

**Federal State Budgetary Educational Institution of Higher Education**

**"Dagestan State Medical University"**

**Health Ministry of the Russian Federation**

«I AFFIRM»

Vice Rector for Academic Affairs,  
professor Shakhbanov R.K.

\_\_\_\_\_  
« \_\_\_\_\_ » \_\_\_\_\_ 2019.

## **WORKING PROGRAMM**

on «Chemistry»

**Discipline index – Б 1. Б. 14**

**Specialty – 31.05.01 « General Medicine »**

**Level of higher education – specialty**

**Graduate qualifications – medical doctor**

**Faculty - Medical**

**The department** General and Biological Chemistry

**Form of training** - full-time

**Course: 1**

**Semester: I**

**Total labor input:** 3 c.u. / 108 hours

**lectures - 24** hours.

Lab sessions: **48** hours

Student's independent work: **36** hours.

Control form: credit in the 1st semester

**Makhachkala - 2019**

The working program of the discipline "Chemistry" was developed on the basis of the working curriculum for the specialty 05.31.01 General medicine (the level of higher education - specialty), approved by the Academic Council of the FSBEI HE DSMU of the Ministry of Health of Russia, protocol No. 1 of 08.30.2019, in accordance with the Federal State Educational Standard of Higher Education in the direction of training 05/31/01 - General Medicine (higher education level - specialty), approved by order No. 95 of the Ministry of Education and Science of the Russian Federation dated 02.09.2016.

The work program was approved at a meeting of the Department of General and Biological Chemistry on August 27, 2019, minutes №1

#### Work program agreed:

1. Director of NML DSMU \_\_\_\_\_ V.R. Musaeva
2. The Head of ED and CCE \_\_\_\_\_ A.M. Karimova
- 3 Dean of the Medical Faculty \_\_\_\_\_ R.M. Ragimov

#### Compiled by:

1. Head of the Department, Doctor of Medical Sciences, Professor \_\_\_\_\_ (E.R. Nagiyev)
2. Head of study work of the department, MD, professor, Candidate of Chemical Sciences, Associate Professor \_\_\_\_\_ (D.P. Babaeva)

#### Reviewers:

1. Head of the Department of Biophysics,  
Informatics and Medical Equipment DSMU, professor \_\_\_\_\_ (M.A. Rizakhanov)
2. Professor of the Department of Biochemistry, DSU, Doctor of Biological Sciences  
\_\_\_\_\_ (N.K. Klichkhanov)

1.	PURPOSE AND OBJECTIVES OF LEARNING THE DISCIPLINE (MODULE)	
2.	LIST OF PLANNED LEARNING OUTCOMES	
3.	PLACE OF THE EDUCATIONAL DISCIPLINE (MODULE) IN THE STRUCTURE OF THE EDUCATIONAL PROGRAM	
4.	LABOUR INTENSITY OF THE EDUCATIONAL DISCIPLINE (MODULE) AND TYPES OF CONTACT WORK	
5.	STRUCTURE AND CONTENT OF THE EDUCATIONAL DISCIPLINE (MODULE)	
5.1.	Sections of the academic discipline (module) and competencies that must be mastered when studying them	
5.2.	Sections of the discipline (module), types of educational activities and forms of current control	
5.3.	Title of lecture topics with indication of the number of hours	
5.4.	Names of topics for practical lessons, indicating the number of hours	
5.5.	Laboratory practicals	
5.6.	Student's independent work in the discipline	
6.	LIST OF BASIC AND ADDITIONAL LITERATURE REQUIRED FOR LEARNING THE DISCIPLINE	
7.	LIST OF RESOURCES OF INFORMATION AND TELECOMMUNICATION NETWORK "INTERNET"	
8.	INFORMATION TECHNOLOGY	
9.	MATERIAL AND TECHNICAL SUPPORT	
10.	STAFF SUPPORT	
11.	FUND OF EVALUATION FUNDS FOR RUNNING CONTROL AND INTERMEDIATE VALIDATION	
12.	REGISTRATION SHEET OF CHANGES TO THE WORKING PROGRAM	
13.	<i>Application: AMF</i>	

The purpose of mastering the discipline Chemistry (hereinafter referred to as the discipline): Participation in the formation of the corresponding competencies of students:

**GC-1**:- ability to abstract thinking, analysis, synthesis.;

**GC-5** readiness for self-development, self-realization, self-education, use of creative potential.;

**GC -8** - willingness to work in a team, tolerantly perceive social, ethnic, confessional and cultural differences;

**GPC -1**– willingness to solve the standard tasks of professional activity using information, bibliographic resources, biomedical terminology, information and communication technologies and taking into account the basic requirements of information security;

**GPC -7**: readiness to use the basic physicochemical, mathematical and other natural science concepts and methods in solving professional problems.

**PK-21** - the ability to participate in scientific research.

The work program of the discipline consists of module I "General chemistry" and module II « Bioorganic chemistry»

### **MODULE I« GENERAL CHEMISTRY»**

1. The purpose and objectives of mastering the General Chemistry module (hereinafter - the module).

The purpose of mastering the module: - the formation of students' systemic knowledge and skills to perform calculations of the parameters of physical and chemical processes, when considering their physicochemical essence and the mechanisms of interaction of substances that occur in the human body at the cellular and molecular levels, as well as when exposed to a living organism by the environment.

Module objectives:

As a result of studying the discipline, the student must

***Know:***

- work rules and safety measures in a chemical laboratory when working with devices and re-assets;
- thermodynamic and kinetic laws that determine the course of chemical and biochemical processes;
- physicochemical aspects of the most important biochemical processes and various types of homeostasis in the body: theoretical foundations of bioenergetics, factors affecting the displacement of the balance of biochemical processes;
- properties of water and aqueous solutions of strong and weak electrolytes;
- the main types of equilibria and vital processes: protolytic, heterogeneous, ligand exchange, redox;
- mechanisms of action of the body's buffer systems, their relationship and role in maintaining acid-base homeostasis; features of acid-base properties of amino acids and proteins;
- the regularities of the course of physical and chemical processes in living systems from the point of view of their competition, arising from the combination of equilibria of different types;
- the role of biogenic elements and their compounds in living systems;
- physical and chemical foundations of surface phenomena and factors;
- affecting free surface energy; peculiarities of adsorption at different phase boundaries;
- the chemical and biological essence of the processes occurring in living organisms at the molecular and cellular levels;
- features of physical and chemistry of disperse systems and solutions of biopolymers.

***Be able to:***

- predict the results of physicochemical processes occurring in living systems, based on theoretical provisions;

- scientifically substantiate the observed phenomena;
- to make physicochemical measurements characterizing certain properties of solutions, mixtures and other objects that simulate the internal environment of the body;
- to provide data from experimental studies in the form of graphs and tables;
- to observe the course of chemical reactions and make informed conclusions;
- present the results of experiments and observations in the form of a complete research protocol;
- solve typical practical problems and master the theoretical minimum at a more abstract level;
- to solve situational tasks, relying on theoretical provisions that simulate physicochemical processes occurring in living organisms;
- confidently navigate the information flow (use reference data and bibliography for one reason or another).

**Own:**

basic technologies for transforming information, text and tabular editors, techniques for working on the Internet for professional activities;  
 skills in determining the pH of biofluids;  
 skills in measuring the rate of chemical reactions;  
 skills in determining the buffer capacity of solutions, including biological fluids.

## 2. LIST OF PLANNED LEARNING OUTCOMES

### Competencies formed in the process of studying the academic discipline:

Competency code	Competency name	Competency description
1	2	3
<b>Общекультурные компетенции (GC)</b>		
<b>GC-1</b>	ability to abstract thinking, analysis, synthesis	Know: - mathematical methods for solving intellectual problems and their application in medicine. Be able to: - to use educational, scientific, popular science literature, the Internet for professional activities. - classify chemical compounds based on their structural formulas. Own: - basic information transformation technologies.
<b>GC-5</b>	Readiness for self-development, self-realization, self-education, use of creative potential	Know: - physicochemical aspects of the most important biochemical processes and various types of homeostasis in the body: theoretical foundations of bioenergy, factors affecting the displacement of the balance of biochemical processes;  Be able to: - scientifically substantiate the observed phenomena;  Own: - The main methodological approaches to the interpretation of chemical and physical-chemical results based on modern theoretical views.
<b>GC-8</b>	Willingness to work in a team, tolerantly perceive social, ethnic, confessional and	Know: - the chemical and biological essence of the processes occurring

	cultural differences	<p>in living organisms at the molecular and cellular levels;          Be able to:</p> <ul style="list-style-type: none"> <li>- confidently navigate the information flow (use reference data and bibliography for one reason or another).</li> </ul> <p>Own:</p> <ul style="list-style-type: none"> <li>- Basic techniques of laboratory work, draw up reports and use reference material.</li> </ul>
<b>General professional competences (GPC)</b>		
<b>GPC-1</b>	Willingness to solve standard tasks of professional activity using information, bibliographic resources, biomedical terminology, information and communication technologies, taking into account the basic requirements of information security	<p>Know:</p> <ul style="list-style-type: none"> <li>- the physicochemical essence of the processes occurring in a living organism at the molecular, cellular, tissue and organ levels.</li> <li>- the main types of chemical equilibria (protolytic, heterogeneous, ligand-exchange, redox) in the processes of life.</li> <li>- structure and chemical properties of the main classes of biologically important organic compounds.</li> </ul> <p>Be able to:</p> <ul style="list-style-type: none"> <li>- to carry out thermochemical calculations necessary for drawing up an energy menu, to study the basics of rational nutrition.</li> </ul> <p>Own:</p> <ul style="list-style-type: none"> <li>- Basic technologies of information transformation: text, tabular editors; technique of work on the Internet for professional activities.</li> </ul>
<b>GPC-7</b>	Readiness to use basic physical and chemical, mathematical and natural science concepts and methods in solving professional problems	<p>Know:</p> <ul style="list-style-type: none"> <li>- the mechanism of action of the body's buffer systems, their interrelation and role in maintaining the acid-base state of the body.</li> <li>- electrolyte balance of the human body, colligative properties of solutions (diffusion, osmosis, osmolarity, osmolality).</li> <li>- the role of colloidal surfactants in the assimilation and transfer of low-polarity substances in a living organism.</li> <li>- the structure and functions of the most important chemical compounds (nucleic acids, natural proteins, water-soluble and fat-soluble vitamins, hormones, etc.).</li> <li>- the role of biogenic elements and their compounds in living organisms, the use of their compounds in medical practice.</li> </ul> <p>Be able to:</p> <ul style="list-style-type: none"> <li>- to predict the direction and result of physicochemical processes and chemical transformations of biologically important substances.</li> <li>- use the IUPAC nomenclature for compiling names according to the formulas of typical representatives of biologically important substances and drugs.</li> </ul> <p>Own:</p> <ul style="list-style-type: none"> <li>- use computer programs for chemical modeling of processes and other types of illustrative material.</li> </ul>
<b>Professional competencies (PC)</b>		
<b>PC -21</b>	Ability to participate in scientific research	<p>Know:</p> <ul style="list-style-type: none"> <li>- safety regulations and work in physical, chemical, biological laboratories, with reagents, devices, animals.</li> <li>- methods of expressing the concentration of substances in solutions, methods of preparing solutions of a given concentration.</li> <li>- physicochemical methods of analysis in medicine (titrimetric, electrochemical, chromatographic, visco-zimetric).</li> </ul> <p>Be able to:</p> <ul style="list-style-type: none"> <li>- use physical, chemical and biological equipment.</li> <li>- to carry out calculations based on the results of the experiment, to carry out elementary statistical processing of experimental data.</li> </ul> <p>Own:</p> <ul style="list-style-type: none"> <li>- Own:</li> </ul>

		- skills of working with educational, scientific, reference literature, search and make generalized conclusions; skills of safe work in a chemical laboratory and the ability to handle chemical utensils, reagents, work with devices.
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### 3. PLACE OF THE EDUCATIONAL DISCIPLINE IN THE STRUCTURE OF THE EDUCATIONAL PROGRAM

The academic discipline "Chemistry" belongs to the basic part of the B1 curriculum in the specialty 31.05.01 General Medicine

The material of the discipline is based on the knowledge previously acquired by students in biology, mathematics, physics, physical education and sports.

#### Interdisciplinary links with provided (follow-up) disciplines

№	Name provided by (subsequent) disciplines	№ № sections of this discipline, necessary to study the provided (subsequent) disciplines				
		1	2	3	4	5
1	Biology	+	+			
2	Biochemistry	+	+		+	+
3	Normal physiology	+	+		+	
4	Pathophysiology	+	+	+	+	
5	Pharmacology	+	+		+	+
6	Hygiene	+	+			
7	Occupational diseases				+	
8	Urology		+		+	
9	Internal illnesses	+			+	
10	Anesthesiology, rheumatology and intensive care		+		+	
11	The basics of nutrition for a healthy and sick person	+	+			+
12	Ophthalmology		+			
13	Microbiology		+			
14	Clinical pharmacology	+	+			
15	Physiotherapy					

### 4. LABOUR INTENSITY OF УЧЕБНОЙ THE DISCIPLINE AND TYPES OF CONTACT WORK

Type of educational work	labour intensity		labour intensity by semester (AH)
	volume in credit units (CU)	volume in academic hours (AH)	
			1

Classroom work, including	2	72	72
Lectures (L)	0,7	24	24
Laboratory workshops (LP)	0,4	16	16
Practical lessons (PZ)	0,9	32	32
Clinical Practices (CLP)	-	-	
Seminars (C)			
Student independent work (IWS)	1	36	36
Intermediate certification offset			
TOTAL	3	108	108

## 5. STRUCTURE AND CONTENT OF THE EDUCATIONAL DISCIPLINE

### 5.1 Sections of the academic discipline (module) and competencies that must be mastered when studying them

п/№	Discipline section name	Competence code	Contents of the section in didactic units
<b>Module I</b>			
1	Biologically active low molecular weight inorganic substances (structure, properties, participation in the functioning of living systems).	GPC7 PC 21	<p><b>Chemistry of biogenic elements</b> The concept of the biogenicity of chemical elements. Macro- and microelements. Biosphere. The turnover of biogenic elements. Accumulation of biogenic elements by living systems. Classification of elements according to their functional role in the body. Ecological aspects of the chemistry of biogenic elements.</p> <p><b>Chemistry of d-block elements</b> Electronic structures of atoms and cations. The most important biogenic elements of the d-block are biomes: chromium-copper, molybdenum. Oxidation-reduction properties: regularities of the stability of oxidation states, disproportionation of intermediate oxidation states. Stability in the conditions of the organism of the oxidation state. Complex compounds of d-elements. Classification of complexes by the charge and nature of the ligands. Werner's coordination theory. Nomenclature of complex compounds. Fundamentals of ligand exchange equilibria and processes. Ionic equilibria in solutions of complex compounds. Instability constants. The role of complex compounds in the life of the organism. Their use in therapy, ecology.</p> <p>Brief comparative characteristics and medico-biological value of compounds of iron, molybdenum, tungsten, cobalt, nickel, copper, silver, zinc, mercury. Environmental aspects of the toxic effect of mercury and cadmium salts. Peroxide oxidation triggering mechanism. Formation of superoxide radical ions.</p>
2	Elements of chemical thermodynamics, thermodynamics of solutions and chemical kinetics	GC 1,5,8 GPC 1 GPC-7	<p><b>Theoretical foundations of thermodynamics and bioenergy</b> <b>The concept of a thermodynamic system. The first law of thermodynamics.</b> Enthalpy. Hess's law. Application of the first law of thermodynamics to biosystems. Entropy. Gibbs energy. Predicting the direction of spontaneous processes. Principle of energy conjugation.</p> <p><b>Chemical kinetics and catalysis</b> Chemical kinetics. Speed reaction. The law of the acting masses. Molecularity and order of reaction. Dependence of speed on concentration and temperature. Arrhenius equation. Homo- and heterogeneous catalysis. The concept of enzymes as biological catalysts.</p>
3	The main types of chemical	GC 1, 5,	<b>Chemical equilibrium</b>



	equilibria and processes in the functioning of living systems.	GPC 1 GPC 7	<p>Reversible and irreversible reactions, constants of chemical equilibrium. Predicting chemical equilibrium displacement. Buffering action. The concept of homeostasis and stationary state of a living organism.</p> <p><b>Solution properties and chemical kinetics</b></p> <p><b>The doctrine of solutions</b></p> <p>The role of water in life. Colligative properties of solutions. Raoult's law. Osmosis and osmotic pressure: Van't Hoff's law. The concept of isoosmia. The role of osmosis in biological systems. Plas-molysis, hemolysis.</p> <p><b>Protolithic equilibria and processes</b></p> <p><b>Protolithic theory. Dissociation of water.</b> The formation of hydrogen bonds as a factor in the self-organization of living systems. PH-hydrogen pGC indicator. Buffer solutions and buffer systems. The theory of acid-base balance as a basis for the assimilation of the regularities of the functioning of the proto-lytic buffer systems of blood, lymph and other biological fluids. Heterogeneous equilibria and processes in the body Conditions for the formation and dissolution of sediments. Constant solubility and solubility. The phenomenon of isomorphism.</p>
4	Physicochemistry of surface phenomena in the functioning of living systems.	PC21, GPC 7,	<p><b>Physicochemistry of surface phenomena and properties of dispersed systems</b></p> <p>Surface Gibbs energy. Adsorption. Gibbs equation. Surfactants and non-surfactants. Orientation of molecules in the surface layer and the structure of biomembranes. Micelle structure.</p> <p><b>Adsorption</b></p> <p>Adsorption equilibria and processes at stationary and mobile interfaces. Langmuir's equation. Phenomena of adsorption in biology and medicine.</p>
5	Physicochemistry of dispersed systems in the functioning of living systems.	PC 21, GPC 1	<p><b>Disperse systems</b></p> <p>Classification of dispersed systems. Micelle formation in surfactant solutions.</p> <p>Obtaining, properties and purification of colloidal solutions. The principles of stability of colloidal solutions. Coagulation phenomena.</p>

## 5.2 Sections of the discipline (module), types of educational activities and forms of current control

п/№	№ term	Discipline section name	Types of educational work (in AH)							Evaluation means
			L	LP	PL	CPC	S	SSS	total	
1.	2	Biologically active low molecular weight inorganic substances (structure, properties, participation in the functioning of living systems).	2	1	6			8	17	Test control,
2.	2	Elements of chemical thermodynamics, thermodynamics of solutions and chemical kinetics	8	3	6			3	20	colloquium, oral survey,
3.	2	The main types of chemical equilibria and processes in the functioning of living systems.	4	4	8			12	28	abstracts.

4	2	Physicochemistry of surface phenomena in the functioning of living systems.	2	1	4			2	9	Test control, control works,
5	2	Physicochemistry of dispersed systems in the functioning of living systems.	2	1	2			3	8	colloquium, abstracts.
		TOTAL	18	10	26			28	82	

### 5.3 Distribution of lectures by semester

п/№	Name of lecture topics	Volume in AH
		Semester
Section 1		
1	Chemistry of biogenic elements. Complex compounds. Instability constant, stability constant.	2
Section 2		
2	The beginning of thermodynamics. Thermochemical equations. Hess's law. Application of the first principle of thermodynamics to biosystems. II Beginning of thermodynamics. Entropy. Gibbs energy. Endergonic and exergonic processes in the body.	2
3	Thermodynamics of chemical equilibrium. Chemical equilibrium constant. The principle of displacement of chemical equilibrium. Thermodynamics of non-electrolyte solutions. Colligative properties.	2
4	Chemical kinetics. Kinetic models of chemical processes. The dependence of the reaction rate on various factors. Catalysis.	2
Section 3		
5	Elements of the theory of strong electrolyte solutions. Proteolytic theory of acids and bases. Water autoprotolysis constant	2
6	Hydrogen pGC indicator. Buffer systems, their mechanism of action. Buffer capacity, buffer systems of biological fluids of living organisms.	2
7	Heterogeneous equilibria. Solubility constant.	2
Section 4		
8	Physicochemistry of surface phenomena.	2
Section 5		
9	Physicochemistry of dispersed systems.	2
	TOTAL (total - hours)	18

### 5.4 Distribution of practical lessons topics by semester:

п/№	Name of topics for practical lessons	Volume in AH
		semester 1
Section 1		
1	Introductory lesson	2

2	Biogenic elements. Complex compounds.	3
Section 2		
3	Thermodynamics	2
4	Kinetics and catalysis	2
5	Chemical equilibrium	2
Section 3		
6	Solutions. Colligative properties of solutions	2
7	Acid-base balance. Hydrolysis of salts	2
8	Buffer systems. Buffer capacity	4
9	Heterogeneous processes and equilibria	2
Section 4		
10	Physicochemistry of surface phenomena	3
Section 5		
11	Disperse systems. Colloidal solutions.	2
	TOTAL (totally - AH)	26

### 5.5 Distribution of laboratory practicals by semester:

п/№	№ semester	Name of laboratory practicals	Volume in AH
Section 1			
1	1	Complex compounds and their properties.	1
Section 2			
2	1	Determination of the thermal effect of a chemical reaction.	1
3	1	Chemical reaction rate. Catalysis.	1
4	1	Chemical equilibrium.	1
Section 3			
5	1	Osmosis, osmotic pressure. Growth of an artificial Traube cell	1
6	1	Acid-base balance. Hydrolysis of salts	1
7	1	Properties of buffer solutions.	1
8	1	Study of the conditions of dissolution and formation of precipitates.	1
Section 4			
9	1	Sorption phenomena	1
Section 5			
10	1	Preparation and properties of colloidal solutions.	1
		TOTAL (totally - AH)	10

### 5.6. Distribution of student self-study (SSS) by type and semester:

п/ №	№ se- mes- ter	Discipline Section Name	SSS*Type name	Volume in AH
				semester 1
1	1	Biologically active low molecular weight inorganic substances (structure, properties, participation in the functioning of living systems).	Atom. Atomic structure of s-block, p-block, d-block elements. Periodic properties of atoms. Chemical bond. Atom hybridization. Types of crystal lattices. Types of chemical bond breaking. (preparation for the colloquium). Biomedical role of s-block elements. (Abstract). Biomedical role of p-block elements. (Abstract). Biomedical role of d-block elements. (Abstract)	8
2	1	Elements of chemical thermodynamics, thermodynamics of solutions and chemical kinetics	Chemical thermodynamics. Heat of combustion of a substance. Second consequence of Hess's law. (Calculation and graphic work; abstract; preparation for the test). Chemical equilibrium. Reversible and non-reversible in the direction of the reaction. Predicting the displacement of the chemical equilibrium (Le Chatelier principle) (preparation for test work). Chemical kinetics. Dependence of the rate of a chemical reaction on temperature. Van't Hoff's rule. Temperature coefficient. (Settlement and graphic work; abstract).	5
3	1	The main types of chemical equilibria and processes in the functioning of living systems.	S. Arrhenius' theory of electrolytic dissociation. Dissociation degree. Strong and weak electrolytes. Ion exchange reactions. (Test). The role of water and solutions in life. Physicochemical properties of water, which determine its unique role as a universal solvent. The dependence of the solubility of substances on the ratio of hydrophilic and hydrophobic properties of substances. Dissolution thermodynamics. The influence of external conditions on solubility. (preparation for the colloquium; abstract). Salt hydrolysis. Hydrolysis degree and constant. (preparation for the colloquium). Buffer solutions. Buffer capacity. (Settlement work; preparation for the colloquium; abstract). Colligative properties of solutions. (Settlement work; abstract). The condition for the formation and dissolution of the precipitate (preparation for the colloquium).	10
4	1	Physicochemistry of surface phenomena in the functioning of living systems.	Surface phenomena. Adsorption: Freundlich isotherm, Langmuir equation, experimental determination of constants. (preparation for the colloquium; abstract)	2
5	1	Physicochemistry of dispersed systems in the functioning of living systems.	Disperse systems: optical properties, Rayleigh equation; molecular-kinetic properties of colloids; flow and sedimentation potentials. Mutual coagulation of sols. Colloidal protection. Peptization. (Test)	3
TOTAL (totally - AH)				28

## 6. LIST OF BASIC AND ADDITIONAL LITERATURE REQUIRED FOR LEARNING THE DISCIPLINE

### 6.1. References

#### Hard-copies:

№	Publication	Number of copies in the library
1	General chemistry. Biophysical chemistry. Chemistry of biogenic elements. Textbook for medical schools. (Yu.A. Ershov, V.A.Popkov, A.S. Berlyand.Ed. Yu.A. Ershov), 9th ed., 560 p.	790
2	Workshop in general chemistry. Biophysical chemistry. Chemistry of biogenic elements. Textbook for students of medical universities (Ed. V.A.Popkov, A.V. Babkov) .	145
3	General chemistry: Textbook / V.A. Popkov, S. A. Puzakov. M.: GEOTAR	499
4	Methodical developments for laboratory and practical classes in chemistry for 1st year students of the therapeutic and prophylactic faculty of the DSMU:	50

#### Electronic sources:

1	4. Chemistry [Electronic resource]: textbook / Puzakov S.A. - 2nd ed., Rev. and add. - M.: GEOTAR-Media, 2006. Access mode: <a href="http://www.studmedlib.ru/book/ISBN5970401986.html">http://www.studmedlib.ru/book/ISBN5970401986.html</a>
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### 6.2. Additional literature

#### Hard-copies:

№	Publications	Number of copies in the library
1	N.L. Glinka, ed. V.A. Popkova, A.V. Babkova, General Chemistry: Textbook for Academic Bachelor's Degree, 19th edition M., Yurayt, 19th ed., 900 p., 2015.	5
2	N.L. Glinka edited by V.A.Popkov, A.V. Babkov Problems and exercises in general chemistry - L: chemistry, 2015 236p., 2015	14
3	Laboratory and seminars on general and inorganic chemistry: textbook / NS Akhmetov; M.K. Azizov - 5th ed. rev. - M.V. sh. 2018	47

#### Electronic sources:

№	Publications
1	2
4	SEL Medical University (Student Consultant) <a href="http://www.studmedlib.ru">http://www.studmedlib.ru</a> – access for all 1st year students of the Faculty of General Medicine of the DSMU

## MODULE II "BIOORGANIC CHEMISTRY"

### 1. Objectives of mastering module II "Bioorganic chemistry" (hereinafter - BOC).

#### *Know*

1. Fundamentals of the structure and reactivity of organic compounds: types of structural and spatial isomerism; the electronic structure of the carbon atom and organogenic atoms, their chemical bonds; mutual influence of atoms and methods of its transfer in a molecule using

electronic effects; conjugation and aroma; principles of stabilization of molecules, radical and ionic particles at the electronic level; theory of acidity and basicity of organic compounds.

2. The most important homofunctional compounds: structure, nomenclature rules, typical and specific chemical properties. The most important heterofunctional compounds: structure, nomenclature rules, specific reactivity of heterofunctional compounds, traditional for pharmaceutical and medical practice.

3. The structure and basic chemical properties of biopolymers (polysaccharides, proteins, nucleic acids).

4. Organic compounds of plant and animal origin - terpenoids, steroids, alkaloids and their synthetic analogs, structure and basic chemical properties..

#### *Be able to*

1. Determine the belonging of organic compounds to certain classes and groups on the basis of classification signs; draw up formulas by name and give a name by structural formula in accordance with the rules of the IUPAC international nomenclature.

2. To depict the structural and stereochemical formulas of compounds, to determine the types of stereoisomers.

3. Determine the nature of the electron density distribution, taking into account the action of electronic effects and identify the presence of acid and / or basic, electrophilic and / or nucleophilic reaction centers in the molecule.

4. Describe the mechanisms of electrophilic and nucleophilic addition and substitution, as well as elimination, aldol and ester condensations in general terms and in relation to specific reactions.

5. To present in general terms and for specific compounds the chemical basis of keto-enol, lactim-lactam and cyclo-GC-co-tautomerism.

6. Carry out a simple experiment based on mastering the basic techniques of work in the laboratory, draw up reports and use reference material.

7. Independently work with chemical literature: conduct a search, turn what has been read into a tool for solving typical problems, work with tabular and graphic material.

#### *Own*

1. Skills of independent work with educational, scientific and reference literature.

2. Skills of safe work in a chemical laboratory and the ability to handle chemical utensils and reagents.

## **2. Requirements for the results of BOC development.**

The study of BOC is aimed at the formation of the following general cultural (GC), general professional (GPC) and professional (PC) competencies in students

<b>com- peten- cies</b>	<b>Competency name</b>	<b>Characteristics of competencies</b>
1	2	3
<b>General cultural competences (GC)</b>		
GC-1	Ability for abstract thinking, analysis, synthesis	Know: - The most important modern concepts of the relationship of biological and pharmacological activity with the chemical structure of biologically active organic compounds. Reveal at the molecular level the essence of the physicochemical processes occurring in the body.

		<p>Be able to:</p> <ul style="list-style-type: none"> <li>- To carry out a systematic approach to solving professional problems in the medical field on the basis of the most important regularities in the structure and reactivity of organic compounds used in the field of creating medicines. To carry out the selection of information materials of a professional orientation and its logical interpretation in terms and laws of physical and chemical processes.</li> <li>- classify chemical compounds based on their structural formulas.</li> </ul> <p>Own:</p> <ul style="list-style-type: none"> <li>- The main methodological approaches to the classification, structure and reactivity of organic compounds. The ability to predict the sequence of stages of chemical processes at the molecular level.</li> </ul>
GC-5	Readiness for self-development, self-realization, self-education, use of creative potential	<p>Know:</p> <ul style="list-style-type: none"> <li>- The most important theoretical concepts of the electronic and spatial structure of organic compounds and their reactivity;</li> </ul> <p>Be able to:</p> <ul style="list-style-type: none"> <li>- To carry out a systematic approach to solving professional problems in the medical field on the basis of the most important concepts and patterns of structure and reactivity of organic compounds used as medicines;</li> </ul> <p>Own:</p> <ul style="list-style-type: none"> <li>- The main methodological approaches to the interpretation of chemical and physicochemical results based on modern theoretical views.</li> </ul>
GC-8	Willingness to work in a team, tolerantly perceive social, ethnic, confessional and cultural differences	<p>Know:</p> <ul style="list-style-type: none"> <li>- Understand the role of biologically significant organic compounds as structural and functional components and molecular participants in chemical processes taking place in living organisms;</li> </ul> <p>Be able to:</p> <ul style="list-style-type: none"> <li>- Carry out a simple experiment based on mastering the basic techniques of work in the laboratory, draw up reports and use reference material;</li> </ul> <p>Own:</p> <ul style="list-style-type: none"> <li>- The basic techniques of work in the laboratory, as well as as part of educational and research and problem groups, draw up reports and use reference material.</li> </ul>
<b>General professional competencies (GPC)</b>		
GPC-1	Willingness to solve standard tasks of professional activity using information, bibliographic resources, biomedical terminology, information and communication technologies, taking into account the basic requirements of information security	<p>Know:</p> <ul style="list-style-type: none"> <li>- Collection, storage, search, processing, transformation, dissemination of information in medical and biological systems, the use of information computer systems in medicine and healthcare;</li> </ul> <p>Be able to:</p> <ul style="list-style-type: none"> <li>- Use educational, scientific, popular science literature, the Internet for professional activities;</li> </ul> <p>Own:</p> <ul style="list-style-type: none"> <li>- Basic information transformation technologies: text, tabular editors; technique of working on the Internet for professional activities.</li> </ul>
GPC-7	Readiness to use basic physical and chemical, mathematical and natural science concepts and methods in solving professional problems	<p>Know:</p> <ul style="list-style-type: none"> <li>- Basic computer databases on the structure and properties of organic compounds, including chemical graphics and 3D computer programs;</li> </ul> <p>Be able to:</p> <ul style="list-style-type: none"> <li>- Use the rules for constructing chemical formulas, graphs, tables using appropriate computer programs, including for creating computer presentations;</li> </ul> <p>Own:</p>

		- Use computer programs to construct chemical and stereochemical formulas of organic compounds and other types of illustrative material.
GPC-8	Readiness for medical use of drugs and other substances and their combinations in solving professional problems	<p>Know:</p> <ul style="list-style-type: none"> <li>- The most important classes of organic compounds traditional for the medical field (structure, nomenclature rules, typical and specific chemical properties in conjunction with the electronic mechanisms of the corresponding reactions).</li> </ul> <p>Use modern informational capabilities to establish the chemical and physicochemical nature of processes;</p> <p>Be able to:</p> <ul style="list-style-type: none"> <li>- Use chemical equipment ;; classify chemical compounds based on their structural formulas; predict the result of physicochemical processes and chemical transformations of biologically important substances; use the IUPAC nomenclature for composing names according to the formulas of typical representatives of biologically important substances and drugs;</li> </ul> <p>Own:</p> <ul style="list-style-type: none"> <li>- Chemical classification and the main characteristics of the reactivity of biologically important substances.</li> </ul>
<b>Professional competence (PC)</b>		
PC-21	Ability to participate in scientific research	<p>Know:</p> <ul style="list-style-type: none"> <li>- Rational approaches to the identification of specified organic compounds using a complex of physical and chemical methods;</li> </ul> <p>Be able to:</p> <ul style="list-style-type: none"> <li>- To set up a simple educational and research experiment, experimentally detect functional groups and specific fragments in organic compounds using qualitative reactions;</li> </ul> <p>Own:</p> <ul style="list-style-type: none"> <li>- Experimentally carry out reactions that visually confirm the presence of certain functional groups or structural fragments in the molecule.</li> </ul>
PC-22	Readiness to participate in the introduction of new methods and techniques aimed at protecting the health of citizens.	<p>Know:</p> <ul style="list-style-type: none"> <li>- Typical and specific chemical properties in relation to the electronic mechanisms of the corresponding reactions).</li> </ul> <p>Modern informational capabilities for establishing the chemical and physicochemical essence of processes;</p> <p>Be able to:</p> <ul style="list-style-type: none"> <li>- Determine the belonging of organic compounds to the classification groups; to draw up structural and stereochemical formulas by name in accordance with the rules of the IUPAC nomenclature.</li> <li>- Determine the types of stereoisomers and use the basic rules of nomenclature systems.</li> <li>- Describe electronic mechanisms in general terms and in relation to specific reactions.</li> </ul> <p>Determine the specific information content of chemical and physicochemical approaches to determine the results of the studied processes</p> <p>Own:</p> <ul style="list-style-type: none"> <li>- Establish the presence of potential reaction centers in the molecule.</li> <li>- Give the equations of reactions of GC-redox, nucleophilic and electrophilic interactions on the corresponding examples of substrates and reagents.</li> <li>- Bring equilibrium forms for various types of tautomeric transformations.</li> </ul> <p>Predict the structure of some interacting organic compounds using a complex of chemical and physicochemical information</p>

### 3 The place of BOC in the structure of the GPEP HE of the University.

3.1. To study the discipline, the following knowledge, abilities and skills are required, formed



by the previous disciplines:

### **Chemistry**

**Knowledge:** Modern model of the atom, chemical bond; acid-base and oxidation-reduction reactions.

**Skills:** Make electronic configurations of atoms and ions; determine the type of chemical bond; apply the rules of different nomenclatures to different classes of inorganic compounds.

**Skills:** Technique of chemical experiments, conducting test-tube reactions, working with chemical glassware.

### **Physics**

**Knowledge:** Theoretical foundations of modern physical methods for the study of substances; principles of operation of physical devices used in medicine.

**Skills:** Working with educational and scientific literature to solve educational and practical problems.

**Skills:** Working on a personal computer. Independent work with educational and scientific literature for solving educational and practical problems and for writing abstracts.

**3.2** The study of the discipline is necessary for the knowledge, skills and abilities formed in the following disciplines:

### **Biochemistry**

**Knowledge:** Molecular mechanisms of physiological functions of the body of an adult and a child, the basic laws of metabolic processes.

**Skills:** To identify leading signs, symptoms, syndromes, etc. based on biochemical data.

**Skills:** Formation of skills in studying scientific literature. Formation of students' teamwork skills.

### **Pharmacology**

**Knowledge, skills:** Predict pharmacological and pharmacodynamic processes based on knowledge of the properties of a substance and the properties of an organism; to evaluate the possibilities of using drugs for the purposes of pharmacotherapy based on ideas about their properties

## **5. Module structure and content II**

### **5.1. Sections of BOC and competencies that are formed during their study:**

П/№	Code of competence	Discipline Section Name	Section content in didactic units
1.	GC-1 GC-5 GC-8 GPC-1 GPC-7	Poly- and heterofunctional compounds involved in vital processes.	Specific reactivity of polyfunctional and hetero-functional organic compounds.

	GPC-8 PC-21 PC-22		
2.	GC-1 GC-5 GC-8 GPC-1 GPC-7 GPC-8 PC-21 PC-22	Biopolymers and their structural components.	Biologically important heterocyclic compounds. $\alpha$ -Amine acids, peptides, proteins. Carbohydrates (mono-, di- and polysaccharides). Nucleic acids, nucleotide coenzymes. Low molecular weight bioregulators.

### 5.2. BOC Sections, types of educational work and forms of monitoring:

п/ №	№ semes- ter	Discipline Section Name	Evaluation means					
			L	LC	PL	SSS	total	
1.	1	Poly- and hetero- functional com- pounds involved in the processes of life.	2		2	4	8	Test assignments, practical assign- ments, essays.
2.	1	Biopolymers and their structural components.	4	6	4	4	18	Test assignments, practical assign- ments, assignments for midterm control, essays.
		total	6	6	6	8	26	

### 5.3. Distribution of lectures by semester:

п/№	Name of lecture topics	AH	semester
1.	Chemical bond and mutual influence of atoms in organic compounds. Specific reactivity of poly- and heterofunctional compounds.	2	1
2.	Carbohydrates	2	1
3.	Biologically important heterocyclic compounds Nucleic acids. Nucleotide coenzymes.	2	1
	TOTAL (total AH)	6 hrs	1

### 5.4. Distribution of practical classes by semester:

п/№	Name of classes	Volume in AH	semester
Section 1			
1.	Specific reactivity of poly- and heterofunctional compounds.	2	1
Section 2			
2.	$\alpha$ -Amine GC acids, peptides, proteins.	4	1
3.	Carbohydrates (monosaccharides, disaccharides and polysaccharides).	2	1
4.	Biologically important heterocyclic compounds. Nucleic acids. Nucleotide coenzymes. Cross-border control.	4	1
	Total:	12	

### 5.5 Distribution of laboratory workshops by semester:

п/№	№ semester	Name of laboratory practicals	Volume in AH
Section 1			
Section 2			
1	1	Qualitative reactions for $\alpha$ -amino acids.	2
2	1	Trommer's test, Selivanov's reaction, reduction of ammonia solution of silver hydroxide with glucose, lack of reducing ability of sucrose. Qualitative reaction to starch.	2
TOTAL (total AH)			4

### 5.6. Distribution of student self- study (SSS) by type and semester:

п/№	№ semester	Discipline Section Name	SSS Type name *	Volume in AH
				semester 1
1	1	Fundamentals of the structure and reactivity of monofunctional organic compounds. Poly- and heterofunctional compounds involved in vital processes..	Preparation for practical training. Preparing for the current test control. Performing extracurricular tasks - essay.	3
2	1	Biopolymers and their structural components. Low molecular weight bioregulators..	Preparation for practical knowledge. Performing extracurricular tasks - essay. Preparation for midterm control.	5
TOTAL (total AH)				8

## 6. List of basic and additional literature required to master the module II

### 6.1. List of main literature:

№	Name according to bibliographic requirements	Number of copies	
		At the department	At the library
1.	Bioorganic chemistry: Textbook for universities / - M.: Bustard, 2018, - 542 p. : silt		291
2.	Textbook "Guide to laboratory studies in bioorganic chemistry." Ed. Tyukavkina N.A. Authors: Artemyeva N.N., Beloborodov V.L., Zurabyan S.E., Luzin A.P., Ruchkin V.E., Selivanova I.A., Tyukavkina N.A., Khvostova A.I. - M.: Medicine. - 2018. -- 256 p.	—	339
3.	Textbook "Bioorganic chemistry. Guide to practical training." Ed. Tyukavkina N.A. Authors: Tyukavkina N.A., Beloborodov V.L., Zurabyan S.E., Selivanova I.A., Artemyeva N.N., Khvostova A.I. M.: - Publishing group "GEOTAR-Media" –2010. - 160 p.	—	250

### 6.2. List of additional literature:

№	Name according to bibliographic requirements	Number of copies	
		At the	At the library

		department	
1.	Textbook "Bioorganic Chemistry". Tyukavkina N.A., Baukov Yu.I., Zurabyan S.E.	–	248
2.	Bioorganic chemistry: Textbook for medical universities / N. A. Tyukavkina	–	415

### **Electronic sources:**

1	4. Chemistry [Electronic resource]: textbook / Puzakov S.A. - 2nd ed., Rev. and add. - M.: GEOTAR-Media, 2006. Access mode: <a href="http://www.studmedlib.ru/book/ISBN5970401986.html">http://www.studmedlib.ru/book/ISBN5970401986.html</a>
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## **7. List of information and telecommunication resources**

**the Internet»:**

*Websites:*

- *Chemlib.ru, Chemist.ru, ACD Labs, MSU.Chem.ru., u òp.*

## **8. EDUCATIONAL TECHNOLOGIES**

- When studying the discipline, a general package of documents is used, Internet materials, which provide ample opportunities for improving university training in chemistry in order to master the skills of educational activities. The standard features of most programs are the implementation of the didactic principle of visibility in teaching; their use enables students to use various methods to solve an educational problem.
- Teaching methods using information technology.
- The methods of teaching using information technologies used in the classroom in the discipline "Chemistry" include:
  - - computer testing;
  - - demonstration of multimedia materials, including video films;
  - - a list of search engines (site moodle.dgmu.ru).

**list of encyclopedic sites.**

**Department page address:**

<https://dgmu.ru/fakultety/farmatsevticheskij-fakultet-3/obshhej-i-biologicheskoi-himii/>

## 9. MATERIAL AND TECHNICAL SUPPORT

### Information about the material and technical support necessary for the implementation of the educational process on discipline

№ п/п	Address (location) buildings, structures, structures, premises	Own or operational control, economic maintenance, rent, sublease, gratuitous use	Name of discipline	Appointment equipped buildings, structures, premises *, territories with indication of area (sq.m.)	Name of special premises and premises for independent work	Equipment of special rooms and premises for independent work	List of licensed software. Requisites confirming document
1	2	3	4	5	6	7	8
	Avenue I. Shamil,44	Oper. control.	Chemistry	For educational and scientific educational process: Lecture halls No. 1, 2, 3 - 160m2 each (for 250 seats); Educational laboratories No. 1, 2, 3, 4 - 60 m2 each. Educational laboratory No. 6 - 45m2. Study room No. 5 - 25m2. Scientific laboratory No. 7 - 60m2. Educational and methodical room No. 13 - 25 m2.	• For lectures - halls No. 1, No. 2 and No. 3),  for practical training  Educational laboratories No. 1, 2 Educational laboratories No. 3, 4 Training laboratory No. 6  Training room No. 5 for IWS  Scientific laboratory No. 7	Amplifier Yamaxa EMX 62, Acoustics ASK SA-112, Projector Aser Wall screen roll-ny (white, matte) Drager Luma 267 * 356  Study tables, reagent kits and chemical glassware  Study tables, fume hoods with water and electricity supply - 2 pcs, a cabinet for storing reagents - 2 pcs, chemical glassware.  Chemical tables, exhaust cabinets with reagent kits and chemical dishes.	List of software (Win HOME 10 Russian OLP (Subscription agreement Tr000044429 dated 08.12.15); Kaspersky Edition Security for Business - Standard Russian Edition. 100-149 Node (License agreement No. 1081-2015 dated 14.10.2015); Office ProPlus 2013 RUS OLP NL Acdmc (contract No. DP-026 dated 16.10.13), etc.)

				<p>Reactive number 15 - 40 m<sup>2</sup>. Laboratory No. 8 - 25 m<sup>2</sup>. Preparatory room No. 14 - 20 m<sup>2</sup>.</p>	<p>Educational and methodical room No. 13</p> <p>Reactive room №15</p> <p>Laboratory assistant' №8</p>	<p>Study tables. Laboratory tables with built-in pedestals in the count. 4 pcs, hoods with water and electricity sup- ply - 2 pcs., Dish drainer - 1 pc., Heating mantles, magnetic stirrers, reagent storage cabinets - 3 pcs., Dry-air thermo-stat, labor- atory centrifuge, ionome- ter, scales ana - lytic, fluo- rometer, spectrophotome- ter SF-16, photoelectric GC calorimeter, sets of chemical glassware and reagents.</p> <p>personal computer - 1 pc., XerGCc Ca-non Fc-228, BENQ DLP projector, HP laser Jet 1020 laser printer, Eco view mobile screen 200x200 cm, refrigerator.</p> <p>Fume hood with water and electricity supply, cabinets for storing reagents - 3 pcs., Laboratory tables - 2 pcs.</p> <p>Laboratory tables with water and electricity sup- ply, refrigerator, aqua dis- tiller.</p> <p>Laboratory tables, shelves</p>	
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					Preparator №14	for storing chemical dishes, aqua distiller.	
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### **STAFFING**

Information about the staffing required for the implementation of the educational process in the discipline "Chemistry"

The total number of scientific and pedagogical workers implementing the discipline is 8 people.

The total number of positions occupied by scientific and pedagogical workers implementing the discipline is 6.

№	teacher full name	Terms of attraction (full-time, internal part-time, external co-host, under a contract	Position held, academic degree / title position,	The list of taught disciplines according to the curriculum	Education (what educational institution of professional education did he graduate from, year)	Level of education, naming of the specialty by diploma, name of the awarded qualification	The volume of the academic load in the discipline (share of 0.75 )	Information about additional professional education, year		work experience	Practical work experience in the profile of the educational program in specialized organizations with an indication of the period of work and position
								Specializing in	in pedagogy and psychology		
1	Alimirzoeva Z. M.	ft.	Senior Lecturer	Chemistry Organic chemistry	SSU, 1987г	Specialist, chemistry teacher	0,126		2014	34 года	Since 2001 assistant of the department, since 2016 senior lecturer
2	Babaeva D.P.	ft.	assistant professor.	Chemistry	DSPU, 1987	Specialty, chemistry, biology, teacher.	0,266		2014	32 года	Since 2002 Associate Professor
3	Gamzaeva U.G.	ft.	assistant professor	Chemistry of biogenic elements	DSU, 2002	Specialty, chemistry, teacher	0,266		2013	16 y.o	From 2009-2015 assistant of the department, from 2015 associate professor
4	Gamzatova P.A.	ft.	assistant professor	General and inorganic chemistry	DSU, 1969	Specialist, chemistry, chemistry teacher	0,346	1987	2016	50 y.o	Since 1988 - Associate Professor of the Department



5	Idrisova A. Kh.	ft.	assistant professor	Chemistry	DSU, 1982	Specialist, chemistry teacher.	0,346		2015	36 y.o	From 2002 to 2014 assistant, from 2014 assistant professor
6	Magomedova K.M.	ft.	assistant professor	Analytical chemistry	DSPI, 1971	Specialty, chemistry, biology, teacher	0,453	1984, 1997	2010, 2017	48 y.o	Since 1971 assistant, associate professor since
7	Mekhtikhanov S.D.	ft.	assistant professor	Chemistry	PMPI, 1964	Farm. chemistry	0,126		2015	46 y.o	
8	B. I. Shapiev	ft..	assistant professor	Chemistry	DSPI,, 1982	Specialty, chemistry. Biology, teacher	0,126		2016	36 y.o	2002-2008 - Senior Lecturer, 2008 - Associate Professor

