Federal State Autonomous Educational Institution for Higher Education
PEOPLES' FRIENDSHIP UNIVERSITY OF RUSSIA named after P. Lumumba

(RUDN University)
Science faculty

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

COURSE SYLLABUS

THEORETICAL ORGANIC CHEMISTRY
course title

Recommended by the Didactic Council for the Education Field of:

04.04.01 «Chemistry»
field of studies / speciality code and title

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

«Fundamental and applied chemistry»
higher education programme profile/specialisation title

2025

1. COURSE GOAL(s)

The goal of the course of «Theoretical 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 to solve specific problems.

2. REQUIREMENTS FOR LEARNING OUTCOMES

Mastering the discipline "Theoretical organic chemistry" expects students to acquire the following competences /(competences in part):

Table 2.1. List of competences that students acquire through the course study

Competence code	**Competence descriptor**	**Competence formation indicators** (within this course)
PC-2	Ability, based on a critical analysis of the results of research and development, to evaluate the prospects for their practical application and continuation of work in the chosen field of chemistry, chemical technology or sciences related to chemistry.	PC-2.1. Ability to systematize information obtained in the course of research and development, to analyze it and compare it with literature data
		PC-2.2. Ability to determine possible directions for the development of work and prospects for the practical application of the results obtained

3. COURSE IN HIGHER EDUCATION PROGRAMME STRUCTURE

The course refers to the elective component of (B1) block of the higher educational programme curriculum.

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

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

Competence code	**Competence descriptor**	**Previous courses/modules***	**Subsequent courses/modules***
PC-2	Ability, based on a critical analysis of the results of research and development, to evaluate the prospects for their practical application and continuation of work in the chosen field of chemistry, chemical technology or sciences related to chemistry.		NMR of organic compounds Molecular spectral analysis Mass spectrometry of organic compounds Stereochemistry Experimental research methods in chemistry Scientific research practice Undergraduate practice

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

4. COURSE WORKLOAD AND ACADEMIC ACTIVITIES

The total workload of the course is 3 credits.

Table 4.1. Types of academic activities during the periods of higher education programme mastering (full-time training)

Type of academic activities		Total academic hours	Semester(-s)			
			1	2	3	4
Contact academic hours		36				
including:						
Lectures (**LC**)		36	36			
Lab Works (**LW**)						
Seminars (workshops/tutorials) (S)						
Self-studies		*54*	*54*			
Evaluation and assessment (exam/passing/failing grade)		*18*	*18*			
Course workload	academic hours_	**108**	**108**			
	credits	**3**	**3**			

5. COURSE CONTENTS

Table 5.1. Course contents and academic activities types

Course module title	Course module contents (topics)	Academic activities types*
Section 1. Chemical bond in organic compounds. Electronic effects.	Theme 1.1. Types of chemical bonds. Hybridization. Localized and delocalized chemical bonds. Multicenter bonds. Method of molecular orbitals.	LC
	Theme 1.2. Inductive effect and conjugation effect. The effects of superconjugation. Dependence of effects on the structure of molecules.	LC
Section 2. Acid-base properties and spatial structure of organic compounds.	Theme 2.1. Organic acids and bases, influence of steric and electronic effects on acid-base properties, solvation. The principle of hard and soft acids and bases.	LC
	Theme 2.2. Conformations of acyclic and cyclic molecules. Influence of conformation on reactivity. Chirality and symmetry. Optical activity. Types of chiral molecules. Enantiomers and diastereomers.	LC
Section 3. Mechanisms of organic reactions. Nucleophilic substitution in the aliphatic series, Elimination and addition reactions by multiple bonds.	Theme 3.1. General ideas about the mechanisms of organic reactions. Intermediate particles in transformations of organic compounds. Methods for establishing and studying the mechanisms of organic reactions.	LC
	Theme 3.2. Reactions S_N1, S_N2, S_Ni. Influence of the structure, substrate and reaction conditions on the mechanism. E1 and E1cB mechanisms, E2-mechanism. Factors affecting the mechanism of cleavage reactions. Mechanisms of electrophilic addition at C=C-bond and nucleophilic at C=O-	LC

Course module title	Course module contents (topics)	Academic activities types*
	bond. The role of the acidity of the medium upon addition to C=O.	
Section 4. Aromaticity. Substitution in the aromatic series. Pericyclic reactions. Rearrangements	Theme 4.1. Types of aromatic systems. Aromaticity criteria. Antiaromatic. Electrophilic substitution: reagents, π- and σ-complexes. Nucleophilic substitution: mechanism of the process, Meisenheimer complexes. Arin mechanism.	LC
	Theme 4.2. [4+2]-Cycloaddition, process synchronism, influence of substituents. Woodward-Hoffmann rules. Rearrangements: nucleophilic, electrophilic and free-radical. Cope and Claisen rearrangements.	LC

* - to be filled in only for **full** -time training: *LC - lectures; LW - lab work; S - seminars.*

6. CLASSROOM EQUIPMENT AND TECHNOLOGY SUPPORT REQUIREMENTS

Table 6.1. Classroom equipment and technology support requirements

Type of academic activities	Classroom equipment	Specialised educational / laboratory equipment, software, and materials for course study (if necessary)
Lecture	A lecture hall for lecture-type classes, equipped with a set of specialised furniture; board (screen) and technical means of multimedia presentations.	
Self-studies	A classroom for independent work of students (can be used for seminars and consultations), equipped with a set of specialised furniture and computers with access to the electronic information and educational environment.	

* The premises for students' self-studies are subject to **MANDATORY** mention

7. RESOURCES RECOMMENDED FOR COURSE STUDY

Main readings:

1. M. B. Smith, J. March March′s Advanced Organic Chemistry: Reactions, Mechanisms, and Structure, 6th Edition, Wiley-Interscience, 2007.

Additional readings:

1. J. Hine Physical Orgamic Chemistry, McGraw-Hill, 2013.

2. D.A. Dougherty, E.V. Anslyn Modern Physical Organic Chemistry, Univ. Sci. Books, 2006.

3. J. Clayden, N. Greeves, S. Warren, P. Wothers Organic Chemistry, Oxford Univ. Press. 2001.

4. T.H. Lowry, K.S. Richardson Mechanism and Theory in Organic Reactions. 3rd Ed. Benjamin Cumming Publ., 1987.

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:

- Yandex search engine https://www.yandex.ru/
- Google search engine https://www.google.ru/
- abstract database SCOPUS http://www.elsevierscience.ru/products/scopus/
- database Reaxys https://www.reaxys.com/#/search

*Training toolkit for self- studies to master the course *:*

1. The set of lectures on the course "Theoretical organic chemistry".

* The training toolkit for self- studies to master the course is placed on the course page in the university telecommunication training and information system under the set procedure.

DEVELOPERS:

Associate Professor of Organic Chemistry Department		**N. E. Golantsov**
Position, Department	Signature	name and surname

HEAD OF EDUCATIONAL DEPARTMENT:

Organic Chemistry Department		**L. G. Voskressensky**
Name of Department	Signature	name and surname

HEAD OF HIGHER EDUCATION PROGRAMME:

Dean of Science faculty, Head of the Department of Organic Chemistry		**L. G. Voskressensky**
Position, Department	Signature	name and surname