Federal State Autonomous Educational Institution of Higher Education
PEOPLES' FRIENDSHIP UNIVERSITY OF RUSSIA named after Patrice Lumumba
RUDN University

Faculty of Science

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

INTERNSHIP SYLLABUS

Student Scientific-Research work

internship title

Work practice

internship type

Recommended by the Didactic Council for the Education Field of:

04.04.01 «Chemistry»

field of studies / speciality code and title

The student's internship is implemented within the professional education programme of higher education:

«Bioenergies and Biorefineries»

higher education programme profile/specialisation title

2024

1. INTERNSHIP GOALS

The goals of the work practice (the scientific-research work) are:
- consolidation and deepening of theoretical knowledge obtained during study;
- acquisition of practical skills and abilities, general and professional competencies, experience of independent performance of the professional activity;
- mastering the techniques, methods and ways of processing, presenting and interpreting the results of the research;
- collection of primary information for the performance of qualifying work;
- formation of students' ability to work independently and as part of a team, readiness for cooperation, decision-making, the ability for professional and social adaptation.

2. REQUIREMENTS FOR LEARNING OUTCOMES

The Student Scientific-Research work is designed for students to acquire following competences (competences in part):

Table 2.1. List of competences that students acquire during the internship

Competence code	**Competence descriptor**	**Competence formation indicators** (within this course)
GC-1	Ability to carry out critical analysis of problem tasks applying a systematic approach, to develop an action strategy	GC-1.1. Ability to analyze the problem task as a system, identifying its components and relationships between them.
		GC-1.2. Ability to identify lack in information needed to solve a problem task and to design processes to address them.
		GC-1.3. Ability to critically evaluate the reliability of information sources, to work with conflicting information from different sources.
		GC-1.4. Ability to develop and substantively argue a strategy for solving a problem situation based on a systematic and interdisciplinary approach.
GC-2	Ability to manage a project at all stages of its life cycle.	GC-2.1. Ability to formulate, on the basis of the posed problem, a project task and a way to solve it through the implementation of project management.
		GC-2.2.Ability to develop the project concept within the framework of the indicated problem: to formulate the goal, objectives, to justify the relevance, significance, expected results and possible areas of their application.
		GC-2.3. Ability to plan the necessary resources, including taking into account their replaceability.
		GC-2.4. Ability to develop a project implementation plan using planning tools.
		GC-2.5. Ability to monitor the progress of the project, to correct deviations, to make additional changes to the project implementation plan, to clarify the areas of responsibility of the project participants.
GC-3	Ability to organize and manage the work of the	GC-3.4. Ability to organize discussions on a given topic and discussion of the results of the team's work with the

Competence code	Competence descriptor	Competence formation indicators (within this course)
	team, developing a team strategy to achieve the goal.	involvement of opponents of the developed ideas.
GC-4	Ability to apply modern communication technologies, including foreign language(s), for academic and professional interaction.	GC-4.1. Ability to establish and develop professional contacts in accordance with the needs of joint activities, including the exchange of information and the development of a common strategy for interaction.
		GC-4.2. Ability to compile, translate and edit various academic texts (abstracts, essays, reviews, articles, etc.).
		GC-4.3. Ability to present the results of academic and professional activities at various social events, including collections, choosing the most appropriate format.
		GC-4.4. Ability to argue and constructively defend the positions and ideas in academic and professional discussions in the state language of the Russian Federation and a foreign language.
GC-6	Ability to identify and implement the priorities of their own activities and self-development based on self-assessment.	GC-6.1. Ability to evaluate the resources and their limits (personal, situational, temporary), optimally uses them for the successful completion of the assigned task.
GC-7	Ability to look for the necessary sources of information and data, perceive, analyse, memorize and transmit information using digital means, as well as using algorithms when working with data obtained from various sources in order to effectively use the information received to solve problems; evaluate information, its reliability, build logical conclusions based on incoming information and data.	GC-7.1. Ability to use digital technologies and methods of searching, processing, analysing, storing and presenting information in the field of chemistry.
		GC-7.2.Ability to develop the conception of digital technologies and methods of searching, processing, analysing, storing and presenting information within the framework of the designated problem: to be able to formulate the purpose, objectives, justify the relevance, significance, expected results and possible areas of their application in the digital economy and modern corporate information culture.
		GC-7.3. Ability to monitor the use of digital technologies and methods of search, processing, analysis, storage and presentation of information in the field of chemistry, corrects deviations, makes additional changes to the plan for the use of digital technologies.
GPC-1	Ability to carry out complex experimental and computational-theoretical studies in the chosen field of chemistry or related sciences using modern equipment, software and databases for professional purposes.	GPC-1.1. Ability to use existing and develop new methods for obtaining and characterizing substances and materials for solving problems in the chosen field of chemistry or related sciences.
		GPC-1.2. Ability to use modern equipment, software and professional databases for solving problems in the chosen field of chemistry or related sciences.
		GPC-1.3. Ability to use modern computational and theoretical methods of chemistry to solve professional problems.

Competence code	Competence descriptor	Competence formation indicators (within this course)
GPC-2	Ability to analyze, interpret and generalize the results of experimental and computational-theoretical work in the chosen field of chemistry or related sciences.	GPC-2.1. Ability to carry out a critical analysis of the results of own experimental and computational-theoretical works and to interpret them correctly.
		GPC-2.2. Ability to formulate summary and conclusions based on the results of the analysis of literature data, own experimental and computational-theoretical works in the chosen field of chemistry or related sciences.
GPC-3	Ability to use computational methods and adapt existing software products to solve problems of professional activity.	GPC-3.1. Ability to use modern IT-technologies in the collection, analysis, and presentation of chemical profile information.
		GPC-3.2. Ability to use standard and original software products, if necessary, adapting them, to solve the problems of professional activity.
		GPC-3.3. Ability to use modern computational methods for processing chemical experiment data, modelling the properties of substances (materials) and processes with their participation.
GPC-4	Ability to prepare publications, participate in professional discussions, present the results of professional activities in the form of scientific and popular science reports.	GPC-4.1. Ability to present the results of the research in the form of scientific publications (abstract, paper, review) in Russian and in English.
		GPC-4.2. Ability to present the results of the work orally in Russian and English.
PC-1	Ability to develop a work plan and to choose adequate methods for solving research problems in the chosen field of chemistry, chemical technology or sciences related to chemistry.	PC-1.1. Ability to prepare a general plan of research and detailed plans for individual stages.
		PC-1.2. Ability to select experimental and computational-theoretical methods for solving the problem based on the available material and time resources.
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. INTERNSHIP IN HIGHER EDUCATION PROGRAMME STRUCTURE

The scientific research internship refers to the **core** component of (B2) 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 scientific research internship.

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

Competence code	**Competence descriptor**	**Previous courses/modules, internships***	**Subsequent courses/modules, internships***
GC-1	Ability to carry out critical analysis of problem tasks applying a systematic approach, to develop an action strategy.	Actual problems of modern chemistry	Pre-graduation practical training
GC-2	Ability to manage a project at all stages of its life cycle.	Bioenergy	Pre-graduation practical training
GC-3	Ability to organize and manage the work of the team, developing a team strategy to achieve the goal.	Foreign/Russian language in professional activity Experimental lab 1: Flow synthesis and alternative technologies Experimental lab 2: Biorefineries and Bioproducts	Pre-graduation practical training
GC-4	Ability to apply modern communication technologies, including foreign language(s), for academic and professional interaction.	Foreign/Russian language in professional activity	Pre-graduation practical training
GC-6	Ability to identify and implement the priorities of their own activities and self-development based on self-assessment.	Actual problems of modern chemistry	Pre-graduation practical training
GC-7	Ability to look for the necessary sources of information and data, perceive, analyse, memorize and transmit information using digital means, as well as using algorithms when working with data obtained from various sources in order to effectively use the information	The method of working with databases Artificial intelligence and additive technologies in chemistry	Pre-graduation practical training

Competence code	Competence descriptor	Previous courses/modules, internships*	Subsequent courses/modules, internships*
	received to solve problems; evaluate information, its reliability, build logical conclusions based on incoming information and data.		
GPC-1	Ability to carry out complex experimental and computational-theoretical studies in the chosen field of chemistry or related sciences using modern equipment, software and databases for professional purposes.	Actual problems of modern chemistry Bioenergy Advanced Organic Synthesis Alternative/new tools for organic synthesis Catalyst (nanomaterials) design and applications Catalysis: from Basic principles to applications. Homogeneous, Heterogeneous, Photocatalysis, Biocatalysis, Electrocatalysis Experimental lab 1: Flow synthesis and alternative technologies Experimental lab 2: Biorefineries and Bioproducts Experimental lab 3: Advanced Organic Synthesis	Pre-graduation practical training
GPC-2	Ability to analyze, interpret and generalize the results of experimental and computational-theoretical work in the chosen field of chemistry or related sciences.	Actual problems of modern chemistry Bioenergy Modern organic synthesis and pharmacology Alternative/new tools for organic synthesis Bioproducts, Biomaterials and Biorefineries Advanced Organic Synthesis Catalyst (nanomaterials) design and applications Catalysis: from Basic principles to applications. Homogeneous, Heterogeneous, Photocatalysis, Biocatalysis,	Pre-graduation practical training

Competence code	Competence descriptor	Previous courses/modules, internships*	Subsequent courses/modules, internships*
		Electrocatalysis Experimental lab 1: Flow synthesis and alternative technologies Experimental lab 2: Biorefineries and Bioproducts Experimental lab 3: Advanced Organic Synthesis	
GPC-3	Ability to use computational methods and adapt existing software products to solve problems of professional activity.	Bioenergy Bioproducts, Biomaterials and Biorefineries Catalyst (nanomaterials) design and applications Experimental lab 3: Advanced Organic Synthesis Student Scientific-Research work	Pre-graduation practical training
GPC-4	Ability to prepare publications, participate in professional discussions, present the results of professional activities in the form of scientific and popular science reports.	Actual problems of modern chemistry Foreign/Russian language in professional activity	Pre-graduation practical training
PC-1	Ability to develop a work plan and to choose adequate methods for solving research problems in the chosen field of chemistry, chemical technology or sciences related to chemistry.	Modern organic synthesis and pharmacology Alternative/new tools for organic synthesis Advanced Organic Synthesis Catalyst (nanomaterials) design and applications Experimental lab 1: Flow synthesis and alternative technologies Experimental lab 2: Biorefineries and Bioproducts Experimental lab 3: Advanced Organic Synthesis Emerging contaminants: from fate to environmental remediation The method of working with	Pre-graduation practical training

Competence code	Competence descriptor	Previous courses/modules, internships*	Subsequent courses/modules, internships*
		databases	
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.	Bioproducts, Biomaterials and Biorefineries Catalyst (nanomaterials) design and applications Experimental lab 1: Flow synthesis and alternative technologies Experimental lab 3: Advanced Organic Synthesis Artificial intelligence and additive technologies in chemistry	Pre-graduation practical training

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

4. INTERNSHIP WORKLOAD

The total workload of the Scientific Research Internship is 30 credits (1080 academic hours).

5. INTERNSHIP CONTENTS

*Table 5.1. Internship contents**

Modules	Contents (topics, types of practical activities)	Workload, academic hours
Module 1. Preparatory	Acquaintance with the goals and objectives of the Student Scientific-Research work.	36
	Preparing a plan for the implementation of Student Scientific-Research work.	
Module 2. Scientific Research	Fulfillment of an individual task, collection, processing and systematization of statistical and analytical material. Safety briefing.	684
	Determination of the object and subject of research. Justification of the relevance of the chosen topic.	
	Conducting research as part of an individual assignment.	
Module 3. Analytical	Fulfillment of an individual task, collection, processing and systematization of statistical and analytical material for a report on the internship.	342
	Analysis of the received information.	
	Preparation of a report on the completion of the Student Scientific-Research work.	
Module 4. Reporting	Writing an internship report.	18
	Preparing for defence and defending the internship report.	
	TOTAL:	**1080**

* The contents of internship through modules and types of practical activities shall be FULLY reflected in the student's internship report.

6. INTERNSHIP EQUIPMENT AND TECHNOLOGY SUPPORT REQUIREMENTS

RUDN University and partner universities have a material and technical base that complies with the current fire rules and regulations and provides practical and research work for students. There are scientific laboratories for research, classrooms for group and individual consultations, rooms for independent work of students, equipped with computers with the ability to connect to the Internet and provide access to the RUDN University electronic information and educational environment. Scientific laboratories and classrooms are equipped with specialized furniture and teaching aids. Each student is provided with individual unlimited access to the electronic library systems “Yurayt”, “LAN”, etc., access to the electronic information and educational environment of RUDN University. Licensed or freely distributed software is used.

7. INTERNSHIP LOCATION AND TIMELINE

The Student Scientific-Research work can be carried out both at the structural divisions of RUDN University or in organizations in Moscow (stationary), and at bases located outside Moscow (visiting).

The internship at an external organisation (outside RUDN University) is legally arranged on the grounds of an appropriate agreement, which specifies the terms, place and conditions for an internship implementation at the organisation.

The period of the internship corresponds to the period indicated in the training calendar of the higher education programme. However, the period of the internship can be rescheduled upon the agreement with the Department of Educational Policy and the Department for the Organization of Internship and Employment of RUDN students.

8. RESOURCES RECOMMENDED FOR INTERNSHIP

Main readings to prepare for the degree thesis defence:

1. Smith, M. B. (2020). March's advanced organic chemistry: reactions, mechanisms, and structure. John Wiley & Sons.
2. Jha, A. K. (2023). Solid-State Chemistry: A Modern Approach. CRC Press.
3. Uskoković, V. (2010). Major Challenges for the Modern Chemistry in Particular and Science in General. Foundations of Science, 15(4), 303–344. doi:10.1007/s10699-010-9185-8
4. Tietze, L. F. (1996). Domino reactions in organic synthesis. Chemical reviews, 96(1), 115-136.
5. John A. Joule, Keith Mills (2010) Heterocyclic Chemistry, 5th Edition, Wiley-Blackwell

Additional readings:

1. Rothenberg, G. (2017). Catalysis: concepts and green applications. John Wiley & Sons.

2. Julian R.H. Ross, Contemporary Catalysis, Fundamentals and Current Applications, Elsevier, 2019
3. Kosak, J.R., & Johnson, T.A. (Eds.). (1993). Catalysis of Organic Reactions (1st ed.). CRC Press.
4. Vladislav Sadykov, Advanced Nanomaterials for Catalysis and Energy Synthesis, Characterization and Applications, Elsevier, 2018
5. Zhou, Bing, Sophie Hermans, and Gabor A. Somorjai, eds. Nanotechnology in Catalysis Volumes 1 and 2. Vol. 2. Springer Science & Business Media, 2003.
6. Glasnov, Toma. Continuous-flow chemistry in the research laboratory. Cham: Springer, 2016.
7. Butt, John. Activation, deactivation, and poisoning of catalysts. Elsevier, 2012.

Internet sources:

1. Electronic libraries with access for RUDN students:
- 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"
- Federal Portal "Russian Education" http://www.edu.ru
- University Information System RUSSIA https://uisrussia.msu.ru/

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/
- www.reaxys.com
- Library of the Faculty of Chemistry, Moscow State University: http://www.chem.msu.su/rus/library/welcome.html
- Journals of the American Chemical Society: www.pubs.acs.org
- Journals of the Royal Society of Chemistry http://pubs.rsc.org/en/journals/

The training toolkit and guidelines for a student to do an internship, keep an internship diary and write an internship report:*

1. Safety regulations during the passage of The Scientific-Research work (initial briefing).
2. The general design and principles of operation of technological production equipment used by students during their internship; process flow charts, regulations, etc. (if necessary).
3. Guidelines for keeping an internship diary and writing an internship report.
4. Requirements for the report format.

*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.

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

The assessment toolkit and the grading system* to evaluate the level of competences (competences in part) formation as The Scientific-Research work results are specified in the Appendix to the internship 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 Organic Chemistry Department **Voskressensky L.G.**

position, educational department	signature	name and surname.

HEAD OF EDUCATIONAL DEPARTMENT:
Organic Chemistry Department **Voskressensky L.G.**

educational department	signature	name and surname.

HEAD OF HIGHER EDUCATION PROGRAMME:
Dean of Faculty of Science

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

position, educational department	signature	name and surname