Federal State Autonomous Educational Institution for Higher Education
PEOPLES' FRIENDSHIP UNIVERSITY OF RUSSIA

Agrarian and Technological Institute

WORKING COURSE SYLLABUS

Organic chemistry

Recommended by the Methodological Council for the Education Field:

36.05.01 Veterinary medicine

2022 г.

1. GOALS AND OBJECTIVES OF THE DISCIPLINE

The aim of mastering the discipline "**Organic chemistry**" is to familiarize students with the theoretical foundations of organic chemistry, the most important practical applications, without which it is impossible to solve modern technological, environmental problems, understanding of the processes occurring in living organisms.

2. REQUIREMENTS FOR THE RESULTS OF MASTERING THE DISCIPLINE

The development of the discipline "**Organic chemistry**" is aimed at creating the following competencies (parts of competencies) for students:

Table 2.1. List of competencies formed by students during the development of the discipline (results of the development of the discipline)

Code	**Competence**	**Indicators of competence accomplishment** (within the discipline)
UK -8	The ability to create and maintain safe living conditions in everyday life and in professional activities for the preservation of the natural environment, ensuring the sustainable development of society, including in the event of a threat and occurrence of emergencies and military conflicts.	UK-8.1 Analyzes the factors of harmful influence on the vital activity of elements of the habitat. (technical means, technological processes, materials, buildings and structures, natural and social phenomena);
		UK -8.2 Identifies dangerous and harmful factors within the scope of the task being performed;
		UK-8.3 Identifies and eliminates problems related to safety violations in the workplace;
		UK-8.4 Explains measures to prevent emergencies;
		UK -8.5 "Explains the rules of conduct in the event of emergencies of natural and man-made origin, as well as in the event of military conflicts;"
		UK-8.6 Provides first aid, participates in recovery activities.
GPC -4	The ability to use methods of solving problems using modern equipment in the development of new technologies in professional activity and to use modern professional methodology for conducting experimental research and interpreting their results.	GPC-4.1 Possesses the conceptual and methodological apparatus of basic natural sciences at a level sufficient for full-fledged professional activity at the modern level.
		GPC-4.2 He knows the methods of solving problems using modern equipment.
		GPC-4.3 He is ready to use modern methodology in the development and conduct of experimental research.

		GPC-4.4 Uses modern professional methodology in interpreting research results.
PC -3	Ability to develop animal research programs using special (instrumental) and laboratory methods.	PC-3.1 He is able to develop individual animal research programs, including the use of special (instrumental) and laboratory methods to detect deviations from the physiological norm of the state of a living organism, conduct differential diagnosis of the detected pathology or control the course of the disease and the effectiveness of the prescribed treatment.
		PC-3.2 Capable of developing mass comprehensive animal research programs (medical examination programs) of animals, taking into account their type and purpose, both general and special.
PC -7	The ability to choose the necessary drugs of chemical and biological nature for the treatment of animals, taking into account their combined pharmacological effect on the body.	PC -7.1 He is able to choose medicines of chemical and biological nature necessary for the treatment of animals, guided by the principles of evidence-based medicine, taking into account their combined pharmacological effect on the body.
		PC-7.2 He is able to justify the prescription of a drug in a certain clinical case or the impossibility of using this drug in the situation under consideration.
		PC-7.3 He is able to calculate the dose, frequency and duration of the course of application of the drug to the patient, taking into account the form of release and the characteristics of the administration of the drug to the patient.
		PC-7.4 He is able to take into account drug interactions when prescribing a course of treatment to an animal already receiving medications and biologically active additives due to the presence of diseases identified earlier.
		PC-7.5 He is able to take into account economic, species and age characteristics, as well as the results of laboratory studies of the patient when choosing drugs for the treatment of the patient.
PC -17	Ability to organize disinfection and disinfection of livestock premises to ensure veterinary and sanitary well-being in	PC-17.1 He is capable of collecting and analyzing information necessary for the organization and planning of veterinary and sanitary measures

	accordance with the plan of veterinary and sanitary measures	PC-17.2 He is able to choose the optimal equipment, consumables and medicinal and disinfecting preparations necessary and safe enough for the conduct of veterinary and sanitary measures
		PC-17.3 He is able to determine the procedure for disinfection, disinsection, deratization and other veterinary and sanitary measures, taking into account the peculiarities of animal husbandry, technical characteristics of premises and epizootic situation
		PC-17.4 He is able to monitor the results of veterinary and sanitary measures

3. COURSE IN HIGHER EDUCATION

The discipline "**Organic chemistry**" refers to the mandatory part of block B1 of the Educational Program of Higher Education.

As part of the Educational Program of Higher Education, students also master other disciplines and /or practices that contribute to achieving the planned results of mastering the discipline "**Organic chemistry**".

Table 3.1. List of Higher Education Program components disciplines that contribute to expected learning outcomes

Competence code	Competence	Previous Disciplines (Modules)	Subsequent Disciplines (Modules)
UK -8	The ability to create and maintain safe living conditions in everyday life and in professional activities for the preservation of the natural environment, ensuring the sustainable development of society, including in the event of a threat and occurrence of emergencies and military conflicts.	History Inorganic and analytical chemistry	Biological physics Physical and Colloidal Chemistry Life safety Biological chemistry Veterinary Microbiology and Mycology Virology and biotechnology Veterinary radiobiology Parasitology and invasive diseases Epizootology and infectious diseases Organization of veterinary affairs

			General and Veterinary Ecology Veterinary sanitation Veterinary deontology Laboratory diagnostics of infectious and invasive diseases Organization of state veterinary supervision
GPC -4	The ability to use methods of solving problems using modern equipment in the development of new technologies in professional activity and to use modern professional methodology for conducting experimental research and interpreting their results.	Inorganic and analytical chemistry	Biological physics Computer science Physical and Colloidal Chemistry Cytology, Histology and Embryology Biological chemistry Veterinary Microbiology and Mycology Virology and biotechnology Physiology and ethology of animals Breeding with the basics of private animal husbandry Pathological physiology Veterinary radiobiology Clinical diagnostics Pathological anatomy Operative surgery with topographic anatomy Instrumental diagnostic methods Toxicology Obstetrics, gynecology and andrology Internal diseases General surgery Private Veterinary Surgery Parasitology and invasive diseases

			Epizootology and infectious diseases Maths Immunology Veterinary sanitation Processing technology for livestock products Medicinal and poisonous plants Fodder plants The basics of intellectual work Personality psychology and professional self-determination Clinical laboratory diagnostics Laboratory diagnostics of infectious and invasive diseases Horse diseases Diseases of Productive Animals Diseases of small pets Болезни мелких домашних животных Diseases of bees and entomophages Fish pathology and aquaculture Diseases of exotic animals Anesthesiology, resuscitation and intensive care Dermatology Cardiology Endocrinology Nephrology Reconstructive surgery Veterinary ophthalmology Animal Dentistry
PC -3	Ability to develop animal research	Animal anatomy	Biological physics

	programs using special (instrumental) and laboratory methods.		Physical and Colloidal Chemistry Biological chemistry Veterinary Microbiology and Mycology Virology and biotechnology Physiology and ethology of animals Pathological physiology Clinical diagnostics Pathological anatomy Instrumental diagnostic methods Toxicology Obstetrics, gynecology and andrology Internal diseases General surgery Private Veterinary Surgery Parasitology and invasive diseases Epizootology and infectious diseases Immunology Veterinary deontology Clinical laboratory diagnostics Laboratory diagnostics of infectious and invasive diseases Veterinary and industrial laboratories with design basics Horse diseases Diseases of Productive Animals Diseases of small pets Болезни мелких домашних животных Diseases of bees and entomophages

			Fish pathology and aquaculture Diseases of exotic animals Anesthesiology, resuscitation and intensive care Dermatology Cardiology Endocrinology Nephrology Reconstructive surgery Veterinary ophthalmology Animal Dentistry
PC -7	The ability to choose the necessary drugs of chemical and biological nature for the treatment of animals, taking into account their combined pharmacological effect on the body.	Inorganic and analytical chemistry	Physical and Colloidal Chemistry Biological chemistry Veterinary Microbiology and Mycology Virology and biotechnology Pathological physiology Veterinary pharmacology Toxicology Obstetrics, gynecology and andrology Internal diseases General surgery Private Veterinary Surgery Parasitology and invasive diseases Epizootology and infectious diseases Medicinal and poisonous plants Horse diseases Diseases of Productive Animals Diseases of small pets Болезни мелких домашних животных

			Diseases of bees and entomophages Fish pathology and aquaculture Diseases of exotic animals Anesthesiology, resuscitation and intensive care Dermatology Cardiology Endocrinology Nephrology Veterinary ophthalmology Animal Dentistry
PC -17	Ability to organize disinfection and disinfection of livestock premises to ensure veterinary and sanitary well-being in accordance with the plan of veterinary and sanitary measures	Inorganic and analytical chemistry	Physical and Colloidal Chemistry Life safety Veterinary Microbiology and Mycology Virology and biotechnology Veterinary pharmacology Veterinary sanitation Здоровье и благополучие животных

4. COURSE WORKLOAD AND TRAINING ACTIVITIES

Course workload of the discipline "**Organic chemistry**" is 2 credits.

*Table 4.1. Types of academic activities during the period of the HE program mastering for **full-time** study*

Types of academic activities	**HOURS**	**Semesters**			
		2	-	-	-
Contact academic hours	36	36	-	-	-
including					
Lectures	18	18	-	-	-
Lab work	18	18	-	-	-
Seminars (workshops/tutorials)	-	-	-	-	-
Self-study	26	26	-	-	-
Evaluation and assessment (exam/pass/fail grading)	10	10	-	-	-

Course workload	Academic hour	**72**	**72**	-	-	-
	Credit unit	**2**	**2**	-	-	-

*Table 4.2. Types of academic activities during the period of the HE program mastering for **part-time** study*

Types of academic activities		**HOURS**	**Semesters**			
			2	-	-	-
Contact academic hours		18	18	-	-	-
including						
Lectures		-	-	-	-	-
Lab work		18	18	-	-	-
Seminars (workshops/tutorials)		-	-	-	-	-
Self-study		44	44	-	-	-
Evaluation and assessment (exam/pass/fail grading)		10	10	-	-	-
Course workload	Academic hour	**72**	**72**	-	-	-
	Credit unit	**2**	**2**	-	-	-

5. CONTENT OF THE DISCIPLINE

Table 5.1 Content of the discipline (module) by type of academic work

Name of the discipline section	**Content of the section (topics)**	**Types of academic activities**
Section 1. Introduction	Topic 1.1. The subject of organic chemistry. Carbon compounds, their characteristics, natural sources of organic compounds. The importance of organic chemistry as a tool of knowledge of man's technogenic influence on the environment. Brief sketch of the history of organic chemistry. The theory of structure of organic compounds (Butlerov A.M.), the present state of the theory of chemical structure. Principles of nomenclature of organic compounds. Nomenclature of UPAC. Classification of organic compounds. Rows, classes, functional groups. Basic principles of qualitative and quantitative analysis, methods of	Lectures, Lab work.

	establishing the structure of organic compounds.	
Section 2. Hydrocarbons.	Topic 2.1. Alkanes. Homological series. Nomenclature, isomerism, methods of preparation of alkanes. Physical properties. Chemical properties. Identification of alkanes.	Lectures, Lab work.
	Topic 2.2. Alkenes. Homological series, nomenclature. Isomerism. Methods for obtaining alkenes. Physical properties. Chemical properties: electrophilic mechanism of addition to alkenes. Markovnikov's rule. Radical addition in the presence of peroxides (Harash). Identification of alkenes.	
	Topic 2.3 Alkynes. Homological series, nomenclature. Methods for preparation of alkynes. Physical properties. Chemical properties. Adhesion reactions. Dimerization of acetylene. Reactions of acetylene hydrogen atom: formation of acetylenides. Identification of alkynes.	
	Topic 2.4. Diene hydrocarbons. Homological series, classification and nomenclature. Electronic structure of conjugated double bond system. Methods of preparation of divinyl, isoprene and chloroprene. Chemical properties of conjugated dienes: reactions of addition to 1,2- and 1,4- positions; polymerization reactions. Rubber (NK, SK) and plastics. Identification of dienes.	Lectures, Lab work.
Section 3: Aromatic hydrocarbons and homofunctional compounds.	Section 3.1. Aromatic hydrocarbons (arenes). Homological series, nomenclature and isomerization of benzene hydrocarbons. Electronic structure of the benzene molecule. Aromaticity, Hückel rule. Methods for obtaining arenes, their physical properties. Chemical properties: electrophilic substitution of hydrogen in the benzene nucleus. Mechanism of reaction. Orientation rules for electrophilic substitution: ortho- and meta-orientants and their influence on subsequent substitution in the benzene core. Condensed aromatic systems. Methods for the identification of arenes.	Lectures, Lab work.

	Section 3.2. Halogen derivatives. Nucleophilic substitution reactions of halogen in halide alkyls and arynes. SN1 and SN2 - Mechanisms of substitution. Elimination reactions. Zaitsev's rule. Organometallic compounds. Comparison of chemical activity of halogen bound to carbon of benzene ring with carbon of side cycle. Identification of halogen derivatives of HC.	Lectures, Lab work.
	Section 3.3. Alcohols. Classification, nomenclature and isomerism. Methods for the production of alcohols. Physical properties, hydrogen bonds. Chemical properties of monatomic alcohols. Simple esters. Preparation, properties and applications. Bi-atomic alcohols (glycols). Preparation, chemical properties, applications. Three-atom alcohols (glycerols). Natural sources and chemical methods of production. Properties and applications of glycerol. Phenols. Nomenclature and isomerization. Methods of production. Physical properties. Electronic structure of phenol molecule. Influence of substituents in benzene ring on acid properties of phenols. Chemical properties of phenols. Electrophilic substitution reactions in the benzene ring of phenols. Phenol-formaldehyde resins. Identification of alcohols and phenols.	Lectures, Lab work.
	Section 3.4. Amines. Classification, nomenclature, isomerism. Methods for preparation of amines. Physical properties. Chemical properties salt formation, alkylation, acylation, action of nitric acid on amines. Aromatic amines. Aniline, methods of its preparation. Substitution reactions of aromatic amines in the nucleus and reactions by amino group. Comparison of basic properties of fatty and aromatic amines. Identification of amines.	Lectures, Lab work.
	Section 3.5. Aldehydes and ketones. Isomerism and nomenclature. Methods of production. Structure of the carbonyl group. Physical properties. Chemical	Lectures, Lab work.

	properties: reactions of nucleophilic addition to carbonyl group. Substitution reactions of carbonyl oxygen. Haloform reaction. Reaction of formation of acetals (catalysts). Reactions involving hydrogen in the α-position to the carbonyl group. Aldole and croton condensations. Reduction and oxidation of aldehydes and ketones. Identification of oxo compounds.	
Section 4. Carboxylic Acids and Heterofunctional Compounds	Section 4.1. Carboxylic acids. Isomerism and nomenclature. Structure of the carboxylic group. Influence of the structure of carboxylic acids on their acidic properties. Methods for production. Physical properties. Chemical properties: reactions by carboxylic group and by α-position to carboxylic group. Derivatives of carboxylic acids: halogenanhydrides, anhydrides, nitriles, amides, esters.	Lectures, Lab work.
	Section 4.2. Lipids. Natural fats and oils - glycerides of higher fatty acids. Hydrolysis of fats, soaps. Hydrogenation of fats, margarine.	Lectures, Lab work.
	Section 4.3. Non-saturated carboxylic acids. Methods of production and chemical transformations. Acrylic and methacrylic acids, methods of their production, synthetic materials based on polymers of these acids.	Lectures, Lab work.
	Section 4.4. Bivalent carboxylic acids, methods of their production, properties and applications. Unsaturated bivalent acids.	Lectures, Lab work.
	Section 4.5. Oxic acids. Basicity and atomicity. Methods of preparation. General and specific properties of oxyacids. Salicylic acid. Relation of α-, β- and γ-oxy acids to heating.	Lectures, Lab work.
	Section 4.6. Oxo acids (aldehyde and keto acids). Nomenclature, structure and methods of production. Chemical properties.	Lectures, Lab work.
	Section 4.7. Amino acids. Classification, nomenclature, structure and methods of production of amino acids. Isoelectric current. Chemical properties of amino	Lectures, Lab work.

	acids, transformations by heating of α-, β- and γ-amino acids. Peptides.	
Section 5. Carbohydrates	Section 5.1. Monosaccharides: aldoses and ketoses, isomerism, configuration. Ring-chain tautomerism of monoses. Mutarotation. Reactions of monoses by carbonyl and oxy groups.	Lectures, Lab work.

6. CLASSROOM INFRASTRUCTURE AND TECHNOLOGY SUPPORT REQUIREMENTS

Table 6.1. Material and technical support of the discipline

Classroom for Academic Activity Type	***Equipping the classroom***	**Specialized educational/laboratory equipment, software and materials for the development of the discipline** (if necessary)
Lecture	An auditorium for conducting lecture-type classes, equipped with a set of specialized furniture; a board (screen) and technical means of multimedia presentations.	*BENQ MX661 projector, NEC NP40 projector, motorized screen for projectors*
Laboratory	An auditorium for laboratory work, individual consultations, routine monitoring and interim certification, equipped with a set of specialized furniture and equipment.	*specialized equipment of the chemical laboratory: fume hood SHVP-4 (6 pcs.), rotary evaporator Hei-value digital G3B, rotary evaporator IKA, digital instruments to determine the melting point SMP10, electronic laboratory scales AND EK-610, MK-M flask heaters of different volumes, drying oven PE-4610, magnetic stirrer MRHei-Mix S, magnetic stirrer with heating MRHei-Standart, Refractometer, combined laboratory bath, chemical vacuum station PC3001 VARIO-pro. RZ2.5 rotary vane vacuum pump, MZ2CNT chemistry diaphragm vacuum pump, Steinel air blower, Spectroline EB-280C UV*

		lamp, chemical glassware, refrigerator
Self-studies	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 an electronic information and educational environment.	-

7. RECOMMENDED SOURCES FOR COURSE STUDIES

Main reading:

1. Grandberg Igor Johannovich. Organic Chemistry: textbook / I.I. Grandberg, N.L. Nam. - 10th ed. - Saint-Petersburg: Lan' Publisher, 2021. - 608 p.: ill. - (Higher Education). - 978-5-8114-8835-3: 2571.25.00.
2. Fundamentals of organic chemistry: textbook for students in pharmacy / T.N. Borisova, A.V. Varlamov, E.A. Sorokina [etc.]. - 2nd ed. amended; Electronic text data. - M.: RUDN, 2019. - 355 p.: ill. - ISBN 978-5-209-09033-5: 352.76.
3. organic chemistry: educational and methodical manual for laboratory works for students of the 1st year, studying on the specialty "Ecology and nature management" / E. V. Nikitina, E. A. Sorokina, F. I. Zubkov, L. N. Kulikova. - Electronic text data. - M.: RUDN, 2019. - 36 c. - ISBN 978-5-209-09035-9: http://lib.rudn.ru/MegaPro/Web

Additional Reading:

1. Questions and Problems in Organic Chemistry: Textbook / Compiled by T.N. Borisova, A.A. Varlamov, E.A. Sorokitina, E.A. Nikitina. T. N. Borisova, A. V. Varlamov, E. A. Sorokina, E. V. Nikitina. - 3rd ed. - M.: RUSSIAN ASSOCIATION OF RUSSIAN TRADE UNIONS, 2020. - 97 c. - 978-5-209-09582-8: 79.40.
2. organic chemistry. Tasks for the general course with solutions: a textbook in 2 parts. Part 1 / M.V. Livantsov, G.S. Zaitseva, L.I. Livantsova [et al]; ed. by N.S. Zefirov. - Ed. 3-th edition; Electronic text data. - M.: Laboratory of knowledge, 2019. - 255 p.: ill. - (Textbook for higher school). - ISBN 978-5-00101-174-3: http://lib.rudn.ru/MegaPro/Web

Resources of the Internet information and telecommunication network:

1. Electronic library system of RUDN and third-party Electronic library systems to which university students have access on the basis of concluded contracts:
- Electronic library system of RUDN - ELS RUDN http://lib.rudn.ru/MegaPro/Web
- ELS "University Library online"http://www.biblioclub.ru
- ELS Yurayt http://www.biblio-online.ru
- ELS "Student Consultant"www.studentlibrary.ru
- ELS "Lan"http://eZlanbook.com/
- ELS "Trinity Bridge"http://www.trmost.com/

2. Databases and search engines:
- electronic fund of legal and regulatory and technical documentation http://docs.cntd.ru/
- search engine Yandex https://www.yandex.ru/
- search engine Google https://www.google.ru/
- abstract database SCOPUS http://www.elsevierscience.ru/products/scopus/

Educational and methodological materials for independent work of students during the development of the discipline/ module*:

1. A course of lectures on the discipline "**Organic chemistry**".
2. Laboratory workshop on the discipline "**Organic chemistry**".

* - All educational and methodological materials for independent work of students are placed in accordance with the current procedure on the discipline page in the **Telecommunication educational and Information System!**

8. MID-TERM ASSESSMENT

Evaluation materials and a point-rating system* for assessing the level of competence formation (part of competencies) based on the results of mastering the discipline "**Organic chemistry**" are presented in the Appendix to this Work Program of the discipline.

* - Assessment Materials and a Point Rating System are formed based on the requirements of the relevant local regulatory act of the RUDN.

DEVELOPER:

Associate Professor in the Department of Organic Chemistry		Kulikova L.N.
Position, Basic curriculum	Signature	Full name.

HEAD OF THE DEPARTMENT:

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