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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 of:

31.05.03 Dentistry
(code and direction of training/specialty)

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

Dentistry
higher education programme profile/specialisation title

2023-2024

1. COURSE GOAL(s)

The goal of the course "Chemistry" is to equip students with the knowledge of systematic knowledge about the structure of a substance, the main laws governing chemical reactions, patterns in the chemical behavior of the main classes of inorganic and organic compounds in conjunction with their structure for using this knowledge as a basis for studying processes occurring in a living organism, and basic materials used in dental practice.

2. REQUIREMENTS FOR LEARNING OUTCOMES

Mastering the course (module) "Chemistry" is aimed at the development of the following competences /competences in part: GC-6, GPC-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-6	Able to determine and implement the priorities of their own activities and ways to improve it on the basis of self-assessment and lifelong education.	GC -6.1. Evaluates own resources and their limits (personal, situational, temporary), uses them optimally for the successful completion of the task.
GPC-3	Capable of counteracting the use of doping in sports and the fight against it.	GPC-3.2. Understands the effect of the main types of doping on the physical qualities of a person, their side effects.

3. COURSE IN HIGHER EDUCATION PROGRAMME STRUCTURE

The course refers to the core/variable/elective* component of (B1) block of the higher educational 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***	**Subsequent courses/modules***
GC-6	Able to determine and implement the priorities of their own activities and ways to improve it on the basis of self-assessment and lifelong education.	Chemistry of Biogenic Elements	Biological Chemistry - Oral Biochemistry Pharmacology
GPC-3	Capable of counteracting the use of doping in sports and the fight against it.	Chemistry of Biogenic Elements	Pharmacology

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**)**

Type of academic activities		Total academic hours	Semesters/training modules			
			1	2	3	4
Contact academic hours				*54*		
including:						
Lectures (LC)				18		
Lab work (LW)				36		
Seminars (workshops/tutorials) (S)						
Self-studies				*54*		
Evaluation and assessment (exam/passing/failing grade)						
Course workload	academic hours_	**108**		**108**		
	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
Classes of inorganic compounds	Main classes of inorganic compounds. Double oxides. Ceramic materials.	LW
Basic concepts of thermodynamics. First and second laws of thermodynamics.	Subject and methods of chemical thermodynamics. The relationship between the processes of metabolism and energy in the body. Chemical bioenergetics. Basic concepts of thermodynamics. Intensive and extensive parameters. State function. Internal energy. Work and heat are two forms of energy transfer. Types of thermodynamic systems (isolated, open, closed). Types of thermodynamic processes (isothermal, isobaric). Standard state. First law of thermodynamics. Enthalpy. Standard enthalpies of formation and combustion of a substance. Standard enthalpy of reactions. Hess' law. Application of the first law of thermodynamic to biosystems. The second law of thermodynamics. Reversible and irreversible processes. Entropy. Gibbs energy. Forecasting the direction of spontaneous processes in isolated and closed systems; the role of enthalpy and entropy factors. Thermodynamic equilibrium conditions. Standard Gibbs energies of formation and biological oxidation of matter. Standard Gibbs energy of the reaction. Examples of exergonic	L, LW

	and endergonic processes occurring in the body. The principle of energy conjugation.	
Basic concepts of chemical kinetics. Classification of reactions in kinetics.	Chemical balance. Reversible and irreversible reactions. Thermodynamic equilibrium conditions in isolated and closed systems. Chemical equilibrium constant. The equation of the isotherm and isobar of a chemical reaction. Subject and basic concepts of chemical kinetics. Chemical kinetics as a basis for studying the rates and mechanisms of biochemical processes. Average speed and true speed. Classification of reactions in kinetics: homogeneous, heterogeneous, simple and complex reactions. Molecularity of the elementary act of the reaction. Kinetic equations. Reaction order. half-life. Dependence of reaction rate on concentration. Kinetic equations of zero, first, second order reactions. Experimental methods for determining the rate and rate constant of reactions. The dependence of the reaction rate on temperature. The temperature coefficient of the reaction rate and its features for biochemical processes. The concept of the theory of active collisions. Activation energy. Arrhenius equation; the role of the steric factor. The concept of the theory of the transition state. Catalysis. Homogeneous and heterogeneous catalysis. Energy profile of the catalytic reaction. Features of the catalytic activity of enzymes. Michaelis-Menten equation and its analysis.	L, LW
Concentrations and colligative properties of solutions.	Classification of solutions. Methods for expressing the concentrations of solutions. Volumetric analysis. Titration. Raoult's law, cryoscopy, ebullioscopy, Van't Hoff's law, isotonic, hyper-, hypotonic solutions.	LW
Ionic equilibrium in electrolyte solutions.	Proton theory of Lewis acids and bases. Acidity, basicity constants, the relationship between the acidity and basicity constant in a conjugated protolytic pair, the general constant of the combined protolytic equilibrium. Protolytic processes occurring in the oral cavity, their effect on hard dental tissues. Ionic product of water, pH of solutions; hydrolysis of salts, degree and constant of hydrolysis. Hydrolysis of food products in the oral cavity and its effect on hard dental tissues. buffer solutions. hydrolysis of starch. Ampholytes. Acidity of gastric juice. The role of pH in body fluids. Solubility constant. General constant of combined heterogeneous equilibrium. Conditions for the formation and dissolution of precipitates. The phenomenon of isomorphism.	L, LW

Reactions of complexing	Werner's coordination theory. The nature of the chemical bond in complex compounds. Classification of complex compounds. Nomenclature of complex compounds. Polydentate ligands. Chelation. The structure of hemoglobin, chlorophyll. Stability of complex compounds in solutions. Complex instability constant. Toxic effect of salts of heavy metals. Antidotes.	LW
Disperse systems	Classification of dispersed systems. Classification of dispersed systems according to the degree of dispersion; according to the state of aggregation; according to the strength of intermolecular interaction between the dispersed phase and the dispersion medium. The nature of the colloidal state. Obtaining and properties of dispersed systems. Obtaining suspensions, emulsions, colloidal solutions. Dialysis, electrodialysis, ultrafiltration. Molecular-kinetic properties of colloidal dispersed systems: Brownian motion, diffusion, osmotic pressure, sedimentation equilibrium. Optical properties: light scattering (Rayleigh's Law). Electrokinetic properties: electrophoresis and electroosmosis; flow potential and sedimentation potential. The structure of the electrical double layer. Electrokinetic potential and its dependence on various factors. Stability of dispersed systems. Sedimentation, aggregation and condensation stability of lyosols. Factors affecting the stability of lyosols. Coagulation. Coagulation threshold and its definition, Schulze-Hardy rule, habituation phenomenon. mutual coagulation. The concept of modern theories of coagulation. Colloidal protection and peptization. Colloidal surfactants; biologically important colloidal surfactants (soaps, detergents, bile acids). Micellization in surfactant solutions. Determination of the critical micelle concentration. Liposomes.	L, LW
Electrochemical processes and redox reactions.	The theory of redox processes. The concept of redox systems. Standard redox potentials. The occurrence of EMF in the oral cavity during metal prosthetics. The appearance of a double electric layer at the metal-electrolyte interface. Electrode potential, methods of its measurement. Electrochemical series of voltages of metals. The principle of operation of galvanic cells. Dental materials. Their classification, brief description, application in dentistry. Basic (structural) dental materials: metals and alloys, polymers, ceramics. Corrosion of metals, its types. Electrochemical corrosion: conditions of occurrence; factors contributing to its flow in the oral cavity during metal	L, LW

	prosthetics.	
Classification of organic reactions. Conjugated and aromatic compounds.	Classification of organic reactions according to the number of initial and final substances, according to the nature of the reagents. Conjugated connections: types of conjugation, examples of open and closed conjugated systems. Aromaticity of compounds.	L, LW
Mutual influence of functional groups in molecules of biologically active polyheterofunctional and high molecular weight organic compounds.	Mutual influence of atoms in a molecule. Electronic effects: inductive and mesomeric. Electrodonor and electroacceptor substituents, their influence on the reactivity of compounds.	L, LW
Biologically active macromolecular substances (structure, properties, participation in the functioning of living systems).	Polymers. The concept of medical polymers. Properties of IUD solutions. Features of the dissolution of IUDs as a consequence of their structure. The shape of macromolecules. The mechanism of swelling and dissolution of the IUD. Dependence of the swelling value on various factors. Anomalous viscosity of HMS solutions. Staudinger equation. Viscosity of blood and other biological fluids. Osmotic pressure of biopolymer solutions. Polyelectrolytes. Isoelectric point and methods for its determination. Donnan membrane equilibrium. Oncotic pressure of plasma and blood serum. Stability of biopolymer solutions. Salting out biopolymers from solution. Coacervation and its role in biological factors. Gelation of IUD solutions. Jelly properties: syneresis and thixotropy.	L

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)
Lab work	Classroom for lab works, equipped with a set of specialized furniture	A set of specialized furniture, reagent kits, stands, chemical glassware (test tubes, cups, flasks, pipettes, burettes), D.I. Mendeleev's table, activity series of metals, solubility table, marker board, markers, sponge, fume hood, centrifuge,

Type of academic activities	Classroom equipment	Specialised educational / laboratory equipment, software, and materials for course study (if necessary)
		photocolorimeters, potentiometers, analytical balances, multimedia systems.
Self-studies	Classroom for seminar-type classes, self-studies, group and individual consultations, current control and intermediate certification, equipped with a set of specialized furniture and multimedia equipment	A set of devices includes portable multimedia projector, laptop, projection screen, stable wireless

7. RESOURCES RECOMMENDED FOR COURSE STUDY

Main readings:

- Harper`s Illustrated Biochemistry: textbook / Rodwell V. W., Bender D. A., Botham K. M., Kennelly P. J., Weil P. A. - United States: McGraw Hill Education, 2015 - 817 p. - 30-th Edition.
- Brown T, LeMay H., Bursten B. et al. Chemistry: The Central Science. 14th Edition. -Pearson, 2017 – 1248 p.
- Sharma R.K. Textbook of Coordination Chemistry.-New Delhi: Discovery Publishing House, 2007 – 285p.
- Charles E Carraher Jr. Introduction to Polimer Chemistry. 4th Edition - CRC Press, 2017 – 588 p.
- 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.
- Langdon J. Physical Chemistry: Theories, Models and Applications. - NY RESEARCH PRESS, 2018 – 246 p.

Additional readings:

- Geoffrey A. Lawrance. Introduction to Coordination. A Wiley Series of Advanced Texbooks.- NSW, Australia, 2010 -304 p.
- David R. Klein. Organic Chemistry. 1sh Edition. Wiley, 2011 – 1392 p.
- Kovalchukova O.V., Avramenko O.V., Vu Thi Nkog An The theoretical foundations of the course "Chemistry". M .: Publishing house of RUDN,2018.
- Nivaldo Tro. Chemistry: A Molecular Approach. 5th Edition. – Pearson, 2019 – 1320 p.

c) List of educational and electronic materials:

- Lectures on general chemistry for the specialty “Dentistry”.
- Lectures on organic chemistry for the specialty “Dentistry”.

Internet-(based) sources:

1. Electronic libraries with access for RUDN students:
- Electronic libraries of RUDN http://lib.rudn.ru/MegaPro/Web
- ELS «University Library Online» http://www.biblioclub.ru
- ELS Юрайт http://www.biblio-online.ru
- ELS «Student Advisor» www.studentlibrary.ru
- ЭБС «Lan’» http://e.lanbook.com/

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

1. The set of lectures on the course “Chemistry”
2. The laboratory workshop (if any).on the course “Chemistry”
3. The guidelines for writing a course paper / project (if any) on the course “Chemistry”.
4. ……

* 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 (GC-6, GPC-3) 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:

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Assistant of the General
Chemistry Department — Polyanskaya N. A.

position, department	signature	name and surname

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HEAD OF EDUCATIONAL DEPARTMENT:
of General Chemistry — Davydov V.V.

name of department	signature	name and surname

HEAD
OF HIGHER EDUCATION PROGRAMME:
First Deputy Director of Medical
Institute — Razumova S.N.

position, department	signature	name and surname