparation of phenol.	LC, LW
	Theme 3.3. Amines. The main properties of amines. Influence of electronic effects of substituents on the basic properties of amines. The salt formation. Acylation and alkylation of amines. Reaction with nitrous acid. Diamines. Ethylenediamine, putrescine, cadaverine, hexamethylenediamine - their biological importance and application. p-Aminophenol. Analgesic drugs derived from it.	LC
	Theme 3.4. Aldehydes and ketones. Electronic structure of the carbonyl group. Reaction of the carbonyl group and $\alpha$ -hydrogen in oxo-compounds. Acetals and ketals. The mechanism of their formation. Reactions of oxo-compounds with nitrogen-containing nucleophiles. The reaction mechanism. Urotropin. Aldol and crotonic condensation. Preparation of acetaldol and crotonaldehyde. The mechanism of the condensation reaction. Paraldehyde, paraformaldehyde, chloral hydrate. Dialdehydes and diketones. Acetylacetone. Keto-enol tautomerism.	LC, LW

Name of discipline section	Content of the section (themes)	Type of training activity *
	<p>Theme 3.5. Carboxylic acids.</p> <p>The structure of the carbonyl group. Influence of electronic effects of substituents on the hydrocarbon residue on the strength of acids. Reactions of carboxylic acids on the carboxyl group and <math>\alpha</math>-position. Derivatives of carboxylic acid salts, halides, anhydrides, amides, nitriles, esters. Methods for preparation and properties. Natural higher fatty acid (HFA): palmitic, stearic, oleic, linoleic, linolenic, arachidonic. Lipids and phospholipids. Enzymatic hydrolysis of fats. Acid oxidation in the body. Fragments of phosphoric acid in the nucleic acid and adenosine. Phosphatides. Lecithin and cephalins. Dicarboxylic acids: oxalic, malonic, succinic, glutaric and adipic. Their behavior during heating.</p>	LC, LW
Section 4. Heterofunctional compounds, Carbohydrates and Heterocycles.	<p>Theme 4.1. Hydroxy-Acids.</p> <p>Structure and nomenclature of hydroxy-acids. Reaction of alcohol and carboxylic groups. Transformation under the heating. Lactic acid formation during lactic acid fermentation, and in the muscles. The conversion of lactic acid to pyruvic during metabolism. Malic, tartaric and citric acid. Salicylic acid. Aspirin. Examples optical isomers of lactic and tartaric acids. Configuration chirality chiral center, the enantiomers. Absolute and relative configuration. D-L and R-S nomenclature</p>	LC
	<p>Theme 4.2. Aldo- and keto acids.</p> <p>Nomenclature. Chemical properties aldo- and keto acids. Pyruvic acid.</p>	LC
	<p>Theme 4.3. Amino acids.</p> <p>The amino acids that make up proteins: classification, structure, nomenclature, stereoisomerism, acid-base properties (formation of zwitter-ion). Formation <math>\alpha</math>-amino acids from ketoacids: reductive amination and transamination reactions (pyridoxal catalysis). The chemical properties of amino acids. Biologically important reactions <math>\alpha</math>-amino acids: deamination (oxidative and non-oxidative),</p>	LC

Name of discipline section	Content of the section (themes)	Type of training activity *
	<p>hydroxylation, decarboxylation <math>\alpha</math>-amino acids (formation kolamina, histamine, tryptamine). Acid-base properties of amino acids. Transformations <math>\alpha</math>-amino acids in the body. Optical isomerism <math>\alpha</math>-amino acids. Peptides and proteins. Hydrolysis of the peptides. The primary structure of proteins. Partial and complete hydrolysis. The concept of complex proteins. Glycoproteins, lipoproteins, nucleoproteins. p-Amino benzoic acid and its derivatives benzocaine and procaine. Sulfanilic acid. Sulfa drugs. p-Aminosalicylic acid. The amino alcohols. Ethanolamine in nature. Novocaine, choline, acetylcholine. Biogenic amines and their synthesis in the living organisms</p>	
	<p>Theme 4.4. Monoses. Carbohydrates. Carbohydrates in nature. The value of carbohydrates. Photosynthesis. Monosaccharides. Cyclo-chain tautomerism. D- and L- series. Reactions of monosaccharides functional groups. Glucose, mannose, galactose, fructose, ribose and deoxyribose; being in nature and biological significance. Ascorbic acid.</p>	LC, LW
	<p>Theme 4.5. Bioses Reducing and non-reducing disaccharides sucrose, maltose, cellobiose, lactose. The polysaccharides starch, glycogen, cellulose, pectin. Heteropolysaccharides: chondroitin sulfates, heparin, hyaluronic acid.</p>	LC, LW

Name of discipline section	Content of the section (themes)	Type of training activity *
	<p>Theme 4.6. Biologically important heterocyclic systems.</p> <p>Heterocycles with one heteroatom: pyrrole, indole, pyridine, quinoline. The concept of the structure of porphyrin and heme. Pyridine derivatives - nicotinamide, pyridoxal.</p> <p>Heterocycles with several heteroatoms: pyrazole, imidazole, thiazole, pyrazine, pyrimidine, purine (tautomerism for example imidazole).</p> <p>Indole. Biologically active compounds containing an indole cycle.</p> <p>Pyridine, quinoline, isoquinoline. Nicotinic acid and its amide (vitamin PP) as a structural unit of the co-enzymes NAD and NADP.</p> <p>Nucleotides. Ribonucleic and deoxyribonucleic acids. The nature and position of the connections between mononucleotide moieties. The secondary structure of DNA. Complementarity heterocyclic nucleotide bases. The role of hydrogen bonds in the formation of the secondary structure of DNA.</p> <p>Types of RNA. The concept of RNA secondary structure. The role of RNA in protein biosynthesis.</p> <p>Alkaloids. The classification, structure. Theobromine, theophylline, caffeine. Nicotine, morphine, quinine, atropine. Action on the body.</p>	LC

\* - filled in only for full-time education: LK - lectures; LW - laboratory work; SZ - seminars.

## 6. LOGISTICAL SUPPORT OF THE DISCIPLINE

- *Table 6.1. Classroom Equipment and Technology Support Requirements*

Type of room	Audience equipment	Specialized educational / laboratory equipment, software and materials for mastering the discipline (if necessary)
Lecture	An auditorium for lecture-type classes, equipped with a set of specialized furniture; board (screen) and technical means of multimedia presentations.	Room 612: a set of specialized furniture; hardware: BENQ MX661 projector, NEC NP40 projector, motorized screen for projectors, tables; there is wi-fi.
Laboratory room	Educational chemical laboratory for group laboratory-type classes, individual consultations, monitoring, intermediate certification, independent work	Room 623: a set of specialized furniture; specialized equipment of the



Type of room	Audience equipment	Specialized educational / laboratory equipment, software and materials for mastering the discipline (if necessary)
		<p>chemical laboratory: ventilation hood cabinet SHVP-4 (4 pcs.), rotary evaporator Hei-value digital G3B, rotary evaporator IKA, digital devices for determining the melting point SMP10; electronic laboratory scales AND EK-610, MK-M mantles of different sizes, drying cabinet PE-4610, magnetic stirrer MRHei-Mix S, magnetic stirrer with heating MRHei-Standart, refractometer, combined laboratory bath BKL, vacuum chemical station PC3001 VARIO-pro, circulating cooler Rotacool Mini, rotary vane vacuum pump RZ2.5, chemical membrane vacuum pump MZ2CNT, Steinel thermal blower, Spectroline EB-280C UV lamp, electronic vacuum controller with CVC3000 detect Vacuumbrand valve, chemical ware, refrigerator; there is wi-fi</p> <p>Room 620: a set of specialized furniture; specialized equipment of the chemical laboratory: ventilation hood cabinet SHVP-4 (4 pcs.), rotary evaporator Hei-value digital G3B, rotary evaporator IKA, digital devices for</p>

Type of room	Audience equipment	<b>Specialized educational / laboratory equipment, software and materials for mastering the discipline</b> (if necessary)
		<p>determining the melting point SMP10, electronic laboratory scales AND EK-610, MK-M mantles of different volumes , drying cabinet PE-4610, magnetic stirrer MRHei-Mix S, magnetic stirrer with heating MRHei-Standart, refractometer, combined laboratory bath BKL, vacuum chemical station PC3001 VARIO-pro. rotary vane vacuum pump RZ2.5, membrane vacuum chemical pump MZ2CNT, thermal blower Steinel, UV lamp Spectroline EB-280C, chemical glassware, refrigerator; there is wi-fi</p> <p>Room 800: a set of specialized furniture; specialized equipment of the chemical laboratory: ventilation hood cabinet SHVP-4 (4 pcs.), drying cabinet PE-4610, electronic laboratory scales, chromatograph, combined laboratory bathhouse BKL, gas burners, gas cylinders, chemical glassware; there is wi-fi</p>
room for independent work of students	An auditorium for independent work of students (can be used for seminars and consultations), equipped with a set of specialized furniture and computers with access to the EIOS.	<p><b>Science Faculty Reading Room</b> Ordzhonikidze D.3. Coworking area Monday - Friday 10.00 – 22.00 <b>Reading room of the main building of the RUDN</b></p>

Type of room	Audience equipment	Specialized educational / laboratory equipment, software and materials for mastering the discipline (if necessary)
		Coworking area Monday - Saturday 9.00 - 23.00 Hall No. 2 Monday - Thursday 10.00 - 17.45 Friday 10.00 - 16.45 Hall No. 6 Monday - Thursday 10.00 - 17.45 Friday 10.00 - 16.45

\* - the audience for independent work of students is indicated **MANDATORY!**

## 7. RECOMMENDED SOURCES FOR COURSE STUDIES

### *The main literature:*

1. Zurabyan S.E.  
Fundamentals of bioorganic: textbook for medical students / S.E. Zurabyan. - . - Moscow : GEOTAR-Media, 2019. - 304 p. : ill.. - ISBN 978-5-9704-4990-5.  
[http://lib.rudn.ru/MegaPro/UserEntry?Action=Rudn\\_FindDoc&id=464603&idb=0](http://lib.rudn.ru/MegaPro/UserEntry?Action=Rudn_FindDoc&id=464603&idb=0)
2. L. G. Voskressenky, A. V. Listratova, A. V. Varlamov. "Bioorganic Chemistry for Medicine Students. Lectures", Moscow, Peoples' Friendship University of Russia, 2015
3. Kulikova L. N., Listratova A. V., Borisov R. S., Sorokina E. A. Guidelines for laboratory work in organic chemistry. Moscow, Peoples' Friendship University of Russia, 2018

### *Additional literature:*

1. B. S. Bahl, Arun Bahl. A Textbook of Organic Chemistry. S. Chand & Company LTD. Ram Nagar, New Delhi-110 055, 1997.
2. Reinhard Bruckner "Advanced Organic Chemistry" Academic Press.
3. Francis A. Carey, Richard J. Sundberg "Advanced Organic Chemistry" Springer, 2008

### *Internet sources:*

1. Electronic libraries (EL) of RUDN University and other institutions, to which university students have access on the basis of concluded agreements:  
- RUDN Electronic Library System (RUDN ELS) <http://lib.rudn.ru/MegaPro/Web>

- EL "University Library Online" <http://www.biblioclub.ru>
- EL "Yurayt" <http://www.biblio-online.ru>
- EL "Student Consultant" [www.studentlibrary.ru](http://www.studentlibrary.ru)
- EL "Lan" <http://e.lanbook.com/>
- EL "Trinity Bridge"

## 2. Databases and search engines:

- electronic foundation of legal and normative-technical documentation <http://docs.cntd.ru/>
- Yandex search engine [https:// www .yandex.ru/](https://www.yandex.ru/)
- Google search engine <https://www.google.ru/>
- Scopus abstract database <http://www.elsevierscience.ru/products/scopus/>

*Learning toolkits for self-studies in the RUDN LMS TUIS \*:*

1. The course of lectures on «Organic Chemistry».
2. Kulikova L. N., Listratova A. V., Borisov R. S., Sorokina E. A. Guidelines for laboratory work in organic chemistry. Moscow, Peoples' Friendship University of Russia, 2018

\* - all educational and methodological materials for independent work of students are placed in accordance with the current procedure on the page of the discipline in TUIS!

## DEVELOPERS:

**Organic Chemistry Department**

		<b>Listratova A. V.</b>
Position, Department	Signature	Full name

## HEAD OF DEPARTMENT:

**Organic Chemistry Department**

		<b>Voskressensky L. G.</b>
Name of Department	Signature	Full name

## HEAD OF EP HE:

**Director of the  
Department of  
Veterinary Medicine**

		<b>Vatnikov Yu.A.</b>
Position, Department	Signature	Full name