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

Chemistry of natural compounds

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 «Chemistry of natural compounds» is in:

- familiarization with the properties, structure and synthesis of molecules of organic compounds found in wildlife;
- study of the relationship of structural formulas with their biological functions;
- getting an idea about the most important classes of natural compounds that play a significant role in the life of plants and animals;
- disclosure of the fundamental mechanisms of action, biosynthesis and industrial synthesis of vitamins and hormones on the human body;
- study at the molecular level of the transmission of hereditary information (amino acids, proteins, nucleic acids);
- discussion of the most important processes occurring in plants: photosynthesis, the formation of terpenoids and alkaloids.

2. REQUIREMENTS FOR LEARNING OUTCOMES

Mastering the discipline "Chemistry of natural compounds" is aimed at developing 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)
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-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 chemistry	Methods of Organic Chemistry Theoretical organic chemistry The method of working with databases Fundamentals of biotechnology Molecular spectral analysis Domino reactions in the synthesis of heterocycles Research work Experimental methods in the 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 Molecular spectral analysis Domino reactions in the synthesis of heterocycles NMR of organic compounds Experimental methods in the chemistry 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 3 credits

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

Types of academic activities		Total, ac.h.	Semester(-s)			
			1	2	3	4
Contact academic hours		*36*			*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**	

Types of academic activities		Total, ac.h.	Semester(-s)			
			1	2	3	4
	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. Introduction.	Theme 1.1. Organic compounds of human and animal organisms - proteins, nucleic acids, lipids; plants - carbohydrates, alkaloids. Biosphere and its development. Theoretical and practical significance of studying the chemistry of natural compounds.	LC
Section 2. Proteins.	Theme 2.1. Protein content in the body and their functions. Variety of natural proteins. The beginning of protein chemistry. Qualitative reactions of proteins. The primary structure of proteins. Secondary structure of proteins. Tertiary structure of a proteins. Polypeptide synthesis.	LC
Section 3. Nucleic acids.	Theme 3.1. Deoxyribose nucleic acid is the human genome. The structure of the macromolecule, DNA, gene and other parts. DNA is the primary template for the synthesis of proteins in each individual. Cell plasma is matrix ribose nucleic acid, mRNA. Protein synthesis. One gene, one protein. Discovery of DNA (I. Miter). The structure of a section of DNA - a gene. Nucleotides, nucleosides, D - 2 - deoxyribose furanose, D - ribose furanose, purine and pyrimidine bases. Primary structure of NC. Nucleotide sequence. A triplet of nucleotides is the code of a - amino acids. Secondary structure of DNA. Double helix of nucleotide chains with antiparallel orientation.	LC
Section 4. Enzymes (enzymes).	Theme 4.1. Enzymes are biocatalysts. Biochemical enzymatic processes - baking, alcoholic fermentation (yeast). Simple enzymes. Complex proteins. Anoenzyme and coenzyme. Enzymatic reactions. Nicotinamidin dinucleotide NAD.	LC
Section 5. Lipids (fats).	Theme 5.1. Lipids are the building material of cell membranes and various body tissues; a source of energy that ensures the vital activity, growth and development of the body. Neutral (simple) triglycerides. Isomerism of triglycerides according to the position of acyl radicals. Targeted synthesis of triglycerides.	LC
Section 6. Vitamines	Theme 6.1. The biological role of vitamins.	LC

	Avitaminosis and hypervitaminosis. Classification of vitamins. fat soluble vitamins. Structure and chemical synthesis. Vitamins A, D, K, E. Water-soluble vitamins. Structure, biological role and synthesis. Vitamins C, group of vitamins B, vitamin PP. Mechanisms of the biological action of vitamins.	
Section 7. Terpenes and terpenoids.	Theme 7.1. Classification, finding in nature, methods of isolation from natural sources. Synthesis and application.	LC
Section 8. Hormones.	Theme 8.1. Hormones, physiologically active substances - regulators of biochemical metabolic processes in the body. Hormones of a number of biogenic a-amino acids. Thyroxin. Synthesis of thyroxine. Thyroxine analogues: thyroidin, diiodothyrosine, betazine. Synthesis of these hormones. Hormones of a number of amino alcohols: Adrenaline, Serotonin, Histamine (synthesis, biosynthesis, functions). Nonapeptides, vasopressin and oxytocin. The difference is in the structure of the peptide chain and in the physiological action. Samotropin. Insulin (Structure. Biotechnological production of insulin). Steroid hormones. Pregnane derivative - cortisone. Industrial production of cortisone from sapogenin. Sex hormones. Androstan derivatives, male sex hormones: testosterone, androsterone, dehydroandrosterone. Estrane derivatives, female sex hormones: estrone, estradiol, estrol. Cholesterol is the basis for the synthesis of steroid hormones in the body. Industrial methods for obtaining steroid hormones.	LC
Section 9. Alkaloids.	Theme 9.1. Alkaloids are organic compounds found in various parts of a plant. Piperidine (coniine, arecoline, lobeline and its analogues), Pyridine (nicotine, anabasine), Tropanic (tropine, atropine, scopolamine, cocaine, cynamylcocaine), imidazole alkaloid pilocarpine, Quinoline alkaloids. Industrial method for the synthesis of papaverine. Purine alkaloids are tea alkaloids. Industrial method for the synthesis of theophylline Caffeine is a psychotropic agent, a tonic. Quinolizidine alkaloids: lupinine, pachycarpine, cytisine. Condensed systems with a fragment of quinolizidine. Pyrrolysine alkaloids, esters of the dihydric alcohol of platinecin - platifillin and sarracin. Polycyclic condensed alkaloids: berberine, emytine, ezerine, reserpine, morphine. Morphine derivatives: codeine and heroin. Morphine is an	LC

	effective pain reliever (analgesic). Morphine and heroin are strong drugs. Acyclic alkaloids (phenethylamine): tyramine, mexalin, ephedrine. Industrial synthesis of ephedrine. The steroidal alkaloids salosidin and salonidin.	
Section 10. Photosynthesis.	Theme 10.1. The essence and significance of photosynthesis for the development of the Earth. History of the doctrine of photosynthesis. The scale of photosynthetic activity in the biosphere. Basic and additional photosynthetic pigments: chlorophylls, carotenoids, phycobilins. Chloroplasts and their role in photosynthesis. The structure of chloroplasts. Chlorophyll a and chlorophyll b. The porphine structure is the basis of the molecular structure of the chloroplast.	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. BIOCHEMISTRY 2nd ed., corrected. and additional Textbook and workshop for open source software. Scientific school: Moscow State Technical University named after N.E. Bauman (Moscow). Ershov Yu. A., Zaitseva N. I.; Ed. Schukina S.I. https://www.biblio-online.ru/book/biohimiya-442538
2. BIOCHEMISTRY FOR TECHNOLOGIES IN 2 H. PART 2 2nd ed. Textbook and workshop for secondary vocational education 1 Scientific school: Vologda State Dairy Academy named after NV Vereshchagin (Vologda). https://www.biblio-online.ru/book/biohimiya-dlya-tehnologov-v-2-ch-chast-2-442534
3. BIOLOGICAL CHEMISTRY 2nd ed., Per. and additional Textbook for bachelor's, specialist's and master's programs 2. Scientific school: Crimean Federal University

named after V.I. Vernadsky (Simferopol). Dryuk V. G., Sklyar S. I., Kartsev V. G. https://www.biblio-online.ru/book/biologicheskaya-himiya-442129

Additional readings:

1. Chemistry of natural compounds (carbohydrates, nucleides, steroids, proteins). Kochetkov N.K., Torgov I.V., Botvinik M.M. 1961. (http://biblioclub.ru/index.php?page=book_view_red&book_id=430998)
2. Fundamentals of the chemistry of natural compounds (volumes 1 and 2). Semyonov A.A., Kartsev V.G., Moscow, 2009
3. Soldatenkov A.T., Kolyadina N.M., Shendrik. I.V. - Fundamentals of organic chemistry of medicinal substances - Chemistry, Moscow, 2003.
4. V.V. Plemenkov, Introduction to the chemistry of natural compounds. Kazan, 2001
5. Chemistry of biologically active compounds (Theory and Practice): textbook 2018 Bolotov V. M. Komarova E. V. Savvin P. N. Publisher: Voronezh State University of Engineering Technologies 85 pp. ISBN: 978-5-00032-306- 9 BBK: G2 i7 UDC: 577.15/.17 (http://biblioclub.ru/index.php?page=book_red&id=487998)

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/

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

1. Course of lectures on the discipline "Chemistry of Natural Compounds".
2. Guidelines for the study of the special course "Chemistry of natural compounds" Chapters 1-4. Lipids, hormones, plant protection chemicals. RUDN University, Moscow, 1987.
3. Guidelines for the study of the special course "Chemistry of natural compounds" Chapters 5-8. Protein substances, nucleic acids, photosynthesis, organic drugs. RUDN University, Moscow, 1987.
4. Varlamov A.V., Borisova T.N., Sorokina E.A., Voskresensky L.G., Nikitina E.V. Fundamentals of organic chemistry. - M .: RUDN University, 2007. - 356.

* 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:

Associate Professor of the Department of Organic Chemistry		**E.V. Nikitina**
Position, Department	Signature	name and surname

HEAD OF EDUCATIONAL DEPARTMENT:

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