Federal State Autonomous Educational Institution of 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

Domino-reactions in the synthesis of heterocycles

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

2023

1. COURSE GOAL(s)

The goal of the course of «Domino reactions in the synthesis of heterocycles» 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 LEARNING OUTCOMES

Mastering the couse "Domino reactions in the synthesis of heterocycles" is aimed at developing the following competencies (competencies 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)
M-PC-1-s	The ability to plan work and choose adequate methods for solving research problems in the chosen field of chemistry, chemical technology or sciences related to chemistry	M-PC-1-s-1. Draws up a general research plan and detailed plans for individual stages.
		M-PC-1-s-2. Selects experimental and computational-theoretical methods for solving the problem based on the available material and time resources
M-PC-2-s	Ability to conduct patent information research in the chosen field of chemistry and/or related sciences	M-PC-2-s-1. Searches for specialized information in patent information databases.
		M-PC-2-s-2. Analyzes and summarizes the results of a patent search on the subject of the project in the selected field of chemistry (chemical technology).

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***
M-PC-1-s	The ability to plan work and choose adequate methods for solving research problems in the chosen field of chemistry, chemical technology or sciences related to	Methods of Organic Chemistry Theoretical organic chemistry The method of working with databases Fundamentals of biotechnology Research work	Chemistry of natural compounds Chemistry of heterocyclic compounds Mass spectrometry of organic compounds Stereochemistry Fundamentals of drug design Research work

Competence code	Competence descriptor	Previous courses/modules*	Subsequent courses/modules*
	chemistry	Experimental methods in chemistry	Undergraduate practice
M-PC-2-s	Ability to conduct patent information research in the chosen field of chemistry and/or related sciences	Methods of Organic Chemistry Theoretical organic chemistry The method of working with databases Fundamentals of biotechnology Research work Experimental methods in chemistry	Chemistry of natural compounds Chemistry of heterocyclic compounds Mass spectrometry of organic compounds Stereochemistry Fundamentals of drug design Research work 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 4 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	Semesters			
			1	2	3	4
Contact academic hours		72		72		
including:						
Lectures (**LC**)		36		36		
Lab Works (**LW**)		36		36		
Seminars (workshops/tutorials) (S)						
Self-studies		*54*		*54*		
Evaluation and assessment (exam/passing/failing grade)		*18*		*18*		
Course workload	academic hours_	**144**		**144**		
	credits	**4**		**4**		

5. COURSE CONTENTS

Table 5.1. Course contents and academic activities types

Course module title	Course module contents (topics)	Academic activities types
Section 1. Introduction. Classification of domino reactions	Theme 1.1. The concept of domino reactions. Terminological contradictions – “cascade”, “tandem” and domino processes.	LC
	Theme 1.2. Anionic, cationic, radical, pericyclic domino processes - the principle of referring to	LC, LW

Course module title	Course module contents (topics)	Academic activities types
	one or another type.	
Section 2. Anionic domino reactions	Theme 2.1. General description Anion-anion processes, anion-radical reactions. Anionic-pericyclic domino reactions.	LC
	Theme 2.2. Anionic reactions and transition metal catalysis.	LC, LW
Section 3. Cationic domino reactions	Theme 3.1. General characteristics. Cation - cationic processes.	LC
	Theme 3.2. Cationic-pericyclic reactions. Cationic-reductive domino reactions	LC, LW
Section 4. Radical domino reactions	Theme 4.1. General description	LC
	Theme 4.2. Radical-radical domino processes. Radical pericyclic reactions.	LC, LW
Section 5. Multicomponent domino reactions	Theme 5.1. General description. Strecker, Biginelli, Hanch, Ugi, Passerini reactions. Examples of reactions and analysis of mechanisms.	LC, LW
Section 6. Domino reactions based on Knoevenagel condensation	Theme 6.1. General example of a reaction. Study of the mechanism and analysis of typical cases of application.	LC
	Theme 6.2. Various combinations of this reaction with others in the synthesis of more complex structures.	LC, LW
Section 7. Knoevenagel Condensation - Cycloaddition	Theme 7.1. Examples of the combination of the Knoevenagel condensation and various types of cycloadditions ([1+4], [2+3], [2+4]) in the synthesis of five-membered and six-membered heterocyclic compounds.	LC, LW
Section 8. Knoevenagel Condensation - Cycloaddition	Theme 8.1. Examples of the combination of Knoevenagel condensation and Michael addition in the synthesis of five-membered and six-membered heterocyclic compounds.	LC, LW

* - 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.	
Lab work	A classroom for laboratory work, individual	rotary evaporator, heating

Type of academic activities	Classroom equipment	Specialised educational / laboratory equipment, software, and materials for course study (if necessary)
	consultations, current and mid-term assessment; equipped with a set of specialised furniture and machinery.	mantle, magnetic stirrer without heating, magnetic stirrer with heating, electronic weighers, vacuum pump
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. L. Titze, G. Brashe, K. Guericke Domino-reactions in organic synthesis. Moscow, Binom, 2010.

Additional readings:

1. J. Joule, M. Mills Chemistry of heterocyclic compounds, Moscow, Mir, 2004

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 *:*

Course of lectures on the discipline "Domino reactions in the synthesis of heterocycles".

2. Guidelines for laboratory works "Preparative 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.

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

The assessment toolkit and the grading system* to evaluate the competences formation level (competences in part) upon the course study completion 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).

DEVELOPERS:

Head of the Department of Organic Chemistry		**L. G. Voskressensky**
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**
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