

Federal State Autonomous Educational Institution of Higher Education

“Peoples' Friendship University of Russia”

Faculty of Physics, Mathematics and Natural Sciences

Recommended by MSSD

ACADEMIC COURSE WORKING PROGRAM

Course name

Chemistry

Recommended for the direction of training (specialty)

31.05.03 Dentistry

Program (profile, specialization)

Dentistry

1. Aims and objectives of discipline:

The purpose of studying the course of chemistry is to form system knowledge of 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. Place of discipline in the structure of OP VO:

Discipline **Chemistry** refers to **the basic** part of curriculum block 1

Table 1 shows the preceding and subsequent disciplines aimed at the formation of the competences of the discipline in accordance with the matrix competencies of the OP VO.

Table 1. Preceding and following the discipline aimed at creating competencies

No	Code and title of competence	Preceding disciplines	Following disciplines
Universal competences:			
1	UC-6. Able to determine and implement the priorities of his own activity and ways to improve it on the basis of self-esteem and education throughout his life.		Biological Chemistry
General professional competencies:			
2	GPC-3. Capable of resisting and combating doping in sports		Biological Chemistry

3. Requirements for the entrance knowledge, skills and competencies of the student necessary for its study: for the successful study of the discipline, the student must have a basic level of knowledge of secondary (complete) education in chemistry. General, inorganic and analytical chemistry lays the physicochemical basis for studying the functioning of biological systems at various levels of organization, determines the possibility of an approach to considering life support processes and regulation of homeostasis of living organisms at the molecular level.

Requirements for the results of mastering the discipline: The process of studying the discipline is aimed at the formation of the following competencies:

Table 2. Formed competencies

Competencies	Competency name	Competence achievement indicators
UC-6.	Able to determine and implement the priorities of his own activity and ways to improve it on the basis of self-esteem and education throughout his life.	UC-6.1. Assesses his resources and their limits (personal, situational, time), uses them optimally for the successful completion of the assigned task.
GPC-3.	Capable of resisting and combating doping in sports	GPC-3.2. To be able to analyze the biochemical, physicochemical and molecular biological mechanisms of the development of pathological processes in the cells of the tissues of the athlete's body, when taking prohibited drugs, defining the principles of the course of biochemical processes when taking prohibited drugs

As a result of studying the discipline, the student must:

Know:

1. main chemical concepts and laws of general chemistry
2. concepts about the structure of the atom and chemical bonds, the basis of classification, nomenclature, preparation and chemical properties of chemical elements and their inorganic and coordination compounds;
3. Principles of classification, nomenclature and isomerism of organic compounds;
4. the spatial and electronic structure of organic molecules and chemical transformations of substances, their connection with the biological function;
5. structure and chemical properties of the main classes of biologically important organic compounds.

Be handy at

1. Use the properties of chemicals in laboratory practice.
2. Predict the direction and result of chemical transformations of inorganic compounds.
3. Perform calculations related to the characterization of substances or solutions.
4. Classify organic compounds according to the structure of the carbon skeleton and the nature of the functional groups.
5. Allocate functional groups to determine the chemical behavior of organic compounds.
6. Make formulas by name and call them by structure formula typical representatives of biologically important substances of the products.
7. Predict the direction and result of chemical transformations of organic compounds.

Manage

1. Handling chemical dishes skills.
2. Safety skills in the chemical laboratory.
3. The ability to handle caustic, toxic, volatile compounds.
4. Skills of working with burners and electric heating devices, centrifuges, Photocolorimeters and other devices.

4. Volume of discipline and types of study
 General credit value of the discipline is **3 credit units**.

Type of study load	Total hours	Semesters	
		I	II
Class hours (total)	54	-	54
Include:	-	-	-
<i>Lectures</i>	18	-	18
<i>Practical training (PT)</i>			
<i>Seminars (S)</i>			
<i>Laboratory research (LR)</i>	36	-	36
Independent work (total)	54	-	54
Total labor input	hours 108	-	108
	Credit Unit 3	-	3

5. Content of the discipline

5.1. The content of the discipline sections

No.	The name of the section discipline	Content section
1	Substance structure	Wave corpuscle dualism of the material world. Wave function. Electronic configurations of atoms and ions. Periodic law D.I. Mendeleev. Chemical connection. The method of valence bonds. Hybridization of orbitals. Spatial configuration of molecules.
2	Thermodynamics and kinetics of chemical reactions	Basics of thermochemistry. Enthalpy. Hess law. Entropy. Gibbs free energy. The conditions of spontaneous reaction. The rate of chemical reaction. Reaction order Chemical equilibrium Speed constant and equilibrium constant. Displacement chemical equilibrium. The concepts of adsorption and catalysis.
3	Chemical reactions in solutions	General concepts of dispersed systems. Ways of expressing the concentration of solutions: mass fraction, titer, molar, normal concentration. Theory of electrolytic dissociation. The dependence of the acid-base properties of electrolytes on the nature of their dissociation. Amphoteric electrolytes (ampholytes). Ionic reactions. Conditions for the reactions of ion exchange.
4	Chemical equilibria in solutions	Weak electrolytes. The law of dilution. The effect of a common ion. Strong electrolytes. Activity and activity ratio. Ionic strength. Ionic product of water. Hydrogen indicator. Buffer solutions. Hydrolysis of salts. Constant hydrolysis.

		<p>Dependence of hydrolysis on temperature and concentration of solutions.</p> <p>Constant solubility. Solubility. Conditions of dissolution and sediment formation.</p> <p>Electrolytic dissociation and the constant instability of complex compounds.</p> <p>Colloidal solutions.</p>
5	Classes of inorganic compounds	The main classes of inorganic compounds. Double oxides. Ceramic materials..
6	General properties of metals	General properties of metals
7	Electrochemical processes	Electrochemical processes. The emergence of the electric double 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. Electrochemical corrosion.
8	Introduction to Organic Chemistry	<p>Organic chemistry as a field of science, studying the structure and mechanisms of functioning of biologically active molecules from the standpoint of organic chemistry. The main provisions of the theory of chemical structure. Isomerism Classes of organic compounds. Mechanisms of organic reactions. Saturated and unsaturated hydrocarbons: the main types of chemical reactions of alkanes and alkenes. Conjugated dienes. 1,2- and 1,4-Addition to conjugated diene. Polymerization of conjugated dienes.</p> <p>Aromatic compounds. Electrophilic substitution reactions in the aromatic nucleus.</p> <p>Alcohols (alcohols and alkanols). Atomicity of alcohols. Hydrogen bond Reactivity of alcohols.</p> <p>Phenol. Acidic properties of phenol.</p> <p>Aldehydes and ketones. Electronic structure of the carbonyl group. Oxo compound reactions at the carbonyl group and at the alpha position. Dialdehydes and diketones. Acetylacetone. Keto-enol tautomerism.</p> <p>Carboxylic acids. The structure of the carboxyl group. Carboxylic acid derivatives: salts, halides, anhydrides, amides, nitriles, esters. Methods of obtaining and properties. Natural higher fatty acids (HFA): palmitic, stearic, oleic, linoleic, linolenic, arachidonic.</p> <p>Lipids and phospholipids. Enzymatic hydrolysis of fats. Oxidation of acids in the body. Phosphoric acid fragments in nucleic acids and adenosine phosphates. Phosphatides. Lecithin and cephalin.</p> <p>Hydroxy Acids The structure and nomenclature of hydroxy acids. Lactic acid, formation during lactic fermentation and in muscles. The transformation of lactic acid into pyruvic acid during metabolism. Malic, tartaric and citric acids. Optical isomerism with examples of lactic and tartaric acids.</p> <p>Amines. The main properties of amines. Diamines Ethylenediamine, putrescine, cadaverine, hexamethylenediamine - their biological significance and use.</p> <p>Amino acids that make up proteins: classification, structure, nomenclature, stereoisomerism, acid-base properties (formation of a bipolar ion). Chemical properties of amino acids. Biologically important alpha-amino acid reactions: deamination (oxidative and</p>

		<p>non-oxidative), hydroxylation, decarboxylation of alpha-amino acids (formation of colamine, histamine, tryptamine). Peptides and proteins. The primary structure of proteins. Partial and complete hydrolysis. The concept of complex proteins. Glycoproteins, lipoproteins, nucleoproteins, phosphoproteins. Carbohydrates. Carbohydrates in nature. The value of carbohydrates. Photosynthesis. Monosaccharides. Cyclo-chain tautomerism. D- and L- series. Reactions of monoses by functional groups. Glucose, mannose, galactose, fructose, ribose and deoxyribose; being in nature and biological significance. Vitamin C. Reducing and non-reducing disaccharides: sucrose, maltose, cellobiose, lactose. Biologically important heterocyclic systems. Nucleic acids. Nucleic bases.</p>
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5.2. Sections of disciplines and types of classes

№	Section Name, disciplines and topics	lectures	<i>Practical training and Laboratory research</i>			Total hour.
			PC	LR	independent work	Total hour.
1.	Substance structure			2	4	6
2.	Thermodynamics and kinetics of chemical reactions	2		2	4	8
3.	Chemical reactions in solutions			6	4	10
4.	Chemical equilibria in solutions	4		8	4	16
5.	Classes of inorganic compounds	2		2	4	8
6.	General properties of metals	2		2	4	8
7.	Electrochemical processes	2		2	4	8
8.	Introduction to Organic Chemistry	6		12	26	44
Total:		18		36	54	108

6. Laboratory training (if available)

In a laboratory class, it is examined in detail, repeated, and a generalization of the main theoretical issues is carried out. Homework is checked. Tasks are solved that correspond to the content of the practical lesson. Laboratory work is carried out with a theoretical analysis of each experiment.

№	No. of section of discipline	Name of laboratory training	Labor capacity (hour.)
1.	Inorganic Chemistry	The main classes of inorganic compounds. General properties of metals.	4
2.	Physical chemistry	Chemical reaction rate. Chemical equilibrium.	2

3.	Analytical chemistry	Preparation of acid solution.	2
4.		Standardization of the acid solution (acid-base titration).	2
5.	General Chemistry	The structure of the atom. Chemical bond.	2
6.		Ionic equilibria in solutions.	2
7.		Heterogeneous equilibria in solutions.	2
8.		Electrochemical processes.	4
9.	Organic Chemistry	Isomerism of organic compounds.	4
10		Alkanes, alkenes.	2
11		Aromatic hydrocarbons.	2
12		Alcohols and phenols.	2
13		Aldehydes and ketones.	2
14		Carboxylic acids.	2
15		Amines and amino acids.	2

7. Practical training (*interactive*)

№	No. of section of discipline	Interactive training topic	Training type	Labor capacity (hour.)
1	1-8	Lectures by topic.	Heuristic conversation, Socratic dialogue.	4
2	1	The main classes of inorganic compounds.	Discussion	1
3	2	Lab. Work. Thermochemistry. Chemical equilibrium.	Discussion, work in small groups, work with visual aids.	2
4	3	Lab. Work. Solutions. Electrolytic dissociation.	Discussion, work in small groups, work with visual aids.	2
5	4	Lab. Work. Dissociation of weak and strong electrolytes. Ionic equilibria.	Discussion, work in small groups, work with visual aids.	2
6	5	Lab. Work. Heterogeneous equilibria.	Discussion, work in small groups, work with visual aids	2
7	6	Lab. Work. Classification and nomenclature of organic compounds.	Discussion, work in small groups, work with visual aids.	2
8	7	Basic properties of hydrocarbons	Discussion	1
9	8	Properties of organic compounds with functional groups.	Research method, work with visual aids.	6
10	9	Properties of multifunctional and polyfunctional organic compounds.	Research method, work with visual aids.	6

8. Material and technical support of the discipline:

Educational laboratories: 620, 621, 622, 705. Laboratory work is carried out in specially equipped educational laboratories. General chemistry laboratories are equipped with standard equipment: a set of special chemical glassware, a set of necessary chemical reagents, an analytical balance, a

distiller, and a centrifuge. All equipment in laboratories is quite modern. Students have access to electronic versions of the lecture course, homework, tests.

9. Information support of the discipline:

a) Microsoft Word, Microsoft Office software (Excel, Power Point), ACD Chemoffice

b) resources information and telecommunication network "Internet"

1. EBS PFUR and third-party EBS, to which university students have access on the basis of concluded contracts:

- Electronic library system RUDN - EBS RUDN
<http://lib.rudn.ru/MegaPro/Web>
- EBS "University Library Online" <http://www.biblioclub.ru>
- EBS Yurayt <http://www.biblio-online.ru>
- EBS "Student Consultant" www.studentlibrary.ru
- EBS "Lan" <http://e.lanbook.com/>

2. 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://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://www.chemport.ru> Chemical encyclopedia
- <http://ru.wikipedia.org>

10. Educational and methodical support of the discipline:

a) Main literature

- Slesarev V.I. Chemistry. The basics of living chemistry. St. Petersburg: Himizdat, 2005.
- Glinka N.L. Tasks and exercises in general chemistry M.: Higher. shk., 1988.
- Kovalchukova O.V, Avramenko O.V Laboratory work in general and bioorganic chemistry. Part 1. General chemistry. M.: publishing house of RUDN, 2007
- 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.
- Kolyadina N.M., Kovalchukova O.V., Shebaldina L.S. Laboratory work in general and bioorganic chemistry. Part 2. Bioorganic chemistry. M.: publishing house of RUDN, 2008.

b) additional literature

- Khomchenko G.P., Tsitovich I.K. Inorganic chemistry. -M.: Higher School, 1986, and others.

- Tyukavkina N.A., Baukov Yu.I. Bioorganic chemistry. "Drofa", Moscow, 2005, 2011.
 - Grandberg I.I., Organic Chemistry. "Bustard", Moscow, 2002.
- c) List of educational electronic materials:
- Lectures on general chemistry for the specialty "Dentistry".
 - Lectures on organic chemistry for the specialty "Dentistry".

11. Guidelines for students on the development of the discipline (module)

In laboratory classes and lectures, the relevant topics are analyzed using multimedia technology (computer, projector). For each lecture there are presentations prepared in Microsoft PowerPoint, containing from 10 to 60 slides. The main purpose of laboratory studies is to perform experimental experiments in order to consolidate the theoretical material.

Students are required to attend laboratory classes, weekly consultations, obligatory participation in certification tests, perform assignments within the framework of classroom and independent work using recommended textbooks and teaching aids, electronic educational resources, databases, information and reference and electronic search systems.

During certification, the quality of students' work in the classroom, the completeness and quality of laboratory work and assignments for independent work, control and test work is assessed. Preparation and subsequent implementation of laboratory work is a prerequisite for admitting a student to test work, including the subject of laboratory work. The postponement of laboratory work and the writing of test papers is considered valid only in the event of a student's illness, which is confirmed by the presence of a medical certificate. Unfinished laboratory work must be completed within ten days after the closing date of the medical certificate.

Educational materials in electronic form on all topics studied, as well as virtual laboratories are posted on the RUDN University Training Portal, in TUIS, on the local resources of the RUDN University electronic library system. Presentations on the topics of classes can be recorded on CDs or flash cards for independent work of students on a home computer.

For the final certification, a point-rating system for assessing knowledge is used. Students are required to submit all assignments within the timeframe established by the curriculum. Works submitted with a delay are not evaluated, tests are not rewritten.

12. Fund of estimated means for the interim assessment of students in the discipline (module)

Materials for assessing the level of mastering the educational material of the discipline "Chemistry" (evaluation materials), including a list of competencies indicating the stages of their formation, a description of indicators and criteria for evaluating competencies at various stages of their formation, a description of the assessment scales, standard control tasks or other materials, necessary for assessing knowledge, abilities, skills and (or) experience of activities that characterize the stages of the formation of competencies in the process of mastering the educational program, methodological materials that determine the procedures for assessing knowledge, abilities, skills and (or) experience of activity that characterize the stages of formation of competencies, are developed in full and are available for students on the discipline page at TUIS RUDN University.

The program is compiled in accordance with the requirements of the FSES HE.

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