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 of biogenic elements

course title

Recommended by the Didactic Council for the Education Field of:

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

1. COURSE GOAL(s)

The course " Chemistry of biogenic elements" is included in the program of the specialty "Dentistry" in the direction 05.31.03 "Dentistry" and is studied in 1 semester 1 the course. The discipline is implemented by the Department of General and Inorganic Chemistry. The discipline consists of 5 sections and 8 topics and is aimed at studying the formation of systemic knowledge about the role of inorganic cations in biological processes for using this knowledge as a basis for studying processes occurring in a living organism and the basic materials used in dental practice. The purpose of mastering the discipline is to study the properties of inorganic substances by students; the properties of solutions, various types of equilibria of chemical reactions and vital processes; the mechanisms of action of the body's buffer systems, their interrelation and role in maintaining acid-base homeostasis; - the study by students of the patterns of physico-chemical processes in living systems from the point of view of their competition, emerging as a result of the combination of different types of equilibria; the role of biogenic elements and their compounds in living systems; physico-chemical foundations of surface phenomena and factors affecting free surface energy; features of adsorption at various boundaries of phase sections; - formation of students' skills in studying scientific chemical literature; formation of students' skills for solving problematic and situational tasks; formation of students' practical skills in setting up and performing experimental work.

2. REQUIREMENTS FOR LEARNING OUTCOMES

Mastering the course (module) “Chemistry of biogenic elements” is aimed at the development of the following competences /competences in part: GC-1, PC-1, PC-3

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

Competence code	**Competence descriptor**	**Competence formation indicators** (within this course)
GC-1	He is able to carry out a critical analysis of problematic situations based on a systematic approach, to develop a strategy of action	GC-1.1 Analyzes a problematic situation as a system, identifying its components and the connections between them
PC-1	Capable of conducting an examination of the patient in order to establish a diagnosis	PC-1.1 Conducts an initial and/or repeated examination. the patient in order to establish a preliminary diagnosis;
PC-3	Capable of developing, implementing, and monitoring the effectiveness of individual rehabilitation programs	PC -3.2 Draws up an individual rehabilitation plan for a patient with diseases of the maxillofacial region

3.COURSE IN HIGHER EDUCATION PROGRAMME STRUCTURE

The discipline "Chemistry of biogenic elements " refers to the part formed by the participants of educational relations in block 1 "Disciplines (modules)" of the educational program of higher education.

As part of the educational program of higher education, students also master other disciplines and/or practices that contribute to achieving the planned results of mastering the discipline " Chemistry of biogenic elements".

Table 3.1. The list of components of higher education program that contribute to achieving the planned results of mastering the discipline

Competence code	Competence descriptor	Previous courses/modules*	Subsequent courses/modules*
GC -1	He is able to carry out a critical analysis of problematic situations based on a systematic approach, to develop a strategy of action		Dental Assistant (Therapist); Dental Assistant (Orthopedic surgeon); Human anatomy; Gnathology and functional diagnostics of the temporal mandibular joint; Pediatric Dentistry; Pediatric Maxillofacial surgery; Dental prosthetics (simple prosthetics); Immunology, clinical immunology; Medical genetics in dentistry; Orthodontics and children 's prosthetics; Otorhinolaryngology; Dental prosthetics (complex prosthetics); Prosthetics with complete absence of teeth; Psychology, pedagogy; Philosophy; Maxillofacial prosthetics; Midwifery; Pathophysiology - Pathophysiology of the head and necks; Medical rehabilitation; Evidence-based medicine; History of medicine; Socially significant projects in medicine;
PC -1	Capable of conducting an examination of the patient in order to establish a diagnosis		Dental Assistant (Therapist); Dental Assistant (Surgeon); Dental Assistant (for children); Dental Assistant (Orthopedic surgeon); Dental Assistant (Hygienist); Gnathology and functional

			diagnostics of the temporal mandibular joint; Pediatric Dentistry; Pediatric Maxillofacial surgery; Head and neck diseases; Dental prosthetics (simple prosthetics); Immunology, clinical immunology; Implantology and reconstructive surgery of the oral cavity; Cariesology and diseases of hard tissues of teeth; Medical genetics in dentistry; Local anesthesia and anesthesiology in dentistry; Orthodontics and children 's prosthetics; Otorhinolaryngology; Propaedeutics dental diseases; Dental prosthetics (complex prosthetics); Prosthetics with complete absence of teeth; Oral surgery; Maxillofacial and gnatic surgery; Maxillofacial prosthetics; Midwifery; Fundamentals of military training. Life safety; Gerontostomatology and diseases of the oral mucosa; Periodontology; Endodontics; Modern endodontics**; Aesthetic dental restoration**; Medical rehabilitation;

			Three-dimensional X-ray diagnostic methods in dentistry**; Three-dimensional-computer modeling of teeth**; Ophthalmology; Cone beam computed tomography in the diagnosis, planning and evaluation of the effectiveness of dental solutions; Oncostomatology and radiation therapy; Pathophysiology - Pathophysiology of the head and necks; Pathological Anatomy - Head and neck pathology; Radiation diagnostics
PC-3	Capable of developing, implementing, and monitoring the effectiveness of individual rehabilitation programs		Head and neck diseases; Implantology and reconstructive surgery of the oral cavity; Local anesthesia and anesthesiology in dentistry; Oral surgery; Maxillofacial and gnatic surgery; Disaster Medicine; Medical rehabilitation;

*- filled in in accordance with the matrix of competencies and SUPERPOSITION
** - elective disciplines /practices

4. COURSE WORKLOAD AND ACADEMIC ACTIVITIES

The total workload of the course "Chemistry of biogenic elements " is "2" credits (72 academic hours).

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

Type of academic activities		Semesters/training modules

		Total academic hours	1	
Classes (total) ac.h.		34	34	
Including:				
Lectures (LC)		-	-	-
Lab work (LW)		34	34	
Seminars (workshops/tutorials) (S)		-	-	-
Self-studies		20	20	
Evaluation and assessment (exam/passing/failing grade)		18	18	
Total course workload	academic hours	72	72	
	credits	**2**	**2**	

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

5. COURSE CONTENTS

Table 5.1. Content of the discipline (module) by type of academic work

Section number Name of the discipline section	**Content of the section (topic) Topic content**	**Type of academic work***
Section 1 The forms of metal cations in living systems. Coordination compounds.	1.1 General concepts of the chemistry of biogenic elements. The role of inorganic elements (metal cations) in the processes of vital activity. Classification of biogenic elements. The role of individual groups of elements(s, p, d- elements)	LW
	1.2 Complex compounds. Composition, electronic structure, and nomenclature. Chemical reactions involving complex compounds. Examples of vital complex compounds: hemoglobin, chlorophyll, and metalloenzymes Study of the formation of complex compounds involving biogenic elements, their properties, and structure.	LW
Section 2 Ways to maintain pH in living systems. Buffer solutions.	2.1 The concept of pH. pH changes in neutral, acidic, and alkaline solutions. Basic definitions: solution, solvent, and solute. Dissociation of weak and strong electrolytes. Ion	LW

	strength of a solution. Ion product of water. pH value. Electrolytes in the human body.	
	2.2 Buffer solutions. The mechanism of action and pH of buffer solutions of various compositions. Buffer capacity. Buffer solutions in living systems. Classification of buffer solutions. Mechanism of their action. Buffer capacity. Buffer systems in the human body. Buffer systems in chemical practice, their biological significance	LW
Section 3 Forms of transportation and storage of metal cations in living systems. Colloidal solutions.	3.1 Soluble and insoluble forms, including biometals. Stabilization of soluble forms due to micelle formation. The concept of colloidal solutions. Composition and the structure of the micelle. Methods of preparation and physico-chemical characteristics of colloidal solutions Structure and classification of dispersed systems. Methods of their preparation, properties, and purification of colloidal systems. Dialysis. Micella. Structure and properties. Stability of colloidal solutions. Coagulation and sedimentation	LW
Section 4 Redox reactions.	4.1 Concepts of oxidation and reduction. Typical oxidizing and reducing agents. Changes in the oxidation states of typical oxidizing and reducing agents. The method of ion-electron balance of redox reactions. Redox reactions in living systems. Metals and alloys in dentistry. Solid solutions. Chemical properties of metals. Fundamentals of electrochemistry. Galvanic cell. Chemical and electrochemical corrosion. Electrolysis. Corrosion resistance of dental materials in the oral cavity	LW
Section 5 Methods of qualitative and quantitative analysis in bioorganic chemistry.	5.1 The concept of qualitative analysis. Group and specific reactions of cations and anions Qualitative reactions of biogenic elements. Classification of cations	LW
	5.2 Quantitative titrimetric analysis and its application in bioorganic chemistry Quantitative determination of the test sample	LW

* - to be completed only for FULL–time studies: LC – lectures; LW – laboratory work; S - practical/seminar classes

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	An auditorium for conducting lecture-type classes, equipped with a set of specialized furniture; a blackboard (screen) and multimedia presentation equipment.	Multimedia systems.
Lab-work	An auditorium for conducting laboratory work, individual consultations, current control and intermediate certification, equipped with a set of specialized furniture and equipment.	Educational chemical laboratories equipped with laboratory tables, chemical glassware, instruments and reagents, multimedia systems.
Self-studies	An auditorium for students to work independently (it can be used for seminars and consultations), equipped with a set of specialized furniture and computers with access to EIOS.	

7. RESOURCES RECOMMENDED FOR COURSE STUDY

Main readings:

- Slesarev V.I. Chemistry. The basics of living chemistry. St. Petersburg: Himizdat, 2007
- Glinka N.L. Tasks and exercises in general chemistry M .: Urait , 2013.
- Kovalchukova O.V., Avramenko O.V., Kolyadina N.M. Chemistry of biogenic elements. Laboratory work. M .: Publishing house of RUDN, 2017г.
- Kovalchukova O.V Lectures on general and bioorganic chemistry. Part 1. General chemistry. M .: Publishing house RUDN, 2011.
- Kovalchukova O.V, Avramenko O.V Lectures on general and bioorganic chemistry. Part 2. Bioorganic chemistry. M .: Publishing house of RUDN, 2010.
- Kovalchukova O.V., Avramenko O.V., Vu Thi Nkog An The theoretical foundations of the course "Chemistry". M .: Publishing house of RUDN,2018.

b) additional literature

- Khomchenko G.P., Tsitovich I.K. Inorganic chemistry. -M .: Higher School, 2017
- Tyukavkina N.A., Baukov Yu.I. Bioorganic chemistry. “Drofa”, Moscow, 2011.
- Grandberg II, Organic Chemistry. “Bustard”, Moscow, 2009.

. Databases and search engines::

- electronic fund of legal and regulatory and technical documentation
- http://docs.cntd.ru/
- Yandex search engine https://www.yandex.ru/
- search system Google https://www.google.ru/
- http://web-local.rudn.ru/web-local/prep/prep_1844/,

- http: biblioclub.ru
- www.studentlibrary.ru
- http://www.chemistry.ssu.samara.ru/
- http://www.chem.msu.su/rus/library/welcome.html
- www.xumuk.ru
- http://www.ch.ic.ac.uk/local/organic/
- http://ru.wikipedia.org
- *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/

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

1. The set of lectures on the course
2. The laboratory workshop on the course

* 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.

DEVELOPERS:

Senior lecturer of the General and Inorganic Chemistry Department		**Polyakova E. I.**
position, department	signature	name and surname

HEAD OF EDUCATIONAL DEPARTMENT:

The Department of General Chemistry		**Khrustalev V. N.**
name of department	signature	name and surname

HEAD

OF HIGHER EDUCATION PROGRAMME:

First Deputy Director of Medical Institute		**S.N. Razumova**
position, department	signature	name and surname