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

Faculty of Science

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

COURSE SYLLABUS

Experimental lab 2: Biorefineries and Bioproducts

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:

«Bioenergies and Biorefineries»

higher education programme profile/specialisation title

2024

1. COURSE GOAL

The goal of the course “Experimental lab 2: Biorefineries and Bioproducts” is to familiarize students with a number of experimental practices on bioproducts from biomass/waste.

2. REQUIREMENTS FOR LEARNING OUTCOMES

Mastering the course “Experimental lab 2: Biorefineries and Bioproducts” is aimed at the development of the following competences:

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

Competence code	Competence descriptor	Competence formation indicators (within this course)
GP-3	Ability to organize and manage the work of the team, developing a team strategy to achieve the goal	GC-3.3. Ability to resolve conflicts and contradictions in business communication taking into account the interests of all parties;
		GC-3.4. Ability to organize discussions on a given topic and discussion of the results of the team's work with the involvement of opponents of the developed ideas;
		GC-3.5. Ability to plan teamwork, distribute assignments and delegate authority to team members
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-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
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 calculation-theoretical methods for solving the problems based on the available material and time resources

3. COURSE IN HIGHER EDUCATION PROGRAMME STRUCTURE

The course “Experimental lab 2: Biorefineries and Bioproducts” refers to the **variable** 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*
GP-3	Ability to organize and manage the work of the team, developing a team strategy to achieve the goal	Foreign Language in Professional Activities Russian Language in Professional Activities Experimental lab 1: Flow synthesis and alternative technologies	Student Scientific-Research work Pre-graduation practical training
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 Alternative/new tools for organic synthesis Advanced 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	Student Scientific-Research work 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	Student Scientific-Research work Pre-graduation practical training

Competence code	Competence descriptor	Previous courses/modules*	Subsequent courses/modules*
		Catalyst (nanomaterials) design and applications Catalysis: from Basic principles to applications. Homogeneous, Heterogeneous, Photocatalysis, Biocatalysis, Electrocatalysis Experimental lab 1: Flow synthesis and alternative technologies	
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	Student Scientific-Research work Pre-graduation practical training

* 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 “Experimental lab 2: Biorefineries and Bioproducts” is 4 credits (144 academic hours).

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	Training modules			
			1	2	3	4
<i>Contact academic hours</i>		24				24
including:						
Lectures (LC)		16				16
Lab work (LW)		8				8
Seminars (workshops/tutorials) (S)						
<i>Self-studies</i>		102				102
<i>Evaluation and assessment (exam/passing/failing grade)</i>		18				18
Course workload	academic hours	144				144
	credits	4				4

5. COURSE MODULES AND CONTENTS

Table 5.1. Course contents and academic activities types

Course module title	Course module contents (topics)	Academic activities types
Module 1. Synthesis of biodiesel	Topic 1.1 Synthesis of biodiesel. Explanation. Lab applied work	LC, LW
Module 2. Extraction of biochemicals from biomass/waste	Topic 2.1 Extraction of biochemicals from biomass/waste. Explanation. Lab applied work	LC, LW
Module 3. Synthesis of soap via saponification reaction	Topic 3.1 Synthesis of soap via saponification reaction. Explanation. Lab applied work	LC, LW
Module 4. Preparation of mesoporous carbonaceous materials from starch	Topic 4.1 Preparation of mesoporous starch from plain starch. Explanation. Lab applied work	LC, LW
	Topic 4.2. Preparation of mesoporous carbonaceous materials from mesoporous starch. Explanation. Lab applied work	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 a set of devices for multimedia presentations.	Projector, motorized screen for projectors, wi-fi
Lab work	A classroom for laboratory work, individual consultations, current and mid-term assessment; equipped with a set of specialised furniture and machinery.	A set of specialized furniture; specialized equipment of the chemical laboratory: fume hood SHVP-4, rotary evaporator Hei-value digital G3B, rotary evaporator IKA, digital devices for determining the melting point SMP10; electronic laboratory scales AND EK-610, MK-M flask heaters of different volumes, drying cabinet, magnetic stirrer MRHei-Mix S, magnetic

Type of academic activities	Classroom equipment	Specialised educational / laboratory equipment, software, and materials for course study (if necessary)
		stirrer with heating MRHei-Standart, refractometer, combined laboratory water bath, vacuum chemical station RS3001 VARIO-pro, circulation cooler Rotacool Mini, rotary plate pump vacuum RZ2.5, membrane vacuum chemical pump MZ2CNT, Steinel thermal air blower, Spectroline UV lamp, electronic vacuum controller with CVC3000 detect Vacuumbrand valve, stainless steel emergency cabin SHVV, chemical dishes, refrigerator; wi-fi
Self-studies	A classroom for self-studies (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.	Faculty of Science Reading Room Ordzhonikidze D.3. Coworking area Monday - Friday 10.00 – 22.00 Reading room of the main building of the RUDN Coworking area Monday - Saturday 9.00 - 23.00 Hall No. 2 Monday - Thursday 10.00 - 17.45 Friday 10.00 - 16.45 Hall No. 6 Monday - Thursday 10.00 - 17.45 Friday 10.00 - 16.45

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

7. RECOMMENDED RESOURCES FOR COURSE STUDY

Main sources:

1. Biorefineries-Industrial Processes and Products: Status Quo and Future Directions, Editor(s) B. Kamm, P.R. Gruber, M. Kamm, 2006, Wiley-VCH, DOI:10.1002/9783527619849
2. Refining Biomass Residues for Sustainable Energy and Bioproducts

Technology, Advances, Life Cycle Assessment, and Economics, 1st Edition - November 1, 2019, Eds R.P. Kumar, E. Gnansounou, J. K. Raman, G. Baskar, ISBN: 9780128189962

3. Bioprocessing of Renewable Resources to Commodity Bioproducts, Eds. V. S. Bisaria, A. Kondo, 2014, Wiley-VCH, ISBN:9781118175835 DOI:10.1002/9781118845394

Additional sources:

1. Website of the American Chemical Society ACS Publications: Chemistry journals, books, and references <https://pubs.acs.org/>
2. <http://www.thieme.com/journals-main>
3. <http://onlinelibrary.wiley.com/>
4. <http://www.springer.com/gp/products/journals>
5. Server with the ability to search for methods for synthesizing compounds <http://www.orgsyn.org/>

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"

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.scholar.google.ru

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

1. A set of lectures on "Experimental lab 2: Biorefineries and Bioproducts"
2. The laboratory workshop on "Experimental lab 2: Biorefineries and Bioproducts"

* 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).

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