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**Federal State Autonomous Educational Institution of Higher Education
PEOPLES' FRIENDSHIP UNIVERSITY OF RUSSIA
RUDN University**

Agrarian and Technological Institute

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

COURSE SYLLABUS

Organic chemistry

course title

Recommended by the Didactic Council for the Education Field of:

36.05.01 Veterinary

field of studies / speciality code and title

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

36.05.01 Veterinary

higher education programme profile/specialisation title

1. GOALS AND OBJECTIVES OF THE COURSE

The aim of mastering the course "**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 LEARNING OUTCOMES

The implementation of the course "**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 course (results of the development of the course)

Competence code	Competence descriptor	Indicators of competence accomplishment (within the course)
GC-8	Is able to create and maintain safe living conditions in everyday life and professional activities to preserve the natural environment, ensure the sustainable development of society, including the threat and emergence of emergencies and military conflicts	GC-8.1 Analyzes factors of harmful influence on the life activity of elements of the environment (technical means, technological processes, materials, buildings and constructions, natural and social phenomena)
		GC-8.2 Identifies hazardous and harmful factors within the scope of the job
GPC-4	Is able to use in professional activity methods to solve problems using modern equipment in the development of new technologies and use modern professional methodology to conduct experimental research and interpretation of the results	GPC-4.1 Has the conceptual and methodological apparatus of the basic natural sciences at a level sufficient for full professional activity at the modern level
		GPC-4.3 Willing to use modern methodology in designing and conducting experimental research
		GPC-4.4 Uses modern professional methodology in interpreting research results

3. COURSE IN HIGHER EDUCATION PROGRAMME STRUCTURE

The course "**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 courses and /or practices that contribute to achieving the planned results of mastering the course "**Organic chemistry**".

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

Competence code	Competence descriptor	Previous courses/modules, internships*	Subsequent courses/modules, internships*
GC-8	Is able to create and maintain safe living conditions in everyday life and professional activities to preserve the natural environment, ensure the sustainable development of society, including the threat and emergence of emergencies and military conflicts	Basics of Professional Ethics Inorganic and analytical chemistry	Biological physics Life safety Veterinary Microbiology and Mycology Virology and biotechnology Veterinary radiobiology General and Veterinary Ecology Study practice Preparation for and passing the state exam
GPC-4	Is able to use in professional activity methods to solve problems using modern equipment in the development of new technologies and use modern professional methodology to conduct experimental research and interpretation of the results	Inorganic and analytical chemistry	Biological physics Physical and Colloidal Chemistry Biological chemistry Maths Immunology Laboratory diagnostics of infectious and invasive diseases Veterinary and industrial laboratories with design basics Study practice Clinical internship Industrial practice Academic research practice with the preparation of a scientific qualification project Preparation for and passing the state exam

4. COURSE WORKLOAD AND TRAINING ACTIVITIES

Course workload of the course "**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	-	-	-

5. COURSE CONTENTS

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

Modules	Content of the modules (topics)	Types of academic activities
Module 1. Introduction	<p>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.</p> <p>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.</p> <p>Basic principles of qualitative and quantitative analysis, methods of establishing the structure of organic compounds.</p>	Lectures, Lab work.
Module 2. Hydrocarbons.	<p>Topic 2.1. Alkanes. Homological series. Nomenclature, isomerism, methods of preparation of alkanes. Physical properties. Chemical properties. Identification of alkanes.</p> <p>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</p>	Lectures, Lab work.

	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.
Module 3: Aromatic hydrocarbons and homofunctional compounds.	Module 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.
	Module 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.
	Module 3.3. Alcohols. Classification, nomenclature and isomerism. Methods for the production of alcohols. Physical	Lectures, Lab work.

	<p>properties, hydrogen bonds. Chemical properties of monatomic alcohols. Simple esters. Preparation, properties and applications. Bi-atomic alcohols (glycols). Preparation, chemical properties, applications.</p> <p>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.</p>	
	<p>Module 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.</p> <p>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.</p>	Lectures, Lab work.
	<p>Module 3.5. Aldehydes and ketones. Isomerism and nomenclature. Methods of production. Structure of the carbonyl group. Physical properties. Chemical 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.</p>	Lectures, Lab work.
Module 4. Carboxylic Acids and Heterofunctional Compounds	Module 4.1. Carboxylic acids. Isomerism and nomenclature. Structure of the carboxylic group. Influence of the	Lectures, Lab work.

	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.	
	Module 4.2. Lipids. Natural fats and oils - glycerides of higher fatty acids. Hydrolysis of fats, soaps. Hydrogenation of fats, margarine.	Lectures, Lab work.
	Module 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.
	Module 4.4. Bivalent carboxylic acids, methods of their production, properties and applications. Unsaturated bivalent acids.	Lectures, Lab work.
	Module 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.
	Module 4.6. Oxo acids (aldehyde and keto acids). Nomenclature, structure and methods of production. Chemical properties.	Lectures, Lab work.
	Module 4.7. Amino acids. Classification, nomenclature, structure and methods of production of amino acids. Isoelectric current. Chemical properties of amino acids, transformations by heating of α -, β - and γ -amino acids. Peptides.	Lectures, Lab work.
Module 5. Carbohydrates	Module 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. COURSE EQUIPMENT AND TECHNOLOGY SUPPORT REQUIREMENTS

Table 6.1. Material and technical support of the course

<i>Classroom for Academic Activity Type</i>	<i>Equipping the classroom</i>	Specialized educational/laboratory equipment, software and materials for the development of the course (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.	<i>BENQ MX661 projector, NEC NP40 projector, motorized screen for projectors</i>
Laboratory	An auditorium for laboratory work, individual consultations, routine monitoring and interim certification, equipped with a set of specialized furniture and equipment.	<i>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</i>
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. RESOURCES RECOMMENDED FOR COURSE STUDIES

Main readings:

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 Readings:

1. Questions and Problems in Organic Chemistry: Textbook / Compiled by T.N. Borisova, A.A. Varlamov, E.A. Sorokina, 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>

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
 - 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/>
- Google search engine <https://www.google.ru/>
- Scopus abstract database <http://www.elsevierscience.ru/products/scopus/>

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

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

* - The training toolkit and guidelines for the internship are placed on the internship page in the university telecommunication training and information system under the set procedure.

8. ASSESSMENT TOOLKIT AND GRADING SYSTEM* FOR EVALUATION OF STUDENTS' COMPETENCES LEVEL AS COURSE RESULTS

The assessment toolkit and the grading system* to evaluate the level of competences (competences in part) formation as the course results are specified in the Appendix to the course syllabus.

* The assessment toolkit and the grading system are formed on the basis of the requirements of the relevant local normative act of RUDN University (regulations / order).

DEVELOPER:

Associate Professor in the Department of Organic
Chemistry

Position, Basic curriculum

Signature

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Full name.

HEAD OF EDUCATIONAL DEPARTMENT:

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Name Basic Curriculum

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**HEAD OF
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