Federal State Autonomous Educational Institution of Higher Education
PEOPLES' FRIENDSHIP UNIVERSITY OF RUSSIA
NAMED AFTER PATRICE LUMUMBA
RUDN University
Institute of Medicine

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

COURSE SYLLABUS

CHEMISTRY

course title

Recommended by the Didactic Council for the Education Field:

31.05.03 Dentistry

field of studies / speciality code and title

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

Dentistry

higher education programme profile/specialisation title

2026 г.

1. COURSE GOAL(s)

The COURSE "Chemistry" is included in the program of the specialty "Dentistry" in the direction of 31.05.03 "Dentistry" and is studied in the 1st semester of the 1st year. The discipline is implemented by the Department of Organic Chemistry. The discipline consists of 6 sections and 13 topics and is aimed at studying the chemical behavior of the main classes of organic compounds.

The goal of the course “Chemistry” is to form of systemic knowledge about the patterns of chemical behavior of the main classes of organic compounds necessary in the study of processes occurring in a living organism at the molecular level, and the main materials used in dental practice.

2. REQUIREMENTS FOR LEARNING OUTCOMES

Mastering the discipline "Chemistry" is aimed at developing the following competencies (parts of competencies) among students:

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

Competence code	**Competence descriptor**	**Competence formation indicators** (within this course)
GC-6	Ability to identify and implement the priorities of their own activities and ways to improve them based on self-assessment and lifelong learning	GC-6.1. Ability to evaluate and control their resources and their limits (personal, situational, temporary), uses them optimally for the successful completion of the assigned task
GPC-3	Ability to counter doping in sports and fight against it	GPC-3.2 To be able to understand the effect of the main types of doping on a person's physical qualities and their side effects.

3. COURSE IN HIGHER EDUCATION PROGRAMME STRUCTURE

The course refers to the core/variable/elective* component of (B1) block of the highere ducational programme curriculum.

* - Underline whatever applicable.

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, internships***	**Subsequent courses/modules, internships***
GC-6	Ability to identify and implement the priorities of their own activities and ways to improve		Psychology; Pedagogy;

Competence code	Competence descriptor	Previous courses/modules, internships*	Subsequent courses/modules, internships*
	them based on self-assessment and lifelong learning		
GPC-3	Ability to counter doping in sports and fight against it		Physical Culture; Applied physical education;

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

4. COURSE WORKLOAD AND ACADEMIC ACTIVITIES

The total workload of the course "Chemistry" is 3 credits (108 academic hours).

*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 1
Contact work ac.h.		*51*	*51*
Lectures (**LC**)		17	17
Lab Works (**LW**)		34	34
Seminars (**S**)			
Self-studies		*30*	*30*
Evaluation and assessment (exam/passing/failing grade)		*27*	*27*
Total labor intensity	**ac.h.**	**108**	**108**
	ac.h.	**3**	**3**

* To be filled in regarding the higher education programme correspondence training mode.

5. COURSE CONTENTS

Table 5.1. Course contents and academic activities types

Course module title	Course module contents (topics)	Academic activities types
Module 1. Introduction Hydrocarbons.	Topic 1.1. Goals for studying chemistry. Demonstration of the interdisciplinary nature of the discipline under study, formed on the scientific basis of organic chemistry and biology. Acquaintance with the basics of the structure and reactivity of organic compounds: the structure of the carbon atom, hybridization of orbitals, the concept of a covalent chemical bond, the properties of a chemical bond, the mutual influence of atoms in a molecule. Acquaintance with the classification and nomenclature of organic substances. Formation of skills in applying the rules of nomenclature.	LC

	Topic 1.2. Familiarization with the reactivity of hydrocarbons - alkanes, alkenes, alkynes, dienes and arenes. Radical substitution reactions in alkanes. Electrophilic addition reactions in alkenes,	LC, LW
Course module title	**Course module contents (topics)**	**Academic activities types**
	alkynes and dienes. Oxidation reactions. Acidity of terminal alkynes. polymerization reactions. Electrophilic substitution reactions in arenes. Reactivity of substituted benzenes. Formation of practical skills for detecting multiple bonds in the analyzed object. Practical demonstration of the chemical stability of alkanes and arenes.	
Module 2. Functional organic compounds	Topic 2.1. Familiarization with the chemical properties of alcohols (monatomic and polyatomic), phenols and thiols. The effect of hydrogen bonding on the physical properties of substances. Demonstration of acidic, nucleophilic properties of these classes of compounds (obtaining alcoholates, phenolates, thiolates, esters and ethers, sulfides, thioethers, sulfonium salts). Reactions of electrophilic aromatic substitution of phenols. The biological role of sulfonium salts and thioethers. The use of alcohols to obtain halogen derivatives, alkenes. Oxidation of alcohols and thiols, with emphasis on the biological significance of such processes. Formation of practical skills for detecting alcohols and phenols by chemical methods, obtaining esters, practical demonstration of the acidic properties of alcohols and phenols, demonstration of the dependence of the solubility of alcohols on the structure.	LC, LW
	Topic 2.2. Familiarization with reactivity of aliphatic and aromatic amines, aminoalcohols and their biological significance, aminophenols. Demonstration of basic and nucleophilic properties of amines – formation of ammonium salts, quaternary ammonium salts, amides. Practical and biological significance of reactions amines with nitrous acid, carcinogenicity of nitrosoamines	LC, LW
	Topic 2.3. Familiarization with reactivity of aldehydes and ketones. Nucleophilic addition, reaction with nitrogen nucleophiles, oxidation, reduction (including enzymatic), reaction via α-position Formation of practical skills for the detection of aldehydes and ketones by chemical methods.	LC, LW

	Topic 2.4. Familiarization with reactivity of carboxylic acids. Preparation of carboxylic acid derivatives and study of their properties. Biological role of carboxylic acid derivatives on the example of lipids. Biologically important dicarboxylic acids: oxalic, malonic, succinic, glutaric and adipic acids, their behavior under the heating. Practical study of structures of fats and oils via hydrolysis and the use	LC, LW
Course module title	**Course module contents (topics)**	**Academic activities types**
	of previously acquired skills for identification of hydrolysis products. Formation of practical skills for the detection of oxalic acid in the form of calcium oxalates. Lipids - classification, structure, biological role. Practical study of the structure of fats and oils by hydrolysis and the application of previously acquired skills to identify hydrolysis products. Application of previously acquired practical skills to prove the non-limiting nature of biologically significant fatty acids. The study of the solubility of fats and oils.	
	Topic 2.5. Familiarization with the chemical properties of hydroxy acids. The structure and chemical transformations of hydroxy acids, participants in metabolism - lactic, malic, citric acids. Demonstration of the basic concepts of stereochemistry – asymmetric (chiral) carbon atom, configuration, chirality, chiral center, enantiomers, optical activity, specific rotation, racemate. Formation of practical skills in depicting the structural formulas of chiral molecules on a plane using Fisher projection formulas and stereochemical wedge-shaped projections, as well as establishing the absolute and relative configuration in R-S and D-L systems. Biological activity of salicylic acid and its derivatives. Formation of practical skills for the detection of lactic acid by a chemical method. Application of previously acquired skills to study the structure and properties of salicylic acid, as well as its derivatives. Practical study of the chemical properties of tartaric acid and the establishment of the structure of citric acid.	LC, LW
	Topic 2.6. Familiarization with the chemical properties of aldehyde and keto acids. The structure and properties of keto acids, participants in metabolism - pyruvic, α-ketoglutaric, oxaloacetic acid. The formation of keto acids in the body from amino acids (cleavage-dehydration, oxidative deamination) and hydroxy acids.	LC

Module 3. Bio-polymers (proteins and carbohydrates) and their components.	Topic 3.1. Familiarization with the structure and chemical properties of proteinogenic amino acids. Optical isomerism of amino acids. Biologically important reactions: deamination, decarboxylation, (formation of colamine, histamine, tryptamine). Peptides and proteins. Hydrolysis of peptides. Chemical synthesis of dipeptides. The concept of complex proteins: glycoproteins, lipoproteins, nucleoproteins, phosphoproteins. A practical	LC, LW
Course module title	**Course module contents (topics)**	**Academic activities types**
	demonstration of the amphoteric character of amino acids. Formation of practical skills for the detection of amino acids and proteins by chemical methods.	
	Topic 3.2. Familiarization with the structure and chemical properties of monosaccharides (glucose, mannose, galactose, fructose, ribose, 2-deoxyribose). Oxidation and reduction reactions, formation of glycosides. Types of glycosides, biological role. Acylation and alkylation reactions. The practical significance of obtaining ozones. Formation of a practical skill in depicting the structural formulas of carbohydrates using Fisher's projection formulas and Haworth's perspective formulas. Stereochemistry of carbohydrates, concept of mutarotation. Establishment of spatial relationships between different types of stereoisomers of monosaccharides - demonstration of the concepts of enantiomer, diastereomer, epimer, anomer. Familiarization with the chemical properties and structure of disaccharides on the example of maltose, lactose, cellobiose and sucrose. Dependence of the properties of disaccharides on the type of bond between monosaccharide residues. Hydrolysis of disaccharides. Acquaintance with the chemical properties and structure of polysaccharides on the example of starch and cellulose. The biological significance of carbohydrates. Formation of practical skills in the detection of reducing sugars, starch. Acquaintance with the structure and biological functions of heteropolysaccharides: chondroitin sulfate, heparin, hyaluronic acid.	LC, LW

Module 4. Biologically important heterocycles	Topic 4.1. Familiarization with the main classes of biologically significant heterocyclic compounds: five-membered heterocycles with one (pyrrole, thiophene, furan) and two heteroatoms (imidazole, pyrazole); six-membered heterocycles with one and two heteroatoms (pyridine, pyrimidine); fused heterocycles (indole, purine). Reactivity of pyrrole, furan, thiophene. Reactions of electrophilic substitution. The structure of porphin and heme. Basic and nucleophilic properties of pyridine. Electrophilic substitution reactions in pyridine. Pyridine derivatives - nicotinic acid and its amide (vitamin PP). Isonicotinic acid, pyridoxal. Tautomerism of imidazole. Keto-enol and lactim-lactam tautomerism on the example of uracil, thymine, cytosine, guanine, uric acid. Practical	LC, LW
Course module title	**Course module contents (topics)**	**Academic activities types**
	demonstration of the chemical properties of pyridine and uric acid. Practical study of the solubility of uric acid salts.	
Module 5. Nucleic acids. Nucleotide coenzymes.	Topic 5.1 Familiarization with the structure of nucleic acid monomers. Nucleosides, hydrolysis. Nucleotides, hydrolysis. RNA and DNA. The primary structure of nucleic acids. Hydrolysis. Nucleotide coenzymes AMP, ADP, ATP, NAD+, NADP, NADH+ S-adenosylmethionine, acetyl-coenzyme, FAD, $FADH_2$, their transformations in the body - phosphorylation, oxidation, reduction, methylation, acylation.	LC
Module 6. Physico-chemistry of macromolecular compounds.	Topic 6.1 Polymers. The concept of medical polymers. Classification of polymers. Types of polymerization reactions. Polymers in medicine and dentistry. Polymers based on acrylic acid. Modern composite materials. Components of adhesive pastes. Other classes of dental materials: GIC, compomers, hyomers, ormokers.	LC

* - filled in only for full-time education: LC - lectures; LW - laboratory work; SZ - seminars.

6. CLASSROOM EQUIPMENT AND TECHNOLOGY SUPPORT REQUIREMENTS

Table 6.1. Classroom Equipment and Technology Support Requirements

Classroom for Academic Activity Type	**Audience equipment**	**Specialized educational / laboratory equipment, software and materials for mastering the discipline** (if necessary)

Lecture	An room for lecture-type classes, equipped with a set of specialized furniture; board (screen) and technical means of multimedia presentations.	
Lab-work	Educational chemical laboratory for group laboratory-type classes, individual consultations, monitoring, intermediate certification, independent work	a set of specialized furniture; specialized equipment of the chemical laboratory: ventilation hood cabinet SHVP-4 (4 pcs.), 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 mantles of different sizes, drying cabinet PE-4610, magnetic stirrer MRHei-Mix S, magnetic stirrer with heating MRHei-Standart, refractometer, combined laboratory bath BKL, vacuum chemical station PC3001 VARIO-pro , circulating cooler Rotacool Mini, rotary vane vacuum pump RZ2.5, chemical membrane vacuum pump MZ2CNT, Steinel thermal blower, Spectroline EB-280C UV lamp, electronic vacuum controller with CVC3000 detect Vacuumbrand valve, chemical ware, refrigerator; there is wi-fi

Self-studies	An room for independent work of students (can be used for seminars and consultations), equipped with a set of specialized furniture and computers with access to the EIOS.	**Reading Room of Faculty of Science** 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 audience for independent work of students is indicated **MANDATORY**!

7. RECOMMENDED SOURCES FOR COURSE STUDY

Main readings:

1. Zurabyan S.E.
Fundamentals of bioorganic: textbook for medical students / S.E. Zurabyan. -. - Moscow : GEOTAR-Media, 2019. - 304 p. : ill.. - ISBN 978-5-9704-4990-5. http://lib.rudn.ru/MegaPro/UserEntry?Action=Rudn_FindDoc&id=464603&idb=0

2. Tyukavkin, N. A. Organic chemistry : textbook / Tyukavkin N. A. - Москва : ГЭОТАР-Медиа, 2022. - 592 с. - ISBN 978-5-9704-6595-0. https://lib.rudn.ru:443/MegaPro/UserEntry?Action=Link_FindDoc&id=508876&idb=0

3. L. G. Voskressenky, A. V. Listratova, A. V. Varlamov. “Bioorganic Chemistry for Medicine Students. Lectures”, Moscow, Peoples’ Friendship University of Russia, 2015

Additional readings:

1. Reinhard Bruckner “Advanced Organic Chemistry” Academic Press.

2. Francis A. Carey, Richard J. Sundberg “Advanced Organic Chemistry” Springer, 2008

3. Organic Chemistry with a Biological Emphasis, Volume I, Timothy Soderberg https://digitalcommons.morris.umn.edu/chem_facpubs/1/
4. Organic Chemistry with a Biological Emphasis, Volume II, Timothy Soderberg
5. https://digitalcommons.morris.umn.edu/chem_facpubs/2/

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:
- 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/

*Learning toolkits for self-studies in the RUDN LMS TUIS *:*

1. The set of lectures on the course « Chemistry».
2. Guidelines for laboratory works on the discipline « Chemistry»

* - all educational and methodological materials for independent work of students are placed in accordance with the current procedure on the page of the discipline in TUIS!

DEVELOPERS:

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